ISAES 2025 - Chile

Punta Arenas

XIV International Symposium on Antarctic Earth Science

ABSTRACT BOOK

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INSTITUTO ANTÁRTICO CHILENO
MINISTERIO DE RELACIONES EXTERIORES

Ministerio de Relaciones Exteriores
Gobierno de Chile

SCAR

Comité Nacional de Investigaciones Antárticas
SCAR CHILE

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APECS
Association of Polar Early Career Scientists

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ISAES 2025. XIV International Symposium on Antarctic Earth Science

Abstract Book

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Chile

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Jorge Carrasco, Laura De Santis, Marcelo Leppe, Raúl Cordero, Francisco Fernandoy, Joaquín Bastías, Doug Wiens, Giulia Matilde Ferrante, Joachim Jacobs, Johan Eourneau, John Smellie, Karsten Gohl, Kenichi Matsouka, Mauro Guglielmin, Mirko Scheinert, Naresh Pant, Rogier Westerhoff, Sharon Robinson, Cui Yingchun, Yeadong Kim, Tomokazu Hokada, Anne Grunow, Ricardo Jaña, Adelaida Geyer, Francisco Hervé, and Jesús Galindo. (2025). *Abstract Book: ISAES 2025 XVI International Symposium on Antarctic Earth Science*, Punta Arenas, Chile, August 18-22, 2025. Edited by Jorge Carrasco and Gino Casassa, pp. 244.

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Final Testimony

Tomorrow, I will fall silent.
The snow will cover my words.

Outside, the wind stalks;
in our weariness, it traps us.
Collins has vanished into the whiteness,
gone in search of his own hope.
Willy, beside me, will soon drift to sleep—
and I, surely, will follow tomorrow.

(One year later)

They found me asleep,
without the breath that gives life.
In my journal, it is written:

They will know we arrived,
that we honored and bore witness,
that Amundsen was here before us.

And we were found.
Our story will not be forgotten.
Many will follow in our footsteps:
we opened a door to science.

NQI

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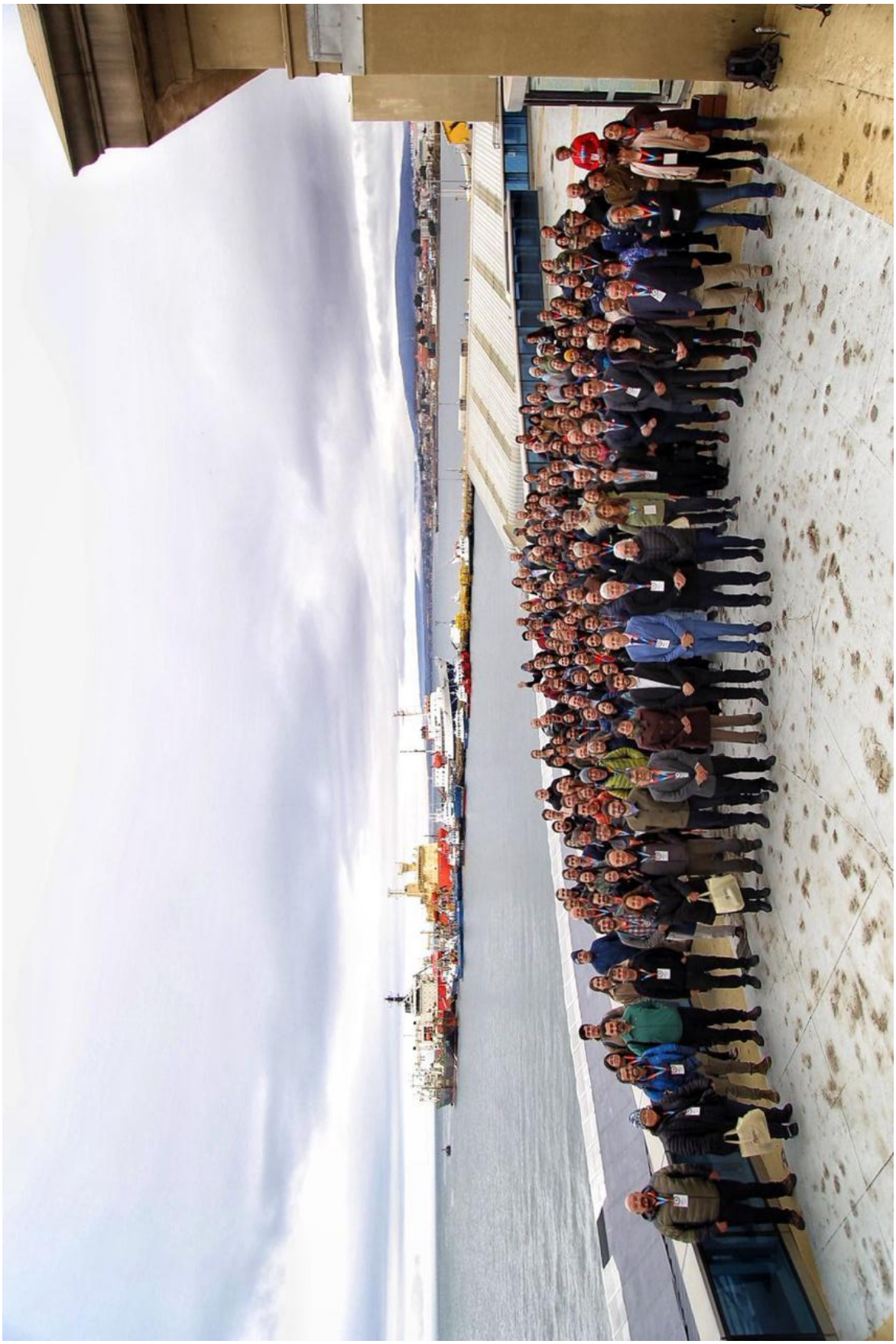

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Editorial

With the memory still fresh from last year's XI SCAR Open Science Conference in Pucón, Chile -the largest Antarctic science gathering in history, Punta Arenas has now hosted the XIV SCAR International Symposium on Antarctic Earth Sciences (ISAES), the first one since the COVID-19 pandemic. This underscores Chile's strong commitment to the Antarctic continent and to polar research.

Recent milestones illustrate this commitment: in January, President Gabriel Boric became the first head of state to reach the South Pole from the South American sector; that same month, the Chilean Navy's new icebreaker *Almirante Viel* embarked on its inaugural Antarctic campaign. In October 2024, the third edition of the National Antarctic Policy was released, to be carried out through the Strategic Antarctic Plan 2026–2030, a five-year framework to be agreed by the end of 2025 by all national stakeholders engaged in Antarctica.

The XIV ISAES Symposium enabled leading scientists in earth sciences to present and share their latest research and also allowed early career researchers and students to present their studies and interact with a much wider specialized community.

Symposium sessions included 5 broad topics:

- Antarctic Geology, Tectonics, and Planetary Connections
- Ice Sheets, Climate, Ocean, and Geosphere Interactions
- Present and Past Biodiversity, Ecosystem Dynamics, and Climate Interactions
- Advances in Earth Science Technologies and Remote Sensing
- Antarctica and the Global Earth System

Ten side events were held as well during the Symposium in order to exchange information and ideas for further development of Antarctic research:

1. Antarctic Volcanism Group
2. Groundwater Action Group
3. International Collaboration for Paleoclimate Research
4. Paleoclimate Records from the Antarctic Margin and Southern Ocean (PRAMSO)
5. RINGS Action Group
6. Antarctic Geologic Evolution (AGE)
7. Chile's Antarctic Geosciences and International Collaboration
8. Geological Heritage and Geoconservation (EG-GEOCON)
9. Geosciences Group
10. Participation of the Chilean Armed Forces in Earth Sciences in Antarctica.

The Symposium received 198 accepted abstracts and was attended by about 220 participants with a total of 170 presentations (9 keynote speakers, 100 oral presentations and 61 posters), representing 21 countries. Additionally, the Symposium featured a remarkable equal gender parity and a large participation of young researchers and students.

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Significant advances in Antarctic earth sciences were presented, including, among many other exciting results, the integration of airborne geophysical methods to probe the entire periphery of the ice sheet and derive its mass balance; marine geophysics and sediment cores to map and understand the past evolution of the ice sheet; interdisciplinary reconstructions of Antarctica's tectonic history; analysis of ancient DNA from the ocean bed for characterizing Antarctic ecosystems; tsunami hazard related to volcanism and active faulting in the Bransfield Strait; and innovative technologies. Collectively, these developments highlight the future of the Antarctic earth sciences research, which converge to sharpen our understanding of Antarctica's past, present, and future within the global system.

A 7.5 magnitude earthquake in the Drake Passage on the eve of the last day was a sharp reminder of the tectonically active nature of Antarctica and the surrounding Southern Ocean. It activated a precautionary tsunami alert in Chile, which was finally suspended due to the small wave height.

A key message from the Punta Arenas XIV ISAES is that Earth sciences are central to understanding Antarctica's relevant role within our planet, linking processes to major climate drivers such as global warming due to anthropogenic rise of greenhouse gases, El Niño Southern Oscillation (ENSO) and the Southern Annular Mode (SAM). Abundant evidence allows to conclude that Antarctica's influence on ocean currents, atmospheric processes, and global sea level is a primary driver of Earth's environmental conditions.

Jorge Carrasco Cerda
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Chair Local Organizing Committee

XIV SCAR International Symposium on Antarctic Earth Sciences (ISAES)

Keynote Speakers

Gary Wilson

Deputy Vice-Chancellor Research, University of Waikato, New Zealand

President of SCAR

"Antarctic Science in a Changing World"

Laura De Santis

Geology and Geophysics – Nat. Inst. Oceanography and Applied Geophysics, Italy

"Geological boundary conditions are important drivers of ice sheet stability"

Marcelo Leppe

Paleontologist-Paleobotanist – Universidad Mayor, Chile

"The life, passion and death of *Nothofagus* in Antarctica"

Gao Liang

China University of Geosciences (Beijing), China

"Tectonic pulses of the Drake Passage controlled Cenozoic million-year-scale ocean-climate cycles"

Sebastián Marinsek

Head of Department of Glaciology, Instituto Antártico Argentino, Buenos Aires (IAA), Argentina

"Antarctica and the Global Earth System: Interdisciplinary connections, present and future challenges"

Naresh Chandra Pant

Geologist – National Center for Polar Ocean Research – GEO, and University of Delhi - India

“GeoEAIS- Exploring Subice geology of Amery Ice Shelf, East Antarctica”

Linda Amberth

Institute for Marine and Antarctic Studies (IMAS), University of Tasmania. Australia

“Reading the ancient ocean: How sedimentary ancient DNA (sedaDNA) can be used to characterise Antarctic ecosystems”

Weisen Shen

Department of Geosciences, Stony Brook University, USA.

“Listening to the Frozen Continent: Dense Seismic Arrays, Hidden Waters, and a Vision for a Continental-Scale Network”

Joaquín Bastías

Geologist – Universidad Santo Tomás, Chile

“The tectonomagmatic evolution of the Antarctic Peninsula”

ORAL PRESENTATIONS

SUNDAY 17		MONDAY 18		TUESDAY 19			WEDNESDAY 20		THURSDAY 21		FRIDAY 22		SATURDAY 23
	08:00-09:00	Onsite Registration (Hotel Dreams, address: O´higgins 1235)											FIELD TRIP
Registration at INACH 09:00-17:00 Plaza Muñoz Gamero 1055	09:00-09:45	Open Ceremony		Plenary lecture 2 Laura De Santis		09:00-09:45	Plenary lecture 4 Gao Ling		Plenary lecture 6 Naresh Chandra Pant		Plenary lecture 8 Weisen Shen		
	09:45-10:30	Plenary lecture 1 Gary Wilson		Plenary lecture 3 Marcelo Leppe		09:45-10:30	Plenary lecture 5 Sebastián Marinsek		Plenary lecture 7 Linda Ambrecht		Plenary lecture 9 Joaquín Bastías		
	10:30-11:00	Coffee break		Coffee break		10:30-11:00	Coffee break		Coffee break		**10:30-10:45 Closing Ceremony**		
		Room 1 S1	**Room 2 S2**	**Room 1 S1**	**Room 2 S5**		**Room 1 S1**	**Room 2 S2**	**Room 1 S3**	**Saloon 2 S2**	10:45-11:15 Coffee break		
	Chair	**Mark Fanning**	**María Manassero**	**Lorena Rebolledo**	**Deniz Bozkurt**	**Chair**	**Jesús Galindo**	**Rodrigo Fernández**	**Peter Convey**	**Francisco Fernandoy**	**Room 1 S4**	**Room 1 S3**	
	11:00-11:15	6: Hansen	4: Ho	40: Fanning		11:00-11:15	122: Huerta	90: Ray	78: Dutta	141: Villarroel	**Felipe Napoleoni**	**Catalina Pardo**	
	11:15-11:30	14: Metcalfe	7: Anderson	43: Arora	68: Neira	11:15-11:30	144: Golynsky	95: Maldonado	80: Gelfo	167: Tinto	126: Bravo	136: Khan	
	11:30-11:45	15: Grunow	8: Westerhoff	46: Zurli	**138: G. Wilson**	11:30-11:45	146: Jacobs	99: Lehrmann	88: Acosta		131: Rebolledo	145: Zambrano	
	11:45-12:00	18: Reading	10: De Santis	48: Cui	162: J. Carrasco	11:45-12:00	151: Wiens	106: Arbieto	105: Salinas	173: Escalona	191: Xie	177: Leppe	
	12:00-12:15	19: Lowe	16: Gohl	60: Loewy	175: Cereceda	12:00-12:15	153: Wang	110: Atkins	121: Rodriguez	183: Bremer	198: Marinsek	181: Hebel	
	12:15-12:30	21: Maletic	26: Guerreiro	75: Galindo	178: Cereceda	12:15-12:30	168: Ferracciolli	111: Amaral	123: Pardo	187: Varela			
	12:30-12:45	22: Dalziel	27: Muehlberger	97: Urgeles	193: Cereceda	12:30-12:45	172: Al Suwaidi	112: Iwai	132: Martinez				
	12:45-13:00		32: Luo	98: Fioraso	196: Sanchez	12:45-13:00	180: Król	115: T. Wilson	135: Sanchez				
	13:00 14:30	Lunch		Lunch		13:00 14:30	Lunch		Lunch		Lunch		
							Room1 S3	**Room 2 S2**	**Room 1 S4**	**Room 2 S2**	**Room 1/INACH**	**Room 2/INACH**	
	14:30-16:10	Room 3 Session Posters 1 14:00-15:00 Geosciences Group Meeting		Room 3 Session Posters 2		**Chair**	**Ingrid Hebel**	**Cliff Atkins**	**Jorge Carrasco**	**Cristobal Emilfork**	Free for any SE	Free for any SE	
						14:30-14:45	23: Grunow	117: Winberry	143: Wang	190: Jaña			
						14:45-15:00	30: Vimercati	124: Oberreuter	2: Kumar	194: Matsuoka			
						15:00-15:15	57: Mackey	130: Fernández	52: Schwarzbach	195: Matsuoka			
						15:15-15:30	71: Convey	47: Sanchez	64: Sharma	197: Fernandoy			
						15:30-16:00	Coffee break		Coffee break				
	16:10-16:30	Coffee break		Coffee break			**Room 1**	**Room 2**	**Room 1**	**Room 2**	Coffee break		
	16:30-17:30	**Room 1 S5**	**Room 2 S2**	**Room 1 S1**	**Room 2 S2**	16:00-17:50	SE8: EG GEOCON	SE2: SCAR - Groundwater action group meeting	SE3: SCAR action group ICEPRO	SE4: SCAR action group PRAMSO (ocean drilling)	Free for any meeting or side activity		
	Chair	**Jorge Carrasco**	**Karsten Gohl**	**Roger Urgeles**	**Ricardo Jaña**								
	16:30-16:45	3: Weeks	35: Cordova	**107: Gao**	59: Bighin								
	16:45-17:00	5; Weeks	36: Manassero	113: Duclaux	65: Giovannetti								
	17:00-17:15	25: Bozkurt	42: Duclaux	114: T. Wilson	79: Ferrante								
	17:15-17:30	58: Valdivia	49: Torricella	116: Duclaux	84: Rabassi								
	17:30 19:30	SE7: EXHAG Chile's antarctic geosciences and International collaboration		**Room 1 SE5** RINGS Action Group	Free for any SE	17:50-19:30	Free for any SE	Free for any SE	Room 1 SE6: SCAR SRP PG meeting	Free for any SE			
	20:00 22:00	Icebreaker											

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Saloon 3	Poster 1: Monday	
No ID	Presenting	
9	Laura	Crispini
13	Marcio	Francelino
24	Andreas	Richter
28	Liang	Gao
33	Felipe	Napoleoni
34	Niam	Askey-Doran
37	Fernando	Bohoyo
38	Adolfo	Maestro-González
39	Adolfo	Maestro-González
44	Mirko	Scheinert
45	RASHMI	Gupta
47	Gabriela	Quispe Sanchez
50	Fiorenza	Torricella
51	Sofía	Palacios
53	Lauren	Lamson
55	Sophia	Lopez
61	Sofía	Palacios
62	Claudio	Tapia
63	Philip	Kyle
70	Marco	Fioraso
72	Lourdes	Gonzaéz-Castillo
73	Lourdes	Gonzaéz-Castillo
91	Matias	Peña
92	Mukut Singha	Konwar
93	Deepak Yuvraj	Gajbhiye
96	Luca	Zurli
100	Ricardo	Leon
101	ismael	escobar
102	Leslie	Mariquez
109	Alexandra	Jurkiw
133	Gabriela	Abarca Sepúlveda
137	Rodrigo	Fernández
140	Luisa	Runho Lucarelli
142	Giselle Lujan	Marincovich
154	Giulia Matilde	Ferrante
158	Carolina	Silva
165	Luis	Lara
179	Manuel	Schilling
185	Giulia Matilde	Ferrante
189	Yocelyn	Carrasco
199	Mauricio	Calderón

Note:
Session 1 Session 3 Session 5
Session 2 Session 4

Saloon 3	Poster 2: Tuesday	
No ID	Presenting	
1	Michael	Stieber
11	Kutsal	Bozkurt
12	Marcio	Francelino
17	Rebekah	Stanton
29	Francesca	Battaglia
31	Anya	Reading
54	Marisol	Juarez Rivera
66	Nicole	Cortez Salvo
69	victor manuel	Neira Ramirez
74	victor manuel	Neira Ramirez
82	Thomas	Mörs
85	Andre	Belem
86	Andre	Belem
87	Andre	Belem
103	Daniela	Accettella
104	Elaine Cristina	Araújo
119	Benjamín	Urra Pacheco
125	Cristine	Trevisan
128	Mónica	Acuña Martínez
129	Antonia	Gonzalez Riquelme
132	Leandro	Martinez
135	Marina	Quiñe
139	Iveth	Chavez
148	Lotse	Blamey
149	Javier	Norambuena Leiva
150	Magdalena	Márquez
152	Ian	Hogg
155	Jorge	Sánchez
156	Cole	Kelleher
157	Rafael	Délano
159	Christan	Szott
160	Iván	Opazo Aballay
161	Natalia	Valenzuela-Aedo
163	Heaven	Biotech
164	Daniela	Schmitz
170	Cathleen	Torres Parisian
174	Tiare	Medina
182	Catalina	Ramos Orellana
184	Pamela	Fletcher
186	Cinthya	Bello
188	Bella	Romero Ortega
192	Rebeca	Fernández
200	Felipe	Gallardo

SIDE EVENTS

SE1. SCAR - AntVolc action group meeting (cancelled)
SE2. SCAR - Groundwater action group meeting.
SE3. SCAR action group ICEPRO
SE4. SCAR action group PRAMSO (ocean drilling)
SE5. SCAR - RINGS Action Group
SE6. SCAR SRP PG meeting, Antarctic Geologic Evolution (AGE)
SE7. Chile's Antarctic geosciences and International collaboration
SE8. EG GEOCON
SE9: Geosciences Group Meeting

List of Sessions of the Symposium

1 Antarctic Geology, Tectonics, and Planetary Connections

- Geologic Evolution and Lithospheric Dynamics
- Comparative Planetary Geology: Insights from Antarctica

Cutting-edge research in Antarctic geology and its broader implications for tectonics and planetary science are very important to understanding the holistic evolution of the planet from an Antarctic perspective. Studies of the lithosphere which identify relevant lateral discontinuities, and of mantle structure and rheology are essential to understanding the geodynamic evolution of the continent, as well as its response to changes in ice mass. We invite contributions on Antarctica's geologic evolution and lithospheric dynamics, comparative planetary geology insights from Antarctic studies, and tectonic processes and volcanism. Contributions should highlight interdisciplinary approaches, or significant findings to its Archean nuclei, orogenic belts, sedimentary basins and its active and passive continental margins and how these advance our understanding of Earth's geological evolution and processes in general.

2 Ice Sheets, Climate, Ocean, and Geosphere Interactions

- Ice-Atmosphere-Ocean-Lithosphere Interactions Under a Changing Climate
- Reconstructing Antarctica's Past: environment, landscape, Ice-sheet and Ocean Evolution
- Integrating proxies and models
- Abrupt Changes in Antarctica and the Southern Ocean: Global Implications and High-Impact Consequences
- Groundwater, Ice-Sheet Hydrology, and Oceanic Systems: Processes and Interactions.
- Landscape and Permafrost Dynamics in Antarctic Ice-Free Areas.

Understanding southern polar changes and the geosphere interactions, particularly in the content climate change, requires comprehensive studies of the interactions between ice sheets, the atmosphere, the ocean, and the lithosphere, as well as the regional and global implications. A better understanding of the interactions between the components of the Earth system will help predict future contributions to sea level rise and climate feedback loops. Studies of permafrost dynamics, groundwater, ice-free areas, and the rheology and hydrology of the ice sheet are needed to understand the complexity of subglacial and near-ice processes and to assess the present and future stability of the Antarctic ice sheet. Reconstructing the past environment, landscape, ice sheet and ocean evolution of Antarctica through the integration of proxies and models is necessary to predict the impact of long-term changes versus short-term events on the stability of the ice sheet. We invite contributions on all these topics from observation to simulation.

3 Present and past biodiversity, Ecosystem Dynamics, and Climate Interactions

- Biodiversity, Climate, and Tectonics: Key Drivers of Antarctic Life.

- Geomicrobiology and Cryomicrobiology in Polar and Subpolar Environments, Expanded to "subpolar" from "Patagonia"

Currently, Antarctica is experiencing environmental changes due to natural and anthropogenic forcing, which could increase the risk of diseases in local wildlife. A better knowledge on present and past pathogens, parasites, and viruses in Antarctic and sub-Antarctic terrestrial and marine ecosystems is needed. The critical role of sea-ice biogeochemistry in climate-relevant elemental cycles, the role of microbes in biogeochemical cycles and their interactions with geological materials, and the studies on microbial life in ice, snow, and permafrost are required to understand the complex interplay between biodiversity, environmental factors, and climate change impacts in polar and subpolar ecosystems. We invite contributions on recent analyses on these topics to fill gaps in our understanding of how present and past climate change, and anthropogenic pressures have, and will continue to impact, the southern polar wildlife.

4 Advances in Earth Science Technologies and Remote Sensing

- Cross-disciplinary Innovations in Remote Sensing and Geoinformation for Polar Earth Sciences
- Cutting-Edge Technologies for Polar Fieldwork and Operations.

Remote sensing and geoinformation are increasingly used in integrating physical, biological, and social sciences to provide a holistic view of polar environments. Technologies improve our capability to monitor, analyze, and understand the complex processes occurring in polar regions, which is vital in advancing our understanding of polar Earth sciences. Satellites provide high-resolution images and data over vast areas of Antarctica and southern oceans, monitoring ice sheet dynamics, glacial retreat, sea ice extent, and changes in land cover and vegetation patterns. Drones and aircraft equipped with LIDAR (Light Detection and Ranging) and photogrammetry systems can create detailed topographic maps and assess surface changes with great and increasing precision. Advanced field technologies play a crucial role in data collection and logistics in extreme environments. We invite contributions on remote sensing and geoinformation technologies advances and applications that enhance our capability to monitor, analyze, and understand the environmental processes occurring in polar regions.

5 Antarctica and the Global Earth System

- Antarctica's Role in the Global Earth System: Teleconnections and Climate Linkages.
- Earth Science for Antarctic Environmental Management and Policy.

Antarctica is a critical part of the Earth system, continent of about 14.2 million square kilometers of ice and snow almost centered at the south pole, which increases about 32 million square kilometers with sea ice toward the end of the austral winter. The vast, ice-covered Antarctic continent is a significant component of the Earth's global climate system. The high contrast in reflective properties of the ice-covered areas and the surrounding dark sea surface in the region plays an important role in regulating regional and global

climate. According to the IPCC, understanding Antarctica's role in climate change is a huge scientific challenge and an urgent societal priority. Antarctica influences ocean currents, weather patterns, and climate systems far beyond its borders. Atmospherically, the Antarctic is linked to the tropics through teleconnection patterns associated with large-scale phenomena such as El Niño Southern Oscillation (ENSO) and to mid-latitude westerly circulation related to the Southern Annular Mode (SAM). Oceanographically, the cold bottom water formed near the Antarctic continent flows throughout the rest of the world's oceans through interaction with the global thermohaline ocean circulation. Improved understanding of the complex interactions between Antarctica and the rest of the Earth's system is vital. We invite contributions on the role of Antarctica in the Earth system, environmental interactions, and teleconnections, but also on Antarctic environmental science, policies, and practices.

Abstracts

ISAES 2025

Session: 1

Antarctic Geology, Tectonics, and Planetary Connections

6

East Antarctic Tectonic Basin Structure and its Implications for Ice-Sheet Modeling and Sea-level Projections

Samantha Hansen[1], Erica Emry[2]

[1]The University of Alabama, Tuscaloosa, AL, United States. [2]New Mexico Institute of Mining and Technology, Socorro, NM, United States

Abstract

The volume of the East Antarctic Ice Sheet (EAIS) is equivalent to ~52 m of sea-level rise, but whether the EAIS is a major contributor to global sea-level increase remains debated. How an ice sheet responds to climate-induced perturbations strongly depends on the physical conditions below the ice-bed interface; therefore, constraining the solid Earth structure beneath the EAIS is critical. However, sparse seismic station coverage has limited our ability to image key characteristics. In our study, we have employed full-waveform ambient noise tomography, an approach that better resolves Earth structure in sparsely sampled areas compared to traditional techniques, and our results reveal previously unrecognized low-velocity anomalies under the Wilkes and Aurora Subglacial Basins. Our findings suggest thinner-than-expected lithosphere and thermally perturbed upper mantle, implying drastically different geothermal heat flux and mantle viscosity inputs compared to those from prior tomographic studies. This has notable implications for accurate ice-sheet modeling and future global sea-level projections.

Category

1 Antarctic Geology, Tectonics, and Planetary Connections

9

New evidence of submarine magmatism offshore northern Victoria Land reveals key tectonic clues from the Antarctic margin

Laura Crispini[1], Dario Civile[2], Antonia Ruppel[3], Giulia Matilde Ferrante[2], Danilo Morelli[1], Daniela Accettella[2], Flavio Accaino[2], Michele Locatelli[1], Valentina Volpi[2], Martina Busetti[2], Egidio Armadillo[1], Andreas Läufer[4]

[1]DISTAV-Department of Earth, Environmental and Life Sciences, University of Genova, Genova, Italy. [2]National Institute of Oceanography and Applied Geophysics – OGS, Trieste, Italy. [3]Federal Institute for Geosciences and Natural Resources- BGR, Hannover, Germany. [4]Federal Institute for Geosciences and Natural Resources- BGR, Hannover, Italy

Abstract

This study integrates new multibeam bathymetry and multichannel seismic profiles (*PNRA-Expeditions 2023-2024, R/V Laura Bassi*), and aeromagnetic data (*BGR-GANOVEX IX*) to deliver an updated and compelling view of the structural framework offshore of northern Victoria Land, Antarctica.

Located at the boundary between E and W Antarctica, this region marks the final site of continental breakup between the Antarctic and Australian margins, which led to the opening of the Tasman Gateway around the Eocene–Oligocene transition. Deciphering the tectonic evolution of this area is key to understanding the geodynamics of the Australian-Antarctic separation and the emergence of the independent Antarctic Plate during the Late Mesozoic–Cenozoic.

The south sector of the study area is characterized by prominent, active magmatic ridges, while the northern area features an isolated block of rifted continental crust. Our tectonic interpretation supports the presence of a NW-oriented intraplate, right-lateral megashear zone, active during the Pliocene–Quaternary, associated with localized magmatism and thinning of the continental crust.

This deformation zone likely represents the intraplate continuation of the Balleny Fracture Zone. It records the switch in local strain field and kinematics: from left-lateral motion in the late Eocene–early Oligocene, to transtensional, right-lateral kinematics in more recent geological time. In addition, bathymetric data reveal the presence of deeply incised glacial troughs terminating at the shelf break, indicative of substantial glacial retreat and ice-sheet dynamics during recent glacial-interglacial cycles and underscoring the interplay between tectonic processes and cryosphere evolution in shaping the continental margin.

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1 Antarctic Geology, Tectonics, and Planetary Connections

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Permafrost Behavior Under the Influence of Research Station Construction

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Abstract

Following three decades of scientific investigations on Antarctic soils, a fire in 2012 destroyed most of the Comandante Ferraz Antarctic Station (EACF). Reconstruction efforts began shortly thereafter, prioritizing modern facilities with enhanced capacity to meet current and future demands of nationally relevant scientific research. One of the most critical steps in ensuring the structural stability and safety of the new station involved geotechnical testing to assess the load-bearing capacity of the foundation soils. Previous studies had identified the presence of permafrost in the region, which raised concerns about potential loss of bearing strength and soil settlement due to thawing. In contrast, seasonal or localized freezing could also lead to frost heave, posing further risks to the integrity of the foundations. To monitor the condition of the permafrost beneath the EACF, a long-term observation site was established directly below the station, equipped with soil temperature sensors installed at various depths, reaching down to 2.5 meters. This setup was designed to assess the thermal dynamics of the permafrost that supports the structure. Additionally, terrestrial laser scanning has been conducted annually to evaluate the structural stability of the station by comparing point cloud data across different years. In 2023, ground-penetrating radar (GPR) surveys were performed at multiple times of the year to investigate subsurface changes beneath the station. The results revealed ongoing alterations in the substrate that supports the EACF, indicating the potential for future structural impacts if such changes persist or intensify.

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1 Antarctic Geology, Tectonics, and Planetary Connections

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Revisiting the SWEAT hypothesis: testing the tectonic affinity of the Read Group (Shackleton Range) through U-Pb zircon geochronology and feldspar Pb isotopic analysis

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Abstract

Palaeoproterozoic basement rocks of the Read Group (Shackleton Range) have traditionally been interpreted as cratonic given they appear to form the hinterland to a Pan-African orogenic front without significant reworking or isotopic resetting by this younger event. Sparse geochronological and geochemical data from the western Read Mountains indicated the addition of near-juvenile melts at 1.85 Ga and subsequent high-temperature/low-pressure *Kimban*-type metamorphism at c. 1.7 Ga. The Kimban orogeny (1.73-1.69 Ga) affected the Gawler Craton of southern Australia and its East Antarctic correlatives in Terre Adélie and the Miller Range, which together formed the continuous *Mawson Continent* – a constituent part of the supercontinent *Nuna*. Preservation of Kimban-type metamorphism in the Read Group has led to the interpretation that the Mawson Continent continues into this region, yet the recent discovery of a significant embayment near the Recovery Subglacial Highlands suggests the structurally continuous Mawson Continent may terminate here, rendering the Read Group a separate crustal block. Some authors have instead championed a connection with the Palaeoproterozoic Mojave-Yavapai provinces of southwest United States in what would provide a key piercing point for the SWEAT/proto-SWEAT model of the Nuna-Rodinia cycle. Here, we report U-Pb zircon dating, whole-rock geochemistry and feldspar Pb isotopic analyses of samples collected during the 1994/95 EuroShack expedition. The new data indicate magmatic pulses at c. 1.84 and 1.80-1.77 Ga and a Pb isotope composition most comparable to the Gawler Craton, thus reaffirming a Mawson-like crustal affinity for the Shackleton Range.

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1 Antarctic Geology, Tectonics, and Planetary Connections

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Geological Heritage and Geoconservation SCAR Expert Group – ISAES 2025 Update

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Abstract

The purpose of the SCAR Expert Group on Geological Heritage and Geoconservation (EG-GEOCON) is to advance the identification of Antarctic geological sites of exceptional value to be designated geological heritage of international relevance, and to contribute to SCAR advice to the CEP and the ATCM on matters related to conservation of geological heritage. Nine broad geological frameworks (GF) were identified by the previous Action Group. The Expert Group decided to focus on three frameworks in 2023-2025 for identification of geosites.

- GF1 (Archean cratons): Six sites were nominated and two were selected as geosites: the Casey Bay Beryllium meta pegmatites and the Mt. Riiser-Larsen Napier Complex ultra-high temperature granulites.
- GF 6 (Cenozoic glacial history): Antarctica has a long and complex glacial history with global relevance. We recognize that this is a broad topic that may have multiple facets and will require longer discussion. Nine sites have been nominated to date.
- GF 7 (Meteorites and evidence of impacts): There are limited geographic occurrences of meteorite fields yet they are critical for understanding the formation of our solar system. Three sites were nominated, and the Yamato Mountains meteorite blue icefield was chosen as a geosite.

The SCAR EG-GEOCON is updating the list of facilities with Antarctic geological collections and providing links on the webpage to inform scientists about the scope of Antarctic holdings. Information about the EG-GEOCON can be found on the SCAR website: https://www.scar.org/science/geoconservation. In addition, we plan to propose two geosites for the IUGS Geological Heritage Sites.

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1 Antarctic Geology, Tectonics, and Planetary Connections

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East Antarctica's lithospheric heterogeneity, and influence on ice sheets from beneath

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Abstract

The East Antarctic lithosphere, and asthenosphere beneath, were investigated through the extensive geophysical campaigns of the 2007/08 International Polar Year, and improved coverage of airborne and satellite data. Geological and geochronological syntheses have also contributed to available datasets for Antarctica. Multivariate studies, using statistical and machine learning based inference to make use of multiple lines of evidence, have recently added greatly to the previously available deterministic studies in constraining the form of the lithosphere and spatial variation of properties such as geothermal heat. Hence, we have a basic understanding of how the lithosphere in turn influences the ice sheet, with the ice-bedrock interface zone as a key region of interaction, including heat transfer and water flow.

This contribution reports on new constraints on lithospheric heterogeneity of East Antarctica, including those from new ground-based campaigns enabled by the Geophysical Research Infrastructure for Antarctica (GRIT) Facility. These deployments include seismic, geoelectric and GNSS results, heralding a new generation of data collection tailored to the machine-learning age. We find that Earth-ice interactions are important boundary conditions for initiatives that aim to improve the prediction of ice sheet response to changes in atmospheric and ocean forcing. Our ongoing challenge is to capture the variability in deep Earth structure, and the diversity of sub-ice processes, at sufficient detail and with sufficient rigour in multivariate and computational approaches to truly represent the interplay between the solid Earth and the systems it supports.

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1 Antarctic Geology, Tectonics, and Planetary Connections

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Automated data processing and equivalent source inversion to homogenise magnetic airborne surveys in Antarctica flown on irregular line spacing, heights and decades

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Abstract

Magnetic data collection in Antarctica is commonly conducted using airborne platforms. However, a challenge in creating a homogenous magnetic data compilation for Antarctica arises from inconsistencies in data collection over the decades, for example from varying flight lines spacing, different observation heights and long-time intervals between surveys. Traditionally, data processing is performed manually which is time consuming. The equivalent source technique is a powerful tool for automating data processing of irregular airborne surveys conducted on different observation heights and time periods. Magnetic field data from various surveys can be represented by a set of equivalent sources that accurately reproduce the input data. The magnetic forward response of the equivalent sources can be calculated at any height making upward / downward continuation obsolete and enabling a uniform observation height across surveys. Furthermore, the magnetic field can be computed on a regular grid overcoming difficulties of grid merge approaches. Combining the equivalent source method with automated despiking-, wavelet filtering-, IGRF/DGRF correction- and weighted distance basestation correction, allow a fully automated processing workflow to create a harmonised magnetic compilation with decreased noise.

We present a test case in East Antarctica to highlight the potential of an automated processing workflow to harmonise magnetic airborne data without biases arising from manual processing. Here, we use ICECAP data (2009-2017) and the ADMAP data compilation grid as prior. The next step is to use ADMAP line data to create a fully automated homogeneous continent wide Antarctic magnetic data compilation under the SCAR ADMAP working group umbrella.

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Advancing our Understanding of the Antarctic-Phoenix Subduction Zone through new U-Pb Geochronology and Geochemistry

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Abstract

The Antarctic Peninsula preserves the life cycle of a continental arc from initiation to demise; in order to learn more about the changing mantle dynamics and volcanism of this system, it is pertinent to have a comprehensive spatial framework of geochronology and geochemistry.

Subduction of the Phoenix plate beneath the Antarctic plate began approximately 200Ma, subduction demise was then initiated 53Mya by the collision of the Phoenix-Antarctic mid-ocean ridge with the subduction trench[1]. Ridge subduction began near Alexander Island and progressed northwards in segments with the most recent collision occurring 3.1Myr. There have been no major overprinting events following the demise, so the volcanism leading up to the demise is well preserved.

From previous studies, there are 148 volcanic rocks which have been dated, and are accompanied by 440 samples with major and/or trace element data[2]. This can be divided into 4 major chemical groups namely, calc-alkaline, adakitic, high-Zr peralkaline rocks, and high-Mg andesites[1]. Work has been undertaken to add 14 new U-Pb dates which will be used alongside 64 new major and trace element analysis to create a more comprehensive framework. This new data has helped improve our understanding of the movement of the volcanic axis prior to demise, the relationship between the South Shetland Islands and Trinity peninsula, and the timing and petrogenesis of the high-Zr group.

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2 - Leat, P.T. & Riley, T.R. 2021b. Mem Geol. Soc., Lond., 55, 213-226

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1 Antarctic Geology, Tectonics, and Planetary Connections

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The Polar Rock Repository: furthering Antarctic Earth Science using legacy collections

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Abstract

Antarctic field research and ship-based operations in the Southern Ocean are logistically difficult, financially expensive, and have a significant environmental impact on unspoiled regions. Few rocks are exposed in Antarctica (~98% ice-covered), and the challenge of dredge operations makes previously collected samples valuable to the science community. The Polar Rock Repository (PRR) is a United States National Science Foundation funded facility that provides online access to rock samples, unconsolidated deposits, terrestrial cores, and dredge samples for scientific research. Use of existing legacy samples and metadata from remote outcrops offers scientists the ability to expand the scientific and geographic scope of their research. The PRR online database (prr.osu.edu) includes a wealth of metadata on all 64,000+ samples, including field notes, sample photos, and information on logistics, stratigraphy, observed minerals (e.g., olivine, garnet, anorthoclase), and surface features (e.g., weathering salts, staining, glacial features, biological features) that can be useful to a broad range of earth scientists. The PRR also archives supporting materials from the collector (e.g., sample images, annotated maps, thin sections, etc.) and hosts a media archive that provides logistical, geological, and glaciological information. The multi-field searchable criteria on the PRR website aims to make finding samples relevant to any researcher's interests easy. Search results can be viewed as a table or thumbnail, downloaded as a spreadsheet, or plotted on an interactive map. Importantly, destructive techniques are allowed on loaned samples as an archival piece is always held within the repository.

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1 Antarctic Geology, Tectonics, and Planetary Connections

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The Ellsworth-Coats Land (Antarctic) Promontory of Laurentia

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Abstract

The Ellsworth Mountains of Antarctica comprise an unbroken succession of Neoproterozoic to Permian strata deformed during the latest Paleozoic to earliest Mesozoic Gondwanide orogeny. The resulting fold-thrust belt terminates at both ends of the range. Its allochthonous nature and probable displacement from the Transantarctic margin of the East Antarctic craton has long been recognized. Restoration of the Gondwanide fold belt from Argentina through South Africa and the Falkland/Malvinas Islands indicates the Ellsworth Mountains formed a link to the Pensacola Mountains along the Pacific margin of Gondwana, a position supported by paleomagnetic studies. The Ellsworths are part of one of four crustal blocks that comprise West Antarctica. Restoration of the fold belt places it on the 'outboard' Pacific side of the Coats Land crustal block of the East Antarctic craton, a likely former fragment of Laurentia. The Precambrian basement of the Ellsworth-Whitmore mountains block is indistinguishable from that of southwestern Texas and the overlying Neoproterozoic-Cambrian strata on both continents reflect two-stage continental rifting and ensuing marine transgression. The detrital zircon population of those strata of the Ellsworths is virtually identical to that of Cambrian sandstones of Texas and therefore of likely Laurentian provenance. The Ellsworth-Whitmore Mountains crustal block of West Antarctica is hence also of likely Laurentian derivation, originally part of a proposed former 'Ellsworth-Coats Land promontory' separated from its parent craton during the late Cambrian and subsequently overlain by the Gondwana supercontinental sedimentary cover. This has global paleogeographic and paleoenvironmental implications for the Pannotia supercontinent and Cambrian biotic radiation.

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New Paleomagnetic and 40Ar/39Ar Geochronological Results for the Cape Melville of King George Island, West Antarctica, and Their Tectonic Implications

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Abstract

The paleoposition of the Antarctic Peninsula (AP), which acts as the southern boundary of the Drake Passage, is critical for limiting the opening process of the passage and the evolution of the Antarctic Circumpolar Current. Although previous studies suggest that the gateway gradually opened during the Cenozoic (Lawver & Gahagan, 2003), this timeframe is still uncertain due to a lack of paleomagnetic constraints from the AP. To address this issue, we report new paleomagnetic and 40Ar/39Ar geochronological data from Cape Melville of King George Island, with geochemical data reconstructing the subduction process of the Phoenix Plate towards the AP. Our new data show that the AP has been rotating anticlockwise since ca. 50 Ma. Declination concordance between the Cape Melville (ca. 22 Ma) and Kerguelen Archipelago (ca. 30-25 Ma; Camps et al., 2007) supports insignificant post-Oligocene relative motion between West and East Antarctica (Cande et al., 2000). Our data also reveal that the collision between the Phoenix Ridge and the AP induced Phoenix slab rollback and Scotia Sea back-arc extension.

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Category

1 Antarctic Geology, Tectonics, and Planetary Connections

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Data-Driven Tectonic Segmentation and Implications for Glacial Isostatic Adjustment

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Abstract

Recent advances in tomography of the Antarctic continent have improved our understanding of the solid Earth in Antarctica. While these tomographic models contain many similarities, large differences between models remain, particularly in data-sparse regions. Understanding how well a tomographic model captures the tectonic, geologic or rheological properties of the lithosphere can be challenging, as each model is the product of numerous choices and assumptions. Such understanding is, however, critical when using a model to constrain inputs for other studies, such as glacial isostatic adjustment or geothermal heat flow.

Data-driven segmentation provides a way of interrogating the tectonic information captured by tomographic models. Segmentation places regions of a model into natural clusters that can be associated with known geological properties. Such clustering is done without assuming prior knowledge about the properties of each cluster. This allows one to appraise the tectonic information implicit in the model and compare models produced from different datasets with different methods.

We use unsupervised clustering and information theory-based analysis to assess how well recent tomographic models represent tectonic structures, providing an approach for comparing different tomographic models. Our analysis provides evidence, for example, for which features of the East Antarctic lithosphere are most robust. These feature comparisons can be used not only to aid in aspects of model selection but also to guide future investigations into the solid Earth in Antarctica.

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The Shackleton Fracture Zone (Drake Passage, Antarctica): a major fault zone that connects continents and separates plates and oceans.

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Abstract

The Shackleton Fracture Zone (SFZ) is an intra-oceanic ridge, several hundreds to thousands of meters above the surrounding seafloor, which cross entirely the Drake Passage. The Drake Passage is an oceanic gateway of about 850 km length locates between South America and the Antarctic Peninsula that was developed in the framework of the Scotia Arc evolution. The SFZ, at present, is an active transpressional and left-lateral transcurrent fault that accommodates, in conjunction with the North Scotia Ridge and South Scotia Ridge, the relative motion between the Scotia Plate and the South-American and Antarctic plates and connects the Chile Trench with the South Shetland Trench (Antarctic Peninsula). The SFZ is thrusted below the Elephant Island sector, in its southern tip, where a triple junction is developed. The SFZ intersects two extinct spreading centers – the West Scotia Ridge (extinct at 6.4 Ma) and the Phoenix–Antarctic Ridge (extinct at 2.6-3.6 Ma) – between which the SFZ acted as an oceanic ridge-to-ridge transform fault when both spreading centers were active. A complete dataset that includes detailed bathymetry, multichannel seismic, high resolution seismic, potential data and seismicity permit to describe its main characteristics, tectonic evolution and present day activity. Its geodynamic evolution began as an oceanic transform fault with strike-slip motion along most of the fracture, transform to a transpressive transcurrent fault zone from at least 29 Ma to the present day, and has formed an important zone of bathymetric uplift in the last 8 Ma that constituted a barrier for bottom oceanic currents circulation.

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Elongation of volcanic edifices in the abyssal plain of the Drake Passage as indicators of paleostresses during the Cenozoic

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Abstract

The Drake Passage is an oceanic corridor located between South America and the Antarctic Peninsula, connecting Pacific and Atlantic oceans. The geodynamic development of this region began in the Eocene, within the evolution of the Scotia Arc.

More than 190 volcanic edifices have been identified on the seafloor. Several studies indicate that elongated volcanic structures exhibit a preferred orientation consistent with the direction of the stress field, with elongation and alignment parallel to the maximum horizontal stress. Therefore, the regional-scale statistical analysis of the distribution and shape of these volcanic edifices provides new insights into the stress state acting in the Drake Passage from the Cenozoic to the present. Morphological analysis of the volcanic edifices has revealed three principal directions of maximum horizontal stress: N000E, N046E, and N125E. Recent stress field analysis based on focal mechanisms of earthquakes in the study area shows a dominant direction of N057E. The maximum horizontal stress fields oriented NW-SE and N-S are related to a combination of processes, including the oceanic subduction of the ancient Phoenix Plate beneath the Pacific margin of the Antarctic Plate, the Cenozoic subduction of the northern Weddell Sea, and the right-lateral strike-slip motion that occurred from the Oligocene to the middle Miocene between the Scotia and Antarctic plates along the South Scotia Ridge. Conversely, the NE-SO compression is associated with left-lateral strike-slip movement from the late Miocene to present-day, along the South Scotia Ridge and the South Shetland Trench.

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Morphostructural analysis of Deception Island (South Shetland Islands): Interpretation and synthesis of tectonic and volcanic lineaments

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Abstract

Deception Island is one of the most active volcanoes in Antarctica, with over 30 Holocene eruptions recorded. Its volcanic evolution includes three main phases: pre-caldera shield formation, caldera collapse, and post-caldera eruptions.

The study of tectonic and volcanic lineaments on Deception Island reveals three main orientations: NE-SW, ESE-WSW, and SSE-NNW. These lineaments, mapped through various methods including field observations, satellite imagery, and geophysical data, show some consistency, but also significant variability due to subjective interpretation, image resolution, and differing criteria among researchers. Despite differences, certain lineament trends correlate with known faults, volcanic structures, and geophysical anomalies, indicating their significance in the island's tectonic framework.

Field measurements of fractures generally display a radial distribution with preferred orientations around NNE-SSW and SE-NW. Faults exhibit normal, reverse, and strike-slip components, with orientations often aligning with regional tectonic trends in the Bransfield Basin. However, correlations between measured fractures and mapped lineaments are weak or inconsistent; highlighting the complex interplay between tectonic processes, volcanic activity, and the island's evolving morphology.

Integrating all data, a coherent morphostructural map identifies three key lineament groups: (i) NE-SW and SE-NW structures of tectonic origin related to regional fault systems and caldera collapse; (ii) concentric faults forming the caldera boundary and controlling volcanic and hydrothermal activity; and (iii) NW-SE lineaments associated with secondary volcanic edifices and ongoing geothermal processes. This comprehensive approach enhances the understanding of Deception Island's tectonic-volcanic evolution and provides a valuable framework for future research.

This work was funded as part of the projects PID2021-126495NB-C32 and PID2021-125778OB-I00.

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1 Antarctic Geology, Tectonics, and Planetary Connections

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Cretaceous to Eocene magmatic evolution in the retreating convergent margin of the northern Antarctic Peninsula: U-Pb age and Hf-O isotope variations

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Abstract

Isotope analyses of zircon from Cretaceous–Eocene plutonic rocks of the northern Antarctic Peninsula provide key information on long-term magma source evolution. SHRIMP U-Pb zircon ages record a 100 myr trench-ward migration of magmatism from late Aptian times. Coupled Hf and O isotopic ratios indicate that primary magma sources of Campanian to earliest Eocene (c.84 and 50 Ma) mafic to intermediate calc-alkaline plutonic rocks had εHf (zrc) values of +4.8 to +8.5 and $\delta^{18}O$ (zrc) of 3.5 to 5.0 ‰. This reflects a mantle-wedge source chemically modified by an ^{18}O-depleted agent through high-temperature hydrothermal alteration of cold subducted oceanic slab. In contrast, zircons from latest Eocene to Miocene plutonic rocks (c.42 to 11 Ma), with εHf (zrc) of +7.3 to +10.2 and $\delta^{18}O$ (zrc) of 4.5 to 6.5 ‰, crystallised from intermediate magmas generated by partial melting of metasomatised mantle-wedge sources atop a warmer, more slowly subducting oceanic slab. Zircons from the youngest diorite (c.10 Ma, 5 myr before arrival of the Phoenix active oceanic ridge) record εHf (zrc) of +6.5 and higher $\delta^{18}O$ (zrc) of 5.5 to 6.6 ‰, documenting an increase of sediment-like components in a hot subduction environment. Overall, the Hf-O isotope data suggest that arc magmatism in a retreating subduction zone records a progressively more depleted, asthenosphere-like, mantle source, metasomatised with subduction components from the upper oceanic crust and/or recycled continental crust material. Subduction erosion and rheological softening of the slab-mantle wedge interface facilitated mass flow to source regions in the deep sub-arc mantle.

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Geothermal Heat Flow in Princess Elizabeth Land, East Antarctica: A Geological Perspective

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Abstract

Princess Elizabeth Land (PEL) in East Antarctica remains largely unexplored due to its extensive ice cover, limiting direct geological observations. Consequently, geothermal heat flow, a key parameter influencing ice sheet dynamics and basal melting, has been estimated through geophysical modelling techniques. However, significant discrepancies exist between model predictions and the cryptic nature of the subglacial geology. In this study, we examine a range of geothermal heat flow models in the context of the known and inferred geological framework of the PEL sector. This work is a part of the multi-institutional GeoEAIS initiative running under the Indian Antarctic Program. By comparing modelled heat flow patterns with crustal structures, tectonic boundaries, and lithospheric composition, we identify areas where geological heterogeneity and mantle-derived heat are likely underrepresented. Our findings underscore the importance of incorporating detailed crustal architecture and potential mantle contributions to improve the accuracy of geothermal estimates in East Antarctica. We advocate for a more geologically-informed approach to heat flow modelling, essential for refining ice sheet models and understanding long-term stability in the region. This case study of PEL highlights the value of interdisciplinary integration to bridge the gap between geophysical inference and the geological reality beneath the Antarctic ice.

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Evolution of the Transantarctic Basin in Victoria Land: insights from quantitative sandstone petrography

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Abstract

Sedimentary clastic sequence analysis is a fundamental tool to understand the Earth plate dynamics, because the sequences record variations in the depositional environments and basin morphology settings. The deposition of the sandstone sedimentary succession of the Beacon Supergroup lasted more than 200 Myr (Devonian to Early Jurassic) in Victoria Land and nearby territories in the so-called Transantarctic Basin, recording crucial events in the history of the Earth. Sedimentation is synchronous with the convergence between the paleo-Pacific plate and Gondwana, to form the large Gondwanide orogenic system. The composition of the Beacon Supergroup sandstones was found to be correlated with major tectonic processes in response to subduction dynamics, which ultimately conditioned the source-to-sink system and provenance imprints. Petrographic variability in sandstone composition is tracked through space and time by a quantitative analysis of all available published data and new updated ones, from Transantarctic Mountains and Tasmania. The variability of grain composition detected by quantitative sandstone petrography reveals that the Victoria Land sector, transitioned from an intracratonic basin in back-bulge position to foredeep basin setting.

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The petrogenesis of Starr Nunatak granite

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Abstract

Starr nunatak, one small, conspicuous and flat nunatak, is composed of granitic rocks which belong to the Larsen Granodiorite, belongs to the Granite Harbour Granodiorilc And Granite (Gunn and Warren, 1962). It is hot topic for the petrogenesis of them. During the GANOVEX XIII campaign of BGR in the 2018-2019 summer season, the geological survey was carried out in the nunatak.

In the field, we found the biotite granite was intruded by the polyphase dykes. Presently, its emplacement age and its petrogenesis are not well constrained. Consequently, in this report, we will firstly provide the lastest information on their ages and geochemistry which measured using the SHRIMP method and the ICP-Ms.

References:

GUNNG M, WARREN G. Geology of Victoria Land between Mawson and Mullock Glaciers, Antarctica. New Zealand Geol. Survey Bull., 1962, 71:1-157.

Category

1 Antarctic Geology, Tectonics, and Planetary Connections

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Coats Land Antarctica, a Tectonic Tracer for Southwestern Laurentia

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Abstract

Reconstructions of the Neoproterozoic Supercontinent Rodinia typically struggle to constrain the elusive conjugate craton to the southern margin of Laurentia. Data from the miniscule outcrops of bedrock in Coats Land, Antarctica provide a critical clue to that paleogeography. Coats Land may be a tectonic tracer, a piece of Southern Laurentia left behind in Kalahari after Rodinia breakup and subsequently transferred to the Mawson craton upon Pangea breakup. Natal-Maud (~1 Ga) sutures separate Coats Land from Kalahari in Gondwana and Pan-African (~600 Ma) sutures separate Coats Land from the main Mawson Craton, indicating that Coats Land had an independent Mesoproterozoic history.

The 1.1 Ga granophyre and rhyolite that comprise the Littlewood and Bertrab nunataks of Coats Land are contemporaneous with the 1.1 Ga Red Bluff Granite Suite (RBGS) and Thunderbird Rhyolite in the Franklin Mountains of West Texas. Quartzo-feldspathic gneiss and amphibolite from the Moltke Nunatak resemble less-deformed basement lithologies of the RBGS. Previous studies use matching ages and colinear Pb isotope signatures of igneous rocks in Coats Land, Southwest Texas, and the Keweenawan Mid-Continent Rift to propose the paleomagnetically-reasonable juxtaposition of the Coats Land block, the present southern margin of Laurentia, and the Natal margin of Kalahari at ~1 Ga (Loewy et al, 2011, Geology). Isotope and trace element analyses of rocks from all three Coats Land exposures and comparable lithologies in the Franklin Mountains of West Texas are currently underway. We will present this new data and use it to rigorously evaluate the proposed Coats Land – Texas connection.

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Geologic history of Cape Barne and the origin and significance of trachyte from Mount Cis, a moraine deposit on Ross Island, Antarctica

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Abstract

Cape Barne on the western flank of the active Erebus volcano, boarders on McMurdo Sound in the southwest Ross Sea. It has a geological history that started with eruptions of 1.31 Ma basanites followed by thick anorthoclase phonolite lava flows. The phonolite is typical of those that forming the bulk of Erebus and erupted for the last ~300 ka. The flow has a new $^{40}Ar/^{39}Ar$ age of 67.9±0.3 ka and a clinopyroxene ^{3}He exposure age of 36±6 ka and a ^{36}Cl exposure age on anorthoclase is 44±4 ka. This implies that ice covered the area for ~30 ka during the Last Glacial Maximum (LGM). Mount Cis on the slopes above Cape Barne was named and described in the early 1900's by British geologists as a trachyte cone. It is only 4 m high. Our field studies show that Cis is a moraine drift mound deposited during the LGM. The trachyte has a $^{40}Ar/^{39}Ar$ age of ~186 ka confirming it is not an in-situ deposit. The trachyte contains autoliths of sanidinite and xenoliths of Paleozoic Beacon Supergroup sediments and dolerite likely to be from the Jurassic Ferrar Group. Trachytic rocks are rare on Erebus and only 4 small occurrences are known in stark contrast to the massive volumes of anorthoclase phonolite that forms the bulk of Erebus. The 4 widely dispersed trachyte lavas erupted between 157 and 185 ka and provide new insight into the magmatic evolution of Erebus.

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Unveiling the long-term landscape evolution of the Transantarctic Mountains

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Abstract

The long-term landscape and tectonic evolution of the Transantarctic Mountains reflects the interplay resulting from surface processes and deep processes, where efficient erosion of the uplifted rift shoulder contrasts with mechanisms sustaining a remarkably high topography. Numerous hypotheses have been proposed to explain the topographic structure of one of the largest and highest rift shoulder on the planet. Since the Cretaceous, the geological evolution of the Transantarctic front has been punctuated by extensional tectonics, magmatism and climate-driven events, including the onset of ice sheets whose variability heavily reshaped the rift shoulder.

In this contribution we present an updated morphometric analysis of both exposed and subglacial topography, along with a preliminary analysis of available published apatite thermochronological data, integrated with minimum exposure ages and field-based geomorphological constraints.

The morphology of the Transantarctic margin is marked by outstanding erosional and fault-related escarpments intersected by transverse troughs, developed through different erosion styles such as fluvial, fluvio-glacial, warm-based glacialism, and cold-based glacialism. Digital elevation models highlight: (i) the influence of orthogonal to oblique rift-related faulting on the morphotectonic evolution of the Transantarctic Mountains, (ii) morphological patterns investigated using topographic metrics, hypsometric distribution and swath profiles. Contrasting elevation distributions reflect the spatial heterogeneity of interactions between glacially-driven surface processes, mantle thermal anomalies and rock uplift. In addition, thermochronological data interpreted at a broader scale along longitudinal and transversal transects of the Transantarctic front may define exhumation patterns. Preliminary analysis of apatite thermochronology comprehensive database investigate how Transantarctic Mountains responded to Cenozoic climatic and tectonic history.

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Magnetotelluric investigation of the Glacial Isostatic Adjustment influence on the asthenospheric mantle electrical structure in Antarctica.

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Abstract

The geodynamic evolution of Antarctica plays an essential role in the processes controlling future climatic warming and sea level rise. The tectonic opening of two major oceanic passages, the Drake and Tasmanian gateways, involved the isolation of the Antarctic continent creating the Antarctic Circumpolar Current around 30-40 million years ago. This change in oceanic circulation doubtlessly affected the global climate and Antarctic ice sheet evolution with consequent sea level change. Mantle rheology influences the motion of lithospheric plates and Glacial Isostatic Adjustment (GIA) processes, which are thought to imprint anisotropic features on the mantle structure. Long-period magnetotelluric (LMT) measurements can be used to identify the electrical properties of the mantle. The GOLETA project aims to identify and characterize mantle electrical anisotropy in north-western Antarctica through the assessment of LMT data recorded at fifteen stations distributed along the Shetland Islands and the Antarctic Peninsula. Two Antarctic Research Campaigns (2021-2022 and 2022-2023) were necessary for data acquisition under the support of the Spanish Polar Program. Here, we present an analysis of LMT transfer functions, suggesting a possible presence of electrical anisotropy in the asthenospheric mantle of the Antarctic Peninsula and South Shetland Islands. Effects from the conductive ocean are considered using 3D modelling. In this area, it is crucial to account for the tectonic evolution of Antarctica to identify the source of potential mantle anisotropy as a result of geodynamic and /or GIA processes. These results may contribute to the improvement of GIA models currently developed in view of an isotropic mantle.

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Magnetotelluric exploration of the Deception Island active volcano (Antarctica)

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Abstract

Deception Island is the most active volcano in the South Shetland Islands (northwestern Antarctica). It is a ring-shaped volcanic island with a central ellipsoidal caldera. Its origin is related to the Quaternary vulcanism associated with the opening of the Bransfield Basin. Continuous seismicity together with high geothermal activity suggest the presence of a shallow magma chamber. This feature has been addressed by several geological and geophysical investigations.

Despite extensive research, there is still a knowledge gap concerning the deep electrical structure of the island. To address this, a Magnetotelluric study was conducted during the 2022-2023 Spanish Antarctic Research Campaign. Broad-band MT data was collected from twenty-nine stations across the island. Their locations based on the island's shape and steep topography, site spacing varied between 0.5 and 1.5 km. Measurements carried out for 48 hours using ADU-07 and MTU5-C instruments. An additional long-period station continuously recorded data for over 2 months.

The data processing was performed using the FFMT software package. The analysis of the transfer functions, including Phase Tensor and Induction Vectors, identifies three sectors with characteristic responses. MT responses are highly influenced by the ocean effect, making the inverse modelling challenging. Therefore, we consider that a priori information about the subsurface resistivity distribution must be included. Here, we present a resistivity model derived from a previous geophysical experiment and geological information in a geodynamic context. The forward responses approximate the observed data, however, certain inconsistencies in the transfer functions suggest the presence of an anisotropic structure at medium depth.

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New insights on cascading geological hazards in Bransfield Strait (Antarctic Peninsula)

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Abstract

The Bransfield Strait forms an active back-arc basin between the Antarctic Peninsula and the South Shetland Islands. The significant relief is primarily driven by the subduction of the former Phoenix Plate beneath the South Shetland Islands block, which is also undergoing westward displacement relative to the Antarctic Peninsula. This tectonic setting results in widespread seismicity throughout the basin, closely associated with volcanism and active faulting. Notably, earthquakes reaching magnitude M 7 are concentrated at the basin tips, where active rifting is occurring, while the central region exhibits early-stage oceanic spreading.

The presence of submarine slopes, combined with seismicity and glaciomarine sedimentation, contributes to the triggering of submarine landslides such as the Gebra landslide, affecting an area of 230 km². Both active seismic faults and landslides have the potential to rapidly deform the water column, thereby generating tsunami waves capable of propagating through the confined waters of the Bransfield Strait. Preliminary tsunami modeling of the recent Gebra landslide indicates that wave generation is limited due to the significant water depths (1000-2000 m). Nevertheless, icefall from glacial calving, iceberg overturn, and shallow small landslides may represent additional sources of potential tsunami waves, capable of generating localized but intense wave activity. The possibility of a cascading hazard, involving a sequence of seismic faulting events, and/or landslides, and/or icefall, underscores the critical need for comprehensive modeling efforts to assess tsunami risks. Such modeling may be critical to enhance tsunami hazard assessment for the Antarctic research stations along the coastlines of Bransfield Strait.

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Lithofacies and architecture of a long-lived Late Miocene volcanic complex at Minna Hook (Erebus Volcanic Province, Antarctica): construction of a large polygenetic glaciovolcano in the West Antarctic Rift

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Abstract

The Minna Hook volcanic complex is superbly exposed in a 12 km-long, 1000 m-high cliff in southern Victoria Land (Antarctica). It is a remnant of a large compound alkaline volcanic centre in the Erebus Volcanic Province within the West Antarctic Rift (WAR) and it was constructed from multiple overlapping volcanic edifices during several major phases of volcanism during the Late Miocene (12-8.5 Ma). The products of more than 50 eruptions are preserved. Each episode comprised eruptions taking place from central vents linked to independently fractionating crustal magma chambers. The eruptive style was very varied and included emplacement of glaciovolcanic ‘a‘ā lava-fed deltas, trachyte and phonolite domes, scoria cones and felsic block lavas. Additionally, fluvial sediments are locally prominent, and thick massive breccias were deposited during sector collapses. Despite the high-latitude location and prevailing glacial environment, glacial diamictites form only a minor component. The record preserved at Minna Hook is the most comprehensive of any volcanic centre within the WAR known so far. It differs in detail from the volcanic records published for other volcanic centres in the WAR and outside of Antarctica, but it is the best example of how a large polygenetic volcano is constructed within a major rift system that was mainly filled by ice and therefore forms the best basis for understanding the construction of such centres. It also illustrates how the large WARS volcanic centres are important repositories of information on terrestrial palaeoenvironments.

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First record of Fault-Slip data in the Lions Rump: Integration with regional deformation and tectonic evolution of King George Island.

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Abstract

A multi scale structural analysis was made in the Cenozoic units of the Lions Rump, in King George Island. 72 meso-scale faults were observed and separated in 7 kinematic stations. Most of the solutions can be associated with a strike-slip strain field, with some solutions giving NNW-SSE contractional direction and 2 extensional solutions associated with a tensional strike between N-S to NE-SW. Fault-slip data analysis relates the strike-slip solutions to NNW-SSE to N-S contractional and tensional directions.

Structural regional observations show a wide wavelength fold around the east coast, being a symmetric syncline the major structure in the area (Smellie et al., 2021), and a minor syncline-anticline structure in the Lions Rump itself. These structures describe a low angle flat-ramp-flat geometry of NE vergency, inferring a possible compressional setting for the Eocene-Oligocene.

High dipping normal faults are cutting the eastern limb of the major syncline, folding the volcano-sedimentary Polonez Cove and Boy Point formations (Bastias et al., 2023), in several locations. These meso-scale faults correlate with some strain field solutions, indicating the presence of an extensional deformation posterior to a compressional one. The 21 Ma Chopin Ridge intrusive shows a clear NE-SW extensional solutions, showing that the extensional process affected the area during the Late Oligocene.

The assembly of the fault-slip data, and the subsurface interpretation of the regional structure, can be a strong approximation of the close relationship between strain fields at different scales, not only for the Lions Rump area, but for all the King George Island.

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Methane seeping along the upslope limit of gas hydrate occurrence off the Antarctic Peninsula facilitated by major crustal fault

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Abstract

A Bottom Simulating Reflector (BSR) associated with the presence of gas hydrates is widely present north of the South Shetland Islands, spanning an area exceeding 5,000 km^2. Potential glacio-isostatic and tectonic uplift, possibly combined with ocean bottom-water warming, may have induced gas hydrate dissociation, leading to methane release into the Southern Ocean. During a research cruise conducted aboard the RV Sarmiento de Gamboa in January-February 2025, we acquired high-resolution multichannel seismic profiles, swath bathymetry, water column acoustic data, sediment cores, and water samples. The water column was also surveyed using a CTD rosette equipped with multiple sensors, including a methane detector. Acoustic imaging of the water column revealed several methane plumes near the upslope limit of the gas hydrate occurrence zone. The most prominent plume is associated with a major sinistral strike-slip fault on the upper continental slope. This fault, imaged in the bathymetric and seismic data, evidences recent activity, shown by clear seafloor displacement. The plume, as depicted by anomalies on the methane sensor and acoustic data, occurs in ~750 m water depth, and rises ~350 m above the seafloor vanishing at ~300 m depth. Other plumes in shallower water vanish at similar depth. These plumes indicate the potential for methane to migrate toward the atmosphere and underscore the importance of quantifying how methane consumption within the water column may influence local acidification.

Acknowledgments

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Structural architecture and thermochronological constraints of rift flank faulting in the Transantarctic Mountains

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Abstract

The Transantarctic Mountains represent the longest and highest extensional mountain range on Earth, marking the boundary between the Antarctic craton and the rifted Ross Sea lithosphere, while experiencing over 100 Myr of quasi-continuous extension. A major oblique rifting regime, overprinting an initial orthogonal phase, has driven the development of the Ross Sea basins alongside the Transantarctic Mountains since the Oligocene. The timing of deformation along the rift flank was conventionally inferred through analysis of fission-track age transects to reconcile differing exhumation patterns observed along the basin-boundary faults. By focusing on the Convoy Range of southern Victoria Land, this study integrates structural investigation and apatite thermochronology on fault zones exposed along the NS-to NE-oriented rift-flank of the Terror Rift, where the fault damage zones are decorated by a pervasive hydrothermal alteration. Fault data have been accompanied by microtextural investigations on fault rocks to define the tectono-thermal environment of rock deformation during faulting. The age of deformation was constrained by apatite fission-track thermochronology recording hydrothermal fluid-rock interactions within the fault damage zones. These new findings pose new structural and temporal constraint on the linkage between Cenozoic rifting, exhumation and onset of the McMurdo volcanism in the region.

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The Pacific Margin of the South Shetland Islands: Evidence of major recent deformation in a supposedly extinct accretionary prism

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Abstract

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The Pacific margin of the South Shetland Islands (Antarctic Peninsula) has been traditionally regarded as an inactive plate boundary since the cessation of the subduction in the Pliocene. However, recent analyses on archive and new acquired data during the 2025 ICEFLAME cruise, including geomorphological and geophysical datasets, reveal active deformation within the accretionary prism. High-resolution multichannel seismic profiles indicate fault displacements affecting the upper sedimentary units, while seafloor features such as ridges, scarps, and linear depressions align with active structural trends. Additionally, the geomorphological analysis of bathymetric data show a complex incision network characterized by abrupt strike changes, knickpoints, reverse profiles, and straight terminations, all spatially associated with active structures. Such morphologies and structures support recent tectonic activity in the accretionary prism. Moreover, seismicity recorded in the area correlates with zones of recent faulting. Active mud volcanoes emitting gas flares in the water column have been identified along the middle and upper slope and are linked to fluid migration on overpressured zones and active fault systems driven by tectonic force. Altogether, our findings underscore active geodynamic processes in a margin previously considered tectonically inactive, prompting a re-evaluation of its current tectonic regime.

Acknowledgments

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Unveiling Paleocene Hydroclimate Dynamics in Antarctica: Evidence from Seymour Island Sediments

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Abstract

During the Cenozoic, climate shifted from a greenhouse state in the Paleocene and Eocene, marked by multiple hyperthermal events, to a coolhouse state following the Eocene-Oligocene boundary, with the onset of permanent Antarctic glaciation. However, the Paleocene high-latitude climate remains poorly understood. This study presents high-resolution geochemical and paleontological data from Paleocene shallow marine deposits on Seymour Island, Antarctic Peninsula, interpreted within the context of paleomagnetic chronologies. We primarily utilize elemental ratio profiles obtained via X-ray fluorescence, such log(Fe/K) (hydroclimate and weathering intensity proxy), log(Zr/Rb) (sediment grain size proxy), log(Ca/Fe) (terrigenous input versus carbonate production proxy), and log(Al/Ti) (provenance proxy), to reconstruct paleoenvironmental settings. Furthermore, we use palynological analyses and clay mineralogy data to further understand the hydroclimatic variability in this high-latitude environment. Our results indicate that global warming events during the Paleocene were associated with drier hydroclimatic conditions over the Antarctic Peninsula. This is evidenced by indicators of reduced chemical weathering intensity (high log(K/Fe) and increased illite content), and input of fine-grained terrigenous sediments (low log(Zr/Rb)) associated with increased carbonate content. Toward the upper stratigraphic section, the data reveal a shift toward more intense chemical weathering, suggesting overall wetter conditions. However, this trend is punctuated by drier hydroclimate conditions during less intense hyperthermal events within the Paleocene Carbon Isotope Maximum. In summary, our data reveal previously unrecognized hydroclimate patterns in southern high latitudes during Paleocene carbon cycle perturbations [Paleoclima Project process 88887.314454/2019-00); Fondecyt Postdoctoral Nº 3230319].

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The Antarctic Peninsula-Scotia Sea coastal orogenesis triggered reorganization of global ocean-climate system in the Cenozoic

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Abstract

The opening of the Drake Passage created the conditions necessary for the onset and enhancement of the Antarctic Circumpolar Current (ACC), a critical driver of global ocean circulation that influences nutrient distribution, density, and deep-water flow. The initial opening of the Drake Passage, at least at a shallow depth, is proposed to have occurred during ca. 62-59 Ma and interrupted the land-bridges that allowed dispersal events of therian mammals from South America to Antarctica (Gao et al., 2025). However, the subsequent evolution of the Drake Passage is difficult to determine due to the complex geological evolution.

Here, we use Sr/Y and Ce/Y proxies to show that the crust along the Antarctic Peninsula-Scotia Sea coastal area has been thickening and thinning since ca. 59 Ma. The thinning crust associated with crustal extension occurred during the collision between the Phoenix Ridge and the Antarctic Trench, which coincided with the deeper Scotia Sea and the stronger ACC. Simulations using the Community Earth System Model reveal that this deepening increased ACC, decreased global abyssal oxygen concentrations, and induced hemispheric temperature asymmetry. These findings, which are consistent with independent geological data, have global implications for improving our understanding of Earth system interactions during the Cenozoic.

Reference:

Gao, L., Guo, X., Pei, J., Gelfo, J. N., Hu, X., Li, S., ... & Zhao, Y. (2025). The Initial Opening of the Drake Passage Occurred During ca. 62-59 Ma. Geophysical Research Letters, 52(7), e2024GL111455.

Category

1 Antarctic Geology, Tectonics, and Planetary Connections

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Advancing Geological Mapping in Antarctica: Overcoming Challenges with Digital Tools

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Abstract

Understanding the surface geology of Antarctica is crucial for deciphering its architecture and evolution. However, geological mapping in remote polar regions presents significant technical challenges, particularly in areas like Adélie Land (East Antarctica), where outcrops are scarce and limited to coastal islands, capes, and isolated nunataks. Historically, the lack of precise topographic maps hindered traditional field mapping. Today, satellite imagery and digital elevation models (DEMs) provide a robust foundation for geological data collection. Modern digital mapping techniques—using tablets and drones—have greatly improved positioning accuracy and enabled rapid acquisition of rich datasets, including geotagged photographs and structural measurements. Over the past 3 field seasons we have used iPad-mini units (3G models) protected in water-resistant cases and running FieldMove software to carry structural and geological mapping in Adélie Land. However, structural measurements near the South Magnetic Pole (~200 km North) are severely affected by magnetic storms, randomly causing large declination shifts. Solar compasses, triangulation, and GPS bearings are impractical under time constraints. To overcome this, we developed a GNSS-based digital compass with dual helical antennas and an accelerometer. This portable device calculates True North via double-difference algorithms, unaffected by magnetic noise, while a shared clock corrects atmospheric delays for sub-degree accuracy. We supplement fieldwork with drones (despite high-latitude magnetic interference), 360° photography, and 3D models from photogrammetry/LiDAR. All data integrate into QGIS for analysis and map production. By openly sharing these datasets in the future, we aim to maximize their utility for the geoscience community.

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Active intraplate deformation in Antarctica: Constraints from GNSS

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Abstract

The West Antarctic Rift System developed in the Cretaceous, had significant activity in the Cenozoic, and is commonly described as active. Constraints on very young rift-related displacements in the Terror Rift come from seismic reflection profiles in the western Ross Sea where faults reaching the seafloor may indicate Holocene activity and where there is active volcanism. Recent to active volcanism also occurs in Marie Byrd Land, subglacial volcanism has been interpreted in sectors of West Antarctica, and associated rift activity has been inferred. Here we document modern intraplate deformation in West Antarctica using GNSS data from sites that span the rift system from the Transantarctic Mountains to the coastal Amundsen Embayment region. With Antarctic plate motion removed, it is clear that the primary deformation signal is from glacial isostatic adjustment. We build on early studies using GPS constraints on intraplate deformation, using much longer measurement time series, to consider whether any active intraplate tectonic signals can be discriminated from the GNSS data.

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Reassessing the Terre Adélie Craton: A Key to Proterozoic Geodynamics in East Antarctica

Guillaume Duclaux[1,2], Josselin Gremmel[3,1], Yann Rolland[4], Jérôme Bascou[5], Maria Naumenko-Dèzes[1], Antonin Laurent[5], and the GEOLETA and ARLITA Teams[5]

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Abstract

The Antarctic continent, covering 10% of Earth's landmass, remains one of the least understood continental regions due to its remote polar position, limited outcrops (<2%), and extreme accessibility challenges. East Antarctica, composed of Precambrian terranes, plays a pivotal role in reconstructing potential ancient supercontinents. The Terre Adélie Craton (TAC), part of the Mawson Continent - a critical fragment of Rodinia -offers a rare, well-preserved record of Neoarchean to Mesoproterozoic crustal evolution, unaffected by Grenville or Ross orogenic overprints.

Twelve field seasons - supported by the French Polar Institute (IPEV) over 30 years - of geological mapping and geophysical studies in Adélie Land and George V Land (135–146°E) have revealed the TAC's structure and polyphase formation history. Our findings distinguish two distinct crustal domains and key structures shaped during two major tectono-metamorphic and magmatic events between 2.6 and 2.4 Ga (Neoarchean-Siderian), and 1.7 to 1.5 Ga (Statherian to early Calymmian). The multiple phases identified during these two long lasting events mirror those documented in the Gawler Craton (South Australia), reinforcing their shared identity as the Mawson Continent. Revised maps and structures correlations, along with new geophysical and petrochronological data help us redefine the TAC's architecture, highlighting its significance as a stable continental block amidst Proterozoic geodynamic upheavals.

This work provides a revised framework for the TAC's evolution, offering insights into Precambrian supercontinent assembly and crustal growth processes. By correlating Antarctic and Australian terranes, we advance the understanding of Rodinia's configuration and the role of the Mawson Continent in global Proterozoic tectonics.

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GeoEAIS- Exploring Subice geology of Amery Ice Shelf, East Antarctica

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Abstract

East Antarctic Ice Sheet (EAIS) represents the largest single deposit of the fresh water on earth and there is a realization that the threshold for stability of EAIS may strongly depend on bedrock geology and structures. Following aerogeophysical surveys, including Radar based surveys, increasingly larger number of subice water bodies in Antarctica have been mapped indicating significant basal melting. Subice geology is possibly be one of the important boundary conditions in context of basal melting.

The Amery Sector of East Antarctica is of major scientific interest due to its complex glaciological and geological features. It hosts the Lambert Glacier, one of the largest drainage systems on the continent, characterized by strong flow convergence and acceleration near the coast. Geologically, it holds significance in supercontinent reconstruction, as it contains crustal blocks with Indian affinities. To its south lies the Gamburtsev Subglacial Mountains (GSMs).

An initiative namely **Geological Exploration of Amery Ice-Shelf (GeoEAIS)** is being developed as part of India's national antarctic program for the last five years. The primary data generation includes study of exposed outcrops, heavy mineral data and other information from the coast proximal marine sediments of Princess Elisabeth Land (PEL) and terrestrial glacial sediments, interpreted alongside regional-scale geophysical datasets.

Besides results consistent with exposed rocks, initial results suggest a Tonian–Cryogenian (800-700 Ma) event in the hinterland of the Amery Sector, potentially linked to the GSMs.

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Cretaceous formation of Southern TAM, followed by Paleogene down-dropping of Ross Sea

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Abstract

Analysis of geomorphic features supplemented by previous work on glaciation patterns and low-temperature thermochronology provide evidence of high elevation in the southern TAM prior to development of normal faulting and down-dropping of the Ross Sea. Distributions of slope aspect direction in the current highlands indicate fluvial drainages developed on topography. These fluvial drainage patterns were then modified by glacial processes including alpine style glaciation in the highlands and selective erosion and incision of surrounding river drainages. Thus, the highlands must have existed prior to onset of glaciation in the southern TAM, before 34 Ma, and possibly as early as 60 Ma. In regions adjacent to the Ross Sea, slope aspect distributions capture the sea-ward facing escarpments, associated with normal faulting and down-dropping of the Ross Sea. Drainage reversals with a sweeping morphology are found throughout the southern TAM, but are not evidenced in the rest of the TAM. These indicate drainage reorganization via fluvial erosion in response to the down-dropping of the Ross Sea. Thus, the down-dropping of the Ross Sea occurred after development of the highlands and river systems, and prior to the onset of glaciation in the southern TAM. Thus geomorphic analysis indicates that both of these tectonic events occurred prior to widespread glaciation of the region, suggesting possible Cretaceous development of high elevation, followed by Paleogene normal faulting., followed by the onset of glaciation in this region.

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Enhanced Aeromagnetic Coverage of Antarctica towards ADMAP-3

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Abstract

Substantial advancements in Antarctic geomagnetic mapping have occurred since the 2017 ADMAP-2 compilation, with over 745,000 line-km of new airborne and shipborne data acquired. These surveys, often conducted in conjunction with airborne laser altimetry, radio echo sounding, and aerogravity data, provide a comprehensive dataset for investigating ice sheet characteristics, crustal thickness, and geological structure. This enhanced data coverage significantly improves our understanding of Antarctic crustal architecture and tectonic evolution, strengthening correlations with formerly connected continents. Key improvements include coverage of previously poorly surveyed areas such as the Recovery Basin, South Pole region, southern Princess Elizabeth Land, the Ross Ice Shelf, and other East Antarctic regions. Specifically, European Space Agency PolarGAP data at the South Pole reveal an irregular cratonic margin and embayment reminiscent of late Neoproterozoic rifting along Rodinia's margins in Australia and Laurentia. The Recovery and Polar Gap surveys address significant gaps in East Antarctic aeromagnetic coverage, potentially indicating the western limit of the Mawson craton. A major dataset (125,800 line-km) from AWI/BGR in and around Dronning Maud Land offers insights into the Tonian Oceanic Arc Super Terrane. Russian surveys in Queen Mary Land reveal the East Antarctic extent of a Stenian-aged accretionary orogen, constraining the Indo-Antarctica/Australo-Antarctica suture. The ROSETTA–Ice survey highlights a major crustal boundary between rifted East Antarctic edges, potentially extending further west than previously thought. While currently unavailable, CHINARE data from southern Princess Elizabeth Land promise crucial insights into the central Antarctic plate's lithology and structure, essential for tectonic reconstructions.

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U-Pb zircon provenance analyses of (meta-) sedimentary rocks of the Shackleton Range, East Antarctica: significance for paleogeographic reconstructions of parts of East Antarctica in Columbia, Rodinia and Gondwana.

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Abstract

The Shackleton Range form remote and important basement outcrops in East Antarctica, SE Weddell Sea region. Previous studies have highlighted its critical role in advancing our understanding of East Antarctica's geodynamic evolution and in providing ground-truth constraints for various geophysical blocks and linear features. The Shackleton Range likely marks the transition from the Mawson Craton (Australian heritage) to the Coast Land Block (Laurentian heritage), separated by a Late Neoproterozoic/Early Paleozoic suture zone. During Late Neoproterozoic/Early Paleozoic amalgamation of East Antarctica, the Shackleton Range lay at the southern termination of the major East African-Antarctic Orogen that was characterised by major strike-slip tectonic and lateral extrusion.

The range comprises high- to medium-grade basement gneiss complexes of Paleoproterozoic to Late Neoproterozoic age, which are locally interleaved with several distinct sedimentary units that range from non-metamorphosed to low-grade metamorphism. Some of these sedimentary sequences are interpreted as passive margin deposits associated with the Mawson Craton, while others are considered remnants of pre-suturing basins or post-orogenic molasse deposits.

In this study, we present the first comprehensive U-Pb-Hf zircon study of the region, including 15 samples from seven distinct mostly low- to non-metamorphic sedimentary units. More than 1600 new concordant U-Pb zircon ages provide significant new information of the composition of the Mawson continent and the Coats Land Block. The presence of significant Grenville-age age components, Tonian Oceanic Arc Super Terrane signatures, and detritus from the East African–Antarctic Orogen significantly enhances our understanding of this cryptic and geologic complex region of East Antarctica.

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The Thermal and Chemical Structure of the Antarctic Upper Mantle

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Abstract

The thermal and chemical structure of the Antarctic upper mantle has important implications for geological processes as well as ice sheet dynamics. We develop a new seismic model (ANT-41; Zhou et al, in prep) using adjoint tomography and full waveform synthetics to improve the ANT-20 (Lloyd et al, 2020) model. ANT-41 incorporates a new crustal thickness map, Green's functions from ambient noise correlation, double-difference measurements, additional 2017-2023 seismic data, and extends the short period surface wave cutoff to 20 s. The mantle thermal and chemical structure is then estimated using petrologic modeling and Bayesian Monte-Carlo joint inversion of seismic velocities, surface elevations, and geoid anomalies. Lithospheric thickness is estimated from the depth of the 1250C isotherm. East Antarctica is characterized by 250-300 km thick lithosphere showing depleted, high Mg-number mantle extending from Terra Adelie to grid-north of South Pole, representing the Archean to Proterozoic cratonic core. Thinner lithosphere occurs in regions of Phanerozoic tectonic activity in Dronning Maude Land, the Lambert Graben, and several coastal areas. Thin lithosphere (< 60 km), high mantle temperatures, and high heat flow occur near the West Antarctic coastline, extending from the Marie Byrd Land to the Antarctic Peninsula, likely resulting from the thermal effects of a mantle plume as well as a slab window that traversed the region as the Phoenix-Antarctic plate boundary migrated northward. Mantle temperatures and experimentally-derived rheological relationships indicate very low upper mantle viscosity in West Antarctic regions characterized by rapid ice mass loss and land uplift measured by GNSS.

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Isotopic composition and evolution of Mesoproterozoic Maud Belt in Dronning Maud Land and implications for the lateral termination of the Grenville Orogen

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Abstract

The Maud Belt in Dronning Maud Land (DML) represents a Mesoproterozoic orogen that formed along the eastern margin of the Proto-Kalahari Craton (present-day coordinates hereafter) prior to its detachment from Kalahari during the breakup of Gondwana. This study presents new and compiled zircon U–Pb–Hf isotopic data (ca. 1180–950 Ma) and whole-rock Nd isotopes from across the Maud Belt and the adjacent Archean Grunehogna Craton to investigate its tectonic evolution and broader role in Rodinia assembly. The isotopic composition and evolution of the Maud Belt reveal a dominant addition of juvenile material compared to other contemporaneous Rodinia-forming orogens including the Grenville Orogen, indicating a long-lived subduction and accretionary system rather than continent-continent collision.

This work also contributes to a better understanding of the lateral termination of the Grenville Orogen and the paleogeography reconstruction adjacent to southwest Laurentia within Rodinia. The Maud Belt likely marks a tectonic transition where collisional assembly between Laurentia and Kalahari transitioned into an accretionary continental margin that may have persisted into the Neoproterozoic, promoting the development and accretion of arc terranes until Gondwana amalgamation. Paleogeographic reconstructions have placed several continental fragments, such as Coats Land and the Haag Nunataks, with affinities to both the foreland and hinterland of the Grenville Orogen in southwest Laurentia. These blocks were subsequently dispersed in multiple directions and ultimately accreted to different continents. The Mesoproterozoic tectonic transition from the collisional Grenville Orogen-Natal Belt to the accretionary Maud Belt may have established the initial conditions for this fragmentation and dispersal.

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Antarctic Geologic Evolution (AGE): SCAR Science Program Planning Group to Unveil the 4D Lithospheric Architecture and Dynamics of Antarctica

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Abstract

The Antarctic Geologic Evolution (AGE) program is a new SCAR initiative designed to integrate multidisciplinary data and expertise to resolve the complex lithospheric structure and evolution of the Antarctic continent. AGE aims to develop a four-dimensional (4D) framework of Antarctica's tectonic architecture, from Archean cratons to Cenozoic rift systems, and to understand the processes that have shaped its crust and upper mantle over geological time.

Structured around three scientific pillars—Architecture, Processes, and Interactions—AGE will synthesize geophysical, geological, and geochemical data to produce high-resolution maps and models of crustal provinces, lithospheric boundaries, and heat flow regimes. The program will explore geodynamic mechanisms such as rifting, magmatism, orogenesis, and sedimentary basin evolution, and assess their role in modulating geothermal flux, surface topography, and glacial dynamics.

AGE further emphasizes the coupling between the solid Earth and surface systems, seeking to constrain how lithospheric heterogeneity influences ice sheet behavior, subglacial hydrology, and biogeochemical fluxes. These investigations are essential to contextualize Antarctica's geological history within supercontinent cycles and to anticipate its future role in Earth system processes.

AGE is designed as an open, inclusive, and collaborative platform supporting international polar science priorities, and aims to deliver key geoscientific products in time for the International Polar Year 2032/33.

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Stratigraphic analysis of the Eocene-Oligocene transition exposed on Lions Rump-Polonez Cove area (King George Island, Antarctic Peninsula)

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Abstract

A detailed stratigraphic analysis was performed in Lions Rump-Polonez Cove area (King George Island, Antarctic Peninsula) in volcanic and sedimentary successions which record the time of the formation of the ice sheet in Antarctica during the Eocene-Oligocene transition (EOT). Previous systematic stratigraphy of the area was published by Birkenmajer (1980, 1982), Porebski and Gradzinski (1987, 1990), Troedson and Smellie (2002), Smellie *et al*. (2021), among others.

Eocene is represented by at least two jointed basaltic-andesite lava flows from Hennequin Fm., without stratigraphic relation with local subaerial welded tuffs.

The Eocene-Oligocene contact is sharp and the base of the Oligocene is represented by a glacier diamictite which grades upwards into graded-stratified and poorly-sorted sandstones and conglomerate sandstones. The sequence continues with well-bedded sandstones and siltstones, rich in bivalves. This could be part of the Krakowiak glacier member of the Polonez Cove Formation (PCF).

A volcanic-dominated unit follows upwards represented by dome-shaped basaltic-andesite agglomerates overlain by dark green beds of polymictic poorly-sorted scoria-rich sandstone (probably part of Low Head member of PCF).

Volcaniclastic beds are overlain by a palagonite-rich unit with massive thick layers of jigsaw-fit hyaloclastites and inversely-graded scoria flow layers (probably Obereck Cliff member of PCF).

Thick graded-stratified subaqueous tuffs intercalated with a dacitic breccia with prismatically-jointed bombs (subaqueous block and ash flow?) marks the start of the upper unit of the sequence (Boy Point Fm.).

By means of a stratigraphic and lithofacies scheme, we aim to understand the Eocene-Oligocene environmental transition.

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40Ar/39Ar geochronology and geochemistry of Paulet Volcano: insights into the Larsen rift at Antarctic peninsula

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Abstract

Quaternary volcanism in the Antarctic Peninsula is mostly located along the Bransfield Strait and Shetland Islands. However, scattered stratovolcanoes have been recognized further southeast forming alignments from which some rift systems have been inferred (Larsen and Prince Gustav rifts). The existence of the latter would be relevant to the present lithospheric structure and might exert control on petrogenesis and magma ascent. However, the geophysical nature of these structures is not well understood, and the geochemical signature of the magmas erupted there remain poorly constrained. We here report both 40Ar/39Ar geochronology and geochemical/isotopic data to show that Paulet Volcano erupted enriched primitive alkaline magmas with a very subtle subduction signature, compared to other centers nearby such as Cape Purvis, Brown Bluff, and Jonassen Island, during the Late Pleistocene and Holocene. The origin of these trachybasalts is related to an enriched mantle source with an OIB-like signature, similar to that of the James Ross Island Volcanic Group and comparable to that observed in the rear-arc domain of subduction systems. The reappraisal of the published geophysical data show that regional features can be reproduced without those large-scale tectonic structures.

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Linking geothermal heat flux heterogeneity unveiled from aeromagnetic data with crustal provinces and processes

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Abstract

Geothermal heat flux (GHF) is ill-constrained in Antarctica compared to other continents despite its influence on Antarctic ice sheets and its important linkages with the properties of the subglacial crust and lithosphere.

We analyse a new Antarctic aeromagnetic anomaly compilation conformed with SWARM satellite magnetic data to estimate Curie depths as a proxy for GHF. Elevated GHF is associated with the thinned and weak crust and lithosphere of the West Antarctic Rift System (WARS), particularly beneath the rapidly changing Thwaites and Pine Island sectors of the West Antarctic Ice Sheet and along the edge of the Marie Byrd Land block. Our results also imply greater variability in GHF beneath the central part of the WARS compared to previous estimates.

In East Antarctica, we retrieve elevated GHF under the Byrd glacier catchment, inland of the Transantarctic Mountains that likely arise from radiogenic Paleo to Mesoproterozic basement terranes. Lower GHF values are retrieved beneath the northern Wilkes Subglacial Basin (NWSB). However, these spectral methods have low spatial resolution and hence we cannot disprove localised areas of higher GHF here too, especially as aeromagnetic signatures over the NWSB resemble those over formerly adjacent highly radiogenic Proterozoic terranes in Southeastern Australia.

Over other areas, such as the Dome C, Dome A and Dronning Maud Land regions we find higher GHF that we relate to heterogeneities in heat production in the Precambrian crust and the evolution of major Gondwana-forming orogenic belts respectively.

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Ferrar Large Igneous Province Link and impact on Early Jurassic Climate and Environment

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Abstract

Volcanism in the Karoo and Ferrar Large Igneous Provinces (LIP) is considered to be the trigger for significant environmental changes in the Early Jurassic associated with the Toarcian Oceanic Anoxic Event and carbon isotope excursion (CIE), as well as the Pliensbachian-Toarcian Event and CIE. This environmental change is characterised by carbon cycle perturbations that affected the whole ocean-atmosphere system and mass extinction in the marine realm. Significant work has been undertaken to understand the' impact, absolute age, and duration of these events with relation to LIP activity. However despite the plethora of vintage and recent geochronological datasets generated for Karoo and Ferrar, questions remain about the impact and effect of this activity on the environment, specifically in Ferrar as well as Chon Aike Silicic LIP. Here we provide a statistical analysis of Ferrar and Chon Aike radiometric ages, examining the intrusive and extrusive activity and the relationship to the timing and duration of the Early Jurassic Pliensbachian–Toarcian and Toarcian global carbon cycle perturbations and hyperthermals, as well as climatic cooling in the Aalenian. We also examine this data with respect to Antarctic palaeobotanical data to assess the relationship between volcanism and the local environment during the Early Jurassic to improve our understanding of environmental and climatic conditions during this critical interval in Earth's History.

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Geological heritage sites of the Antarctic Peninsula: challenges for their conservation and their potential to promote scientific research, education, and geotourism

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Abstract

The Antarctic Peninsula boasts a spectacular diversity of geological and geomorphological processes as evidenced by specific landscapes and sites. This geodiversity has attracted the attention of geoscientists from different parts of the world, especially since the 20th century. The knowledge generated from geological studies of this remote region has contributed to the development of plate tectonics theory and the understanding of past climates. Three examples of geological heritage sites of the Antarctic Peninsula are: 1) the Deception Island, one of the most active volcanoes of the continent with a caldera structure and high historic value; 2) Edinburgh Hill, a stunning Quaternary columnar jointed volcanic neck about 250 m in diameter and 100 m high; 3) The Lemaire Channel, a fault-related strait with steep cliffs of high scenic value where Jurassic volcanic and sedimentary rocks are exposed. The system of Antarctic Specially Protected Areas (ASPAs) allows the consideration of outstanding geological and geomorphological areas for their protection. However, there is a recognized challenge for the conservation and management of these geological heritage sites, particularly given the significant increase in the tourism industry and scientific activities in the area. Also, these sites can support the development of educational and geotouristic activities related to the Earth sciences. These efforts will require the collaborative participation of various entities, including the Parties that signed the Antarctic Treaty, international research agencies, the tourism industry, educational institutions, and non-governmental organizations, particularly those related to nature conservation and working to address climate change.

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Archean Assembly of the Napier Complex, east Antarctica: Insights from U–Pb Zircon Geochronology and Hf–O Isotopes

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Abstract

The Napier Complex, as part of the East Antarctic Shield, preserves crustal evolution from the Eoarchean to the Neoarchean. It experienced high to ultra-high temperature (UHT) metamorphism at 2.5 Ga, and locally at 2.8 Ga. Although UHT metamorphism is generally linked to convergent margin tectonics and supercontinent assembly (Jiao et al., 2023, Nat. Rev. Earth Environ.), the timing of final assembly remains unresolved. To address this, we analysed U–Pb-Hf–O isotopes in zircon from samples from Amundsen Bay in the west and the Scott Mountains in the SW of Enderby Land. The data from Amundsen Bay revealed magmatism at ca. 2.9, 2.8 and 2.7 Ga, with mantle-like $\delta^{18}O$ in the range of 4.9–5.8 ‰, with one sample giving zircon grains with ~3.0 ‰, indicating involvement of material hydrothermally altered at high temperatures. Hafnium-isotope signatures (εHf) indicate recycling of preexisting crust (≤3.7 Ga) along with juvenile magma generation at 2.7 Ga. The southern part of the Napier Complex records magmatic pulses at 3.1 Ga, 2.7 Ga and 2.5 Ga. Here, $\delta^{18}O$ ranges from mantle-like to supra-mantle levels of 9 ‰, attesting to variable contributions of surficially weathered material. Similarly to the Amundsen Bay, both juvenile mantle melts at 2.7 Ga and melts derived from very old crustal protoliths (> 3.6 Ga) are indicated by variable εHf.

Together, these results demonstrate the recycling of crust older than 3.6 Ga and juvenile-arc magmatism at ca. 2.7 Ga in both regions, indicating final assembly by 2.7 Ga.

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Timing of of high-P/T metamorphism in southern Patagonian and Fuegian Andes

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Abstract

The southernmost tip of South America represents a fascinating and relatively underexplored region that probably remained geologically connected to the Antarctic Peninsula from the Permian through the early Mesozoic. In this study, we present new petrological and geochronological data on high-pressure metamorphic events associated with the dynamics of the southwestern convergent margin of Gondwana. These processes were influenced by global geodynamic changes, including the breakup of Gondwana, the opening of the Atlantic Ocean, and accelerated seafloor spreading in the Pacific Ocean. High-P/T metamorphism recorded during the Early Jurassic and Early Cretaceous in the subduction zone facing an open ocean basin occurred contemporaneously with the formation of marginal basins linked to trench retreat. Based on geochemical evidence, we evaluate the hypothesis that a marginal basin developed between the Antarctic Peninsula continental block and southern South America. Additionally, we examine subduction- and collision-related metamorphism associated with the closure of the Rocas Verdes Basin during the mid- to late Cretaceous. A critical review of existing tectonic models is provided, alongside a discussion of the potential southward migration of the Antarctic Peninsula during the Early Mesozoic times. This contribution aims to offer a comprehensive synthesis of the origin of the continental basement in southern Patagonia and the tectonic evolution of an active convergent margin. Acknowledgements. This work is funded by Fondecyt 1161818 and Exploracion 13220141 projects (ANID).

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Machine Learning Reveals Intermediate-Depth Earthquakes Beneath East Antarctica

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Abstract

Intermediate-depth earthquakes (IDEs), which occur at depths between 70-300 km, are a unique phenomenon that have been recognized in some subduction environments, but little is known of their occurrences in intraplate settings. The apparent lack of IDEs in continental interiors has been attributed to a lack of high-pressure dehydration reactions and extreme differential stresses, as the intraplate lithosphere is generally thermally equilibrated and relatively stable. Recent advancements in machine learning have opened new opportunities to investigate IDEs beyond subduction zones and offer insights into the thermal evolution and geodynamic processes shaping Earth's interior. Here, we observe small magnitude (Mw ≤ 3) intraplate IDEs beneath East Antarctica, recorded by the TAMNNET and TAMSEIS seismic arrays between 2001 and 2015. These events are concentrated along the lithosphere-asthenosphere boundary beneath David Glacier, adjacent to Terror Rift. Additionally, the IDEs are concentrated along the boundary between the stronger lithosphere under Victoria Land and the weaker, hotter lithosphere under West Antarctica. This contrast in lithospheric strength between Victoria Land and the Terror Rift likely facilitates stress concentration, while localized thermal weakening may reduce the effective viscosity of deep-seated faults, making them more prone to failure.

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Rates of Holocene thinning from marine-based ice in the western Ross Sea

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Abstract

Retreat of the marine-based ice sheet in the Ross Sea contributed to global sea-level rise during the last deglaciation as the grounding line receded from the continental shelf to the present-day position. However, the timing and rates of Antarctic ice sheet retreat in the Ross Sea during the last deglaciation are poorly constrained due to data gaps in the geological record. To reduce these knowledge gaps, we present a high-resolution chronology of marine-based ice sheet retreat in the western Ross Sea. New in situ 10Be cosmogenic nuclide measurements will constrain the thinning of grounded ice during the Holocene. The lack of geological constraints during this period across the Ross Embayment limits our ability to assess the performance of ice sheet models that are benchmarked against the geological record of ice sheet change. These new exposure ages will be compared with previously published marine-based ice sheet retreat chronologies across the Ross Sea to constrain timing and rates of retreat from the onset of deglaciation to grounding line retreat, and formation of the Ross Ice Shelf. These data will provide boundary conditions for data-model comparison, help tune ice sheet models, and improve their ability to simulate marine-based ice sheet dynamics under varying ocean thermal forcing scenarios.

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Groundwater driving critical Antarctic climate and environmental processes: a collection of evidence.

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Abstract

There is substantial evidence that groundwater, the liquid water sub-terrafirma, drives critical Antarctic climate and environmental processes (i.e. processes of ice sheet dynamics, ecosystem function, carbon and methane cycling, and the global water cycle).

Groundwater has significant potential to contribute to enhanced basal melt rates and ice flow, accelerating discharge to both land and the oceans. Groundwater can be highly saline and solute-rich, which has implications for ecosystem function in situ as well as where it discharges. Additionally, groundwater can transport carbon and methane, bringing in additional detrimental contributions to greenhouse gases. Finally, global inventories of groundwater, the data on which many sea level rise models are based, do not account for the groundwater capacity of the entire continent of Antarctica.

We present and discuss the current collection of evidence encountered in literature so far and explain potential strategies to better address the current knowledge gaps.

The SCAR Groundwater Action Group is currently tasked with bringing together the community to address this topic. Our presentation explains the magnitude of the knowledge gap on both global and local scales and the recent activities of the Action Group.

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Cook and Ninnis glaciers (East Antarctica) and Ocean interaction in the Pleistocene from marine geological records

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Abstract

The glaciers draining the ice sheet covering the subglacial Wilkes subglacial Basin (East Antarctica) and terminating in the Cook Ice Shelf and Ninnis Glacier Ice Shelf contain a volume of ice equivalent to a global sea level rise of 3 to 4 metres. Long-term climate projections and multiproxy studies from ice core records indicate that the retreat of the ice sheet in this area could be triggered by the intrusion of warm ocean water.

During the 2022 the PNRA/COLLAPSE (Cook glacier-Ocean system, sea LeveL and Antarctic Past Stability) project mapped the continental margin in the offshore area at the mouth of the Cook and Ninnis glacier valleys. This talk will present some of the results of extensive work carried out by a large Italian and international team using data collected during the cruise. The combination of geomorphologic, seismic, oceanographic and sedimentary data allowed the identification of a variety of processes occurring on the seafloor today and in the late Quaternary. Diatom and foraminifera analyses were carried out in conjunction with the sedimentary, geochemical, petrographic facies analyses on gravity coring transects. The geophysical data show evidence of slope instability prior to the putative large glacial Cook depression. Sediment drifts controlled by bottom currents grow on channel-levees and slope terraces. This information helps, albeit indirectly, to reconstruct the dynamics of the different glaciers in relation to palaeoclimatic changes and ocean circulation, to estimate their respective contribution to global sea level rise and to constrain models for future scenarios.

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West Antarctic Ice Sheet dynamics shows major shift from Miocene to Pliocene/Pleistocene in the Bellingshausen Sea and Amundsen Sea sectors

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Abstract

The current enormous ice mass loss of the West Antarctic Ice Sheet (WAIS) leads to questions about its behavior during past extended warm periods such as those in the Miocene and Pliocene. The compilation of the network of seismic lines linked to relevant ocean drilling sites of ODP Leg 178 at the western Antarctic Peninsula and IODP Expedition 379 on the Amundsen Sea continental rise enables analyses of the temporal and spatial evolution of the WAIS from early expansions to the continental shelves in the Oligocene-Miocene to variations in its dynamic behavior up to the Pliocene/Pleistocene. Long-period expansion and retreat phases of the main ice-stream outflow systems in the Bellingshausen Sea sector and the Amundsen Sea sector occurred less synchronously than previously assumed. In the Bellingshausen Sea sector, the earliest high-intensity advances of grounded ice occurred in the Miocene with mid- to low-intensity advances in the Pliocene. Extended ice sheet retreat periods during the Pliocene warm times are not as clearly observed as in the Amundsen Sea sector. On the other hand, the Amundsen Sea sector experienced its earliest low-intensity ice advances in the Miocene and high-intensity advances in the Pliocene with extended ice-sheet retreat periods embedded during the Pliocene Amundsen Sea Warm Period from 4.2 to 3.2 Ma. Different paleotopographic conditions of the respective hinterlands likely caused different ice-stream/ice-sheet dynamics. We show newest seismic data analyses and try to synthesize our observations into a consistent model for past WAIS dynamics from the Miocene to the Pleistocene.

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Geodetic constraints on tidal anelasticity in the Antarctic Peninsula

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Abstract

We present first results of an ongoing project dedicated to the determination and geophysical interpretation of semidiurnal and diurnal ocean tidal loading displacements (OTLD) in the Antarctic Peninsula (AP). OTLD are the response of the solid Earth to the load imposed by the ocean tides, producing a periodical 3D surface displacement, which can reach centimeters in amplitude. A specifically designed processing of all suitable GNSS data in the region is carried out. Since ocean tides are not well constrained in this region (Sun et al. 2022), a new regional model adjusted to in situ observations is utilized to model the OTLD. Insights into viscoelastic solid-Earth properties in the AP are inferred by comparing the GNSS-observed OTLD with model predictions based on a suite of Earth models. Glacial-isostatic adjustment (GIA) models allow us to quantify the solid-Earth response to ice-mass changes, but require regionally valid Earth model parameters. OTLD observations provide a rare opportunity to constrain viscoelastic Earth properties which span a continuum from elastic behaviour to purely viscous behaviour over milenia, central to improving models of Antarctic GIA (Ivins et al. 2020). GNSS observations are instrumental to study Earth's viscoelastic response to surface loads. Since first attempts at OTLD determination in Antarctica (King et al. 2005), a significant number of GNSS sites have been deployed in the AP, and GNSS observations have revealed regional OTLD anomalies in various continents (Bos et al. 2015; Matviichuk et al. 2021), which are attributed to lateral variations in the anelastic dispersion in the asthenosphere.

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Antarctic Greening: Global Warming Impacts

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Abstract

Antarctica is an important regulator of the planet's temperature and plays a critical role in the world's climate. With the increase in global warming, a great intensification in the melting of glaciers has been observed since 2016, contributing to the growth in the continent's vegetation cover. Some species are native, while others may have been introduced by humans and/or wind influence. Analysis of satellite data has recorded a more than tenfold increase in vegetation cover on the Antarctic Peninsula in the period from 1986 to 2025, from 0.86 to 11.95 km^2, suggesting that vegetation is adapting to more favorable conditions for life as glaciers melt and temperature rises. The successive significant decreases in sea ice ultimately reveal the intense process of greening over the years. The aim of this study is therefore to analyze the main impacts of climate change observed more recently on the Antarctic continent, especially with regard to the increase in vegetation cover, considering the variations in the spectrum corresponding to vegetation in the region. This initial study will be based on a short bibliographical review of satellite images and secondary data obtained from renowned scientific publications.

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Past depositional environments and ice sheet dynamics from seismic reflection data of Vincennes Bay, East Antarctica

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Abstract

The East Antarctic Ice Sheet (EAIS) has long been assumed to remain relatively stable under current climate forcing. However, recent improvements in subglacial topographic data and observations of increased mass loss have challenged this assumption. Glacial-marine sediments deposited on the continental shelf record past ice sheet expansion and retreat periods that occurred since the onset of major Southern Hemisphere glaciations.

We use deep-penetrating seismic reflection data collected in early 2024 and pre-existing data to construct a seismic stratigraphic model of the continental shelf in Vincennes Bay, allowing us to decipher dominant phases of EAIS development in this sector. The new seismic data reveal preglacial depositional patterns on the middle shelf from the Late Cretaceous to the Oligocene overlain by a giant grounding zone wedge of inferred Quaternary age. The earliest clear indications of grounded ice advancing onto the continental shelf are inferred for the early Miocene from buried subglacial channel systems (~24 Ma) and massive glacial progradational wedges (~14 Ma). Upper glacially transported sequences on the outer shelf exhibit steeply dipping progradational patterns (inferred late Miocene to Pliocene age) and lack preserved topset sediments. This indicates frequent repeated advances of grounded ice across the continental shelf in Vincennes Bay.

The distribution of glacial sedimentary features across sequences suggests that the EAIS in Vincennes Bay had few expansion periods and long retreat conditions in the early Miocene. Periods of frequent ice advances across the continental shelf started in the late Miocene. This highlights how this system reacted to changing climate conditions.

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Pliocene–Pleistocene Variability of the Antarctic Peninsula Ice Sheet Based on a refined Seismic Stratigraphy

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Abstract

A refined seismic stratigraphy from the largest sediment drift, Drift 7, on the Pacific margin of the Antarctic Peninsula provides new insights into the behaviour of the Antarctic Peninsula Ice Sheet (APIS) and eastern West Antarctic Ice Sheet (WAIS) during the Pliocene and Pleistocene. Our interpretation suggests a warm period between ~4.2 Ma and at least 3.8 Ma, with regular glacial–interglacial oscillations, consistent with the onset of the Pliocene Amundsen Sea Warm Period recognised further west. A major shift at ~3.8 Ma marks the onset of colder conditions with enhanced channel influence, indicating more frequent ice sheet advances. The transition toward a more stable glacial regime appears to have started before 3.0 Ma, persisting until ~1.8 Ma—later than in the Amundsen Sea (~2.58 Ma) but prior to the global Mid-Pleistocene Transition (~1.2 Ma). These results highlight the importance of regional variations in ice sheet dynamics along West Antarctica. Future work aims to integrate seismic stratigraphy from the Bellingshausen Sea, Amundsen Sea, and Ross Sea sectors to establish a regional framework for WAIS and APIS variability. This correlation will provide new constraints for paleo-ice sheet modelling and for improving reconstructions of past Antarctic climate evolution.

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Investigating Subglacial Drainage Dynamics and Ice–Bed Interactions at Thwaites Glacier: New Insights from Radio-Echo Sounding

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Abstract

Thwaites Glacier, one of Antarctica's largest and fastest-flowing outlets, has the potential to contribute ~0.65 metres to global sea-level rise and to destabilise adjacent sectors of the West Antarctic Ice Sheet. Constraining its subglacial processes remains critical for understanding its future evolution. Here, we present new radio-echo sounding (RES) data collected along Thwaites' central flowline, including the first high-resolution survey (110 km² grid, 500 m spacing) across subglacial lake Thw124, a dynamic water body last observed filling in 2017 (Hoffman et al., 2020) and recently identified as part of a broader subglacial drainage network (Gourmelen et al., 2025).

We analyse bed reflectivity, specularity content, and returned power to infer potential basal conditions, differentiating subglacial water, saturated sediments, frozen till, and consolidated substrates. Beyond Thw124's perimeter, we observe consistently high bed reflectivity power (BRP) with low variability, while portions within the lake boundary display anomalously low BRP. These patterns point to heterogeneous drainage conditions, with potential for localised water retention and episodic drainage events.

Comparisons with previous studies reveal consistent basal signatures, supporting our interpretations. These new RES constraints on subglacial hydrology and ice–bed interactions can inform models of ice flow and stability in this vulnerable sector of West Antarctica.

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Análisis de la línea de costa en las proximidades de la Estación Científica Antártica Machu Picchu, Punta Crepín, Isla Rey Jorge, Antártida

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Abstract

La Punta Crepín, ubicada en la Isla Rey Jorge, archipiélago Shetland del Sur, Antártida es una formación costera compuesta por terrazas marinas de depósitos fluvioglaciares del cuaternarios, constituye el sustrato geológico de la Estación Científica Antártica Machu Picchu (ECAMP). Durante las expediciones peruanas (ANTAR), se ha observado la evolución de la línea costera, lo que podría impactar en la infraestructura de la ECAMP. Estos cambios son causados por procesos naturales, especialmente por la dinámica litoral (olas y mareas), que favorecen el transporte de sedimentos. Además, factores como el colapso recurrente de los frentes glaciares Domeyko, Znosco y Lange, y la redistribución del hielo marino, pueden influir en este comportamiento. Se ha registrado también la expansión de cuerpos de agua en áreas periglaciares, asociada a la fusión glaciar y el posible desarrollo de permafrost cerca de la ECAMP.

Este estudio aplicó el Sistema de Análisis Digital de la Línea Costera (DSAS) del Servicio Geológico de EE.UU. UU. utilizando 20 imágenes satelitales Sentinel-2 de los veranos e inviernos australes entre 2016 y 2025. Los resultados indican que la punta Crepín ha experimentado cambios significativos por la erosión y acumulación en los últimos 10 años. La flecha litoral ubicada al NEE de la ECAMP ha seguido un proceso retrógrado, además se ha calculado que la tasa de cambio es mayor en el sector NO en comparación con el SE. Este análisis es crucial para la formulación del proyecto peruano de renovación de la ECAMP y una adecuada gestión de riesgos asociados.

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Unravelling the Dynamics of Denman Glacier, East Antarctica: Insights from MT and Integrated Geophysical Investigations

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Abstract

Denman Glacier in East Antarctica flows through what has been modelled as the deepest land trough on Earth, approximately 3.5 km below sea level. These models suggest that Denman Glacier may hold enough ice to raise global sea levels by approximately 1.5 m. Despite this, the only reliable bed elevation data are radar measurements at the glacier's flanks; the full extent of the glacier's trough has never been directly imaged, and no information exists about its subglacial hydrology or its impacts on ice flow.

To better understand Denman Glacier dynamics, we collected magnetotelluric (MT) data along a profile across the deepest section of the modelled trough. The MT models reveal a clear contrast between the highly resistive glacial ice and the less resistive underlying bedrock. The newly modelled Denman trough aligns well with the radar data on the flanks and provides new constraints at its centre. Notably, the basal depths imaged using MT are significantly shallower than previously estimated. These depths are supported by an analytical glacier model based on basal sliding and internal deformation, informed by in-situ surface velocity observations and full-Stokes ice flow modelling. We also observe deep electrical conductors in the centre of the glacier that could be interpreted as a meltwater channel. Co-located seismic and gravity data help to accurately constrain the trough's shape. This work provides the first direct measurements of Denman Glacier's thickness and suggests that a proportion of ice mass loss could be through meltwater at the base

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Data collection recommendations to optimize the performance of gravity inversions for bathymetry beneath Antarctic ice shelves

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Abstract

Sub-ice-shelf bathymetry exerts a primary control on the stability of ice shelves by guiding melt-inducing water masses and through pinning points that resist the flow of the overriding ice. Collecting sub-ice-shelf bathymetry data using active source seismic surveying or direct observations is accurate but time-consuming, and often impractical. Gravity methods provide a pragmatic, but more uncertain, alternative, by which observed variations in Earth's gravitational field are used to estimate the underlying bathymetry. We utilize a new open-source gravity inversion algorithm developed specifically for modeling sub-ice-shelf bathymetry. The inversion is tested on a suite of models created with real bathymetric data. These tests enable 1) determination of the best practices for conducting bathymetric inversions, 2) recognition of the limitations of the inversion and uncertainty quantification, and 3) identification of where community efforts should be focused for the future determination of Antarctica's sub-ice-shelf bathymetry. We find that estimating and removing the regional component of gravity before the inversion is the largest source of error in the resulting bathymetry model, but this error can be greatly reduced with additional known bathymetry points. From an analysis of Antarctic ice shelves, we predict inversion would reduce errors compared to Bedmap2 for the majority of shelves.

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Polished bedrock and marine sediments in Adélie Land as records of late-Quaternary to Holocene East Antarctic Ice Sheet deglaciation dynamics

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Abstract

As the East Antarctic Ice Sheet (EAIS) is a key driver of sea level rise and climate change, we try to understand its response to past climate variations. We propose here a chronology of glacial fluctuations and a reconstruction of the extent of the ice cap and outlet glaciers – Astrolabe and Mertz – in Terre Adélie since the Late Pleistocene. Exposure ages for ^{10}Be and ^{26}Al measured in polished surfaces and glacial moraines suggest two phases of deglaciation at ~40ka and ~20ka, interspersed with a glacial advance during the last glacial maximum (MIS 2: 25-18ka). However, this glacial advance seems less marked than at MIS 3 (50-27ka). These variations could be linked to changes in precipitation patterns in the southern hemisphere, notably an increase in precipitation at the start of the last glacial phase (~70ka) and a second, more moderate, increase at the time of the LGM (~25ka). Following the deglaciation, isotopic concentrations in marine sediments reveal an episode of glacial discharge at 4.2ka followed by the establishment of an environment dominated by sea ice until 2.5ka.

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Advancing geodynamic research in Antarctica: Reprocessing GNSS data to infer consistent coordinate time series(GIANT-REGAIN)

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Abstract

For almost three decades, geodetic GNSS measurements have been used to infer bedrock displacement in Antarctica. However, until now Antarctic-wide studies could only use a limited number of GNSS stations for a limited time. Within the SCAR-endorsed project GIANT-REGAIN (Geodynamics In ANTarctica based on REprocessing GNSS DAta INitiative), geodetic GNSS data have been compiled for as many Antarctic bedrock stations as possible, covering the period from 1995 to 2021. The recordings include permanent and episodic observations at more than 280 sites. Four processing centres joined forces to consistently and reliably analyse the data. The background and the most important issues of the reprocessing will be reported. We will discuss the resulting coordinate time series in terms of their reliability and uncertainty. These coordinate time series will allow to investigate the Antarctic bedrock displacement pattern in much more detail than before, especially for GIA. This includes the response of the solid Earth on short time scales due to a weak upper mantle or the variability of the Antarctic ice sheet in the Holocene which may lead to present-day subsidence. A detailed discussion is given by Buchta et al. (2025, Earth System Science Data). Data products are freely available at PANGAEA, the German data publisher for Earth and environmental science. Thus, the resulting GNSS-inferred coordinate time series can now be used in further, detailed investigations to advance our knowledge of glacial isostatic adjustment and geodynamics in Antarctica.

Category

2 Ice Sheets, Climate, Ocean, and Geosphere Interactions

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Reconstructing the Dynamics of Marine-Based East Antarctic Ice Sheet Sectors During Past Warm Periods: Insights from Glaciomarine Sediments

Rashmi Gupta, Yael Kiro

Weizmann Institute of Science, Rehovot, Israel

Abstract

The East Antarctic Ice Sheet (EAIS) is the largest reservoir of frozen freshwater on Earth, with the potential to raise global sea levels by approximately 52.2m if fully melted. Despite its critical role in the global climate system, significant uncertainties remain regarding its sensitivity to past and future warming scenarios. Marine-based sectors of the EAIS, such as Wilkes Subglacial Basin (WSB) and Aurora Subglacial Basin (ASB), are particularly vulnerable to climate-induced instability due to their grounding below sea level. Recent studies have documented mass loss from these sectors during past warm periods (Blackburn et al., 2020), and numerical models predict their substantial contributions to future sea-level rise under warming scenarios (DeConto and Pollard, 2016).

This study aims to reconstruct the behavior of the WSB and ASB during past climatic warm periods using glaciomarine sediments deposited along the continental margins of the Sabrina Coast (draining ASB via Totten Glacier) and the George V Coast (draining WSB via the Mertz, Cook, and Ninnis glaciers). These sediments, recovered during IODP Leg 318 and DSDP Leg 28 expeditions, archive multiple glacial cycles and capture evidence of ice sheet advances and retreats.

Preliminary results focus on Nd-Sr-Pb isotopic data to infer sediment provenance and ice sheet dynamics. These findings, combined with available ice core records and numerical ice sheet models, aim to provide a multi-dimensional understanding of EAIS stability under projected warming scenarios. The results will refine predictions of sea-level rise, enhance understanding of glacial-climate interactions, and inform evidence-based strategies for mitigating climate change impacts.

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Estimación del balance de masa en el Glaciar Zongo (Bolivia) mediante el modelo conceptual semidistribuido MCS.

Gabriela Quispe Sanchez[1], Pablo Fuchs[2], Alvaro Soruco[2], Antoine Rabatel[3], Carlos Cardenas[1]

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Abstract

En el caso de un glaciar el balance de masa sirve para cuantificar los procesos de acumulación y de derretimiento que experimenta un glaciar. Con esta información se puede inferir la variación de la cantidad de agua que se encuentra en reserva y así tomar decisiones en base a la oferta y demanda hídrica. El objetivo de este trabajo es mostrar los resultados de una modelación del balance de masa aplicada al Glaciar Zongo en Bolivia. El modelo utilizado es un modelo conceptual semi-distribuido (Schaefli et al., 2005). Se evaluó la sensibilidad mensual de predicción del balance de masa y de la descarga para los años hidrológicos 2004-2006.

Nuestros resultados muestran que el modelo presenta valores de descarga y balance de masa con un error medio absoluto (MAE) de 2.4 y un sesgo (BIAS) de 1.3 con respecto a los datos observados en el glaciar. Los modelos conceptuales simples pueden ser una herramienta valiosa para proyectar el comportamiento de una cuenca y dinámica de glaciares, pero si solo se cuenta con suficiente información para la calibración y validación de los parámetros del modelo.

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New Insights into Circumpolar Deep Water Pathways and Ice Shelf Evolution from High-Resolution Records in the Bassi Channel, George V Land (East Antarctica).

Fiorenza Torricella[1,2], Xavier Crosta[3], Johan Etourneau[3], Amy Leventer[4], Ester Colizza[2], Federica Donda[5], Tommaso Tesi[1], Francesca Battaglia[1], Letizia Roscelli[1], Gesine Mollenhauer[6], Jens Hefter[6], Laura De Santis[5]

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Abstract

Sediment core GC003 (425 m) was recovered in 2022 during the 37 expeditions on R/V Laura Bassi from a sediment drift within the Bassi Channel, in front of Ninnis Glacier (George V Land, East Antarctica), at ca. 2832 m depth. Sedimentological analyses reveal a continuous and undeformed stratigraphic sequence, making this core particularly well-suited for reconstructing past ice sheet-shelf dynamics, sea-ice variability, and changes in water mass properties. A Bayesian age-depth model, based on radiocarbon (^{14}C) dating, constrains the sequence from approximately 30,000 years ago to the present, covering the interval from MIS 3 to MIS 1 at sub-centennial resolution. Previous geophysical surveys (Donda et al., 2024) indicate that the site lies along a main pathway of Circumpolar Deep Water (CDW) intrusion onto the shelf; however, direct evidence of past CDW activity has so far been lacking. Diatom analyses from core GC003 demonstrate that the sediments captured variations in CDW upwelling over the last 30,000 years. For the first time, we present a detailed study of diatom assemblages, integrated with biomarker and GDGT analyses, which will provide crucial insights into the rate and drivers of these oceanographic changes and their links to global climate and sea-level variability.

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SORTING CENTRE OF THE NATIONAL ANTARCTIC MUSEUM - TRIESTE SECTIONAN ITALIAN REPOSITORY FOR MARINE GEOLOGICAL MATERIALS COLLECTED IN ANTARCTICA

Ioanna Protopsalti, Ester Colizza, Gianguido Salvi

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Abstract

Since ratifying the Antarctic Treaty in 1981, Italy has been actively engaged in Antarctic research through the National Antarctic Research Program (PNRA), established in 1985. This initiative has enabled numerous Italian scientific groups to undertake multidisciplinary studies, leading to the creation of the National Antarctic Museum (www.mna.it). The museum, conserves and studies biological, mineralogical, lithological, glaciological, and marine geological samples collected during Italian Antarctic expeditions, and promotes the dissemination of scientific outcomes to the broader community. Each of its three sections includes a permanent exhibition, a study and sorting centre, and a documentation centre.

The Sorting Centre of Trieste section is the main repository of marine geological material from PNRA Antarctic expeditions. The collection includes over 1,000 meters of deep-sea sediment cores, 1,400 kilograms of dredge and grab samples, and 50 meters of box-cores from Antarctic and Magellan regions, along with samples from lakes and beaches. Samples are stored in cold rooms at 4°C for archive material, freezers, and at room temperature shelves for subsamples used in sedimentological studies. This facility is crucial for preserving and managing these specimens, supporting ongoing and future research in the Italian Antarctic program.

The GIS database contains metadata, including PNRA expedition details, core labels, geographic coordinates, and water depths. It also provides links to digitized X-rays and preliminary core descriptions, creating a comprehensive and accessible resource for the global scientific community. By encouraging international collaboration, the Sorting Centre facilitates worldwide distribution of samples upon request, fostering knowledge exchange and joint research endeavours.

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Influence of the Margarita Submarine Canyon on the intrusion of UCDW over the Continental Shelf of the West Antarctic Peninsula

Sofía Palacios[1], Gonzalo Saldias[2], Andrea Piñones[3], Octavio Mercado[3], Pedro Figueroa[4]

[1]University of Concepcion, Concepcion, Chile. [2]University of Bío-Bío, Concepcion, Chile. [3]Austral University of Chile, Valdivia, Chile. [4]Boston University, Boston, United States

Abstract

The Upper Circumpolar Deep Water (UCDW) is a warm and saline water mass that plays a key role in heat and nutrient transport along the West Antarctic Peninsula (WAP). This study investigates the role of the Margarita Submarine Canyon as a preferential pathway for the intrusion of UCDW into the adjacent continental shelf. Using high-resolution ROMS simulations without tidal forcing (1.5 km horizontal resolution, 24 vertical levels), key transects were identified along and across the canyon to evaluate flow patterns and hydrographic properties. Preliminary results reveal a persistent UCDW intrusion primarily along the northern slope of the canyon at depths greater than 200 m, with temperatures above 1.5 °C and salinity values ≥34.65. The thermal structure, velocity fields, and volume transport profiles confirm a channeled and asymmetric inflow. Additionally, an Optimum Multiparameter (OMP) analysis, using temperature and salinity profiles, was applied to quantify the relative contribution of water masses (UCDW, LCDW, and WW) in the region, revealing a higher proportion of UCDW along the northern flank of the canyon throughout the year. Transects along the canyon also reveal a marked seasonal variability in the vertical distribution and thickness of each water mass, with the UCDW being principally distributed in the canyon during winter and spring. These findings suggest that the Margarita Canyon not only facilitates UCDW intrusion events but also modulates its spatial trajectory and vertical structure along the coastal region of the WAP.

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Characterizing the timing and source of glacial flow in the Quartermain Range, Antarctica

Lauren Lamson, Ming Chen, Payton Breitzmann, Sophia Lopez, Nadia McGlynn, Courtney Megerian, Rebekah Stanton, Zoe Storaasli, Daniel J. Morgan

Vanderbilt University, Nashville, United States

Abstract

Tills in the Quartermain Range of the McMurdo Dry Valleys (MDV) were deposited by local glaciers and outlet glaciers of the Antarctic Ice Sheet under different climate conditions since the Miocene. Arena Valley and Beacon Valley offer a chance to compare dated sequences deposited by Taylor Glacier with older deposits left by local glaciers and by northeast-flowing overriding events during the Miocene. We use a combination of provenance and dating tools to test for changes in the source of tills over time: grain size, organic carbon content, soil salt concentration, bulk geochemistry using x-ray fluorescence, and the U-Pb ages of detrital zircon sands. Preliminary analysis of salt concentrations from Arena Valley show no trend over time in the Taylor Sequence, but older tills do show higher concentrations relative to the Taylor Sequence. Salt ions derived from chemical weathering show better trends compared to aerosols. In Arena Valley, organic carbon decreases over time in the Taylor Sequence and stabilizes at ~2% in older tills, while Quartermain I is the only older till with a higher mean concentration of 3.2%. We are using Ba-Zr and Rb-Sr patterns to examine provenance. Initial analysis identifies clusters of Arena and Altar tills which differ from all other deposits, suggesting a different source for both units. This June, we will begin work on Beacon Valley samples from the 2024 field season. We will determine the zircon U-Pb age distribution of each till unit in Arena Valley and Beacon Valley as an additional provenance tool.

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Constraining the Age and Provenance of Glacial Tills in Lower Wright Valley, Antarctica

Sophia Lopez, Payton Breitzmann, Ming Chen, Nadia McGlynn, Courtney Megerian, Lauren Lamson, Rebekah Stanton, Zoe Storaasli, Daniel Morgan

Vanderbilt University, Nashville, United States

Abstract

This project investigates the glacial history of Lower Wright Valley, Antarctica, by addressing two primary questions: (1) Has the Lower Wright Glacier experienced changes in flow patterns or sediment provenance over time? (2) Can geochemical and environmental indicators be used to refine the relative ages of its tills? To answer these questions, we analyzed samples collected from seven glacial drift sites during 2022 and 2024 fieldwork seasons. Methods included grain size analysis, organic carbon content measurement, soil salt concentration analysis, and X-ray fluorescence (XRF) elemental geochemistry. Our laboratory results reveal two key findings. First, calcium salt ion concentrations increase consistently with drift age, suggesting their potential as a relative dating proxy; second, XRF data show statistically significant lower zirconium/barium ratios in the youngest drift, Brownworth, implying a shift away from an igneous-rich sediment source. These findings suggest that Lower Wright Glacier has experienced changes in both sediment source and depositional environment through time. Additionally, all samples have been prepared and mounted for zircon separation, and we plan to conduct U-Pb dating at the University of Arizona LaserChron Center in June 2025. These data will allow us to determine the zircon age distributions of each till unit, further refining provenance interpretations and relative depositional ages. This work contributes to understanding long-term glacial dynamics in the McMurdo Dry Valleys and shows the potential of geochemical proxies in reconstructing Antarctic ice sheet behavior.

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Soluble salt evidence for large paleo-lakes in Wright and Victoria Valleys, McMurdo Dry Valleys

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Abstract

Constraining paleo-lake fluctuations in the Dry Valleys is essential to interpreting local landscape and geomorphic history. Despite this importance, evidence of proposed mega proglacial lakes is contradictory, both in support of and refuting the hypothesis. Lacustrine deposits suggest lake levels could have reached up to 480 meters higher than the present-day lakes since the Last Glacial Maximum (Wright Valley; Hall et al., 2000). Toner et al. (2013) successfully showed the application of soluble salts in identifying paleolakes, however these studies have focused on Taylor Valley. The three major valleys – Taylor, Wright and Victoria – have the potential to respond differently to climatic changes due to their unique geographies. In this work, sediment was collected at various elevations along 20 transects within the Dry Valleys and, along with archived sediment, has been analysed for cation concentrations. These new data have expanded the spatial coverage of soluble salt analyses in Wright and Victoria Valleys in order to clarify the hydrological history of the region and variations between valleys. Dry Valleys hydrology is controlled by a delicate energy balance, and understanding its past is vital as the region once again approaches a threshold of dramatic change under an increasingly erratic climate.

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Influence of the Margarita Submarine Canyon on the intrusion of UCDW over the Continental Shelf of the West Antarctic Peninsula

Sofia Palacios[1], Gonzalo Saldías[2], Andrea Piñones[3], Octavio Mercado[3], Pedro Figueroa[4]

[1]University of Concepcion, Concepcion, Chile. [2]University of Bío-Bío, Concepcion, Chile. [3]Austral University of Chile, Valdivia, Chile. [4]Boston University, Boston, Chile

Abstract

The Upper Circumpolar Deep Water (UCDW) is a warm and saline water mass that plays a key role in heat and nutrient transport along the West Antarctic Peninsula (WAP). This study investigates the role of the Margarita Submarine Canyon as a preferential pathway for the intrusion of UCDW into the adjacent continental shelf. Using high-resolution ROMS simulations without tidal forcing (1.5 km horizontal resolution, 24 vertical levels), key transects were identified along and across the canyon to evaluate flow patterns and hydrographic properties. Preliminary results reveal a persistent UCDW intrusion primarily along the northern slope of the canyon at depths greater than 200 m, with temperatures above 1.5 °C and salinity values ≥34.65. The thermal structure, velocity fields, and volume transport profiles confirm a channeled and asymmetric inflow. Additionally, an Optimum Multiparameter (OMP) analysis, using temperature and salinity profiles, was applied to quantify the relative contribution of water masses (UCDW, AASW, and WW) in the region, revealing a higher proportion of UCDW along the northern flank of the canyon throughout the year. Transects along the canyon also reveal a marked seasonal variability in the vertical distribution and thickness of each water mass, with the UCDW being principally distributed in the canyon during winter and spring. These findings suggest that the Margarita Canyon not only facilitates UCDW intrusion events but also modulates its spatial trajectory and vertical structure along the coastal region of the WAP.

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Sedimentological and Sequence Stratigraphic analysis of the Early Miocene Cape Melville Formation from West Antarctica

Claudio Tapia[1,2], Matthias Magiera[3], Bethany Fox[3], Gary Wilson[4,5], Joaquin Bastias-Silva[6,7], Marcelo Leppe[8,9], Yasmeen Orellana[10,11], Maximilano Rocuant[12], Héctor Mansilla[13]

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Abstract

The early Miocene (ca. 23-19 Ma) was characterised by significant fluctuations in Antarctic ice volume, including the Mi-1 and Mi-1a transient glaciations. Due to the condensed nature of most extant Antarctic sediment cores dating to this time period, our understanding of the dynamics of these ice-sheet fluctuations is drawn from far-field deep ocean cores. The 174-m thick Cape Melville Formation (CMF), exposed on the eastern tip of King George Island, Antarctic Peninsula, is one of the only high-temporal-resolution ice-proximal successions from this time period. Here we present a new sequence stratigraphic analysis of this important formation.

We used field logging and analysis of 363 discrete samples to carry out the analysis. Facies are characterised based on grain size, sedimentary structures, fossil content, dropstone content and XRF elemental composition. The CMF contains a progradational stack of 40 depositional sequences that accumulated in shelf to grounded glacial ice shoreface paleoenvironments in response to glacial advance and retreat. Glacial – interglacial couplets are represented by sequences comprising transgressive (TST), highstand (HST) and regressive (RST) systems tracts that can be readily related to generic sequence stratigraphic models.

Assuming an approximately 4 Ma age span for the entire succession, the average cycle length would be ca. 100 kyrs. However, evidence for grounded ice suggests that some of the boundaries may represent significant hiatuses in the record. If this is the case, sedimentary cycles may be of 40 kyrs. duration, as observed in other sedimentary records from Antarctica.

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Preliminary Insights from the Mineralogy of Glendonite Pseudomorphs after Ikaite in Miers Valley, Antarctica

David A. Giovannetti-Nazario[1], Patryk Brown[1], Ariana Magana-Ramírez[1], Brenda L. Hall[2,3], Kristin D. Bergmann[4]

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Abstract

The stratigraphy of Antarctica's McMurdo Dry Valleys offers a record of paleolake depositional processes since the Last Glacial Maximum. In Miers Valley, carbonate and sulphate phases are associated with lake-level fluctuations influenced by ice sheet advance and recession during the Ross Sea I Glaciation, where the Ross Sea Ice Sheet acted as a dam and prompted the existence of Glacial Lake Trowbridge. Carbonates in Miers Valley include calcite pseudomorphs after ikaite that contain guttulatic microtextures: a hexagonal core, ellipsoidal overgrowth, and a secondary cement rim. Ikaite is a hydrated calcium carbonate ($CaCO_3 \bullet 6H_2O$) stable under frigid temperatures and subsequently decomposes into calcite (var. glendonite). Despite these constraints, the dynamics involved in the growth and decomposition of ikaite remain controversial and must be better understood in order to utilize these minerals effectively for paleoclimate studies.

These glendonites highlight evidence of oscillatory and chemical zoning. Elemental transects show elements (e.g., Mg, Mn, P, and S) depleted in crystal cores and increasing towards the rims, indicating the decomposition process involves a stage of fluid evolution during Lake Trowbridge. Re-analysis of previous $\delta^{18}O$ data from carbonate plates display a strong evaporation signal, suggesting that much of carbonate precipitation occurred during lake-level recession. Likewise, preliminary clumped isotope analyses yield temperatures below 0°C, consistent with evaporatively-concentrated waters and higher salinities much like the proposed history of Lake Bonney's eastern lobe in Taylor Valley. Further assessment of potential kinetic effects on carbonates precipitating in these conditions will aid in understanding lake evolution in Miers Valley.

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Pleistocene advances of four alpine glaciers in the McMurdo Dry Valleys, Antarctica from coupled $^{36}Cl/^{3}He$ in dolerites and ^{10}Be in sandstones

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Abstract

We dated 15 moraines associated with four alpine glaciers in the Olympus and southern Asgard ranges of the McMurdo Dry Valleys. Exposure ages are based on 72 ^{3}He ages, coupled with 18 ^{36}Cl ages, from pyroxenes, as well as 11 ^{10}Be ages from quartz. Cosmogenic exposure ages from ^{3}He yield significant age scatter in all deposits, with regional variations associated with geomorphologic setting. In the Olympus Range, ^{3}He age scatter is mostly caused by nuclide inheritance, likely due to the mesa-butte topography that allows some clasts to be exposed in bedrock outcrops for > 1 Myr before becoming entrained in glaciers. In the Asgard Range, complex burial histories contribute to exposure age scatter, and while nuclide inheritance does occur, it is < 1 Myr, possibly due to the cirque-arete topography. Despite the age scatter, the dated chronologies provide evidence of Pleistocene glacial advances. The alpine glaciers in the Olympus Range advanced at least three times during the past ~700 ka. At Stocking Glacier in the Asgard Range, coupled $^{36}Cl/^{3}He$ ages indicate that the glacier was larger than present for at least ~150 kyr of the past ~850 kyr, with a maximum advance around ~360–400 ka. Rhone Glacier, which flows into central Taylor Valley from the Asgard Range, was larger than present ~62–94 ka, with stratigraphic evidence for out-of-phase retreat of Rhone Glacier and nearby Taylor Glacier (an outlet glacier of the East Antarctic Ice Sheet) after their respective Marine Isotope Stage 5 advances.

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Seismic Oceanography offshore Wilkes Land (East Antarctica)

Giulia Matilde Ferrante, Flavio Accaino, Laura De Santis, Vedrana Kovacevic, Laura Ursella, Manuel Bensi

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Abstract

The Cook and Ninnis glaciers are relatively more stable than other faster-flowing ice streams in Antarctica. Nevertheless, paleoclimatic records and numerical models suggest that they could retreat further inland as their base is below sea level and therefore they are potentially vulnerable to the ongoing ocean warming. However, both the subglacial Wilkes Basin and its margin offshore remain underexplored areas.

Conventional physical oceanography measurements can be integrated with seismic surveying of the water column, offering a way to map the ocean in unprecedented 2D detail in Antarctica along sections of hundreds of kilometers. Here, we analyze a grid of 230 km of multi-channel seismic lines acquired offshore Wilkes Land, East Antarctica, in 2022. We identify the distribution of water masses along the seismic profiles and we combine the results with direct oceanographic measurements, with re-analysis models and with other sonar data collected during the seismic survey and previously.

The fine vertical resolution of the seismic sections allows us to identify the polar front, where open ocean water masses supplying heat to the continental margin meet cold water masses originated in Antarctica, and other internal features such as internal waves propagating within the thermocline. Their presence indicates turbulent and mixing processes which dissipate energy, heat and salt. Our results provide new insights into the ocean dynamics and interaction with the margin morphology that can help to improve models investigating coupled ocean atmosphere sea ice and bedrock dynamics.

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Landscape evolution in the southern Transantarctic Mountains during the early Miocene (c. 20-17 Ma) and evidence for a highly dynamic East Antarctic Ice Sheet margin deduced from the southernmost volcanoes in the world (87°S)

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Abstract

We describe the unique terrestrial record preserved in the most southerly volcanoes on Earth and reconstruct Antarctica's environmental landscape in the southern Transantarctic Mountains (TAM) for three time slices in the Early Miocene. The record demonstrates that the East Antarctic Ice Sheet margin was highly dynamic and fluctuated greatly. It included an astonishingly much-reduced ice cover that left the mountains virtually ice-free, although a few tidewater glaciers reached the shores of the Early Miocene Ross Sea; and a substantially thicker, much more voluminous ice mass that overtopped and 'drowned' the mountains. An intermediate stage of ice retreat is also indicated, when the East Antarctic Ice Sheet had again withdrawn behind the TAM. The causes of the extreme variations in ice sheet thickness and extent indicated are uncertain but they were probably strongly influenced by Milankovitch astronomical forcing. However, they occurred during a period of rapidly fluctuating atmospheric CO_2 compositions and the results also suggest that the EAIS was highly susceptible to comparatively small changes in CO_2 during the warm Early Miocene.

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RITA: Raman non-destructive Ice cores analysis of visible Tephra layers in Antarctica

Marco Rabassi, Sergio Andò, Barbara Delmonte, Claudio Artoni, Deborah Fiorini, Elisa Malinverno, Valter Maggi

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Abstract

Ice cores are exceptional archives of past climate change, preserving climate forcing factors and proxies of the climate system's response. Among these, volcanic eruptions play a key role. Englacial tephras enable the reconstruction of explosive volcanism, offer insights into volcano–climate interactions and allow the correlation of paleoclimate records across distant regions, when the volcanic source is known.

Deciphering the source of far-travelled volcanic products is challenging and requires analysis of the geochemical composition (major and trace elements) of volcanic glass within a given layer, compared with known volcanic sources. This task is further complicated by the broad range of potential source volcanoes and the compositional similarity of their eruptive products. In this context, volcanic minerals, although less commonly used than glass, represent a valuable complementary tool for source fingerprinting.

More broadly, most analytical methods require melting ice cores, compromising both their preservation and future reuse. As climate change poses increasing threat to global ice reserves, the development of new techniques that address this limitation is of critical importance.

Here, we present RITA, a novel, non-destructive Raman spectroscopy-based approach for the analysis of visible tephras layer directly on an ice core retrieved from Campbell Glacier, Antarctica (164.181° E, 74.283° S). The analyzed mineral assemblage is indicative of a highly alkaline volcanic source and shows strong geochemical affinity with published datasets tracing its provenance and effectively rules out alternative sources.

These results confirm the effectiveness of the method while preserving ice core integrity and highlighting the technique's potential for broader applications.

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Geochemistry of sediments and soluble salts associated with buried glacier ice and overlying deposits in the McMurdo Dry Valleys, Antarctica

Matthew Witscheber, Kate Swanger

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Abstract

Buried dead ice lenses occur throughout the Dry Valleys, Antarctica, providing evidence of past glacial fluctuations and serving as potential archives of regional climate. We investigated the depositional and post-depositional interactions between dead ice of glacial origin and overlying sediments at three sites in Taylor Valley, one site in Pearse Valley, and one site in the Quartermain Range. The dead ice sourced from both local alpine glaciers (Taylor Valley and Pearse Valley) and Taylor Glacier (Quartermain Range and Pearse Valley). We analyzed the major-cation geochemistry of buried glacier ice samples (n=123), soluble salts extracted from the overlying sediments (n=60), modern glacier ice samples (n=8), and lake ice samples (n=11). We also conducted comparative studies of the major and trace element geochemistry of sediments within and above the buried ice (n=38). At all studied locations, the major and trace element geochemistry of both englacial and supraglacial sediments is similar to that of the local bedrock geology, suggesting local sources for the sediments. Total cation concentrations in the buried ice are generally higher in sediment-rich sections than in clean ice sections, possibly indicative of meltwater interactions before or at the time of buried ice separation from source glaciers. Relative concentrations of major cations (Na^+, Ca^{2+}, Mg^{2+}, and K^+) differ between the buried ice samples and the soluble salts extracted from the overlying sediments, suggesting minimal hydrological interactions between the modern active layer and the buried dead ice.

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Glacial Moraines as Reliable Indicators of Deglaciation History: A Case Study from Schirmacher Oasis, East Antarctica

Yogesh Ray, Uday Sharma

National Centre for Polar and Ocean Research, Ministry of Earth Sciences (Govt. of India), Headland Sada, Vasco Da Gama, India

Abstract

The Schirmacher Oasis represents a coastal, ice-free region in East Antarctica characterised by significant terrestrial geomorphic features, predominantly glacial and lacustrine landforms. These coastal oases have been extensively studied to reconstruct the continent's deglaciation history. In the Schirmacher Oasis, glacial moraines are prominent in six major valleys, which also host numerous paternoster lakes. A review of the chronology of these lakes and glacial deposits provides insight into their formation and their ability to record deglaciation and paleoclimatic histories. Paternoster lakes and glacial moraines both offer valuable evidence for reconstructing deglaciation phases, but their reliability in determining deglaciation timing varies due to differences in formation processes, preservation, and dating potential. However, sedimentation may begin long after ice retreat if lakes remain ice-covered or lack organic material, potentially leading to underestimates of deglaciation timing. Based on 34 radiocarbon (C^{14}) chronologies from lacustrine deposits and 28 Optically Stimulated Luminescence (OSL) chronologies from glacial deposits, the oldest ages suggest that deglaciation began around 200 ka. Evidence of lakes, however, only appears after 90 ka, with the majority of lacustrine ages accumulating after 50 ka and peaking post-Last Glacial Maximum (LGM) around 15 ka. Glacial activity shows two significant peaks around 140 ka and 30 ka. Glacial moraines provide greater confidence for estimating deglaciation phases compared to lacustrine deposits due to their direct association with glacial margins. Lacustrine deposits, while offering valuable minimum ages and continuous records, are less precise due to potential delays in sedimentation and dating challenges.

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Insights into spatial variability of surface mass balance and ice-dynamics over the Larsemann sub-basin, East Antarctica using ground based observations

MUKUT SINGHA KONWAR, Surendra Jat, Deepak Y. Gajbhiye, Pradeep Kumar

Geological Survey of India, Faridabad, India

Abstract

Antarctica's contribution to global sea level rise by 2100 is projected to be between 0.6m and 1.6-2.3m, with further acceleration due to dynamic processes post-2100 (Fox-Kemper, 2021). Due to our scant grasp of ocean-ice dynamics, particularly in Antarctic, these elevated projections might still undervalue the reality (Siegert, 2020). Rignot (2019) reported an acceleration in Antarctic ice loss from 40 (1979-1990) to 252 Gt/year (2009-2017), while a recent study by Dr. Wang and Prof. Shen indicates a surprising mass gain of 107.79±74.90 Gt/year from 2021-2023, primarily due to elevated precipitation. As reported by many workers the data produced by us in Larsemann sub basin using ground observation data very much corroborates with the trend shown in East Antarctica i.e. positive mass balance. The initial findings from the new stakes installed in the interior of the ice sheet exhibited that the coastal area had lesser accumulation in compared to the interior while the displacement of the ice sheet is notably much more in the interior compared to the coast. Long term monitoring will enhance the evaluation of climate change impacts on the ice sheet's coast with respect to the interior as the coastal area is more susceptible to changes in ocean temperature which increases the basal melting and subsequent ice loss. Furthermore, recent data from the Larsemann sub-basin indicates that although there has been positive mass balance for the recent years within Larsemann sub-basin but there has been a declining trend in mass change of approximately ~ 0.435 Gt/year.

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Ground-Based and Remote sensing Assessing on Ice Dynamics and Mass Flux in Central Dronning Maud Land, East Antarctica: Climatic Implications for Ice Sheet Stability

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Abstract

Antarctica ice sheet slowly rises ocean levels and thus needs to be monitored accurately to understand their response to climatic shifts. The present study synthesizes five years (2019–2023) of glaciological field data and satellite data to asses ice dynamics, mass flux, and climate-driven responses in central Dronning Maud Land (cDML), East Antarctica. Ground-based observations from GNSS of 103 monitored stakes revealed spatially variable ice flow regimes: The High Polar Ice Sheet had velocities of 3.10-45.68 m/yr, which increased to 23.97 m/yr after 2020, while the Impeded Polar Ice Sheet had slower, topographically constrained flow (2.08-9.82 m/yr). The Nivlisen Ice Shelf showed more dynamic motion, ranging from 14.77 to 83.98 m/year, driven largely by ocean and wind forces. Surface mass balance data from 187 ablation stakes revealed strong contrasts: HPIS gained about 1.84 meter of snow between 2020 and 2022, while coastal IPIS areas net loss (–0.55 m/year in 2022–23), due to sublimation and melting caused by katabatic winds. Mass discharge estimates, combining Bedmap2 ice thickness and measured stake velocities, showed a net ice loss of 7.26 Gt (2019–2022), averaging 2.42 Gt/yr. Observations from Total Station surveys at the Polar Ice Front (PIF) recorded a long-term retreat of 39.73 m and 18.95 m at Dakshin Gangotri (since 2001), with a brief advance of 4.55 meters during unusually cold summers between 2020 and 2022. Satellite and ground data show how ice, land, and seasonal changes together make cDML more vulnerable to climate warming.

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Composition of surface sediments and sedimentary records offshore Wilkes Land (60–150°E), East Antarctica: applicability to reconstruct changes during Past Warm Periods

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Abstract

There is a growing concern of ice mass loss in the Antarctic Ice Sheet (AIS) due to global warming in the future. AIS melting could potentially be an initiator of tipping cascade, supposing an important challenge to better understand which parts of the AIS are vulnerable to global warming.

A broad study of Antarctic variability during past warm periods such as the super interglacials, considered as analogous to the near future climate provides useful insights for prediction of future Antarctic ice sheet change. Especially, the response of East Antarctica Ice Sheet (EAIS) to global warming is poorly understood.

Marine-based ice sectors, such as Aurora Subglacial Basin (ASB), EAIS have been found to be vulnerable to oceanic forcing. Moreover, it has been reported that the ice mass of ASB has been rapidly declining over the last decades.

In this study, we reconstruct ice sheet dynamics in the ASB during MIS5e, MIS7e and MIS 9 super interglacials from two sediment cores (PC404, GC1509) collected from the vicinity of the ASB (60–150°E) based on provenance proxies such as XRD-based mineral and Pb-Nd isotopic composition. We also evaluate the provenance proxies based on analyses of surface sediments collected from East Antarctic regions. In addition, sediment grain-size was measured to investigate the link between sediment transport energy to changes in glacial melt or current strength. In this presentation, we report on the application of this approach to the sediment cores collected offshore from the ASB.

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Gravel composition and distribution at KIS3: Preliminary results from the SWAIS2C project

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Abstract

The SWAIS2C (Sensitivity of the West Antarctic Ice Sheet to 2 Degrees Celsius of Warming) project aims to unravel past and present factors influencing West Antarctic Ice Sheet (WAIS) dynamics and to reconstruct WAIS response to warmer temperatures, including those exceeding the +2°C target outlined in the Paris Climate Agreement.

The project targets sediment drilling at two sites (ICDP project 5072). The first site is close to the grounding line of the Kamb Ice Stream (KIS3) and we collected gravity and hammer cores of unconsolidated diamicton at this site in the 2023/24 and 2024/25 seasons. The second site targets grounded ice area at the Crary Ice Rise (CIR; 2025/26 season).

Sediments from remote and poorly known regions of Antarctica are vital to answer key questions about ice sheet stability and subglacial geology. The provenance of the sediments can be used to infer changes of the source areas and evolving dynamics of the West Antarctic Ice Sheet. Furthermore, petrographic analysis of the sediments will allow constraining the enigmatic and ice-covered geology of West Antarctica.

We here present the first petrographic and mineralogical data from the gravel fraction recovered within the diamicton at KIS3. Preliminary results provided a picture of the geological composition of the Kamb Ice Stream catchment area, which is dominated by intrusive, metamorphic, and volcanic rocks.

Moreover, variation in clast lithology along the length of the recovered cores reveals a compositional shift of the sediments, with implications for the routing of ice flow/discharge in the area.

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Tidally influenced interactions between a glacier base and the seafloor substrate recorded by channels and sedimentary ribs in a paleo-grounding zone offshore of the Dotson Ice Shelf (West Antarctica)

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Abstract

Sedimentary ribs (corrugation ridges) found at the sea bed have been postulated to record the daily retreat of a glacier's grounding line. Documented offshore Thwaites Glacier (Graham et al., 2022) and Norway (Batchelor et al., 2023), such ribs occur on flat seafloor interpreted to result from the tidal lifting and settling of the grounding zone during retreat.

In high-resolution bathymetry from Dotson Ice Shelf, collected by the ITGC team's Hugin AUV, the recorded ribs are on flat seafloor and on steeply flanked drumlinoid features. Dotson ribs are taller and more widely spaced than those at Thwaites, suggesting either a faster paleo-retreat rate or a more complex formation history that may not record strictly daily cycles. Ongoing side-scan sonar analysis will test whether substrate variability influenced rib morphology.

Amongst the Dotson ribs are decimeter-scale erosional features that have not been observed in other ribbed seafloor areas, which we interpret as grounding zone channels. Their mutual crosscutting relations indicate contemporaneous formation within the grounding zone. The channels are oriented (sub)parallel to the grounding line and perpendicular to glacial flow, implying a formation mechanism related to the ribs. We suggest that excess water is forced out parallel to the ridges during the ebb of the daily tidal cycle. The observation of channels formed contemporaneously with ribs gives further evidence that similar ribs on the seabed of polar continental shelves form in grounding zones and that they have the potential to be used to calculate retreat rates of ice-sheet grounding lines.

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MONITORING OF ICEBERGS AND SEA ICE IN THE ANTARCTIC PENINSULA USING SENTINEL 1

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Abstract

The Antarctic Peninsula has an increasing maritime activity in inland and oceanic waters during the summer period, therefore, there is a high probability of occurrence of maritime accidents caused by human error, material failures, weather conditions or floating ice. Due to this situation, the Meteorological Service of the Chilean Navy, through its regional maritime center located in the city of Punta Arenas under the Maritime Government and the Third Naval Zone, constantly monitors floating ice (sea ice and icebergs) in the Antarctic Peninsula in order to reduce risks to navigation. For this purpose, remote sensing allows obtaining data quickly and accurately in polar areas. Due to the high cloud cover in Antarctica, active microwave sensors such as Synthetic Aperture Radar (SAR) allow us to obtain polarimetric data both day and night as they are independent of the visible spectrum.

This study is focused on the monitoring of icebergs and floating ice between September 2024 and February 2025 between the Antarctic Sound and the western sector of the Weddell Sea through the use of C-band SAR satellite images from the Sentinel 1A satellite of the European Space Agency (ESA), oriented to the planning and evaluation of future navigational risks associated with the 1st Antarctic campaign of the icebreaker AGB-46 “Almirante Viel” during the month of January 2025. These images allowed to identify the position of the icebergs and subsequently monitor their displacement towards the northeast of the Peninsula associated with the clockwise current of the Weddell Sea and the prevailing wind.

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Different marine environments across the K-Pg boundary in Antarctica: evidence from palynological and sedimentological data

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Abstract

Palynomorph assemblages and sedimentary analysis from the López de Bertodano Formation (Upper Maastrichtian-Danian) were compared in two different continuous sedimentary sections across the K-Pg boundary at Marambio (Seymour) island, Antarctic Peninsula. Section 1 and section 2 with 7.4 m and 13.59 m thick respectively, are composed of marine, monotonous sandy to clayey siltstones. They yielded a palynological assemblage related to a shallow marine sequence, composed mainly of dinocysts, spores, pollen and marine/freshwater algae. Sporomorphs showed no major compositional differences throughout each section; however, significant differences between both sections in the marine assemblages were observed. Section 1 showed, in the lower part, an abundance of the dinocyst *Manumiella* and the marine algae *Palambages*, while in section 2, *Manumiella* is also abundant but *Palambages* is scarce. Subsequently, there is a distinct peak of *Fibrocysta/Cordosphaeridium/Ifecysta* just above the boundary in both sections. In the upper part of section 1, a high abundance of both *Senegalinium* and *Impletosphaeridium clavus* was observed. However, section 2 showed a relative abundance of *Impletosphaeridium clavus*, while *Senegalinium* was scarce. Section 1 represents a restricted coastal environment with high terrestrial input from the continent, supported by: the presence of heterolithic structures, more bioturbated beds, well preserved articulated bivalves and palynomorphs, together with abundant *Palambages*. Conversely, section 2 represents a more open coastal environment with moderate terrestrial input and high wave interaction. The lack of heterolithic structures, less bioturbated beds, highly fragmented bivalve shells, poorly preserved palynomorphs and minor presence of *Palambages*, confirm this assumption.

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Semi-Automated Geomorphological Mapping and Characterisation of the Antarctic Seabed

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Geoscience Australia, Canberra, Australia

Abstract

The pace of Antarctic bathymetric data acquisition is accelerating and advancing our understanding of shallow stratigraphy and seafloor geomorphology. Developing standardised maps of seabed geomorphology is critical for consistent and comparable geoscience map products that meet diverse scientific and management needs. These maps support oceanographic modelling, habitat assessments, fisheries management, and marine spatial planning. Detailed maps of seabed geomorphology also enable the identification of key geomorphic units that have preserved records of ice sheet dynamics and processes that influence global oceanographic and atmospheric circulation.

Geoscience Australia has developed a standardised method to classify the shape and geomorphology of the seabed and a suite of semi-automated GIS tools that enable consistent application of the approach. Minimally modified International Hydrographic Organization (IHO) (2019) terms are first used to guide the mapping of seabed morphology (Dove et al., 2020; Huang et al., 2023); the geomorphology of features is then classified using a standardised vocabulary and framework (Nanson et al., 2023) that manages uncertainty and different levels of subcategorisation. We are applying these tools to IBCSOv2 (2024) and the resulting maps will update earlier work in this area (O'Brien et al., (2009). The results will support ongoing advancements in Antarctic marine science, reinforcing the value of standardised classification for multidisciplinary applications.

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Aeolian sediment sources and transport pathways in the SW Ross Sea, Antarctica

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Abstract

The input of sediment to the Ross Sea water column and ultimately to the sea floor plays a vital role in biogeochemical cycles by delivering essential micronutrients (e.g. Fe) and provides a tool for interpreting past and present meteorology and glacial dynamics. One source of this sediment is windblown sand and dust derived from the ice-free areas onshore, transported over floating ice platforms and released into the ocean.

Here we use x-ray fluorescence to analyse the elemental content of lithogenic sediment from onshore bedrock and glacial moraine sources, offshore dust trapped in snow on sea ice and ice shelves and seafloor sediment samples from across the Ross Sea Embayment.

Our data show that most of the sediment on the sea ice and sea floor along the western margin of the Ross Sea is windblown sand and dust derived from localised point sources of mafic volcanic rocks centered on Ross Island and Southern McMurdo Sound. Aeolian sand and dust generated within the predominantly granitic and quartzose sandstone landscape of the McMurdo Dry Valleys is not exported beyond the valleys to the coast. Further offshore in the Eastern Ross Sea, the seafloor sediment is dominated by felsic compositions. Provenance and ice flow studies indicate this sediment is likely transported by glacial processes from West Antarctica.

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Water mass variability and trends across the New Zealand–Antarctica chokepoint

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Abstract

The Antarctic and Subantarctic regions of the Southern Ocean (SO) play a crucial role in global ocean circulation, connecting all major ocean basins through the Antarctic Circumpolar Current. One key region of interest is the Campbell Plateau, near southwestern New Zealand, where abrupt bathymetric changes influence crucial ocean processes such as water mass formation and deep convection, both of which play a fundamental role in driving the Meridional Overturning Circulation. This study analysed Argo float data collected along the New Zealand-Antarctica 'chokepoint' of the ACC from 2004 to 2024. Located between the subtropical and subantarctic fronts, this region is a known formation site for important water masses, such as the Sub-Antarctic Mode Water (SAMW) and the Antarctic Intermediate Water (AAIW), which contribute to shaping the broader oceanic circulation patterns. The analysis identified eight distinct water masses in the study region. Noteworthy shifts in salinity and temperature trends were observed across different regions of the study area. Since these water masses represent broader conditions across the SO on a variety of spatial and temporal scales, particular attention was given to estimating their temperature trends. Our analysis revealed significant warming trends of approximately 0.008°C/year, 0.018°C/year, and 0.023°C/year for SAMW, AAIW, and Upper Circumpolar Deep Water (UCDW), respectively, over the study period. By focusing on temperature changes in the Subantarctic and Antarctic sectors of the South Pacific and Ross Sea, this research enhances our understanding of the dynamic processes shaping SO circulation and the global climate systems.

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Collapse of Western Antarctic Ice Seat (WAIS) leaded that of EAIS during the warm Pliocene? – Diatom evidence from Amundsen Sea Site U1532 and Wilkes Land Site U1361

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Abstract

The West Antarctic Ice Sheet (WAIS) along the Amundsen Sea is most sensitive against modern warming and remarkable decreasing has been observed, and it has been pointed out that WAIS may have collapsed many times in the past. We have investigated fossil diatoms in samples taken from Pliocene section at the IODP Site 379-U1532 (3962m water depth) on the continental drift, where the estimated linear sedimentation rates up to 20-60 cm/k.y., higher than any other previous drilled sites, to assess details of a highly dynamic WAIS during the warm Pliocene. A total of 528 processed slides were examined for a quantitative diatom analysis, with sampling intervals up to every 5cm for biosiliceous sediments. Diatoms were detected from 489 samples and recognized more than 120 taxa with 49 Genera.

Our detail analysis with precise correlation suggests that the diatom abundance peak of MIS Gi1 near the Gauss-Gilbert boundary (3.596Ma, GMT2020) were more clear and higher than that of Site U1361 off Wilkes Land (Armbrecht et al., 2018). We speculate the sea level rise caused by the collapse of the WAIS may affected the stability of the EAIS and to be a trigger of the collapse of the EAIS which occurred slightly later than that of WAIS.

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Intensifying ice mass change in coastal West Antarctica documented by accelerating bedrock uplift

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Abstract

The coastal margin of the West Antarctic Ice Sheet (WAIS) is the largest contributor to Antarctic Ice Sheet mass loss, vulnerable to irreversible retreat or collapse. Many modeling studies show that feedbacks between the deforming bedrock and the overlying ice sheet influence ice sheet retreat. GNSS measurements of bedrock crustal motion demonstrate that the bedrock underlying coastal WAIS is rapidly changing shape, amplifying these feedbacks. The U.S. ANET-POLENET project has 14 continuous bedrock GNSS stations spanning the length of coastal West Antarctica along the Bellingshausen and Amundsen Seas and extending to the Ross Sea. The station array encompasses the Pine Island, Thwaites and Pope-Smith-Kohler (PSK) glacial drainage basins and, more sparsely, drainage into the Abbott, Cosgrove, and Getz ice shelves. Time series from GNSS sites in this array range from ~6-15 years in length. Most coastal sites have rapid vertical uplift rates, reaching the startling rates of 5-6 cm/yr in the PSK region, where rapid ice thinning and grounding line retreat are well documented. Our most recent Ohio State Parallel-GAMIT solutions document marked accelerations at all coastal sites since approximately 2021-22. We will present new results on regional patterns and magnitudes of measured bedrock displacements and modeling of the drivers of these accelerations.

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Passive Seismic Imaging of Subglacial Conditions on Thwaites Glacier

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Abstract

Subglacial bed-type (bedrock or sediment) is a significant control on fast glacier-motion. Geophysical techniques provide a relatively efficient means to explore variations in bed type. The GHOST project collected a range of geophysical datasets to explore variability in bed type beneath Thwaite glacier including active source seismic and radar measurements. Over the course of two seasons an array of ~ 200 Magseis Fairfield ZLand 3C nodal seismometers were deployed on Thwaites. The primary goal of this array was to record glacier generated seismicity to explore subglacial dynamics via subglacial stick-slip events and ice dynamics via crevasses generated seismicity. We explore the potential use of this seismic array to image bed type using passive source seismic methods. We use the receiver function method, which leverages the recording of earthquakes to identify converted waves that are produced by significant material boundaries, such as those that occur at the ice-bed interface or between sediment-bedrock interfaces. We will present initial results of spatial variability in sedimentary structure across our study area and how these are related to variations in basal conditions and flow-speed of Thwaites Glacier. Finally, we will show how these data can be used to extract information about sediment properties that can be linked interpreted in terms of physical properties that influence ice sheet flow speed such as porosity.

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Ice-thickness measurements from a 2023 Antarctic Peninsula airborne radar survey: Preliminary results

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Abstract

Ice thickness is a fundamental boundary condition for ice-flow and mass-balance models. Even comprehensive gridded datasets (e.g., BEDMAP3) cannot capture fine-scale structural variations. We present in-situ ice-thickness measurements acquired during a November 2023 airborne survey of the Antarctic Peninsula using a 150 MHz chirp radar system (~15 m along-track resolution; vertical accuracy ±5 m). Our survey extensively covered 7 360 km of flight lines across the Larsen C, George VI, Bach, and Wilkins ice shelves. After processing and interpreting the ice/bed interface we estimated thickness values from 1 m to 1980 m (mean 337 m; median 289 m; σ = 222 m). Compared against collocated BEDMAP3 estimates, the full dataset exhibits a Pearson correlation of 0.93, an overall bias of –6 m, and RMSE of 80 m. When stratified, thinner ice (0–500 m) shows strong agreement (R = 0.92; bias ≈ –7.6 m; RMSE ≈ 35.5 m), whereas thicker ice (> 500 m) reveals larger discrepancies (R = 0.76; bias ≈ +5.8 m; RMSE ≈ 225.7 m), indicating unresolved basal roughness and increased signal attenuation at depth. We also identify shifts in englacial layering and basal reflection power near grounding lines, potentially signaling recent changes in basal melt rates. These measurements improve our understanding of ice-column heterogeneity and support enhanced parameterizations of basal friction and melting in ice-dynamic models. Future efforts will integrate this data with high-resolution digital elevation models and regional reanalyses to uncover the physical drivers of observed structural variations and refine projections of ice-shelf stability.

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A first look at newly ice-free environments of the Amundsen Sea, Antarctica: Multiproxy analysis of seafloor samples from the Thwaites Offshore Research Expeditions

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Abstract

The Amundsen Sea is a broad embayment of the West Antarctic Ice Sheet, in which several large glaciers drain to the Southern Ocean. Thwaites and Pine Island glaciers are among the fastest receding glaciers in Antarctica today and are rapidly contributing to sea-level rise, in large part due to relatively warm Circumpolar Deepwater, which flows onto the continental shelf and melts the ice from below. To explore the ocean-ice dynamics of this broad embayment, the Thwaites Offshore Research team of the International Thwaites Glacier Collaboration collected 134 sediment cores during three expeditions of the *Research Vessel/Icebreaker N. B. Palmer* to the Amundsen Sea (NBP19-02, NBP20-02, NBP22-02). Here we present an extensive multi-proxy analysis of the surface seafloor sediment from 50 sites with laser particle size and shape analysis, stable isotopes of carbon and nitrogen, X-ray fluorescence elemental analysis, and the remains of microscopic diatom phytoplankton in the sediment. In so doing, we present the most detailed analysis of sedimentary environments in the Amundsen Sea to date, revealing many patterns, including but not limited to the variability of diatom abundance and stable isotope composition with polynya occurrence, elemental composition with drainage basins, and size, composition, and phytoplankton abundance of sediments in areas of recent melting. By studying--for the first time--the variability of these properties in the broad region of the historically under-explored Amundsen Sea, we can provide a basis for future proxy research on sedimentary archives of this region, particularly in the context of recent oceanographic and glacial changes.

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Purification and biochemical characterization of a catalase from a psychrophilic microorganism of the genus *Flavobacterium*

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Abstract

Catalases from psychrophilic microorganisms are promising biocatalysts for industrial processes requiring cold activity as well as functional versatility at higher temperatures. The present study describes the purification and biochemical characterization of *KatE_FF6*, a novel catalase obtained from *Flavobacterium* sp. FF6, a psychrophilic bacterium isolated from Chilean glaciers. Despite its psychrophilic origin, *KatE_FF6* exhibited unexpected mesophilic enzyme-like traits, with optimal activity at 45 °C and remarkable thermostability (retaining >80% activity after 24 h at 40 °C). However, it maintained functional stability over moderate thermal ranges (25–35 °C) and under cold storage (4–10 °C), suggesting hybrid adaptations to highly variable environmental conditions. The enzyme was purified by protein liquid chromatography using a sequential approach based on the use of resins with different properties, confirming a homotetrameric structure (~320 kDa) with spectral properties associated with the heme group (Soret peak at 406 nm). The induction of activity by H_2O_2 contrasted with the inhibition in the presence of $FeSO_4$, suggesting regulatory mechanisms different from those known for other well-characterized systems such as RpoS/OxyR of *Escherichia coli*. The stability of *KatE_FF6* over moderate thermal ranges positions it as a promising candidate for applications such as textile bleaching or H_2O_2 removal in wastewater, where prolonged enzymatic durability is crucial. This work highlights the biotechnological potential of extremophile biocatalysts with unusual thermal profiles.

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From the Abbot Ice Shelf to Cranton Bay: a multiproxy approach to reconstructing the easternmost Amundsen Sea Embayment in West Antarctica since the Late Pleistocene

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Abstract

Determining the timing, rates, and drivers of past ice sheet retreat is critical to better predicting the future behavior of the West Antarctic Ice Sheet, particularly in its Amundsen Sea Embayment, where ice mass loss has accelerated in recent decades. Paleoenvironmental reconstructions provide new information and enhance our understanding of glacial response to climatic changes.

Sediment cores and sub-bottom profiles collected during the *RV/IB Nathaniel B. Palmer* expeditions (NBP19-02 and NBP20-02) of the International Thwaites Glacier Collaboration - Thwaites Offshore Research team record the paleoenvironmental and palaeoceanographic evolution of the easternmost ASE since the Last Glacial Maximum. Here we present a multiproxy analysis (Computed Tomography scans, magnetic susceptibility, X-Ray Fluorescence, diatoms, stable isotopes, and grain size) of sediment cores in front of the Abbot Ice Shelf and in Cranton Bay. The area just offshore of the Abbot Ice Shelf became free of grounded ice by ~18.2 kyr Before Present (BP) and quickly transitioned to open-marine conditions. To the south, Ferrero Bay deglaciated by ~11 kyr BP, while Cranton Bay, since its earlier deglaciation ~13.0 kyr BP, underwent a transition from ice-shelf to open-marine conditions. The presence of offshore diatoms indicates that Circumpolar Deep Water, a primary driver of modern ice mass loss, advected into Cranton Bay ~7.5 ka BP, enhancing basal melting of the ice shelf. Ongoing work explores the expression of Late Holocene climate events in these bays. Glacial reconstructions like these deepen our understanding of ocean-ice interactions that have shaped regional deglaciation and continue to drive change today.

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Small bays, big trouble: The role of lateral ice drainage during the retreat of the Pine Island Ice Stream following the Last Glacial Maximum

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Abstract

Ice loss from the Amundsen Sea sector of the West Antarctic Ice Sheet significantly accelerated over the past century, contributing to global sea-level rise. Continued mass loss will cause the grounding line to retreat onto a deeper, inland-sloping bed, potentially triggering a positive feedback loop of ice loss, as described by the Marine Ice Sheet Instability hypothesis. However, modeling future scenarios remains challenging due to limited data from past analogues.

The retreat of the Pleistocene Pine Island Ice Stream (PPIIS) from the mid-continental shelf is relatively well studied, although uncertainties remain regarding its main drivers and lateral ice configuration. Here, we present new sediment core and geophysical data from expeditions NBP19-02 and NBP20-02, conducted by the International Thwaites Glacier Collaboration (ITGC) in Cranton Bay—a shallow, broad embayment along the eastern coast of the Amundsen Sea Embayment. Facies analysis and radiocarbon dating indicate that Cranton Bay was free of grounded ice by ~13,500 years ago, though seismic stratigraphy suggests this may be a far minimum age. Comparable deglacial ages from Ferrero Bay and the Abbot-Cosgrove Trough imply that an ocean corridor formed along the eastern Amundsen Sea coast before the final retreat of the PPIIS from the mid-shelf, around or before 12,500 years ago.

We propose that earlier deglaciation of smaller catchments along the flanks of the PPIIS reduced ice input and lateral drag, while increasing exposure to ablation processes that may have contributed to the rapid mid-shelf retreat of the PPIIS.

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Background of Nutrients in Bransfield Strait - Summer 1983 (PROANTAR-III)

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Abstract

The present study shows hydrological and biogeochemical data obtained during the summer 1983 (January) as a part of the Brazilian Antarctic Program (PROANTART III). The data were obtained at Bransfield Strait , a polar region influenced by Weddell sea water and the Brasnfield Current and a place of a distinct primary production. The high availability of dissolved nutrients is characteristic of the Austral Sea presenting particularities related to the hydrodynamic influencing the distribution of nutrients to medium and low oceanic latitudes. The data from 1983 have high historical and scientific importance representing the first Brazilian efforts to monitoring the oceanographic conditions as a part of the global Antarctic studies and could be used in the temporal evaluation in relation to the environmental changes. During the expedition, 27 oceanographic stations were sampled at different depths (surface, 25, 50, 100 and 200 meters and 400m for some of them). The range of hydrological data were: temperature (from -2.07 to 2.42 °C), salinity (from 33.59 to 34.78) and dissolved oxygen (2.31 to 8.19 mL L^{-1}). The range of dissolved inorganic nutrient concentrations were: phosphate (from 0.82 to 2.38 µM), nitrate (from 11.50 to 39.70 µM) and silicate (from 8.50 to 83.00 µM). This dataset is essential for understanding the temporal evolution of nutrient biogeochemical cycles, their relationship with ecological interactions and environmental changes in a region of high relevance to the global climate system.

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Characterization of Tidal Currents in the Western Antarctic Peninsula: An Integrated Approach Combining Numerical Modeling and Observations

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Abstract

Tidal energy dissipation plays a key role in driving turbulent mixing in marine coastal zones and significantly influences the transport of physical, chemical, and biological properties. However, this influence is often underestimated, particularly along the coasts of the Western Antarctic Peninsula (WAP), where tidal dynamics remain poorly understood. This research aims to enhance the understanding of tidal oscillations in the WAP, focusing specifically on the Bransfield Strait (BS), a region critical for circulation and internal dynamics on the western Antarctic shelf. The study integrates direct sea level observations from tide gauges with numerical simulations from the Regional Ocean Modeling System (ROMS), both analyzed using the *t_tide* program to extract harmonic tidal components.

The harmonic analysis revealed a spatial variability in the tidal regime along the WAP. The northern region shows a mixed, predominantly semidiurnal regime, where the M_2 constituent contributes most of the barotropic tidal energy. In contrast, the southern WAP is characterized by a mixed diurnal-type regime dominated by the K_1 constituent. Additionally, the BS was found to suggest favorable conditions for the generation and propagation of semidiurnal baroclinic tides, particularly in areas with strong stratification and irregular bathymetry. This internal tide signal tends to intensify in more stratified regions, though it does not show a clear correlation with spring-neap tidal cycles. These findings support the development of high-resolution numerical models and contribute to a more detailed understanding of tidal processes in this climatically sensitive region.

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Carbonaceous aerosols in Sub-Antarctic and Antarctic sites: observations from Ushuaia and Marambio

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Abstract

Carbonaceous aerosols, including black carbon (BC), play a key role in atmospheric radiation balance and cryospheric processes. In polar and sub-polar regions, these particles contribute to atmospheric warming and, when deposited, can lead to snow darkening and ice melting, with significant implications for regional and global climate. This work presents atmospheric BC observations from two strategic stations in the southern part of South America and the Antarctic Peninsula: Ushuaia (54°S, Argentina) and Marambio (64°S, Antarctica).

We analyze equivalent black carbon (eBC) concentrations measured with Aethalometers (AE33), complemented by meteorological data and other parameters. Our dataset from 2022 to 2024 allows the evaluation of seasonal trends, potential emission sources, and transport pathways. Preliminary results indicate contrasting patterns between both sites, with Ushuaia influenced by local and regional sources, and Marambio reflecting long-range transport under pristine conditions.

Wind sector analysis and back-trajectory modeling help identify air mass origins, supporting the interpretation of observed peaks and background levels. These measurements provide valuable insight into the presence and behavior of carbonaceous aerosols in high southern latitudes, contributing to the understanding of their impact on the Antarctic environment. Providing unique observational constraints for chemical transport and climate modeling, this work also highlights the need to strengthen observational capabilities in the Southern Hemisphere to assess climate-relevant aerosol processes more accurately.

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The onset of the modern Antarctic Circumpolar Current

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Abstract

The Antarctic Circumpolar Current (ACC) is the most powerful ocean current on Earth, exerting a fundamental influence on the global climate system by regulating the ocean's overturning circulation and modulating the uptake and storage of heat and carbon dioxide. Despite its importance, the timing and mechanisms behind the development of a modern-like ACC remain controversial. In this study, we present neodymium isotope and sortable silt records from two pelagic sediment cores in the Southwest Pacific and South Indian Ocean, covering the last 31 million years (Ma). Our findings suggest that a modern-like, deep-reaching circumpolar flow was not established before the Late Miocene. This challenges the long-standing view that the onset of a vigorous ACC was solely controlled by the opening and deepening of Southern Ocean gateways and resulted in significant glaciation across the Eocene-Oligocene Transition (~34 Ma). Instead, we find that, in addition to tectonic preconditioning, the expansion of the Antarctic ice sheet and sea ice during the Middle Miocene Climate Transition intensified meridional density gradients and strengthened the Southern Hemisphere Westerlies, which led to the establishment of a vigorous, deep-reaching circumpolar flow. This reorganization of the ACC may, in turn, have enhanced global overturning circulation, amplifying the late Cenozoic global cooling.

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Geological controls on ice sheet flow from combined onshore-offshore assessment of geophysical data in the Amundsen Sea.

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Abstract

The geological framework beneath the Antarctic Ice Sheet exerts fundamental controls on ice sheet behavior through its influence on ice bed topography, geothermal heat flux and the circulation of subglacial hydrology. These processes vary on both spatial and temporal scales, and do not correlate in a simple manner with geophysical observables such as seismic reflectivity and gravity- and magnetic anomalies. Developing consistent models of geological controls on past, present and future ice shelves is further complicated by the different observations available from the present day onshore and offshore environments.

We have developed a consistent onshore-offshore geological classification using combined geophysical observations from across the entire Amundsen Sea Embayment. We present a classification of geological bed that extends beyond the ice-bed interface to classify the ice sheet bed into regions of similar geological character. The resulting “Bed Classes” allow for consistent parameterizations of geological influences on ice sheet flow across the present-day grounding line and can be used to investigate the fixed and changeable elements of geological control on ice sheet flow.

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Preparation of weather forecasts for radiosonde launch planning on the International Antarctic Coastal Circumnavigation Expedition (ICCE) 2024–2025

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Abstract

During the 2024-2025 International Antarctic Coastal Circumnavigation Expedition, a research program led by Brazilian institutions, including the Federal University of Paraná, the Federal University of Maranhão, and the Federal University of Bahia, was supported. Within the framework of this project, 43 radiosonde launches were carried out around the Antarctic continent, with the aim of studying the interaction of low-pressure systems with the polar atmospheric environment and contributing to the validation of global and regional meteorological models.

The planning of each launch was coordinated through the use of meteorological forecasts, which allowed for the selection of key moments associated with relevant synoptic events. These include episodes of atmospheric rivers, frontal systems, and conditions associated with sea ice in prefrontal, frontal, and postfrontal phases. This strategy made it possible to capture vertical profiles of temperature, humidity, pressure, and wind in contrasting atmospheric contexts, strengthening the scientific value of each observation. The data collected are highly useful for both atmospheric dynamics studies and for improving the representation of polar conditions in numerical prediction models. Experience also demonstrates the importance of integrating operational meteorological analysis with field scientific campaigns, optimizing data collection in remote and extreme regions.

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Antarctic Monitoring and Modeling of the Meteorological Service of the Chilean Navy

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Abstract

The Meteorological Service of the Chilean Navy (SERVIMET) plays a fundamental role in atmospheric monitoring and modeling of the Antarctic continent, providing critical information for navigation, scientific research, and maritime safety in this extreme region.

One of its main tools is the WRF (Weather Research and Forecasting) numerical model, developed in collaboration with the University of Valparaíso and the Computational Modeling Division of the Chilean Meteorological Directorate. This model generates high-resolution forecasts for the Antarctic region, considering variables such as temperature, wind, pressure, and humidity.

In addition, SERVIMET maintains a network of meteorological stations at Chilean Antarctic bases, such as the Presidente Eduardo Frei Montalva Base and the Captain Arturo Prat Naval Base. These stations collect real-time data, which is integrated into the numerical models to improve forecast accuracy and support scientific and logistical campaigns in the region.

The service is also actively involved in the development of graphical modeling products, such as meteorological charts and marine weather forecasts, which are disseminated through its website. These products are used by navigators, researchers, and authorities to make informed decisions in the Antarctic environment.

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Relating sea surface temperature changes to the reduction of glacial cover on the Arrowsmith Peninsula, Antarctica, between 1991 and 2023

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Abstract

This study analysed changes in the glacial cover of the Arrowsmith Peninsula (ArP), in the context of the rising temperatures trend in the Antarctic Peninsula. Five TM, ETM+, and OLI/TIRS Landsat satellite scenes for the years 1991, 2001, 2015, and 2023. The polygons generated from the glacial area features of the ArP enabled the area calculation for each year included in the study. In 1991, the ArP glacial area covered a total of 2,121.29 km². By 2023, this area had decreased to 2,033.89 km², resulting in a loss of 83.4 km² over 32 years. The ArP eastern portion experienced the greatest area loss, retreating by 30.4 km² including the Jones Ice Shelf, which disappeared in less than 20 years, with a total loss of 22 km². The northern portion recorded the 2nd-largest loss, with a retreat of 28.46 km², mainly from the Müller Ice Shelf, which accounted for an 11 km² reduction. The results indicate a significant decrease in glacial areas after 1991. That year, the average sea surface temperature (SST) was -1.11 ºC to the east and south of ArP, and -1.41 ºC to the west and north of ArP. By 2023, the SST had risen to -0.80 ºC in the east and south, and decreased to -1.70 ºC in the west and north. Glacial retreat was observed in all regions between 1991 and 2023; however, the SST increased by 0.31 ºC in the east and south, while it decreased by 0.29 ºC in the west and north.

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Provenance and sediment dynamics in the Ross Sea:a multi-disciplinary approach for IODP Site U1523

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Abstract

IODP Site U1523, located on the southeastern flank of the Iselin Bank, ~50 km northeast of the Pennell Basin (Ross Sea), recovered the first Antarctic Plio–Pleistocene record from a current-influenced sediment drift, documenting a transition from ice-proximal to open-marine depositional environments. This archive offers a key opportunity to investigate the interplay between Antarctic Ice Sheet dynamics, oceanographic variability, and sedimentary processes during a period of major climate reorganization.

In this study, mineralogical observations from core samples, most notably Raman spectroscopy on heavy minerals, are integrated with downhole log and multi-channel seismic data to shed light on sediment provenance and the mechanisms controlling sediment transport and deposition across the Plio–Pleistocene transition. Data from Box Core 008, recovered during the ODYSSEA Project and located near Site U1523, complements the analysis and provide a valuable present-day analogue.

This multiproxy approach provides new constraints on the evolution of sedimentary systems along the Antarctic margin and enhances our understanding of the relationship between ice-sheet behavior, sediment pathways, and marine environmental change over long timescales.

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Multiproxy Detection of Subglacial Meltwater Plumes offshore of East Antarctica

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Abstract

Subglacial meltwater plumes play a critical role in modulating ice–ocean interactions, nutrient fluxes, and sedimentation along Antarctic continental margins, yet their modern and paleo-occurrences remain poorly constrained in space and time. Here, we apply a multiproxy workflow to legacy sediment cores archived at the Oregon State University Marine and Geology Repository (OSU-MGR) from the Pennell Coast and George V Land to identify stratigraphic signatures of past plume activity, by analyzing grain-size and grain micromorphology data, XRF geochemistry, SEM imagery, and CT stratigraphy. A non-exhaustive list of diagnostic characteristics includes grain-size distributions dominated by very fine to fine silt, CT scans revealing either structurally massive plumites (rapid deposition) or normally graded silt laminations (episodic meltwater influx), and SEM imagery showing elevated microfracture densities and angular grain facets consistent with subglacial abrasion and rapid transport. Among other minor indicators, these primary criteria allow us to identify meltwater events in the piston cores at the study sites. Initial results show that Pennell Coast and George V Land cores preserve more frequent and compositionally complex plume deposits at offshore sites compared to near-shore, reflecting proximal versus distal plume influence. Multivariate statistical analyses, including principal component analysis and clustering, demonstrate strong covariation among various sedimentological and geochemical proxies in interpreted plume layers. This study underscores the efficiency and sustainability of utilizing a multiproxy approach in legacy cores to constrain meltwater plume activity over the last 20,000 years.

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Analysis of the evolution of glacier cover and its impact on the Rio Duqueco and Rio Laja Alto sub -basins: estimation of the Sierra Velluda glacier melt through remote sensing, Región del Biobio, Chile.

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Abstract

This research analyzes the evolution of the Sierra Velluda Glacier (GSV), located in the commune of Santa Bárbara, Biobío Region, during the last 25 years. Through remote sensing techniques, a significant reduction of 47% in its glacier area was evident, accompanied by a loss of volume equivalent to 6,171,658,730 km^3 of water. This decrease is directly related to the reduction in precipitation in the area, attributed to climate change, according to the National Action Program to Fight Desertification (PANCD).

The GSV plays a fundamental role in local water regulation, since during the melting period it feeds the sub-basins of the Duqueco and Laja Alto rivers, this contribution being especially relevant in the summer season, when water demand increases and precipitation decreases. Therefore, understanding its decline allows us to measure the impacts of climate change on the region's water resources.

The research used spectral indices applied to multi-temporal satellite images and geodetic balance analysis, which allowed validating the negative trend observed in the glacier mass. Taken together, the findings warn of the need for continuous monitoring and planning for sustainable water management in a scenario of increasing water stress.

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ConGlaBe : Contrasting glacier behaviour in southernmost South America and northernmost Antarctica in response to climate change

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Abstract

This study focuses on six glaciers located in two distinct regions: the northwestern Cordillera Darwin (four glaciers) and King George Island (two glaciers). These glaciers exhibit contrasting behaviours, including retreat, relative stability, and advance. To understand the drivers behind these differences, we are characterising local climate conditions and glacier mass balance using a combination of instruments and methods. Ice flow dynamics and glacier geometry are being analysed, alongside changes in glacier area derived from satellite and UAV imagery. In addition, vegetation sampling in moraines and periglacial zones is being conducted to support the reconstruction of ice retreat chronologies. The primary objective is to elucidate the causes of contrasting glacier behaviour in two key polar environments—southernmost South America and northernmost Antarctica—both of which are influenced by the subpolar low-pressure belt and prevailing westerly winds throughout the year. These six glaciers are not affected by volcanic activity, meaning that climate, geometry, and ice dynamics are likely the primary drivers of their behaviour. The core research questions addressed are: (1) What are the main drivers of current glacier behaviour in the Cordillera Darwin and northern Antarctic Peninsula regions? and (2) How might these glacierised environments evolve in the near future? Preliminary results indicate a more rapid retreat of the Escondido Glacier's ice terminus compared to the land-terminating Bellingshausen Dome glaciers. Meanwhile, the tidewater glaciers—Sorpresa (De Agostini Fjord) and Lange (Admiralty Bay, King George Island)—are calving at different rates, suggesting distinct dynamics at play in each fjord environment.

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Quantifying Knowledge Gaps in Subglacial Topography to Refine Subglacial Hydrology and Ice Discharge Estimates, and Survey Requirements for Antarctic RINGS Missions at the Ice Sheet Margin

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Abstract

The margin of the Antarctic Ice Sheet has multiple tipping mechanisms that could trigger large, rapid, and potentially irreversible changes in the coming centuries. While bed topography largely controls these mechanisms, it remains poorly known beneath the ice sheet and ocean. Antarctic RINGS, a collaborative initiative under the Scientific Committee on Antarctic Research (SCAR) and the Council of Managers of Antarctic National Programs (COMNAP), aims to address critical data gaps in the ice-sheet margin, including subglacial topography, ice discharge, surface mass balance, subglacial hydrology, geological settings, and ice-shelf mass balance. Using the Bedmap3 FAIR database, we generated stochastic ensemble bed topographies within 100 km of the grounding line. Our analysis reveals a much rougher bed than previously suggested by gridded map products, introducing significant uncertainty into assessments of future grounding line retreat, including Marine Ice Sheet Instability scenarios. We further estimate the uncertainty in ice discharge caused by ice thickness uncertainty, demonstrating how targeted RINGS surveys at the grounding line can significantly reduce these uncertainties. Additionally, we assess how gridded bed elevation uncertainty relates to bed roughness and the proximity of survey profiles. This provides an empirical framework for determining optimal survey spacing to meet specific uncertainty tolerances. International collaboration is essential for conducting dense surveys along the ice sheet margin and inland. Ultimately, these efforts will enable the development of high-resolution bed topography products with documented uncertainties for diverse scientific applications.

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Ice sheet discharge constrained by RINGS airborne surveys of bed topography in Dronning Maud Land and Enderby Land

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Abstract

Knowledge of bed topography at the ice-sheet margin is critical for accurate estimation of Antarctic ice discharge and contribution to sea level change. RINGS is an Action Group within the Scientific Committee on Antarctic Research (SCAR) that aims to provide more accurate and complete reference bed topography data all around Antarctica. Here, we present a decade long time series of ice sheet discharge by combining satellite-based records of surface velocity and elevation with newly collected airborne radio-echo sounding data of bed topography for the East Antarctic coast between 10W to 70E; a sector spanning almost a quarter of the continent, including Dronning Maud Land and Enderby Land (DML/EL). The data were collected along parallel lines following the ice sheet grounding line during two regional RINGS surveys in austral summers 2023-24 and 2024-25, facilitated through a scientific and logistic collaboration between Australia, Belgium, China, Finland, Germany, India, Japan, Norway, Sweden, and USA. The results demonstrate the importance of accurate bed topography data for constraining ice discharge in Antarctica and for getting more scientific value out of satellite observations of the surface. The framework for the surveys and data analyses can be used as a guideline for similar efforts in other parts of Antarctica, which put together can improve current and future estimates of ice-sheet discharge, mass balance and the Antarctic contribution to sea level change.

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Current state and partial collapse of Müller Ice Shelf, Antarctic Peninsula

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Abstract

The Müller Ice Shelf, the northernmost floating platform on the west coast of the Antarctic Peninsula (67°15′27″ S, 66°53′28″ W), spanned ~40 km² in 2019 within Lallemand Fjord. It is fed by Brückner and Antevs Glaciers, which flow northward from the Arrowsmith Peninsula, and is bifurcated at its terminus by Humphreys Ice Rise. Field observations in 2019 documented intense surface melting and the formation of free aquifers at the snow–firn interface, factors commonly linked to hydrofracturing and shelf collapse (e.g. Larsen A-B and Jones). Subsequently, from 2019 onward, significant instability manifested, particularly along the western flank. In the 2020 austral summer, crevasses parallel to the front began expanding, precursors to large-scale destabilization. By summer 2023, a block of 0,25 km² detached from the western front, triggering accelerated collapse. From March to April 2025, a sequence of calving events removed an additional 2,89 km² from the western shelf front. January 2025 set a satellite-era record for surface melt: ~3.7 % of the Antarctic ice sheet and ~49 % of the Antarctic Peninsula registered melting in January 2025. Moreover, late-January cyclonic storms (“Ian” and “Jagi”) likely amplified meltwater infiltration and fracture propagation, which also coincides with near-record low of sea ice extent, probably acting as immediate triggers for collapse. This study underscores the influence of long-term meltwater weakening and episodic climate events in ice shelf response to extreme melt and storm regimes.

Category

2 Ice Sheets, Climate, Ocean, and Geosphere Interactions

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Present and Past Biodiversity, Ecosystem Dynamics, and Climate Interactions

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Investigating the relationship between algal blooms and temperature in the Antarctic Peninsula

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Abstract

The Antarctic Peninsula is among the fastest warming regions on Earth, making it a key location to study ecological impacts of climate change. One such impact is the rising frequency and intensity of algal blooms, which are sensitive to environmental shifts. This study examines the relationship between atmospheric temperature and algal blooms in parts of the Antarctic Peninsula using reanalysis, satellite data, and laboratory experiments. From 2016 to 2024, green algae coverage was quantified using Sentinel-2 imagery, and surface temperature data were extracted from ERA5 reanalysis for seven locations. Results show that algal concentrations often increase during warmer periods and seasonal transitions. However, inconsistencies between algal presence and temperature suggest other factors such as nutrient levels, light, and geography also influence bloom development. Laboratory experiments on Antarctic green microalgae, associated with snow blooms, showed that algal biomass significantly affects light absorption and transmittance. Denser samples exhibited greater solar radiation absorption, particularly in the 500 to 700 nm range, indicating reduced surface albedo and potential localized warming. Together, satellite observations and lab results reveal a complex interplay between environmental conditions and algal bloom behavior. These findings highlight the need for integrated approaches to understand biological responses to climate change in polar ecosystems.

This study was carried under the auspices of the Presidency of The Republic of Turkey, supported by the Ministry of Industry and Technology, and coordinated by TUBITAK MAM Polar Research Institute. It was supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK) under project number UPAG 122Y121.

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CO_2 Dynamics in Antarctic Oasis Soils

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Abstract

Antarctic oases are ice-free areas located primarily along the coastal margins of the continent. Although they account for less than 0.5% of Antarctica's total surface area, these regions hold significant scientific value due to their unique ecosystems and the important environmental records they preserve. Oases develop in locations where climatic and geographic conditions—such as low precipitation, high evaporation rates, strong katabatic winds, and increased solar radiation during the summer—prevent the accumulation of ice. The soils in these areas exhibit highly distinctive characteristics. Chief among them is the low organic matter content, which reflects the limited biological activity and sparse vegetation, typically consisting of lichens, mosses, cyanobacteria, and a few extremophilic microorganisms. Soil biological activity is constrained, and biogeochemical cycles—particularly those of carbon and nitrogen—are slow and conservative, largely due to low temperatures and limited availability of liquid water. The objective of this study was to assess the dynamics of CO_2 gases in both the atmosphere and soil across different Antarctic oases. The first monitoring site was established at the Schirmacher Oasis, on the Princess Astrid Coast, while the second was set up at Lanserman Hills. EE872 probe-type sensors, capable of measuring up to 5,000 ppm, were installed at a depth of 20 cm within the soil and at a height of 100 cm above the ground surface. The results demonstrated that, despite the low soil organic carbon content, microbial respiration within the soil significantly increased CO_2 concentrations—surpassing the sensor's maximum detection limit.

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An investigation into how microbial communities are influenced by and change over geologic time in the Transantarctic Mountains, Antarctica.

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Abstract

How does life begin? This question has been asked by many ecologists and earth scientists for as long as we have recorded history. Even in recently disturbed ecosystems, new life often flourishes into a complex system relatively quickly, making it difficult to home in on some of the specifics of community assembly.

Antarctica is known for being one of the most hostile environments on Earth. Yet there is still life that is living there and thriving, it's just very small. Such a small and relatively simple ecosystem provides an ideal proxy for studying how life begins and develops over time.

In the Austral summer of 2017, our team traveled to Ong Valley in the Transantarctic Mountains of Antarctica to collect sediment from moraines left behind by retreating glaciers. While the exact exposure age of these sediments is unknown, they still provide a sequence of deposits with relatively increasing exposure ages, from about 10 Ka to 5 Ma. Previously conducted detrital zircon work found that these moraines are all sourced from the same geologic material, further identifying this area as an ideal proxy for investigating how microbial communities change and transform over geologic time.

The samples were taken to the US, where we extracted and sequenced the 16S DNA. With these sequences, our project aims to compare the microbial community analyses of the moraines as they increase in relative age. We aim to dive deeper into how succession occurs and how communities are built from the ground up.

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The Polar Rock Repository: an underutilized, cross-disciplinary resource for biodiversity studies

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Abstract

Cryosphere changes over time have altered the size and scope of biological refuges around the Antarctic continent. More outcrops are becoming exposed as the Antarctic ice sheet loses mass, with refugia expected to proliferate. The Polar Rock Repository (PRR) is a National Science Foundation funded facility that provides a venue for stewardship of polar sample collections, metadata, and media relevant to understanding changes in biodiversity across these polar landscapes. The PRR provides online access to over 64,000 rock samples, glacial and other unconsolidated deposits, terrestrial drill cores, marine dredge samples, and ~8,000 media from Antarctica and surrounding regions. The collection includes samples and metadata containing lichen, moss, cyanobacteria, marine invertebrates, plants, algae, etc., that could be potential bio-monitors indicating changing habitats. The role of polar biota on physical and chemical weathering also remains largely unknown.

The PRR online database allows multi-field searchable criteria useful to biodiversity studies, including plants, algae, other life, regolith, radioactivity (to help identify micro niches), as well as photos and videos of outcrops and landscapes. Samples can be ordered directly from our website (prr.osu.edu) for research (destructive research techniques permitted). The PRR has also created a media archive that can provide information about surface and habitat features (lakes, mumiyo deposits, algal ponds, etc.) reflecting recent changes.

With online access to a diverse suite of samples, metadata, and images, the PRR offers a unique resource for studying terrestrial biodiversity and ecosystems across Antarctic landscapes.

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Unique Antarctic stromatolites reveal diverse taxa and metabolic complexity: implications for the early evolution of life

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Abstract

Lake Untersee, located in Queen Maud Land, Antarctica, is a perennially ice-covered lake that offers a unique window into ecosystems that may have existed on early Earth and potentially on icy worlds such as Europa, Enceladus, and ancient Mars. Beneath its permanent ice cover, Lake Untersee hosts diverse microbial mats, including flat mats, pinnacles, and the first reported occurrence of large conical stromatolites in a modern environment. These structures are composed of a pigmented surface layer of photosynthetic Cyanobacteria overlying soft, laminated layers of sediment and organic matter. While pinnacles and flat mats are well-known in Antarctic lakes, the large complex cones are unique to Untersee and may provide new insights into microbial ecosystem dynamics under extreme conditions. To explore their formation, we reconstructed metagenome-assembled genomes (MAGs) from adjacent pinnacles and cones. Results show distinct microbial communities, with Microcoleus cyanobacteria dominating cone structures and Elainellaceae more abundant in pinnacles, suggesting microbial influence on mat morphology. Metagenomic profiles revealed sharp stratification in both community composition and metabolic activity, with upper layers enriched in photosynthetic pathways and lower layers favoring heterotrophy. Notably, Untersee's mats are the first in Antarctica where substantial ammonia-oxidizing Nitrospiraceae and amoA genes have been found. Across all structures, genomic evidence highlights nutrient recycling as a key strategy in this ultra-oligotrophic environment. Further work will target desiccated mats on the lakeshore, ancient paleomats, and transient mats in nearby ponds to trace ecosystem evolution. We are also generating metatranscriptomes from stromatolite layers to identify active microbial processes and functional drivers.

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Major microbial mat disruption in Lake Fryxell, Antarctica linked to an increased irradiance event

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Abstract

Perennially ice-covered lakes in the McMurdo Dry Valleys (MDV) of Antarctica are sources of biomass to the surrounding soils, which are among the most organic poor on earth. Biomass export from these closed-basin lakes occurs through buoyant remobilization of benthic microbial mats from gas-supersaturated zones under the ice cover. Bubbles nucleate on mats, causing them to float, freeze onto the ice, and be exported through ice ablation. This biomass remains unaccounted for in current organic carbon cycling models, which assume net transport from soils and streams to lakes. Few constraints on the mechanism, timing, and rates of biomass export make it difficult to assess the extent of biomass transport or predict climate responses. We demonstrate that the depth range supporting mat mobilization (liftoff zone) can expand or shrink, impacting biomass export. Ice thickness has cycled over the past 40 years, with the 2022–2023 austral summer having the thinnest recorded ice cover at Lake Fryxell and a doubling of liftoff surface area compared to 1980–1981 and 2006–2007. Our 2024–2025 field observations show further deepening of the liftoff zone and gas bubbles on thicker, multi-year mats. Expansion into deeper waters increases biomass mobilization, correlated with rising water column dissolved oxygen and irradiance. In deeper zones, liftoff is directly linked to enhanced microbial oxygen production. Exceptional years of biomass export likely have a disproportionate impact on nutrient availability to soil communities. Thus, interannual variability in mat mobilization may play an important role in MDV ecosystem responses to climate change.

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Microbial mat indicators of ecosystem resilience in Antarctic perennially ice covered lakes

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Abstract

Perennially ice-covered lakes are important habitats in Antarctic ice-free regions. Lakes contain benthic microbial mats where sufficient irradiance penetrates for net photosynthetic biomass accumulation. In the McMurdo Dry Valleys (MDV), recent climate change has led to lake level rise with resulting changes in mat environment; deep water mats may receive insufficient light for net accumulation, whereas in shallow water newly inundated sediments become available for growth. Work in Lake Vanda (MDV) demonstrates that mats resembling prior under-ice communities are established in 3–4 years (Ramoneda et al., 2021). However, we lack constraints on mat community resilience over decade-century scale changes. In this study, we use short sediment cores from Lake Joyce (MDV) to assess changes to mats through ~13 m of lake level rise since 1947. Mat morphologies vary with depth due to both microbial activity and environmental conditions: bubble-supported liftoff mat are present <8m depth, webbed and isolated pinnacles continue <15 m depth, and columnar stromatolites are abundant from 21-23 m. Morphologies are partially preserved by calcite, which also records community composition through microfossils. Changes in preserved morphologies are consistent with lake level rise. Shallow liftoff mats are overgrown by pinnacles and pinnacle morphologies are overgrown by low relief mat. Microfossil counts further indicate that cyanobacterial morphotypes have consistently contributed to similar mat morphologies through time. Results suggest that mat communities are generally resilient to lake level rise, but additional work is needed to assess sensitivity to other environmental factors expected to change with further regional warming.

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Viridicatin isolated from the antarctic fungus *Penicillium* sp. shows neuroprotective effect on HMC-3 microglia cells under H_2O_2 oxidative stress

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Abstract

Neurodegenerative diseases increase with the aging of the population. Microglia activity, key to CNS homeostasis, is affected by oxidative stress, which can be mitigated by activation of antioxidant pathways with expression of ARE genes by Nrf2. Finding drugs that protect microglia is crucial to prevent cognitive disaeses. Antarctic fungi offer a promising source of new therapeutic molecules.

The antarctic fungus *Penicillium* sp. was seeded in 80 flasks with YM medium for 28 days, for subsequent extraction with EtOAc. The extract was fractionated and purified by chromatographic techniques and the structure of Viridicatin was determined by GC-MS, XRD and NMR (600 MHz). The protective effects of Viridicatin were evaluated in HMC-3 microglial cells treated with H2O2 (300 µM) for 24h and death was measured with Sytox in INCUCYTE. Changes in the mitochondrial membrane potential of cells treated with H_2o_2 and Viridicatin were studied. Cellular RNA extractions were performed at 3 and 6h of treatment and the expression of Nrf2 and antixodant proteins Nrf2, SOD, CAT, GPX, HO-1 and NOQ1 was analyzed. In addition, immunofluorescence microscopy under confocal microscopy was performed to observe and quantify Nrf2, HO-1 and NOQ1.

Viridicatin showed a protective role against damage caused by H_2O_2-induced oxidative stress, with an IC_{50} of 50 µM and almost 100% protection at a concentration of 100 µM. Viridicatin protected cells from mitochondrial membrane depolarization, increased the expression of antioxidant molecules and, it was observed to prevent nuclear translocation of HO-1 caused by H_2O_2. Therefore, Viridicatin has potential as a future neuroprotective drug.

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Regionalisation and palaeoendemism typify most Antarctic terrestrial fauna across Antarctic Conservation Biogeographic regions and beyond

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Abstract

Today, Antarctica's terrestrial life is dominated by non-charismatic and cryptic organisms, including lower plants and lichens, microarthropods and other microinvertebrates, and microbial groups. Most currently ice-free ground in Antarctica and on at least some of the surrounding sub-Antarctic islands would have been covered and scoured by glacial advances at the Last Glacial Maximum and/or previous maxima. However, as new baseline survey data and material have become available, combined with application of modern molecular biological analysis over the last two decades, it is clear that isolation, long-term multi (tens of) million year persistence, and strong regionalisation and endemism are general features of the Antarctic terrestrial and freshwater biota, although patterns and timescales characterising different biological groups and regions can differ. Within the continent, 16 Antarctic Conservation Biogeographic Regions are currently defined, based primarily on distinct biodiversity features. Given the putative timescales of isolation and divergence within different regions, the presence of multiple refugia and separate evolutionary histories have been the norm across all regions of the continent. However, precise locations for these are elusive and, in many cases, may be impossible to determine. As well as creating a new paradigm in which to consider the evolution and adaptation of Antarctic terrestrial and freshwater biota, these findings highlight important cross-disciplinary linkages in the fields of understanding the geological and glaciological history of the continent itself and its neighbouring landmasses, and of the climatic and oceanographic process that can both lead to isolation and support colonisation processes.

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Mass Mortality in South Polar Skuas by HPAI H5N1 2.3.4.4b in Horseshoe and Dismal Islands, 2025

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Abstract

Highly pathogenic avian influenza H5N1 (clade 2.3.4.4b) poses a serious conservation threat to wildlife globally, as its continued spread into new regions heightens concern over potential ecological consequences. In February and March 2025, we conducted avian surveys in Marguerite Bay, on the western Antarctic Peninsula, the southernmost extent of the virus's known range to date. We documented a mass mortality event among South Polar Skuas (*Stercorarius maccormicki*), finding 47 carcasses across Horseshoe and Dismal Islands.

In addition to confirming infections via qPCR, we evaluated the on-site use of a rapid antigen detection kit under field conditions. The kit proved to be a potentially valuable tool for real-time surveillance in such a remote location lacking immediate laboratory support. Its performance in Marguerite Bay demonstrated practical utility for quick screening of avian influenza in the field, although a ~10% false-negative rate was noted, highlighting some limitations in sensitivity.

These findings underscore the significant impact of HPAI H5N1 on South Polar Skuas and reinforce the need for continuous wildlife surveillance and long-term ecological monitoring. The incursion of this virus into the Antarctic region, its farthest-south reach on record, is of particular concern, as local bird populations have had no prior exposure and may be especially vulnerable. . This heightened vigilance will help inform conservation strategies and biosecurity measures as the virus continues to spread. Funded: TÜBITAK TAE-IX; INACH Regular RT0821

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Ancient diatom DNA as a proxy for Antarctic sea-ice variability in the Scotia Sea

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Abstract

Antarctica is one of the most climate-sensitive regions on Earth, and understanding past ecological and environmental responses is critical for predicting future change. Sedimentary ancient DNA (*sed*aDNA) is increasingly recognized as a powerful paleo-proxy, enabling the reconstruction of past ocean ecosystems from both fossilized and non-fossilized genetic traces. Diatoms, siliceous unicellular phytoplankton, serve as key indicators of Antarctic paleoenvironmental conditions due to their ecological sensitivity and taxonomic diversity. In this study, we analyzed *sed*aDNA from Scotia Sea sediments to reconstruct past sea-ice dynamics by targeting the ice-associated diatom *Fragilariopsis cylindrus*. We observed a significant negative correlation between DNA fragment length and sediment age, and the nucleotide misincorporation patterns further confirmed the authenticity and temporal integrity of the recovered sequences. Genetic signals aligned with major climatic transitions such as the Last Glacial Maximum, Antarctic Cold Reversal, and several key Marine Isotope Stages. Using targeted hybridization capture, we enriched the *F. cylindrus* chloroplast genome, achieving a >1000-fold increase in recovery compared to metagenomic shotgun sequencing. This also provided preliminary insights into the ancient *F. cylindrus* chloroplast genome architecture. Our study highlights the potential of integrating ecological, climatic, and genomic data using *sed*aDNA approaches to unravel past Antarctic marine ecosystem responses to climate variability.

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Isotopic and Morphological Responses to the Eocene-Oligocene Transition in Antarctic Shelf Molluscs

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Abstract

The Eocene-Oligocene transition (~34 Ma) marks Earth's shift from greenhouse conditions to Antarctic glaciation. We analyzed molluscan fossils from Seymour Island (Eocene) and King George Island (Oligocene) to examine this transition in shelf environments. Oxygen isotope analyses of bivalves (Cucullaea, Retrotapes, Leoclunipecten) and Perissodonta gastropods reveal an increasing trend through Seymour Island's stratigraphic beds, consistent with progressive cooling. King George Island samples show more variable signatures, reflecting unstable post-glaciation conditions. Our heterochrony analyses, focused on Perissodonta gastropods, document decreasing shell sizes through time, paralleling similar size reductions in dominant bivalves. These changes indicate physiological responses to environmental stress. Isotopic signatures across growth bands suggest a reversal in seasonal growth patterns: from growth during warmer months in the early Eocene shifting to growth during colder periods as climate cooled. This timing shift represents a critical adaptation to changing thermal regimes. Perissodonta gastropods display particularly pronounced morphological responses to temperature fluctuations, making them valuable paleoenvironmental indicators. By integrating isotopic data from multiple molluscan taxa with morphological changes in Perissodonta, we characterize ecological responses across this major climate threshold, providing insights into how marine ecosystems might respond to current climate change in polar regions.

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ASSESSING BIASES AND PATTERNS BETWEEN THE ANTARCTIC AND PATAGONIAN LAND-MAMMAL FOSSIL RECORDS

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Abstract

Antarctica is the only continent without terrestrial vertebrates, making the history of land mammals that once inhabited it, and the causes of their extinction, of particular interest. Their fossil record is almost restricted to the Paleogene strata of the La Meseta and Submeseta formations on Marambio (Seymour) Island. It includes taxa also known from the Paleogene of South America. This study analyzes potential biases and patterns distinguishing the Antarctic and South American records. The South American sample includes Paleocene–Eocene units and taxa recorded from Patagonia, specifically the "Banco Negro Inferior", the Río Chico Group (Peñas Coloradas, Las Flores, and Koluel Kaike formations), the Laguna del Hunco Tuff, and the basal levels of the Sarmiento Formation (Casamayoran South American Land-Mammal Age). The Antarctic mammal record shows a strong bias due to its allochthonous nature, lack of paleoenvironmental consistency between life habitat and burial site, predominance of dental over skeletal elements, and high fragmentation, though with limited evidence of erosion or transport. There is a mass-related bias favoring mammals under 1 kg, and a very low representation of the maximum number of taxa of the complete sample analyzed. Unlike the Patagonian record, no Antarctic specimens show adaptations for grazing (hypsodonty), folivory (bilophodonty), omnivory (bunodonty), or predation. The Antarctic assemblage reflects selective preservation based on body size and diet and lacks endemic suprageneric taxa. These contrasts highlight ecological and taphonomic differences between the two regions and offer insights into the factors shaping Antarctic fossil land-mammal assemblages, constraining paleobiogeographic and evolutionary inferences.

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Comparative analysis of enamel microstructure in Eocene Sparnotheriodontidae (Litopterna, Mammalia) from Antarctica and southern South America

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Abstract

Among the few terrestrial vertebrates known from the Paleogene of Antarctica, the largest are South American native ungulates (SANUs), including Astrapotheria and the litoptern Sparnotheriodontidae. This study examines the enamel microstructure of postcanine teeth in three sparnotheriodontids: *Notiolofos arquinotiensis* and an indeterminate form from the Eocene of Antarctica, and *Phoradiadus divortiensis* from the Andes. All exhibit a three-zoned schmelzmuster: inner and outer radial enamel surrounding a thick zone of exclusively vertical Hunter-Schreger bands (HSB), with broad transition zones. This is a derived condition compared to the narrow transitions seen in most other SANUs with vertical HSB, except *Astrapotherium*.

Phoradiadus shares with *Notiolofos* an acute-angled interprismatic matrix (IPM) in the inner enamel and HSB, and with the indeterminate Antarctic form, enamel thickness and a prism-parallel IPM in the outer enamel. However, *Phoradiadus* is distinct in combining low and steep prism inclinations in the outer enamel. These features—especially the broad transition zones and acute-angled IPM—distinguish sparnotheriodontids from other SANUs.

Despite their classification within Litopterna based on gross dental traits, sparnotheriodontids show no clear enamel microstructure affinities with other litopterns described so far. Still, their schmelzmuster does not contradict a position as specialized clade within the order. In contrast, the possible litoptern Didolodontidae retains primitive enamel features or develops transverse HSB, indicating a more basal placement. Sparnotheriodontidae thus represents one of the earliest SANU lineages to evolve a schmelzmuster with exclusively vertical HSB, suggesting a unique evolutionary path whose role in their broad, including polar, distribution remains to be clarified.

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Meet the Antarctic giant: The world's largest penguin skull ever discovered

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Abstract

The fossil record provides robust evidence that a diverse assemblage of penguins inhabited Antarctica during the Eocene. Although some crania have been described, most of the elements identified belong to the postcranium. An exception is *Anthropornis grandis*, for which a skull was found in association with a partial hindlimb. More recently, a large skull was recovered from the Bartonian (Eocene) Turritella Alomember (Submeseta Formation). This specimen represents the first nearly complete cranial specimen, lacking only the distal tip of the beak. Its total length would have reached at least 470 mm, measured from the occipital condyle to the tip of the beak, and the head would likely have been even longer when reconstructed with musculature, integument, and feathers. Comparative assessment is limited to Anthropornis, as no reliably associated skull has been preserved for *Palaeeudyptes*, and no other known penguin taxon attained such large dimensions. The main differences with Anthropornis that support a preliminary assignment to *Palaeeudyptes klekowskii* (the largest species within the genus) include the narrower interorbital region, the reduced extent of the cranial roof, the greater height of the occipital elements, the pronounced bilateral concavities in the parasphenoidal plate, the elongation and caudal position of the parasphenoidal processes, and the incomplete ossification of the parasphenoidal wings. The elongated beak, an adaptation for capturing fish, along with the broad temporal fossae that housed powerful musculature, and the robust parasphenoidal processes capable of supporting a long, heavy skull, suggest an ichthyophagous lifestyle involving active pursuit of prey through diving.

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Environmental DNA Metabarcoding Reveals Biodiversity and Potential Non-Native Species in a Warming Antarctic Coastal Ecosystem

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Abstract

Global temperature rise has significantly impacted polar regions, including Antarctica. The Antarctic Peninsula, particularly vulnerable to climate change, has experienced pronounced warming from 1979 to 2019. Doumer Island, located in the Palmer Archipelago of the Western Antarctic Peninsula, is part of an Antarctic Specially Protected Area (ASPA 146) and serves as a key site for observing ecosystem changes in South Bay, one of the region's climate warming hotspots.

To investigate marine biodiversity and detect potential non-native species, we applied environmental DNA (eDNA) metabarcoding in South Bay. Seawater samples were collected from four stations near the Chilean Antarctic base Yelcho (64.9° S, 63.6° W). This study contributes new data on the coastal pelagic community, expanding the biodiversity records of western coastal Antarctica. We identified several previously undocumented species, including potential non-native taxa.

Our findings support eDNA metabarcoding as an effective tool for biodiversity assessment and early detection of invasive species in polar environments. However, the limitation is that current DNA databases are incomplete and require expansion and refinement. This highlights the urgent need to expand and refine these databases to enhance the resolution of eDNA analyses.

We conclude that continued monitoring using eDNA is crucial for understanding ecosystem dynamics and improving biosecurity in rapidly changing Antarctic coastal zones. This approach will be key to informing conservation strategies and detecting ecological shifts driven by climate change.

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Distinct marine eukaryote *sed*aDNA signatures characterise East and West Antarctic ecosystems

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Abstract

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Antarctica is highly vulnerable to climate change and studying past ecosystem responses to environmental change, such as through sedimentary ancient DNA (*sed*aDNA), is a matter of urgency. We extracted *sed*aDNA from different Antarctic locations, including the West Antarctic Scotia Sea (IODP Exp. 382 Site U1536) the East Antarctic Totten Glacier region (IN2017_V01 Sites KC02 and KC14), and from underneath the Ross Ice Shelf (SWAIS 2C). A metagenomic shotgun approach was applied to investigate marine eukaryote composition through time, complemented by the targeted capture of plankton-derived *sed*aDNA. In the Scotia Sea, the shotgun data revealed a clear shift from a *Phaeocystis*-rich to a *Chaetoceros*-rich community starting at ~15.8ka, with *Chaetoceros* becoming the dominant marine eukaryote from 11.75ka to present. In the Totten Glacier region, marine eukaryote communities were much more diverse and fluctuating over the last 22ka, with a short-term dominance of *Chaetoceros* at KC02 from 10.3ka to 8.2ka, and at KC14 from 9ka to 5.3ka. Preliminary paleo-ecosystem data from underneath the Ross Ice shelf differ from the Scotia Sea and Totten Glacier signatures. Our study shows that there are significant differences between the marine paleo-ecosystem structure of East and West Antarctica, and also on relatively small spatial scales such as the neighbouring Totten Glacier sites (~50km apart). Considering additional lithological observations from the same sediment cores showed that differing oceanographic conditions influenced these paleo-ecosystems, warranting further research into the population dynamics around the icy continent.

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Spatial Variability of Chlorophyll-a in the Bransfield Strait, Antarctica, During the Austral Summers of 2024 and 2025

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Abstract

Understanding the spatial variation and vertical distribution patterns of chlorophyll-a (Chl-a) in the Southern Ocean (SO) is important for identifying the productive potential of the ocean as an essential component of the global marine ecosystem. The SO presents seamounts around which hydrothermal systems are found, whose activity could modify the primary production of phytoplankton in the water column due to the emission of metals important for photosynthesis, such as iron. This research studies the changes in Chl-a concentration at 40 stations distributed in areas with hydrothermal activity (Hook Ridge, Little Point, and Three Sisters) where water samples were collected at three depths (2 m, 25 m, and variable bottom depth), and physicochemical parameters, dissolved oxygen, and trace metal concentrations (Fe, Co, and Cu) were measured during the ANTAR XXX (2024) and ANTAR XXXI (2025) campaigns. Preliminary results showed Chl-a concentrations between 0.05 and 12 µg/L, with a heterogeneous spatial distribution in the Hook Ridge area. At the surface, values were relatively homogeneous (up to 4–5 µg/L), while in intermediate layers, maxima of up to 4.5 µg/L were detected, especially towards the south of the study area. A direct relationship with depth was not observed, suggesting a localized influence of hydrothermal sources modulated by oceanographic dynamics. These findings reinforce the hypothesis that natural iron inputs can influence the primary productivity of phytoplankton in specific regions of the Southern Ocean.

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Pre-epidemic long-term influenza virus surveillance in the Chilean-Antarctic axis reveals the dynamic circulation of endemic and introduced strains

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Abstract

Avian influenza viruses (AIV) are globally considered one of the most relevant zoonotic viral pathogens due to their ability to infect a wide variety of hosts. Chile has unique geographical barriers providing protection from several pathogens. However, migratory birds can travel large distances, trespassing these barriers thus can potentially introduce emerging pathogens such as AIVs. Continuous genomic surveillance trace the circulation, to identify the routes of dissemination and to determine the introduction of novel IAVs strains and their zoonotic potential. During 2014 to 2018, we collected more than 6.000 samples across Chilean coasts, including 2.176 from the Antarctic peninsula, to determine the prevalence rates and to evaluate phylogenetic relationships. Positivity ranges of IAV, detected by RT-qPCR, were between 0,2 to 15,8% for the continental coasts and, 3,98 to 14,21% for the Antarctic peninsula. Sequencing analysis resulted on 17 whole IAV genomes that correspond to H13N2, H13N9, H3N8, H3Nx, H12N5 and H5N9 subtypes in the continental area and H11N2 and one H5N5 on the Antarctic region. Phylogenetic analysis revealed that sequences are related with the South American (n=2), the North American (n=7), the Eurasian (n=1) and novel Antarctic lineage (n=7) that include all H11N2 identified after 2016. Also, our data also suggest the appearance of 4 reassortant viruses in the continental coats that retained segments from the other lineages. Our data report the circulation of the different influenza virus strains in waterbirds across time, upgrade the information of the last 10 years, and remarks on the importance of continuous surveillance.

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Analysis and prediction of vegetation in Antarctica using earth observations

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Abstract

Recent earth observations showed an increase in vegetation at Antarctica during the last few years. Antarctica is the world's southernmost continent and posses a unique weather and climate due to its geographic location and supports unique organisms and ecosystems. For that reason, it's critical to anticipate changes in environmental factors to prevent ecosystem losses.

This project explored the feasibility of using NASA Earth observations (EOs) instruments to better understand the relation between Sea Surface Temperature, Chlorophyll, Carbon dioxide (CO_2) and Normalized Difference Vegetation Index (NDVI), to establish historical data, analyze correlation between variables and to create an easy to apply mathematical model to predict behavior of the factors during the following next 10 years. The study period selected was from January 2003 until December 2024, due to launching dates of the selected satellites used, which were NASA's Terra, Aqua and Suomi NPP satellites.

The results of this feasibility study indicate the promise of incorporating remote sensing observations into predictions of surface and maritime vegetation. Also, using EOs can fill gaps in ground sensor data. The relationship may be strengthened if parsed by meteorology and other factors influencing the spatial distribution of the gases.

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Fossil leaves and wood remains from Potter Peninsula, King George Island (25 de Mayo Island), Antarctica

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Abstract

This study presents the description and taxonomic identification of fossil leaf impressions and wood remains collected from Potter Peninsula on King George Island (25 de Mayo Island), located in the South Shetland Islands, Antarctica. The assemblage reveals a diverse fossil flora, mainly dominated by angiosperms, which account for approximately 78% of the specimens. Ferns represent 15% of the flora, while conifers are the least abundant group, comprising 7%. Despite the low number of conifer specimens, the assemblage includes at least three morphologically distinct taxa: *Brachyphyllum*, *Cupressaceae* aff. *Papuacedrus*, and *Araucaria* sp. Remarkably, one of these conifer specimens preserves reproductive structures, providing valuable insight into the biology and diversity of Antarctic gymnosperms. Some of the fossil wood fragments also exhibit features consistent with coniferous affinities. In contrast, all fern fronds appear morphologically uniform and are likely attributable to a single taxon. The angiosperm leaves display a broad range of sizes, from microphyll to mesophyll, and have been classified into at least eight morphotypes. Among these, three have been assigned taxonomically: one at the species level (*Nothofagus subferruginea*), one at the genus level (*Sterculia* sp., Malvaceae), and one at the family level (Myrtaceae). These new findings contribute to the understanding of Antarctic terrestrial ecosystems during the time of deposition, highlighting a well-established angiosperm-dominated flora coexisting with ferns and conifers.

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Spatio-temporal variability of echinoderm assemblages in soft-bottom habitats of Mackellar Inlet (Antarctica): A decade of monitoring (2010-2024)

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Abstract

Echinoderms are key ecosystem engineers in Antarctic seafloor environments, where they modulate benthic community structure through bioturbation, predation, and nutrient recycling (Saucède et al., 2014). Despite their ecological importance, spatio-temporal patterns of their assemblages in localized areas like Mackellar Inlet (South Shetland Islands) remain poorly understood, particularly in the context of accelerated environmental changes (Griffiths et al., 2021). This knowledge gap is critical as coastal regions like King George Island experience thermal and glaciological fluctuations that may impact biodiversity (Deregibus et al., 2023).

We analyzed 53 samples collected at 8 stations during 10 Peruvian Antarctic expeditions (ANTAR XIX-XXX, 2010-2024). Identified echinoderms belonged to 4 classes: Ophiuroidea (39.6%, 21 samples), Holothuroidea (28.3%, 15), Echinoidea (18.9%, 10), and Asteroidea (13.2%, 7). The dominance of ophiuroids suggests their adaptation to soft sediments, while the lower representation of asteroids may reflect their association with hard substrates (Piepenburg et al., 2001). This study reveals marked heterogeneity in Mackellar Inlet's echinoderm assemblage, with ophiuroids as the dominant group. These results underscore the need to integrate environmental variables (e.g., sediment composition, temperature) in future analyses to understand temporal variability. The data provide a baseline for monitoring changes in response to global warming and anthropogenic activities in the region.

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Effect of Extreme Environment and Isolation on Subjective Time Estimation in Antarctica During Summer: A Cross-Sectional Investigation

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Abstract

Antarctica provides an excellent opportunity to study the effect of the environment on human behaviour. However, little research has been done to understand the impact of extreme environmental and living conditions on time estimation in Antarctica. Accurate time estimation is a prerequisite for optimal performance. Antarctica's environment, such as extreme weather, confinement, isolation, absence of movement, and twenty-four hours of light, affects human behaviour. It also affects time estimation. Several environmental and social factors influence interval timing. The present study aimed to investigate the effect of extreme environment and isolation on time estimation in Antarctica. The data was collected from three different locations, namely: members of an expedition on a ship from Cape Town, South Africa (N=19) to Antarctica, Maitri station (N=20), and Bharati station (N=19) at Antarctica. A total of fifty-seven expeditions participated in the study. Analyses of variance were employed to analyze the data. Results revealed that there was an overestimation of time at Bharati station as compared to the expeditioners' performance at Maitri station and on the Voyage. The results could be interpreted in light of the fact that expeditions at Bharati station kept themselves. Interactions among them were quite less as compared to expeditions at Maitri and Voyage. The short interval was overestimated, and the long duration was underestimated.

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Extreme cold to frozen temperatures during the Early Cretaceous, evidenced by the discovery of glendonite in the Zapata Formation, southernmost Chile.

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Abstract

Glendonite is a pseudomorph of calcite that forms through the replacement of ikaite ($CaCO_3 \cdot 6H_2O$), a metastable, hydrous calcium carbonate mineral that precipitates in cold, near-freezing marine environments. Glendonites have been documented in high-latitude regions of the Northern Hemisphere during the Early Cretaceous, including Siberia and the Canadian Arctic, where their presence is associated with brief but significant drops in seawater temperature during the Valanginian to Hauterivian stages. In Chile, unpublished reports suggest the presence of micro-glendonites in central Chile, Tierra del Fuego, and Antarctic regions, dating back to the Jurassic–Cretaceous transition. Here, we present new evidence of massive glendonite crystals preserved in Hauterivian-age sedimentary rocks at the edge of the Tyndall Glacier, within Torres del Paine National Park. Macroscopically, they exhibit radial aggregates of grey acicular crystals. Petrographic analysis reveals glendonite (96%) with irregular acicular habit and high birefringence, accompanied by polycrystalline quartz showing evidence of grain boundary migration. The irregular morphologies, subdued interference colors, and pronounced fracturing suggest unstable crystallization conditions, possibly influenced by the presence of organic matter. The timing of this occurrence correlates with the Arctic glendonite records, indicating a global cold pulse during the Valanginian, followed by gradual warming toward the end of the Hauterivian. The presence of glendonite through geological time has provided crucial insights into short-term climatic perturbations during the Mesozoic. This study contributes to a better understanding of Early Cretaceous paleoclimate in southern South America and explores the palaeoecological implications of marine temperature shifts on local vertebrate and invertebrate assemblages.

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Exploring the antimicrobial potential of biologically synthetized silver, copper and zinc nanoparticles by the thermophilic Antarctic bacterium Geobacillus sp. ID17

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Abstract

Nanoparticles (NPs) have attracted significant interest in biotechnology due to their unique physicochemical properties, such as a high surface area-to-volume ratio, which enable diverse biomedical applications including drug delivery, diagnostics, and antimicrobial treatments (antibacterial, antifungal, antiviral). Traditionally, NPs are synthesized through chemical and physical methods that utilize toxic solvents and generate hazardous by-products. However, there is a pressure to develop clean, nontoxic and environmentally-friendly synthesis of metallic NPs.

Microorganisms play a crucial role in the adsorption and accumulation of metals from their environment. Their extensive metabolic capabilities allow them to survive in high metal concentrations, reducing their toxicity through altering the redox states of surrounding metal ions. This adaptive mechanism facilitates the formation of well-defined bioNPs via intracellular or extracellular pathways.

Biological synthesis of NPs differs from chemical methods and require optimization by using bacteria and their biomolecules (proteins and enzymes) to reduce metal ions. This approach aligns with green chemistry, promoting sustainability and reducing environmental impact by utilizing renewable resources and operating under mild conditions.

In this study, three types of bioNPs were synthesized using the thermophilic bacterium *Geobacillus* sp. ID17, isolated from Deception Island, Antarctica. Bacterial cells were incubated with $AgNO_3$, $CuSO_4$ and $ZnCl_2$ at 65°C for 19 h, and intracellular reduction was evidenced by change in the culture appearance. BioNPs were obtained after cell disruption, centrifugation and biphasic separation. Electron microscopy and energy-dispersive X-ray were used for metallic properties analysis. Plate assays confirmed antimicrobial properties of silver and zinc bioNPs against *Escherichia coli* and *Bacillus subtilis.*

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Monitoring Antarctic near-shore and terrestrial areas with ANTOS

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Abstract

The SCAR Expert Group 'Antarctic Near-shore and Terrestrial Observing System' (ANTOS) aims to develop a trans-continental, biologically focused and coordinated Antarctic-wide observation system to identify and track environmental variability and change. Essential to assessing and interpreting biological change in the Antarctic (and elsewhere) are observations of biologically relevant environmental parameters. The goal is to use these data to understand the drivers of variability and change, across different spatial and temporal scales. The ANTOS members have designed long term observation systems for use in the terrestrial and nearshore marine regions around Antarctica and the Subantarctic. These include instrumentation arrays for *in situ* monitoring of environmental variables, as well as a central web database for real-time data and protocols for baseline biodiversity assessments.

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Isolation, Identification and Functional Screening of Microorganisms from Subglacial Sediments of King George Island, Antarctica

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Abstract

The King George Island, the largest of the South Shetland Islands adjacent to the Antarctic Peninsula, is home to glaciers that have increased melting due to climate change. Soil microorganisms represent the greatest reservoir of biological diversity on Earth and play essential roles in regulating organic matter decomposition and sustaining nutrient cycling within ecosystems. Enzymes derived from psychrophiles, have demonstrated properties of great interest for industrial applications. These enzymes are crucial for the adaptation and survival of psychrophiles under extreme conditions and are highly relevant for biotechnological and commercial uses. As such, cold environments are considered valuable natural laboratories that require detailed study and characterization.

In this study, microorganisms were isolated from water and sediment samples collected from thawing zones of four glaciers: Dobrowolski, Sphinx, Wanda, and Collins. Three culture media (R2A, TSA, and MAG) were used, with pH levels ranging from 6 to 8, adjusted according to environmental conditions. Incubation was carried out at 4–7 °C. After obtaining axenic cultures, isolates were characterized by Gram staining, 16S rRNA gene amplification, and phylogenetic identification. Additionally, enzymatic screening was performed to detect eight enzymatic activities: esterase, cellulase, catalase, gelatinase, caseinase, amylase, pectinase, and β-galactosidase. In preliminary results *Pseudomonas fildesensis* was isolated and identified across all four sampled glaciers.

This work highlights the importance of conserving microbial biodiversity in cold and subglacial ecosystems and exploring their biotechnological potential. Antarctica represents a natural laboratory under threat from climate change, emphasizing the urgent need to study and protect these environments.

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Lost before found? Accelerating drug discovery from Antarctica's climate endangered flora by applying effect-directed analysis coupled to planar chromatography and mass spectrometry

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Abstract

Deschampsia antarctica and *Colobanthus quitensis*, the only vascular plants native to Antarctica, represent an extraordinary case of biodiversity resilience in one of Earth's most hostile environments. These species have evolved near the physiological tolerance limits of most organisms, developing unique bioactive compounds as adaptations to extreme abiotic stress. However, even small temperature increases can irreversibly disrupt these adaptations. For instance, temperatures above 20 °C induce metabolic failure and lead to these plants' death. These thresholds are increasingly relevant as the Antarctic Peninsula warms, threatening both the species' survival and their capacity to synthesize molecules with notable bioactivities and potential pharmacological value. *D. antarctica*, for example, produces orientin and luteolin, both potent antioxidants, as well as tricin derivatives with anticancer activity. *C. quitensis* synthesizes flavonoids that protect against UV-induced DNA damage. In addition, both plants host endophytic fungi that contribute further stress-adapted metabolites. Despite these findings, their medicinal potential remains largely unexplored, highlighting the urgency of studying and protecting these organisms. To accelerate research into these vulnerable bioactivities, we employ effect-directed analysis and mass spectrometry to characterize bioactive compounds in freeze-dried root and stem extracts. Preliminary bioassays reveal antioxidant, acetylcholinesterase, α-glucosidase, and COX-2 inhibitory activities, properties relevant to chronic non-communicable diseases, which account for 70% of deaths worldwide and 85% in Chile. This work addresses two pressing global challenges: the loss of Antarctic biodiversity and the need for novel treatments for unmet medical needs. These species present a rare opportunity to preserve Antarctic biodiversity while discovering novel medicinal resources.

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Metabolitos bioactivos de líquenes antárticos marítimos: una ventana a la adaptación química a entornos extremos

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Abstract

Antarctic lichens such as Usnea antarctica, Usnea aurantiaco-atra, Ramalina terebrata, and Sphaerophorus globosus are key components of the maritime Antarctic flora and represent a valuable reservoir of chemically diverse bioactive metabolites. Their adaptation to polyextreme conditions suggests a unique secondary metabolism, offering promising prospects for the discovery of novel compounds with biomedical relevance. In this study, an effect-directed analysis (EDA) combined with high-performance thin-layer chromatography (HPTLC), liquid chromatography-mass spectrometry (LC-MS), and molecular docking was used to identify and characterize antioxidant and enzymatic inhibitory activities in lichen extracts.

In Sphaerophorus globosus, two bioactive molecules were identified: Sphaerophorin showed significant AChE inhibitory activity, confirming its neuroprotective potential. Imbricaric acid, reported here for the first time in S. globosus, exhibited inhibition of both AChE and COX-2 enzymes, suggesting anti-inflammatory and neuroprotective effects. Molecular docking confirmed strong interactions between these compounds and the active sites of the target enzymes.

These findings contribute to the expanding knowledge of Antarctic biodiversity and its chemical richness, emphasizing the potential of lichen-derived molecules to modulate biological pathways related to oxidative stress, inflammation, and metabolic dysfunction. Our results highlight the importance of continued exploration of Antarctic lichens not only as key elements of polar ecosystems but also as promising sources of molecules with potential biomedical applications.

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Vegetation effects on soil thermal regime in Cryosols from Elephant Island, Maritime Antarctica

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Abstract

Soil temperature and moisture in the active layer are key indicators of climate change in permafrost regions, and their relationship with vegetation is crucial for understanding future scenarios. This study aimed to analyze the fine-scale thermal regime of the active layer in three cryosols under contrasting vegetation at Stinker Point, Elephant Island, Maritime Antarctica. Three sampling sites with distinct vegetation cover were selected: Carpet Moss Community (MCC), Fruticose Lichen Community (FLC), and Turf Moss Community (MTC). At each site, a soil profile was opened to collect samples and install sensors at 10, 20, and 30 cm depths, while an air temperature sensor was placed 1 m above ground at a central location. Hourly data were recorded over a one-year period in 2017, and daily thermal indices were calculated for all 365 days. Our results showed significant differences between air and soil temperatures. Thawing days at 10 cm depth exceeded 94 in all soils, reaching 110 in MCC, compared to 88 in the air. Freezing days were more frequent in vegetated soils (>191 days) than in the air (133 days). Isothermal days were markedly more frequent in the soils (>31 days), while none were recorded in the air. Freeze-thaw cycles were more common in the atmosphere (144 days) but were strongly buffered by vegetation in the soil (<77 days), especially in MCC (2 days). We conclude that vegetation and moisture conditions play a key role in regulating the soil thermal regime in Antarctic permafrost environments.

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Microbial adaptations to subantarctic conditions in modern microbialites from Tierra del Fuego, Chile

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Abstract

Microbialites are sedimentary structures formed by microbial communities that induce the precipitation of minerals, primarily carbonates. They serve as modern analogues for studying life under extreme conditions and have been reported in both warm environments and polar regions, including Antarctica, where they develop in cold, saline, and nutrient-poor lakes.

In this study, a functional and taxonomic analysis was conducted on modern microbialites from Laguna de los Cisnes, located in Tierra del Fuego, Chile a subantarctic environment characterized by low temperatures, high salinity, and areas with limited dissolved oxygen. For this purpose, 16S rRNA gene sequencing was applied, allowing the identification of dominant bacterial phyla and their potential ecological roles.

Among the most prevalent metabolic pathways were the degradation of organic matter as an energy source and the utilization of sulfur compounds for energy production under anoxic and aphotic conditions key functions for sustaining microbial activity in low energy environments.

In addition, a high abundance of silica was detected, an unusual feature not widely documented in this type of ecosystem, which may represent a distinctive geochemical signal of the subantarctic environment in response to its specific conditions.

According to our findings, these microbial communities exhibit versatile metabolic strategies that enable them to grow and form mineralized structures in extreme environments. This subantarctic system provides new evidence of microbial adaptation to cold conditions and may serve as a valuable model for studying the resilience of life in marginal ecosystems of the Southern Hemisphere.

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Cretaceous Climate Shifts, Angiosperm Dominance, and the Fate of Southern Biotas

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Abstract

Significant changes in terrestrial ecosystems began during the Cretaceous, coinciding with the appearance and diversification of angiosperms. This interval was initially termed the Cretaceous Terrestrial Revolution (KTR), marking the origin of many modern plant and animal clades. More recent studies, however, propose a broader framework known as the Angiosperm Terrestrial Revolution (ATR), extending from the Late Cretaceous into the Early Palaeogene (~100–50 Ma), emphasizing the long-term ecological impact of angiosperms. Both concepts are largely based on fossil records from mid- and low-latitude regions, while high southern latitudes remain poorly represented.

The mass extinction at the Cretaceous–Paleogene (K/Pg) boundary also played a major role, with floral extinction rates estimated between 75% and 90%. Yet, the evolutionary and ecological responses of the Weddellian biota—those of the southern high latitudes—remain insufficiently understood. These regions, including Patagonia and the Antarctic Peninsula, experienced dynamic climate shifts: a sustained greenhouse world punctuated by sea-level fluctuations and abrupt cooling events. These environmental changes triggered large-scale reorganizations of terrestrial and marine ecosystems.

In southern South America and Antarctica, stratigraphic and paleontological evidence reveals transient land bridges, floristic turnovers, and episodes of faunal dispersal linked to climatic instability. Nonetheless, the lack of continuous, high-resolution stratigraphic records has hindered precise interpretations of the timing and drivers of these changes.

This study reviews new data from Chilean Patagonia and the northern Antarctic Peninsula, incorporating emerging hypotheses on the origin and diversification of southern biotas, and highlighting the need for further research in these high-latitude ecosystems.

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Microbial adaptations to subantarctic conditions in modern microbialites from Tierra del Fuego, Chile

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Abstract

Microbialites are sedimentary structures formed by microbial communities that induce the precipitation of minerals, primarily carbonates. They serve as modern analogues for studying life under extreme conditions and have been reported in both warm environments and polar regions, including Antarctica, where they develop in cold, saline, and nutrient-poor lakes.

In this study, a functional and taxonomic analysis was conducted on modern microbialites from Laguna de los Cisnes, located in Tierra del Fuego, Chile—a subantarctic environment characterized by low temperatures, high salinity, and areas with limited dissolved oxygen. For this purpose, 16S rRNA gene sequencing was applied, allowing the identification of dominant bacterial phyla and their potential ecological roles.

Among the most prevalent metabolic pathways were the degradation of organic matter as an energy source and the utilization of sulfur compounds for energy production under anoxic and aphotic conditions—key functions for sustaining microbial activity in low-energy environments.

In addition, a high abundance of silica was detected, an unusual feature not widely documented in this type of ecosystem, which may represent a distinctive geochemical signal of the subantarctic environment in response to its specific conditions.

According to our findings, these microbial communities exhibit versatile metabolic strategies that enable them to grow and form mineralized structures in extreme environments. This subantarctic system provides new evidence of microbial adaptation to cold conditions and may serve as a valuable model for studying the resilience of life in marginal ecosystems of the Southern Hemisphere.

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Do Two Species of the Dicranaceae Family Relate to Recently Deglaciated Areas in Fildes Peninsula, Maritime Antarctica?

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Abstract

Evidence indicates that the maximum extent of the Antarctic Peninsula ice sheet reached the continental shelf 20 ka ago (Huybrechts, 1993). Since then, the ice sheet began its retreat to its current position (Ingólfsson et al. 1998; Ó Cofaigh et al. 2014). This continuous retreat, marked by evidence of climatic oscillations during the middle Holocene and the neoglacial period, drove eustatic and isostatic processes that allowed the emergence of ice-free areas (López-Martínez & Serrano, 2004; Ingólfsson, 2004; Hall, 2009; Watcham et al., 2011; Simms et al., 2012). On the Fildes Peninsula, two key moments have been identified, at 11 ka and 6 ka, during which surface availability enabled the colonization of species such as Sanionia uncinata (Gonzalez et al., 2019). Today, these areas host a significant portion of the continent's plant biodiversity. There is considerable concern among researchers due to the damage that climate change and anthropogenic activities can cause, as well as the colonization of newly ice-free areas by non-native and invasive species, which influences genetic pollution and introgression following hybridization (Ellstrand & Schierenbeck 2000; Soltis 2013). Therefore, this work aims to establish the genetic origin of colonization in ice-free areas on the Fildes Peninsula in Maritime Antarctica, specifically within the Dicranaceae family (Chorisodontium aciphyllum and Campylopus sp.), which represents a challenge and a duty for conservation efforts. We support the presence of a haplotype living in the southern part of Tierra del Fuego because of the particular abiotic conditions that facilitated the settlement of these species in the ice-free areas.

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Review of microbial control in lakes of southernmost Chile in the Magallanes and Chilean Antarctic Region: Functional adaptations and paleoenvironmental records

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Abstract

Microbialites are organosedimentary structures formed by microbial communities that induce the precipitation of minerals, primarily carbonates. They represent some of the oldest ecosystems on Earth and serve as a key record for understanding the early evolution of life. Their study enables the analysis of biogeochemical processes under extreme conditions, with relevant applications in paleoecology, geobiology, and astrobiology.

This work presents a review of modern microbialites reported in lacustrine systems of the Magallanes and Chilean Antarctic Region, including sites such as Laguna de los Cisnes, Laguna Larga, Lake Sarmiento, and Laguna Amarga. These subantarctic environments are characterized by low temperatures, high salinity, alkaline pH, and low dissolved oxygen concentrations—conditions that have favored the development of microbially induced structures with diverse morphological and functional traits.

Among the most relevant findings are microbial communities dominated by cyanobacteria such as Nostoc, known for their ability to fix nitrogen and form mucilaginous colonies. The unusual presence of precipitated silica associated with these structures has also been documented, suggesting alternative biomineralization pathways. These communities exhibit metabolic strategies based on oxygenic photosynthesis, nitrogen and sulfur cycling, and organic matter degradation in cold, alkaline conditions. Furthermore, isotopic signatures preserved in these deposits allow for the reconstruction of past environmental conditions, including events such as the Little Ice Age. Altogether, these microbialites represent valuable models for understanding the resilience of life in marginal ecosystems of the Southern Hemisphere and their functional connections to lacustrine environments in Antarctica.

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Glacial Chronology and Provenance Analysis of *Deschampsia antarctica* in Moraines of the Bellingshausen Glacier Dome, King George Island, Antarctica, and Its Potential Distribution.

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Abstract

During the late Pleistocene, approximately 14,000 years before present (BP), the deglaciation of the Bransfield Strait began, with significant temporal oscillations that allowed the development of lichens and mosses (Barrientos et al., 1998). Since 5,700 years BP, the climate has contributed to the reduction of ice in peninsular areas (Arche, 1996; Serrano & López, 1997). Between 2,800 and 2,500 years BP, the Little Climatic Optimum occurred, during which areas that are currently ice-free remained glacier-free (Baroni & Orombelli, 1994). In the last 20 years, ice loss rates have been even faster than in the previous century.

Due to this, the ice-free areas of King George Island, in the South Shetland Islands, Antarctica, are characterized by relatively favorable conditions for vegetation development, primarily composed of cryptogamic vegetation. *Deschampsia antarctica*, one of the two native vascular plants of Antarctica, has established and developed in areas recently freed from ice due to glacier retreat, particularly on moraines of the Bellingshausen Glacier Dome.

The objective of this study is to determine the origin of new settlers through molecular analysis and infer gene flow events between Antarctica and South America, as well as within Antarctica itself. Additionally, isotope dating techniques will be used to establish the chronology of the glacial process and the colonization of species. Finally, ecological niche modeling will be conducted using the MaxEnt software to predict the potential distribution of D. antarctica in the periglacial zone in the future.

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Sentinel-1A and SBAS-InSAR Reveal Accelerating Permafrost Degradation in Rock Glaciers

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Abstract

This study utilizes Small Baseline Subset Interferometric Synthetic Aperture Radar (SBAS-InSAR) to analyze ground displacement trends in permafrost-affected regions. Sentinel-1A SAR data from January 2022 to December 2024 was processed to detect subsidence and lateral movement in active rock glaciers and permafrost zones**.** The study incorporates baseline correction, phase unwrapping, coherence filtering, and time-series displacement analysis to extract deformation patterns. Validation was performed using optical imagery, rock glacier inventory data, and NASA's ITS_LIVE velocity dataset, ensuring the reliability of InSAR-derived results. Time-series displacement analysis across four distinct zones highlights varying permafrost dynamics. Zones 1, 2, and 4 exhibit continuous, long-term subsidence trends, with cumulative displacements exceeding -300 mm, suggesting active permafrost degradation. Conversely, Zone 3 displays short-term fluctuations with a lower cumulative displacement (~-60 mm), indicating localized ground movement and seasonal freeze-thaw influences. The integration of LOS displacement, horizontal, and vertical deformation components provides a comprehensive understanding of permafrost-induced terrain instability. The comparison with rock glacier inventory data confirms that the spatial distribution of detected displacement aligns well with mapped periglacial landforms, reinforcing the accuracy of SBAS-InSAR for permafrost monitoring. The study underscores the effectiveness of multi-source validation**,** demonstrating that optical and radar-based methods complement each other in periglacial studies. The results suggest progressive permafrost degradation in certain zones, which could have implications for slope stability, hydrology, and climate-driven landform evolution.

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GRIT Deployments and Collaboration: Understanding East Antarctica's Tectonic Structure and Outlet Glaciers

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Abstract

This contribution provides an update on Australian field-based progress in understanding East Antarctica's tectonic structure, and outlet glacier systems, through field deployments enabled by the GRIT Facility (Geophysical Research Infrastructure for AnTarctica). GRIT has developed seismic, magnetotelluric and GNSS instrument sets tailored to rapid deployment, and also allowing for selected deployments by skilled personnel who may not be geophysics specialists. Further, GRIT is enabling students and early career researchers to gain experience in working with Antarctic field instruments and carrying out deployments, while building project leadership skills in parallel. GRIT has more recently been joined by GLACI (GLAcier Collaborative Infrastructure) as a partner facility, the latter providing glacier geophysics equipment.

GRIT received funding to support a major expansion through 2024, and the 24/25 field season was witness to multiple field deployments across East Antarctica supported by both the National Antarctic Program of Australia, and also deployments supported by private logistics providers. The campaigns aim to record data to better understand the tectonic structure of East Antarctica, and to probe the nature of the ice-bedrock interface zone. They also aim to determine active glacier processes across major glacier systems and establish a national capability for glacier monitoring. All instrument deployments are designed in tandem with advanced data analysis pipelines, and carried out with a view to archiving data/metadata in open repositories. Into the future, we hope to partner with other logistics providers to access under-sampled locations in East Antarctica and welcome any discussions towards that shared aspiration.

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Updates of the International Bathymetric Chart of the Southern Ocean (IBCSO)

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Abstract

IBCSO v2 is the most comprehensive bathymetric chart, covering the area of the Southern Ocean, the South Atlantic, South Pacific and South Indian Ocean south of 50°S.

IBCSO v2 was published in June 2022 containing 25 billion data points from 1500 datasets from more than 88 institutions and institutes from 22 countries. The resolution is 500 m × 500 m in IBCSO Polar Stereographic projection (EPSG: 9354). In IBCSO v2 approximately 25% of the seabed are constrained by soundings. This means that less than a quarter of seabed south of 50°S is actually mapped, while more than three quarters of the seabed are constrained by satellite derived predicted bathymetry. Furthermore, IBCSO has successfully provided its first annual release – IBCSO 2024 – in October 2024. In time for the Antarctic field season, the IBCSO annual releases provide the most up-to-date IBCSO map for subsequent expedition planning and the deployment of equipment. Whenever possible, it contains the latest data from the previous Antarctic field season thus increasing efficiency by minimising duplication in mapping. We anticipate that especially the science community benefits greatly from these annually update maps and datasets. Here, we would like to give an update on the latest data input and technical enhancements since the release of IBCSO v2 and encourage everybody to engage with the IBSCO Project to help make the invisible seabed visible.

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Distinct ionospheric long-term trends in Antarctica due to the Weddell Sea Anomaly

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Abstract

The ionosphere is a region of the Earth's atmosphere where gases are ionized by solar radiation, forming a layer of charged particles. It bridges the lower atmosphere and space, playing a crucial role in radio wave and satellite signal propagation. Its dynamic behavior, influenced by solar and terrestrial conditions, can disrupt communications and navigation. A particular ionospheric phenomenon that occurs in the Antarctic Peninsula is the Weddell Sea Anomaly (WSA). WSA is a summer ionospheric anomaly characterized by an unusual nighttime peak in the electron density. This study analyzes the seasonal and diurnal variation in long-term trends in the critical frequency of the F2 layer (foF2) at the Vernadsky (65.2°S, 64.3°W) station during the period 1960–2023 and Port Stanley (51.7°S, 57.3°W) station during the period 1960–2019, both located within the region influenced by the WSA. They are also compared with stations Syowa (69.0°S, 39.6°E) and Mawson (67.6°S, 62.9°E), located outside its range. Both solar and geomagnetic influence are extracted from the time series to calculate trends. The results show that Vernadsky exhibits a significant negative trend in foF2 during summer nights, coinciding with the WSA periods, and Port Stanley reveals a weaker evening anomaly also with negative trends in the same periods. Meanwhile, Syowa and Mawson did not show any behavior affected by the WSA. These results highlight the regional impact of the WSA and the need to consider local phenomena when studying global ionospheric trends.

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Permafrost dynamics in Schirmacher Oasis, cDML, Eastern Antarctica – Inferences from inhouse developed low cost Thermoprobe based monitoring system

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Abstract

Permafrost is an intrinsic component of cryospheric terrestrial system constituting proglacial and periglacial environment. The study of the same is immensely important concerning the scientific exploration and infrastructure development in the polar regions. The ANTPAS, a SCAR project, is a co-ordinated effort carried out to develop a borehole network and establish monitoring system of permafrost across the Antarctica. These studies are underway across ice-free regions of the Antarctica, but has been limited in the Schirmacher Oasis, cDML, Eastern Antarctica. Considering the highly dynamic nature of Permafrost, affected by slightest of local and global climatic shifts, and the role of increased anthropogenic influences, the permafrost studies in Schirmacher Oasis, has become very important. The location of Schirmacher Oasis in the margins of continent and iceshelf and its ice-free nature make it a favourable place for the permafrost studies. The same is also crucial for sustainable infrastructural development in order to facilitate other scientific ventures.

A novel study in this regard, was initiated in the oasis to understand the permafrost with in-house developed low-cost Thermoprobe sensor-based monitoring instrument. The microcontroller based Thermoprobe chain with weather-sealed logger were installed at two sites in a first phase near Maitri Research Station. The active layer depth during Austral summer of 2025 varied between 75cm to 100 cm at these two sites. The crucial role of highly undulatory metamorphic terrain along with varying periglacial geomorphological & hydrological dynamics was found to control the permafrost dynamics at Schirmacher Oasis.

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A Time-Variable Spectral Index for Penguin Guano Detection: Toward Satellite-Based Monitoring of Antarctic Colonies

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Abstract

Penguin colonies across the Antarctic Peninsula are dynamic ecological indicators, with guano-covered areas evolving markedly throughout the austral summer breeding season. This study presents a novel, time-variable spectral index - the Antarctic Guano Cover Index (AIGC) - developed to detect and monitor penguin colonies using satellite imagery. We analyzed sun elevation–corrected Sentinel-2 surface reflectance data from 2017 to 2025, covering eight known breeding sites: Petermann Island, Cuverville Island, Paulet Island, Yalour Islands, Neko Harbour, Damoy Point, Yankee Harbour, and Half Moon Island. These sites range from 0.5 to 2.5 km² and host Gentoo (*Pygoscelis papua*), Chinstrap (*Pygoscelis antarctica*), and Adélie (*Pygoscelis adeliae*) penguins, in both mono- and mixed-species colonies. Spectral data were extracted from guano-rich areas, snow, lakes, slopes, and control zones. Ground-truthing was supported by observations collected during all seasons through Citizen & Science programs aboard tourist vessels. Principal Component Analysis (PCA) and K-means clustering confirmed clear spectral separability among surface types. The AIGC was formulated by integrating Sentinel-2 bands with established normalized indices. The index proved highly sensitive to intra-seasonal changes in guano coverage, effectively capturing the spatial and temporal dynamics of penguin colonies throughout the summer. This approach provides a scalable, reproducible, and non-invasive tool for long-term ecological monitoring using freely available satellite data via Google Earth Engine. By accounting for temporal and spectral variability across multiple habitats and species, the AIGC advances Antarctic remote sensing applications and offers new insights into species-specific responses to climate-driven environmental change.

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Tracking Greening Trends in the Antarctic Peninsula Using Sentinel-2 Time Series and Spectral Indices

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Abstract

The Antarctic Peninsula has experienced some of the fastest warming on the planet, prompting ecological responses such as the expansion of cryptogamic vegetation - mosses, lichens, and algae. This study investigates the spatiotemporal dynamics of greening in ice-free zones across the South Shetland Islands and northern Antarctic Peninsula using Sentinel-2 surface reflectance imagery (2017-2025) processed via Google Earth Engine. Study sites include Barrientos Island, Half Moon Island, Yankee Harbour, Hannah Point, Hurd Peninsula, and Cierva Cove - locations frequently visited by tourism-based field programs, which we leveraged for ground-truth observations and photo-verification during the austral summer. To capture subtle vegetation changes, we applied established vegetation indices and tested a modified Antarctic Vegetation Index incorporating red-edge and blue bands to minimize snow and shadow interference. Time series analysis was conducted over selected Areas of Interest (AOIs), enabling inter-annual comparisons of vegetation development from October to March. Atmospheric correction, solar angle normalization, and cloud masking were applied to ensure spectral consistency. Preliminary results indicate a positive trend in vegetated surface expansion, especially on north-facing slopes and low-elevation zones, with notable increases in index values after 2019. Cierva Cove, located farther south, exhibited lower amplitude but similar seasonal behavior. These findings highlight the value of polar vegetation as a sensitive climate indicator and confirm the utility of freely available satellite data for long-term ecological monitoring in Antarctic terrestrial ecosystems.

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Atmospheric Concentrations of CO_2 and CH_4 in the Antarctic: A Case Study in Admiralty Bay

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Abstract

Carbon dioxide (CO_2) and methane (CH_4) are essential in modulating the greenhouse effect and climate feedback in polar regions. In Antarctica, the ocean can simultaneously act as either a sink or a source of CO_2, depending on seasonal factors such as primary productivity, sea ice formation, and gas exchange at the air-sea interface. Based on this premise, the present study aimed to monitor greenhouse gas concentrations at Admiralty Bay region during the austral summer. For this purpose, a portable greenhouse gas analyzer based on absorption spectroscopy was used to quantify atmospheric concentrations of CO_2 and CH_4. The data presented here in include measurements taken during the transit between the ports of Rio de Janeiro and Punta Arenas, as well as at a fixed station at the Comandante Ferraz Antarctic Station, located in Admiralty Bay. During the traject, CH_4 concentrations ranged between 1850 ppb and 2100 ppb, while CO_2 concentrations varied from 415 ppm to 600 ppm, with some outliers exceeding 600 ppm. At the fixed station, CO_2 concentrations were observed to range between approximately 410 ppm and 420 ppm, and CH_4 concentrations ranged between 1850 ppb and 1880 ppb.

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Addressing Data Gaps in Antarctic Geomagnetic Monitoring: A Comparative Study of SAMBA and Vernadsky Observatory

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Abstract

The Antarctic Peninsula's unique geomagnetic environment, influenced by the South Atlantic Magnetic Anomaly (SAMA) and the magnetic equator's maximum southward displacement, requires comprehensive monitoring. Continuous geomagnetic data is crucial but limited. This study presents a comparative analysis of data from the South American Meridional B-field Array (SAMBA) magnetometers at O'Higgins, Escudero (Antarctic Peninsula) and Punta Arenas (Southern Cone) stations, benchmarked against the Vernadsky Geomagnetic Observatory (AIA).

We assess data availability, noise levels, and baseline stability since 2004 across these sites. The analysis addresses instrumental gaps, potential offsets, and the increasing influence of SAMA. We employ RBeast and other statistical methods to detect trend changes, aiming to create a quality metric for each station. Long-term trends due to the displacement of the geomagnetic pole and the SAMA are also discussed.

The expected outcome is a robust assessment of geomagnetic data quality and recommendations for expanding magnetic coverage in this critical region. This is essential for regional field modeling, space weather nowcasting, and guiding future polar instrumentation investments.

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Implementation of a Micro-CT Experimental Platform to Advance Fossil Imaging Protocols in the CPAP Collection

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Abstract

High-resolution X-ray computed tomography (HRXCT), or micro-CT (µCT), has emerged as an innovative, non-destructive three-dimensional imaging technique for the internal investigation of paleontological, geological, and biological specimens. In response to the pressing need for advanced analytical capabilities in southern Chile, we have implemented the first micro-CT platform in the region, marking an important milestone for multidisciplinary research. This infrastructure is currently being applied to the Colección Paleontológica Antártica y Patagonia (CPAP), which houses more than 12,000 fossil records from Antarctica and Patagonia, representing a crucial repository for the study of high-latitude paleobiodiversity. We present the ongoing development and standardization of new micro-CT imaging and analysis protocols for fossil specimens. These protocols are designed to optimize scanning parameters based on the composition, size, and density of the fossil matrix, enabling high-resolution visualization of internal microstructures without compromising specimen integrity. Applications include taxonomic descriptions, virtual reconstructions for morphometric analysis, and digital archiving to support open-access science. This platform not only expands the capacity for noninvasive paleontological research in the region but also fosters international collaboration in the context of Antarctic geosciences. As the project progresses, it seeks to position CPAP as a future reference collection for high-resolution fossil imaging in high-latitude environments. Thanks to its unique technical specifications, the platform supports applications in diverse disciplines, including archaeology, biology, geology, and engineering, promoting interdisciplinary research. This initiative highlights the importance of micro-CT as a fundamental analytical tool in the geosciences and its potential to transform fossil analysis, digital conservation, and integrative scientific research.

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Observations of Ionospheric Disturbances over King George Island, Antarctica, and Concepción, Chile: 1986–1991

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Abstract

Between 1986 and 1991, the ionosphere was continuously monitored over King George Island using the only ionospheric station Chile has established in Antarctica. An ionosonde and its antenna system were installed as part of the Thermospheric Irregularities and Radio-wave Absorption (ITARA) project, funded by the Chilean Antarctic Institute (INACH) and University of Concepción. The station was located at the then-called Antarctic Base Tte. Marsh (Base Presidente Eduardo Frei Montalva), on King George Island (62.2°S, 58.9°W), South Shetland. The project was formally introduced at the 1984 meeting of the Upper Atmosphere Physics group of the Scientific Committee on Antarctic Research (SCAR) in San Diego, USA. Operations began on 15 February 1986 at 16:15 LT (60°W), marking a milestone in Chilean polar science and upper atmospheric research. Simultaneous observations made at the ionospheric station deployed since 1958 at Concepción (36.8°S, 73.0°W), Chile, enable comparative studies across a range of 40° of geomagnetic latitude along the same longitude sector. During the observation period, several significant geophysical events were recorded, including a solar eclipse on 26 January 1990, several sudden ionospheric disturbances (SIDs), and some severe geomagnetic storms. The ionogram data reveal diverse ionospheric responses to these space weather events, particularly in the F and E regions. Revisiting and analyzing these historical data not only enhances our understanding of ionospheric variability in the Southern Hemisphere but also underscores the critical need to maintain and expand ionospheric monitoring capabilities in Antarctica to support ongoing and future space weather research.

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The Importance of Long-Term Monitoring in the Subantarctic and Antarctic Zones

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Abstract

Long-term monitoring is essential to understanding changes in oceanographic variables in the context of global climate change.

The research vessel Karpuj, operated by the Chilean Antarctic Institute (INACH), is an oceanographic vessel of 24 meters in length and 6 meters in breadth, equipped with oceanographic instruments: a winch, an A-Frame, an echosounder EK-60, a thermosalinograph SBE-TS-45, and CTD SBE. During the summer austral season, December 30 to March 15, 2025, this vessel sailed from Punta Arenas (53° S) to the Yelcho (64°S) Station. Karpuj, covering more than 4,200 nautical miles, supporting scientific and logistical operations under the National Chilean Antarctic Science Program (PROCIEN), recorded continuous data on sea surface temperature and salinity.

The oceanographic data were processed using SBE Data Processing, and Ocean Data View (ODV). We observed that the northern sector of the South Shetland Islands and the Antarctic Peninsula is influenced by colder, saltier waters from Transitional Weddell Sea waters (TWS). In contrast, the area between Yelcho and Trinity Island (63° S), is affected by fresher and relatively warmer waters from the Transitional Bellingshausen Sea (TBW).

Besides, INACH has also implemented oceanographic deployment of HOBO sensors, jointly with meteorological stations (Network of latitudinal sensors) across the Antarctic Peninsula and Shetland Islands, which contribute to detecting long-term environmental variability. These network, combined with ship-based observations, provides insights into ocean-atmosphere interactions (atmospheric rivers, heat waves) and help us to understand regional responses to climate change in high-latitude environments.

Acknowledgments: Marine Protected Area Program (INACH-2409052)

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Visible Light Communications Facilitating Antarctic Earth Sciences and Ecosystem

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Abstract

Visible light communication (VLC) technology has potentials for optical wireless communications, as well as navigation, positioning, tracking and sensing applications. This paper reports recent advances of light-emitting diode (LED) based VLC technologies and relevant cyber-physical systems-on-chip (CPSoC) for various smart applications, such as smart home, smart community, smart village, smart city, smart healthcare and smart traffics. We propose to develop LED-based VLC technologies and systems to support Antarctic earth sciences and to facilitate a smart Antarctica. The proposed VLC applications include converting LED lighting infrastructure into green high-speed optical wireless and high-precision indoor/outdoor tracking system, outdoor optical sensing network with embedded wireless communications for live earth monitoring, and high-yield LED-VLC indoor farming to support Antarctic ecosystem, etc. It is envisioned that LED VLC technology will contribute to integrating Antarctica into the global internet-of-everything (IoET) environment. Demo videos will be presented.

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FRIDGE: Empowering Polar Research with Dynamic Access to High-Resolution Satellite Imagery and Digital Elevation Models

Cole Kelleher, Rory Johnson, Danny Im, Jesse Bakker, Claire Porter

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Abstract

FRIDGE (Federal Research Imagery and DEM Geospatial Explorer) is an innovative tool developed by the Polar Geospatial Center (PGC) at the University of Minnesota, designed to facilitate efficient access to PGC's extensive catalog of high-resolution satellite imagery and Digital Elevation Models (DEMs). FRIDGE allows researchers to dynamically query PGC's data by various parameters such as geographic location, time, atmospheric conditions, sensors, band combinations, and illumination angles, providing tailored data sets that meet specific research needs. With access to a repository of approximately 8 petabytes (PB) of sub-meter resolution commercial satellite imagery of the polar regions, FRIDGE supports a wide array of scientific investigations, enabling decade-scale studies of surface changes and environmental dynamics. This tool is particularly valuable for NSF Office of Polar Program (OPP) funded researchers, who can order sub-meter resolution imagery with specific processing options for bulk deliveries, while DEMs are freely accessible to all users and the general public. FRIDGE democratizes data access, empowering researchers to conduct high-resolution spatial analyses essential for studies in glaciology, climatology, ecology, geology, and many other scientific disciplines. By offering easy access to high-resolution polar imagery and DEMs, FRIDGE enhances the ability of scientists to monitor and understand changes in the Earth's polar regions, supporting both academic research and operational applications in some of the most challenging environments on the planet. Through FRIDGE, PGC continues to advance geospatial science, fostering collaboration and innovation in understanding Earth's dynamic systems.

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Application of SAR Interferometry with Sentinel-1 for the Temporal Analysis of Glacier Displacements on King George Island, Antarctica (2021–2023).

Natalia Valenzuela-Aedo

Agate Consulting SpA, Puerto Montt, Chile

Abstract

King George Island, part of the South Shetland Islands located north of the Antarctic Peninsula, is recognized as one of the most climate-sensitive polar environments. Over recent decades, significant changes have been documented in the extent and dynamics of its glacier cover. Recent studies, such as Andrade et al. (2025), have reported ice cap retreat in areas like the Fildes Peninsula using TerraSAR-X imagery from 2014 to 2016.

This study proposes the use of Sentinel-1 data (IW mode, SLC) and differential SAR interferometry (DInSAR) techniques to monitor surface glacier displacements during the austral winter months between 2021 and 2023. The processing follows a reproducible methodological workflow using open-source software (SNAP and SNAPHU), including orbit correction, co-registration, interferogram generation, phase filtering, and phase unwrapping. Interferometric pairs were strategically selected to represent observations from June, July, and August.

The high revisit frequency and free availability of Sentinel-1 data enable continuous and cost-effective monitoring, suitable for detecting both seasonal and interannual displacement patterns. Although results are still under development, the study aims to characterize the spatial distribution of glacier movements and their relationship to topographic and climatic factors. This research contributes to the operational monitoring of ice masses in the insular Antarctic and enhances understanding of their response to regional warming.

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Navigating the Commercial Remote Sensing Landscape for Antarctic Science: Opportunities and Challenges

Michael Cloutier[1,2], Cole Kelleher[1]

[1]University of Minnesota, Minneapolis, United States. [2]Polar Geospatial Center, St. Paul, United States

Abstract

Satellite imagery has become a critical and cost-effective resource for advancing scientific research in Antarctica. The rapid expansion of commercial remote sensing platforms—offering high-resolution optical, radar, and thermal imagery—has opened new possibilities for observing and understanding the remote and dynamic Antarctic environment. From tracking glacier flow and ice shelf stability to monitoring coastal change and surface melting, commercial satellite data offer unprecedented detail and temporal coverage across the continent.

However, integrating commercial satellite data into Antarctic research presents notable challenges. These include high data acquisition costs, fragmented discovery and access pathways, licensing and use restrictions, variable technical specifications across providers, and often significant pre-processing requirements. These barriers can limit the effective use of commercial imagery, particularly for researchers with limited resources or technical support.

This presentation will provide an overview of the global commercial remote sensing landscape with a focus on its relevance and application to Antarctic science. We will explore both the potential and the limitations of key commercial platforms and highlight current efforts to lower access barriers. In particular, we will examine the role of the Polar Geospatial Center (PGC) and NASA's Commercial Smallsat Data Acquisition (CSDA) Program in supporting Antarctic researchers. These initiatives facilitate access to commercial imagery through centralized licensing, data delivery systems, and user support services.

Our goal is to inform and empower Antarctic researchers to better leverage commercial satellite data in their work and to encourage broader engagement with these valuable resources within the polar science community.

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From Elevation to Evolution: Enabling 4D Polar Observation with REMA

Cathleen Torres Parisian

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Abstract

What if we could see Antarctica not just in high resolution, but in motion?

The Reference Elevation Model of Antarctica (REMA) is a transformative, open-access dataset that provides high-resolution (2 m), time-stamped digital surface models of the Antarctic continent. Produced by the Polar Geospatial Center (PGC) in collaboration with the U.S. National Geospatial-Intelligence Agency (NGA) and the National Science Foundation (NSF), REMA leverages polar-orbiting commercial satellite imagery, automated stereophotogrammetry, and high-performance computing to deliver a four-dimensional view of the Antarctic surface: x, y, z, and time.

REMA overcomes long-standing limitations in Antarctic elevation data, offering continent-wide coverage at fine spatial and temporal scales without the need for airborne surveys or complex logistics. The dataset supports diverse applications, including surface change detection, image orthorectification, geophysical modeling, field planning, and hazard assessment. Although PGC is a science support organization and not a primary user, community-led research and publications have shown REMA's critical role in helping understand the rapidly changing region.

Despite its value, REMA production has been suspended due to a lack of sustained funding. Continued investment is essential to preserve and enhance this 4D observational capacity, which underpins a wide array of scientific and operational activities across Antarctica.

This poster highlights REMA's products and accessibility, showcases transformative cross-disciplinary applications enabled by REMA, and emphasizes the growing importance of time-resolved elevation data in polar science, while underscoring the urgent need to sustain this foundational resource for the global research community.

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Multiscale Observation Application (In Situ, Drone and Satellite) for the analysis of Antarctic sea ice, during the "International Antarctic Coastal Circumnavigation Expedition ICCE 2024-2025"

Gonzalo Bertolotto

Universidad de Magallanes, Punta Arenas, Chile

Abstract

During the 2024–2025 International Antarctic Coastal Circumnavigation Expedition (ICCE), a multi-scale observational approach was developed to analyze the conditions and variability of Antarctic sea ice along the continent's coastal edge. This expedition, carried out aboard the Russian icebreaker Akademik Tryoshnikov, combined visual data obtained in situ with aerial and satellite technology, generating a comprehensive record of the polar environment.

Throughout the voyage, numerous photographs were captured from inside the vessel and through drone flights over representative sectors of the sea ice, allowing high-resolution observations of morphological details, fracturing, melting processes, and surface variability. In parallel, freely accessible satellite data—including Sentinel-1 and Sentinel-2 products, among others—was collected corresponding to the dates and locations coinciding with the field observations. The combination of observations from the ship, the drone, and satellites allowed for comparisons across different scales and improved interpretation of remote data. This integration made it possible to more precisely identify areas where the sea ice is experiencing significant changes. Images taken from the ship's deck added a valuable visual perspective that complements traditional analyses.

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Gathering stakeholder input to inform science-enabling subsea telecommunications infrastructure

Pamela Fletcher, Kathryn Costa

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Abstract

Stakeholder input can be helpful to foster collaboration to inform the design and development of Scientific Monitoring And Reliable Telecommunications (SMART) subsea cable systems. For over a decade, stakeholder engagement in Southern Ocean science has occurred and included gathering input on science monitoring with sensors (Kennicutt et al. 2015, 2019; IPY). Recently, stakeholder input for a proposed submarine fiber optic cable to McMurdo Station was conducted at the "*Antarctic Subsea Cable Workshop: High-speed Connectivity Needs to Advance US Antarctic Science"* (Neff et al. 2021). The workshop report summarized the collective knowledge of 60 participants capturing key messages including advancements in science and data transmission by orders-of-magnitude with science-enabled subsea telecommunications infrastructure. Stakeholder feedback reflects that both expected bandwidth and the data from the sensors can be integrated into existing observing systems, validate remotely sensed models, and contribute to human-well-being through consistent communications to and from Antarctica. Fostering collaboration among stakeholders can expand opportunities to collectively build knowledge about science-enabled subsea cable capabilities with industry perspectives to advance earth science technologies and research. Gathering additional stakeholder input can help clarify end-user needs and inform subsea sensing strategies for a proposed cable in the Southern Ocean, and globally, from the perspective of technological advancements in SMART sensing. This poster presentation encourages participants to share best practices for requesting information from the SCAR community to foster science-industry collaboration focused on SMART emerging technologies.

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UAV and GPR data integration to measure ice thickness distribution of Znosko glacier (King George Island, Antarctica)

Cinthya Bello

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Abstract

Worldwide, the knowledge of the ice thickness of most glaciers and ice sheets is limited. This parameter is necessary for glaciology to calculate the potential volume of water, model glacial flow, and determine their contribution to the sea level rise. This study presents the ice thickness distribution of the Znosko Glacier (ZG) located in King George Island, from the combination of low-frequency ground penetrating radar (GPR) and unmanned aerial vehicle (UAV) measurements collected during the austral summer of 2019 and 2020. Our results show that the ice thickness distribution on the Znosko Glacier was heterogeneous, estimating a maximum value of 155 m ± 24 m and a total volume of 0.13 km^3 . Finally, an area of the bedrock topography was below the sea level, which may accelerate the glacier retreat due to the calving effect.

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Detection of multi-year ex-fast ice in the Weddell Sea, Antarctica, using ICESat-2 satellite altimeter data

Younghyun Koo[1], Hongjie Xie[2], Walter Meier[1], Stephen Ackley[2], Nathan Kurtz[3]

[1]University of Colorado Boulder, Boulder, United States. [2]University of Texas at San AntonioSan Antonio, San Antonio, United States. [3]Goddard Space Flight Center, Greenbelt, United States

Abstract

Landfast ice, sea ice fastened to coastal land or ice shelves, generally undergoes distinctive thermodynamic growth and less active dynamic deformation due to its prolonged attachment to the land, resulting in a thicker and smoother surface compared to drifting pack ice. In 2019, large landfast ice floes were detached from the Ronne Ice Shelf, and the broken pieces started to drift into the Weddell Sea. This study employs a random forest (RF) machine learning model to detect these ex-fast ice floes using six key variables from the ICESat-2 ATL10 sea ice freeboard product: freeboard, Gaussian width of photon height distribution, standard deviation of freeboard, floe length, modal freeboard, and sea ice concentration. The RF model achieves an overall accuracy of 99 % in detecting ex-fast ice, effectively capturing the drift, freeboard distribution, and size distribution of ex-fast ice floes across the western Weddell Sea in 2019. Among six variables, freeboard, standard deviation of freeboard, and Gaussian width of photon height distribution contribute over 94 % to the model performance. Furthermore, the detection of ex-fast ice improves the quantification of sea ice topographical features derived from ICESat-2, including modal freeboard, ridge fraction, and surface roughness. This study highlights the effectiveness of discriminating heterogeneous ex-fast ice from typical pack ice to enhance sea ice measurements using ICESat-2 satellite altimeter data.

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Glacier and climate real-time monitoring with 3g/4g and satellite devices

Sebastián Marinsek, Arturo Huber

Instituto Antártico Argentino, Buenos Aires, Argentina

Abstract

Glacier monitoring in Antarctic Peninsula is crucial to understanding their dynamics and evolution. Despite annual visits to field work, usually during summer, when data is recovered from automatic weather stations, obtaining data from time in between the visits is quite difficult. We have designed a system considering the rough climate conditions of glaciers regions and the inaccessibility of the area where it will be located to enable real-time visualization of the data collected by sensors through a web-site, including pictures for glacier surface changes analysis. Several measuring devices were installed in Antarctic Peninsula for taking pictures, measuring air temperature and relative humidity, measuring the position using GNSS receivers and sending all data through 3g/4g communication networks where available or via satellite links. Additionally, the equipment requires a very low production cost since it uses commercial components and has a very low power consumption to be operative during the whole year. When maintenance activities take place, whole data collection and replacement of damaged parts can be carried out if required. However, we have systems still running for more than 3 years without any action taken during this period.

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4 Advances in Earth Science Technologies and Remote Sensing

Session: 5

Antarctica and the Global Earth System

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Between Expectation and Reality: On the Limitations of Generalised Leadership Models in ICE Environments

Michael Stieber

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Abstract

Recent findings highlight the need for a critical reassessment of existing assumptions about leadership and social dynamics in Antarctic overwintering contexts. This contribution draws on two complementary studies that form the basis for a conceptual foundational analysis. The first, a theory-based review, examines relevant scientific literature from recent decades concerning the demands placed on station leaders. It reveals, as shown by Stieber (2024), that expectations are often normatively inflated, insufficiently individualised, and largely detached from psychosocial stressors. The second study is based on quantitative data collected from eleven international research stations between 2020 and 2024. This empirical study by Stieber (2025) analyses team size, gender distribution, age structures, role allocation, and cultural backgrounds. The results indicate a high degree of heterogeneity, challenging prevailing notions of homogeneity within so-called ICE (isolated, confined, and extreme) environments.

The findings from both studies suggest that neither the standardised expectations placed upon Antarctic leadership, nor the analogies derived from them for spaceflight missions are universally applicable. Rather, the overwintering context—long considered well understood—proves to be far more complex, dynamic, and resistant to generalisation than previously assumed. This underscores the necessity of approaching leadership in extreme environments in a context-sensitive, experience-based, and flexible manner—relevant not only for future space missions but also for leadership practice in other high-pressure settings.

Stieber, M. “Antarctica and beyond – unconsidered expectations of leaders in small isolated environments” *Acta Astronautica*, Volume 220 (2024) 94-96. https://doi.org/10.1016/j.actaastro.2024.04.008

Stieber, M., “The diversity of overwintering groups in Antarctica and the limitations of psychological studies” *The Polar Journal,* Volume 15, Issue 1 (2025) 172-182. https://doi.org/10.1080/2154896X.2025.2492492

Category

5 Antarctica and the Global Earth System

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Power Imbalances in the Global Earth System and Cultural Hegemony in a Transforming Antarctica

Edythe Weeks

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Abstract

The aim of this paper is to explore how inherent power imbalances within the global Earth system influence our relationship with Antarctica and its crucial role. It examines how these dynamics, operating through discourses and discursive practices, contribute to cultural hegemony in shaping scientific priorities, resource access, environmental interpretation, and governance. Antarctica's transformation due to climate change unveils opportunities for exploitation and strategic positioning, challenging the Antarctic Treaty System. Increasing human presence in subantarctic settlements and research stations hints at future development.

The paper analyzes how dominant groups establish legitimacy in Antarctic affairs, examining geopolitical influences, colonial legacies, and research disparities evident in discursive practices. It will discuss how cultural hegemony can impact the communication of Antarctic science and climate strategies. By unraveling ideologies within dominant discourses, the paper aims to foster critical consciousness regarding how power imbalances shape our understanding of Antarctica. Recognizing these dynamics is crucial for inclusive collaboration and sustainable stewardship of this vital region.

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5

Manifesting Antarctic Cooperation: Transcending Conflict Assumptions in Our Changing Earth System

Edythe Weeks

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Abstract

The XIV ISAES will convene experts to explore Antarctica's geology, climate, and ecosystems within the Earth's system, and this paper aims to complement this scientific focus by applying Neville Goddard's principles to the future of Antarctic international relations and international law amid rapid environmental change. History suggests resource emergence triggers conflict, but this reflects collective assumptions, not inevitability.

Drawing on Goddard, the proposed paper will argue that Antarctica's future is shaped by global consciousness. Dominant narratives of resource competition may produce specific outcomes. By critically analyzing hidden assumptions, we can cultivate a new collective belief: peaceful collaboration and shared stewardship. This requires "living in the end" of a cooperative Antarctica, vividly imagining and feeling this reality to impress the collective subconscious.

"Revision" offers another tool: mentally re-experiencing historical resource conflicts with peaceful resolutions, dismantling negative precedents. Transcending the perceived scarcity "boundary" involves shifting focus from competition to collaborative innovation and Antarctica's intrinsic value.

Ultimately, consciously rejecting conflict paradigms and cultivating a shared, felt assumption of peaceful international relations offers a path to ensure Antarctica remains a zone of peace, scientific collaboration (central to ISAES), and environmental stewardship, guided by scientific understanding and a transformative collective vision.

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Extreme weather disruption of Antarctic fieldwork: atmospheric rivers and large-scale circulation linkages

Deniz Bozkurt[1,2,3], Francisco Fernandoy[4], Shelley MacDonell[5], Luiz Muñoz Gaete[4], Daniel Rutllant[6]

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Abstract

From 4 to 11 January 2025, a glaciological field campaign on the Laclavère Plateau near Base O'Higgins in the northern Antarctic Peninsula was disrupted by a sequence of severe weather events. A major storm system brought intense winds, blowing snow, and rapid surface warming, ultimately forcing an evacuation. This event offered a clear example of how dynamic atmospheric conditions can directly affect field-based scientific activity in Antarctica. Meteorological analysis indicates the storm was driven by the arrival of a strong atmospheric river, guided by a synoptic configuration featuring a persistent blocking ridge over the Scotia Sea and a low over the Bellingshausen Sea. This circulation pattern facilitated poleward transport of warm, moist air into the Peninsula. The event also aligned with a pronounced negative phase of the Southern Annular Mode, associated with meridional flow anomalies. These features were part of a broader wave-3-like zonal structure that likely contributed to moisture intrusion into the region. Atmospheric rivers in the Southern Ocean are projected to increase in frequency and intensity under ongoing climate change, elevating the likelihood of extreme weather reaching polar latitudes. This case highlights the operational risks such events pose for fieldwork and underscores the importance of understanding the complex interplay between Antarctica and the global Earth system, particularly through large-scale circulation patterns, teleconnections, and moisture pathways.

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HIGHLAND Holocene Insights Gained from High-resolution drilling in North Victoria Land

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Abstract

The HIGHLAND project, part of the IODP3 program, investigates post-glacial climate changes in Antarctica through high-resolution geological drilling in North Victoria Land's fjord systems. It aims to bridge knowledge gaps regarding glacial advances and retreats since the Last Glacial Maximum (LGM). The initiative will analyze interactions among climate variability, sea ice dynamics, and sea level rise, along with the impact of ocean circulation on glacier behavior in fjord environments. Additionally, it will assess factors influencing the formation and preservation of laminated sediments in Edisto Inlet over sub-seasonal timescales. By utilizing sediment cores and seismic data, HIGHLAND seeks to enhance our understanding of the long-term relationships between ice, ocean, and tectonic processes, ultimately supporting better predictions of future sea-level rise.

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Protecting Antarctica's Dark and Quiet Skies: A Missing Link Between Space Governance and Antarctic Environmental Protection.

Victoria Valdivia

European Space Policy Institute, Vienna, Austria. Universidad De Santiago, Santiago, Chile

Abstract

Since its origins, astronomy and radioastronomy have played a central role in advancing scientific knowledge. Beyond their scientific value, these activities are essential for developing space technologies and ensuring the safety of space operations. However, they require very specific environmental conditions—especially clear, dark, and quiet skies—free from human-made interference, light pollution, and industrial noise. As a result, only a few locations worldwide are suitable for hosting observatories, making such sites increasingly valuable and vulnerable.

Today's more volatile international environment has intensified competition over scientific knowledge production. In response, the international community has started to address the need to protect dark and quiet skies. Nevertheless, the skies over Antarctica—despite the continent's unique governance system and growing exposure to climate change—remain largely absent from international regulatory efforts, like those discussed into the Outer Space Treaty System context. Antarctica offers an exceptional environment for astronomy and radioastronomy, providing vast, minimally disturbed areas ideal for observing space and deep-sky phenomena.

This research identifies a regulatory gap concerning the protection of Antarctica's dark and quiet skies. It explores the possibility of framing these skies as part of the "connected ecosystem" recognized under the 1991 Madrid Protocol on Environmental Protection. Adopting an exploratory approach grounded in international studies and comparative analysis between the Outer Space Treaty system and the Antarctic Treaty system, this paper proposes new perspectives on how environmental and technological dynamics influence scientific activity in Antarctica, and how they may impact its governance in the future.

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Tracking the Spread of HPAI A/H5N1 to Antarctica: Genetic Insights from Brown Skuas on James Ross Island

Victor Neira[1], Naomi Ariyama[1], Pablo Castillo[2], Barbara Brito[3], Gabriela Muñoz[1], Karla Diaz[2], Leonardo Almonacid[2], Benjamin Bennett[1], Barbara Berazay[1], Miloš Barták[4], Rafael Medina[5], Marcelo Gonzalez[6], Catalina Pardo-Roa[2]

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Abstract

In early 2024, the Highly Pathogenic Avian Influenza Virus (HPAIV) A/H5N1, clade 2.3.4.4b, was detected in Brown skuas (Stercorarius antarcticus) on James Ross Island, Antarctica. Prior to this, the virus had spread across South America, causing significant mortality events in wild birds and mammals along the coasts of Chile, Argentina, Peru, Uruguay, and Brazil since late 2022. By late 2023, H5N1 expanded into the South Atlantic and Southern Ocean, reaching the Malvinas/Falkland Islands and Bird Island, South Georgia. The detection of H5N1 on Bird Island raised concerns about the virus's potential spread to previously unaffected ecosystems. In this study, we provide the first genetic characterization of HPAI A/H5N1 in Antarctica, focusing on positive cases in Brown skuas detected on James Ross Island in February 2024. Full genome sequencing of six viral samples using Nanopore technology revealed minimal variation, with >99.9% identity in the HA gene and consistent results across all genomic segments. Phylogenetic analysis demonstrated that the virus reached Antarctica via local migrations originating in South America, with the closest genetic matches found in viruses from sub-Antarctic islands. This study underscores the need for continued genetic surveillance and enhanced collaboration among research teams to expand sequencing efforts and improve our understanding of the virus's transmission dynamics, persistence, and potential host adaptations in Antarctica. Expanding sequencing across diverse species will be crucial to fully understanding the virus's spread and its impact in this unique and vulnerable ecosystem. Partially Funded by Inach RT 08-21

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Chilean Surveillance of HPAI H5N1, 2024-2025 Season

Victor Neira[1], Gabriela Muñoz[1], David Gajardo[1], Matthias Cabrera[1], Monserrat Rantul[1], Cristian Torres[1], Barbara Quezada[1], Danny Fuentes[2], Valentina Aravena[2], Douglas Krause[3], Marcelo Gonzalez[4]

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Abstract

We present preliminary findings from a collaborative initiative between the Chilean Antarctic Institute and the Faculty of Veterinary and Animal Sciences (FAVET) at the Universidad de Chile to monitor the panzootic HPAI H5N1 in Antarctica. This surveillance effort targets the detection and tracking of Highly Pathogenic Avian Influenza (HPAI) A/H5N1, clade 2.3.4.4b, a significant global threat to wildlife populations. In December 2024, laboratories were established at Bases O'Higgins and Escudero in Antarctica, enabling on-site real-time PCR diagnostics. In addition, sample collection efforts were expanded through expeditions aboard the Chilean vessel *Betanzos*. A total of 1,472 samples were collected, including 757 environmental fecal samples, 41 carcass samples, and 674 direct samples (swabs and sera) from healthy penguins. Initial tests confirmed the presence of influenza A virus, identifying HPAI H5N1 clade 2.3.4.4b in deceased Antarctic fur seals and Skuas. These findings highlight the rapid spread of HPAI within the Antarctic region, posing significant risks to native wildlife species. Ongoing surveillance efforts will assess the broader ecological impacts of HPAI H5N1 on Antarctic ecosystems. Further subtyping, sequencing, and additional testing will deepen our understanding of the virus's persistence, adaptation, and spread in this unique and fragile environment.

Partially funded by INACH Regular RT0821 and Fondecyt 1211517

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Antarctic Avian Avulaviruses: A Continuing Threat to Wildlife

Victor Neira[1], David Gajardo[1], Gabriela Muñoz[1], Marcelo Gonzalez[2]

[1]Universidad de Chile, Santiago, Chile. [2]INACH, Santiago, Chile

Abstract

Enzootic Antarctic Avian Avulaviruses, including AVV-17, AVV-18, and AVV-19, pose a persistent ecological threat to Antarctic penguins. These viruses belong to a group that can cause respiratory and other clinical issues in avian species, often resulting in subclinical infections that can spread within populations. The impact of these viruses on wildlife populations in Antarctica is still not well understood. Since December 2024, environmental and direct samples have been collected from penguins, skuas, and other wildlife across the Antarctic Peninsula. Initial screenings revealed the presence of several AVV strains, with 8% of tested samples containing AVV-17, 10% containing AVV-18, and 5% containing AVV-19. These findings confirm the ongoing circulation of these viruses among wildlife in Antarctica, contributing to the complex dynamics of disease transmission in this pristine environment. Despite their enzootic nature, the full ecological impact of these viruses remains poorly understood. Their persistence in wild bird populations overtime raises concerns about their potential to disrupt local ecosystems, especially if the viral strains undergo further genetic adaptation. Continued surveillance is essential to assess the broader implications of AVVs on wildlife populations and to understand the risks they pose to Antarctic ecosystems. The data collected will provide critical insights into pathogen persistence, species susceptibility, and the potential for future outbreaks.

Partially funded by INACH Regular RT0821 and Fondecyt 1211517

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Bringing Antarctica to Hand: 3D-Printed Models as Tools for Outreach and Public Engagement

Andre Belem[1,2], Pedro Guimaraes[1], Rafael Pinto[1], Anna Clara Monteiro[1]

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Abstract

The Oceanographic Observatory of the Universidade Federal Fluminense has developed a hands-on outreach and education program utilizing 3D-printed models of Antarctic life, including microorganisms and vertebrates. Designed by undergraduate students from Environmental Engineering, Computer Science, Environmental Science, and Marine Biology, the collection features planktonic organisms (e.g., diatoms and dinoflagellates) as well as skulls of penguins, seals, and whales (both mysticetes and odontocetes). These models are used in lectures and workshops for school-aged children and youth, university students, and the general public. During the 2024-2025 austral summer, the models were incorporated into an outreach program aboard a tourist vessel operating along the Antarctic Peninsula. Pre- and post-activity interviews with passengers revealed that tactile and visual interaction with the models significantly enhanced understanding of ecological adaptation- such as beak morphology in penguins related to feeding behavior, dentition in seals specialized for krill consumption, and the diverse shapes and structural features of Antarctic microalgae. The models are produced through a combination of custom digital design, scanning of museum specimens, and use of open-access repositories such as Sketchfab and Thingiverse. Each model is accompanied by an executive plan detailing both technical specifications and recommended applications for different audiences. This workflow enables accurate and scalable production of scientifically grounded representations that help translate abstract ecological functions into tangible learning experiences.

Our findings indicate that 3D-printed models are powerful tools for Antarctic environmental education, enhancing engagement and understanding across diverse contexts through low-cost, open-source, and student-driven science communication strategies.

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Supporting Antarctic Observations Navigating under the Southern Cross with Laura Bassi — the MIMOSA Initiative

Daniela Accettella, Massimiliano Iurcev, Fabrizio Zgur, Andrea Cova, Laura Desantis, Roberto Romeo, Franco Coren

OGS- National Institute of Oceanography and Applied Geophysics, Trieste, Italy

Abstract

The urgent need to address climate change, biodiversity loss, and environmental instability is reshaping how we observe and study the Earth System. Antarctica plays a central role in this, but vast regions remain inadequately monitored due to limited accessibility and logistical complexity. In this context, research vessels are essential platforms for in situ and multidisciplinary underway observations across the remote and data-poor Southern Ocean.

Italy is making significant efforts to transform its icebreaker, the R/V *Laura Bassi* (LB, formerly *Ernest Shackleton*), into a state-of-the-art mobile observatory through the internal initiative MIMOSA (*Mobile Italian Observatory for the Study of Antarctica*). Born as a bottom-up initiative within the department that manages the *Laura Bassi*, MIMOSA aims to enhance the vessel's observational capabilities during Antarctic campaigns. This effort builds on Italy's polar science legacy and aligns with global strategies promoting interoperable, FAIR-compliant data and standardized protocols, exemplified by initiatives such as INSYNC, which require close collaboration between scientists and infrastructure operators.

The poster outlines the framework of this transformation, including the implementation and upgrade of onboard scientific instrumentation and the development of optimized workflows and protocols to ensure robust underway data collection and accessibility.

Embracing INSYNC objectives, and by investing in open science and integrated data management, the *Laura Bassi* team aims to contribute to a coordinated and comprehensive observing system, supporting the convergence of expertise and resources toward a unified vision for ship-based observations in Antarctica.

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"Green Nanotechnology in Extreme Environments: Rare Earth Nanoparticle Biosynthesis by Antarctic microorganism *Geobacillus* sp. ID17"

Monica ACUÑA-MARTINEZ[1], Jenny M. Blamey[1,2]

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Abstract

Nanoparticles (NPs), with sizes ranging from 1 to 100 nm, exhibit unique biological activities influenced by their size, morphology, and the synthesis method used. Biological synthesis, employing bacteria, fungi, or plants, offers a green alternative to conventional chemical methods, enabling the production of stable and functionalized nanostructures with a reduced environmental impact. Rare earth elements (REEs)-including cerium (Ce), gadolinium (Gd), and neodymium (Nd)-have growing industrial applications in optics, medicine, and energy storage.

This study investigates the biosynthesis of Ce, Gd, and Nd nanoparticles using Geobacillus sp. ID-17, a thermophilic Gram-positive bacterium isolated from Deception Island, Antarctica. The proposed mechanism involves microbial uptake of REE ions and their subsequent enzymatic reduction to nanoparticles.
Characterization of the synthesized NPs was performed using transmission electron microscopy (TEM), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), and UV-Visible spectrophotometry to evaluate localized surface plasmon resonance (LSPR). The results revealed the extracellular formation of spherical REE oxide nanoparticles, with diameters ranging from 64 to 100 nm and LSPR peaks between 250 and 360 nm.

These findings support the potential of *Geobacillus* sp. ID-17 for the eco-friendly biosynthesis of REE-based nanomaterials and contribute to the understanding of nanoparticle formation by extremophiles.

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"Obtaining recombinant antifreeze protein from Antartic psychrophilic microorganisms for use in the agricultural industry."

Antonia González-Riquelme[1], Jenny M. Blamey[2]

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Abstract

Chilean agriculture faces an increase in the frequency and intensity of frosts associated with phenomena such as La Niña and climate change, causing losses of up to 50% in cherry production and more than $200 million in vegetables. Traditional protection methods are expensive and harmful, while chemical cryoprotectants leave persistent toxic residues.

As a sustainable alternative, we explored antifreeze proteins (AFPs) from psychrophilic bacteria of the genus Plantibacter, isolated from Antarctic soils. These extremophiles survive sub-zero temperatures and repeated freeze-thaw cycles. Two variants, AFPgu3A (413 aa) and AFPgu3B (360 aa), were characterized, containing the DUF3494 domain with a triangular β-helix and multiple threonine-rich ice-binding sites. Using in silico models and preliminary tests on cucumbers and zucchini, both AFPs demonstrated thermal hysteresis of up to 0.50 °C and effective protection against freezing cycles.

To ensure scale-up production, the afpgu3A and afpgu3B genes were synthesized and cloned into pET-24a(+) with a His_6 tag. After transformation into Escherichia coli BL21(DE3), temperature, pH, medium composition, and dissolved oxygen were optimized in 300 ml flasks and then in 5 l bioreactors. Purification by affinity chromatography allowed for high yields and purity.

Currently, the purified recombinant AFPs are being evaluated using thermal hysteresis assays to quantify their ability to inhibit ice crystal formation. In addition, there are plans to test their cryoprotective efficacy in plant tissue, seeking to validate their application in sustainable agriculture.

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Beneath the Permafrost: Tracing the Origins of Greenhouse Gas Emissions in Antarctica

Gary Wilson[1], Alessandra Sciarra[2], Fabio Florindo[2], Salomon Hailemikael[2], Claudio Mazzoli[3], Jocelyn Turnbull[4], Chris Moy[5], Jackson Beagley[5], Lucy Davidson[5], Caitlin Berquist[1], livio Ruggiero[6]

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Abstract

Previous SENECA project research revealed significant greenhouse gas (GHG) emissions originating from Antarctic permafrost in the Taylor and Wright valleys of the McMurdo Dry Valleys. These anomalous emissions indicated complex subsurface processes whose underlying mechanisms and gas sources were poorly understood. To investigate these issues, the follow-up project, SENECA 2, explored three main hypotheses regarding the origin and release mechanisms of these greenhouse gases: (1) microbial (in-situ bacterial) production within permafrost; (2) accelerated thawing processes occurring in areas characterized by enhanced degassing; and (3) migration of gases from deep subsurface brines.

The research involved intensive fieldwork and detailed laboratory analyses. Preliminary measurements show notably high concentrations of both CO_2 and CH_4 in soil gases and active-layer permafrost, with observed CO_2 fluxes approximately five times greater than recorded during the 2019/2020 Antarctic field season. To gain deeper insights into the origins and pathways of these gases, isotopic analyses (both stable and radiogenic isotopes) were conducted on samples collected from emission hotspots. Additionally, five continuous CO_2 monitoring stations were installed within the active permafrost layer at strategic locations and a passive micro-seismic network was installed to identify potential subsurface pathways and fracture networks linked to gas emissions.

Overall, the multidisciplinary approaches employed by SENECA 2 provide critical new insights into the nature, magnitude, and mechanisms of greenhouse gas emissions from Antarctic permafrost. These findings significantly improved the scientific understanding of emission dynamics in polar regions, highlighting their potential implications for global climate models and environmental risk assessments.

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Assessing the microplastic density in marine surface water surrounding the Machu Picchu Antarctic Scientific Station – Mackellar Inlet, King George Island during Austral summer 2020.

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Abstract

Perú, as part of the Antarctic treaty, has Antarctic Scientific Station called Machu Picchu (ECAMP). It has been located in the Mackellar Inlet since 1989. The ECAMP only operates during the Austral summer months, when the Peruvian expeditions called ANTAR are carried out. Microplastics have been, distributed across the planet and are causing damage in the most remote marine environments, including the Antarctic waters. To monitor and assess the impact of microplastic pollution in pristine ecosystems are mandatory for Peruvian Antartic Program. The Peruvian Marine Research Institute (IMARPE) use the Marine-Coastal Stressors Research Netwrok (REMARCO) water sampling methodologogy. Nine marine surface water samples were collected fron the Mackellar Inlet in 2020 as part of the ANTAR XXVII expedition. The samples were analyzed in the IMARPE's laboratory in Callao, Peru. The abundance of microplastic was determinated for each of the stations analyzed, reporting amounts between 4000 MP/m^3 and 801000 MP/m^3. In terms of particle shapes, three types of particles were identified and classified into fibers (94%), fragments (5%) and microspheres (1%). The Antarctic environment has always been subject to anthropogenic impact arising from the rest of the planet, however, in recent years they have increased to dangerous levels, the results obteined evidence more presence of microplastics in the water surrounding the Machu Picchu Scientific Station than other sites in the Inlet. It is necessary establish harmonize and comprehensive monitoring regional systems, and foster strategic collaborations to mitigate microplastic pollution's impact on the fragil Antarctic environment in the Norhweater Antarctic Peninsula.

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Enhancing Antarctic Research Visibility and Collaboration through a Current Research Information System (CRIS)

Javier Norambuena[1,2], Pamela Santibañez[2], Marcelo González[1]

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Abstract

Current Research Information Systems (CRIS) are essential tools for the structured organization, integration, and dissemination of data related to research activities. They support institutional research management, improve data quality for decision-making, and promote transparency and collaboration within scientific systems. In the context of Antarctic research, where scientific activity is logistically complex, costly, and environmentally sensitive, reducing redundancy and improving coordination are critical.

One of the persistent challenges in the Chilean Antarctic research landscape is the lack of centralized, accessible information regarding who conducts research, in what areas, under which institutions, and through which collaboration networks. The lack of visibility limits national coordination and reduces opportunities for integration into international scientific agendas.

This presentation introduces the design and early implementation of a CRIS platform tailored to Chilean Antarctic science. The system is designed to aggregate and harmonize data from public and institutional sources and display it through user-friendly interfaces. A core objective is to enable interoperability with other national and international information systems, repositories, and data infrastructures—ensuring that the platform aligns with global standards such as CERIF and FAIR principles. Interoperability is not only a technical challenge, but a strategic imperative to position Chilean research within the global Antarctic science community.

We present the proposed architecture, metadata model, and visual outputs of the system. By improving the mapping of scientific capacities and promoting data exchange and collaboration, this CRIS initiative supports a more transparent, connected, and sustainable Antarctic research system.

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Development of geospatial web services to bring the conservation and protection of ZAEPs closer to different audiences

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INACh, Punta Antenas, Chile

Abstract

The ESRI Geoportal server is a free, open-source portal that offers organizations a great opportunity to display geospatial resources on the web in a user-friendly and interactive way.

The Nodo Austral created a geoportal where nodes operating in the southern macrozone have worked together to develop different educational and outreach materials that seek to showcase the unique features and characteristics of the territories.

One example is the Storymap “ZAEP as a natural laboratory” developed by the Nodo Antártico project and presented as an interactive tool for learning about Antarctica, where users, agents from the productive, cultural, and research sectors, and decision-makers can discover the conservation values and geographical characteristics of the ZAEPs administered by Chile in conjunction with other countries.

The information that can be represented through maps has become very important to the public, therefore, accessibility to geospatial information by organizations is an affordable challenge thanks to tools such as the geoportal.

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Evaluating ERA5 Reanalysis Performance over King George Island, Antarctic Peninsula, Using Radiosonde Observations: Insights into Temperature, Humidity and Wind Representation

Pablo Dénalo-Raby[1], Jorge Carrasco[2], Raúl Cordero[1]

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Abstract

King George Island, located in the Antarctic Peninsula, represents a climatically complex and operationally strategic region for polar research. Its persistent cloudiness, rugged terrain, and limited observational coverage make accurate atmospheric modeling particularly challenging. This study assesses the performance of the ERA5 reanalysis dataset by comparing its outputs to radiosonde observations, focusing on temperature, relative humidity, wind speed, and direction across multiple atmospheric pressure levels. Validation metrics used include Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and Mean Bias Error (MBE).

Temperature is the best-represented variable, with a high Pearson correlation (r = 0.9989) and RMSE values below 1.5 °C at most levels. Optimal performance occurs between 500 and 700 hPa, likely due to this atmospheric layer's relative stability and vertical thickness. In contrast, performance at the surface (1000 hPa) is notably lower (RMSE = 2.29 °C; r = 0.83), likely due to local effects and limited assimilated observations. At 100 hPa, errors increase again, suggesting challenges in capturing upper atmospheric dynamics.

Relative humidity shows greater discrepancies, especially above 300 hPa, with ERA5 underestimating humidity and overestimating surface temperatures in summer. Wind speed is generally well captured, though wind direction errors grow with altitude due to limitations in modeling complex dynamics such as jet streams.

The similarity between MAE and RMSE and the close match between RMSE and error standard deviation indicate systematic rather than random errors. These findings highlight ERA5's strengths and limitations and suggest opportunities for targeted improvements in polar atmospheric modeling. (Financial support Fondecyt Nº1221122).

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Evidence and Challenges of Climate Change in Chile: An Integrated Scientific Analysis from IPCC Reports and the National Reality

Jorge Carrasco Cerda[1], Gino Casa[2], Luis Cifuentes[3], Cristián Szott[4]

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Abstract

This study aims to synthesize current scientific knowledge on climate change at both global and national levels, with special attention to the case of Chile, including the austral southern South America and the Antarctic Peninsula. It reviews the physical evidence of global warming, its impacts on the hydrological cycle, the cryosphere, biodiversity, and productive sectors, and national mitigation and adaptation policies addressing the phenomenon.

A comprehensive documentary analysis was conducted based on the IPCC's six assessment reports, emphasizing the Sixth Assessment Report (AR6). Recent scientific studies on the megadrought, glacier retreat, and climate behavior across different regions of Chile were also included, as were climate model projections under various Shared Socioeconomic Pathways (SSPs).

Results:

- The observed global temperature increase of ~1.1°C since pre-industrial times is unequivocally attributed to human activities.
- In Chile, a sustained decline in precipitation has been observed since the 1980s, with a prolonged megadrought in the central-southern region.
- Andean glaciers are experiencing accelerated retreat, affecting water availability.
- Southern regions, including Patagonia, face particular vulnerabilities due to ice mass loss and ecosystem changes.
- Chile has committed to carbon neutrality by 2050 and has made progress in renewable energy at the national level, yet it faces institutional and social challenges in implementing effective climate actions.

Conclusions:

Climate change is a multidimensional challenge requiring integrated responses from science, policy, and society. Chile must strengthen its environmental institutions, improve water management, and promote locally grounded adaptation based on scientific knowledge and public participation as a highly vulnerable country.

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EVALUATING THE PERFORMANCE OF NEW CMIP6 SIMULATIONS AT KING GEORGE ISLAND, ANTARCTIC PENINSULA

Jorge Carrasco Cerda

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Abstract

Near-surface temperatures in Frei Station were derived from the new state-of-the-art climate model simulations of the Coupled Model Intercomparison Project (CMIP6). These results of present-day air temperature simulations were compared with real data for a detailed assessment of the model performance. This provides information to interpret future warming in the northern end of the Antarctic Peninsula.

The present climate was evaluated for the period 1978-2024. The annual air temperature behavior, simulated by different models, shows a wide dispersion. This complexity is further highlighted by the fact that the average of all simulations resolves February as the warmest and August as the coldest months, instead of the usual January and July, respectively, derived from the average data observed at the Frei and Bellingshausen Stations.

The simulated interannual variability also resolved a large dispersion compared to the observed data. However, the mean simulation ensemble does not resolve the interannual variability. It is close to the average for 1978-2000 but does not resolve the observed cooling from 2000 to 2014. The Taylor Skill Score (TSS) was applied to all simulations to select the five best model performances. Although these models still show large dispersion, the mean ensemble resolves the annual cycle better and partially the interannual variability. These models were used to select the five best simulations for the SSP126 and SSP585 future scenarios. The mean 5-best simulations predict even warmer air temperatures (around 0.2-1.0 degrees) than the all-mean simulations for both the best (SSP126) and the worst (SSP585) future scenarios.

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Ground-Based Tropospheric Ozone Measurements in the Western Antarctic Peninsula Across Nine Antarctic Sites During ECA-61, 2025

Francisco Cereceda-Balic[1], Valeria Campos[2], Magín Lapuerta[3], Ximena Fadic[1], Luis Diaz-Robles[4], Gonzalo Barcaza[1], Benjamín Gallardo[1], Hans Moosmuller[5]

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Abstract

Tropospheric ozone (O_3) plays a crucial role in Antarctic atmospheric chemistry, influencing radiative balance, oxidative capacity, and broader climate feedback. While long-term O_3 observations exist at selected Antarctic stations, simultaneous ground-based measurements across multiple sites remain scarce. In January 2025, we conducted an extensive monitoring campaign in the western Antarctic peninsula across nine sites at different periods throughout January and early February, during the ECA-61, organized by INACH. Measurements were performed using a 2BTech Model 205 UV (USA) photometric ozone analyzer, providing 1-minute data.

The average surface O_3 concentrations measured were: sites with the presence of inhabited and operating Antarctic stations: Yelcho Base (12.2 ppb), O'Higgins Base (14.0 ppb), and LARC Fildes (14.8 ppb); pristine sites Prospect Point (15.3 ppb), Horseshoe Island (16.3 ppb), Carvajal Base (16.2 ppb), La Paloma (17.0 ppb) and Collins glaciers (15.1 ppb); and aboard the research vessel Betanzos (14.6 ppb) during navigation. These values align with previously reported Antarctic ozone levels, underscoring the consistency of Antarctic ozone conditions. Interestingly, the slightly higher O_3 levels observed at pristine sites may reflect the regional transport of ozone or its precursors and the absence of local NO emissions, which would otherwise reduce ozone levels.

By expanding measurements to these nine locations, the campaign provides essential new data for improving our understanding of Antarctica's atmospheric chemistry. Additionally, the dataset offers valuable benchmarks for supporting atmospheric modeling efforts and trend assessments, contributing to our understanding of ozone variability and the temporal ongoing impacts of climate change on Antarctic atmospheric composition.

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Measurements of Aerosols in the Western Antarctic Peninsula Across Four Sites During ECA-61 in 2025

Francisco Cereceda-Balic[1], Hans Moosmüller[2], Magín Lapuerta[3], Valeria Campos[4], Benjamin Gallardo[1], Ximena Fadic[1], Gonzalo Barcaza[1], Luis Díaz-Robles[5]

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Abstract

Understanding and monitoring aerosol properties in Antarctic is essential for efforts to address climate change. During January 2025, we conducted a monitoring campaign with an aerosol laser spectrometer (DUSTDECODER 11-D, DURAG GROUP-GRIMM, Germany) in western Antarctic peninsula during INACH_ECA-61.

The instrument operated a 2 L min^{-1} reported PM_{10}, $PM_{2,5}$, and PM_1 concentrations in four sites on the Antarctic Peninsula: Yelcho Base (YB), La Paloma Glacier (LPG), the Antarctic Cosmic Ray Laboratory (ACRL), and O'Higgins Base (OB). They represent diverse microenvironments, including coastal, glacial regions and areas with different levels of local human activity. YB exhibited moderate concentrations, with PM_{10} averaging 77.2 µg/m³, and $PM_{2,5}$ and PM_1 at 23.9 and 10.4 µg/m³, respectively. ACRL displayed high variability, particularly in PM_{10}, reaching a maximum of 4,387 µg/m³ and an average of 80.8 µg/m³; $PM_{2,5}$ and PM_1 averaged 14.5 and 5.1 µg/m³, respectively, reflecting dynamic atmospheric conditions. OB recorded the comparatively highest values, with an average PM_{10} of 265.4 µg/m³ and a maximum of 22,248 µg/m³, reflecting local combustion sources. However, although the average concentrations of PM2.5 and PM1 were low during the snow events, they reached maximums of 136 µg/m³ and 80 µg/m³, respectively. The GLP, at an altitude of 500 m.a.s.l. and 10 km away from OB, showed the lowest levels of the campaign, with PM_{10} average of 12.6 µg/m³ and $PM_{2,5}$ and PM_1 of 9.1 and 5.1 µg/m³, confirming its pristine condition without aerosol pollution.

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Fungal diversity in ice-free sediments along a coast-to-glacier gradient in Livingston Island, Antarctica

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Abstract

Antarctica is one of the Earth's most extreme environments and a unique natural laboratory for studying microbial adaptation and ecosystem resilience. Despite 98% of ice-covered, terrestrial biodiversity is concentrated in ice-free areas, where sediments host diverse extremophilic fungi. While these fungi are documented across Antarctic and Sub-Antarctic regions, how environmental gradients—e.g. proximity to the coast or glaciers—drive their diversity is poorly understood. In this study, we test the hypothesis that environmental filtering along a coastal-to-glacial gradient leads to (A) a significant decrease in fungal richness and (B) a high taxonomic turnover (β diversity) characterized by a shift from generalist to specialist taxa. To address this, we collected sediment samples from ice-free areas of Livingston Island, spanning a spatial gradient from coastal zones to glacier-proximal sites. Samples were analyzed using Illumina sequencing targeting the ITS1 region to assess fungal richness, relative abundance, and community composition. Preliminary results support our hypothesis, revealing higher fungal diversity in coastal sites, dominated by members of the order *Glomerales* and *Leucoporidiales*. In contrast, glacier-proximal sites are characterized by fungal communities with a high proportion of unclassified fungal taxa, followed by representatives of *Rhizopodiales*.

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Absorption Ångström exponent based on Black Carbon aethalometer measurements on the Antarctic Peninsula

Francisco Cereceda-Balic[1], Magín Lapuerta[2], Benjamín Gallardo[1], Hans Moosmuller[3], Valeria Campos[4], Luis Diáz-Robles[5], Ximena Fadic[1], Gonzalo Barcaza[1]

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Abstract

The absorption Ångström exponent (AAE) is a crucial optical parameter that quantifies the spectral dependence of light-absorbing aerosols (LAA) and provides information about the particle composition and source attribution. Here, we present a methodology of calculating of the AAE from aethalometer (AE-33, Magee Scientific, USA) data. We present findings for ECA61, January 2025.

Although aethalometers measure light attenuation, they provide black carbon (BC) mass concentration (C_{BC}), since they are calibrated for this aerosol type. However, when the nature and composition of the aerosols is uncertain, as in coastal Antarctica, the light attenuation, quantified via absorption coefficient (b_{abs}), must be retrieved from the supposed C_{BC}. Thus, b_{abs}, was computed as the product of the mass absorption cross-section (MAC), ranging from 7.19-18.47 m^2g^{-1}, and C_{BC} at seven wavelengths (370 and 950 nm), with unit conversions to express, b_{abs} in Mm^{-1}.

During the ECA61 expedition, the equipment was installed at two locations on the western Antarctic peninsula, O'Higgins Base (OB, 63°19’15”S 57°53’59”O) and Antarctic cosmic ray laboratory (ACRL, 62° 12’ 09” S 58° 57’ 42”O).

AAE analysis showed differences in statistics and variability. Mean AAE was 0.74 at ACRL and 1.11 at OB, with standard deviations of 0.91 and 0.77, respectively. The AAE at Base O’Higgins remains stable around 1.1, indicating consistent BC-rich aerosols from fossil fuels. In contrast, LARC shows strong diurnal variability with a midday peak, suggesting more dynamic sources or variable aerosol composition.

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Information technologies and the development of a new understanding of Antarctica

Francisco Sánchez

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Abstract

Antarctica represents a privileged environment for the development and implementation of innovative technologies aimed at studying natural systems under extreme conditions. Its isolation, harsh climate, and vast unexplored areas have driven the design of tailored technical solutions that have evolved over time, significantly transforming the way we observe and understand the White Continent.

Today, advances in information technologies allow for the rapid analysis of large datasets, enabling the creation and application of new theoretical models across various scientific disciplines, including meteorology, polar cartography, ocean current studies, surface dynamics, and bathymetric surveying. This technological context opens both strategic and operational opportunities, allowing tools to be adapted with greater precision to complex and changing scenarios.

However, from a critical and philosophical standpoint, it is essential to question how these technologies influence the interpretation and generation of scientific knowledge. While innovation enhances the scope and depth of observation, it also introduces frameworks that may shape or constrain the production of knowledge about Antarctica.

In this sense, Antarctica stands not only as a natural laboratory for technological innovation, but also as a space for reflection on how these tools impact the ways we model, understand, and envision the continent's future.

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Fablab Umag: A key space for the development of research and innovation in the Antarctic and subantarctic context

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Abstract

The University of Magallanes' Fabrication Laboratory, Fablab Umag, is a unique space open to the community of the Magallanes region and Chilean Antarctica. It was created after the University of Magallanes was awarded the Science-HUB Austral project: Implementation and Strengthening of Enabling Capacities for the Innovation and Entrepreneurship Ecosystem in the Antarctic and Sub-Antarctic Context, submitted by the University of Magallanes to the 2022 call for proposals for the Development of Institutional Capacities for Innovation based on Research and Development in Higher Education (INES R&D), of the Subdirectorate of Networks, Strategy, and Knowledge of the National Agency for Research and Development (ANID).

Currently, Fablab Umag is in its start-up phase and has, to date, supported around twenty educational, scientific, and innovative projects in the fields of Antarctic sciences, health sciences, glaciology, ecology, architecture, and energy, from various university units and faculties, as well as from the regional scientific and educational ecosystem.

This work presents the main opportunities available to the regional and international scientific community involved in educational, research, and/or development projects focused on the Magallanes region and Chilean Antarctica. It offers advice on digital manufacturing for the design of prototypes, moving parts, mechanisms, and/or spare parts, access to high-resolution equipment, and workshops and training courses that seek to strengthen the work of relevant regional stakeholders.

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Program ISAES 2025

Monday

09:00-09:45	Open Ceremony
09:45-10:30	Plenary lecture 1 Gary Wilson Antarctic Science in a Changing World
10:30-11:00	Coffee break

	Room 1 S1	**Room 2 S2**
Chair	**Chair: Mark Fanning**	**Chair: María Monassero**
11:00-11:15	6: Samantha Hansen East Antarctic Tectonic Basin Structure and its Implications for Ice-Sheet Modeling and Sea-level Projections	4: Long Ho Machine Learning Reveals Intermediate-Depth Earthquakes Beneath East Antarctica
11:15-11:30	14: Joe Metcalfe Revisiting the SWEAT hypothesis: testing the tectonic affinity of the Read Group (Shackleton Range) through U-Pb zircon geochronology and Feldspar Pb isotopic analysis	7: Jacob Anderson Rates of Holocene thinning from marine-based ice in the western Ross Sea

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11:30-11:45	15: Anne Grunow Geological Heritage and Geoconservation SCAR Expert Group – ISAES 2025 Update	8: Rogier Westerhoff Groundwater driving critical Antarctic climate and environmental processes: a collection of evidence.
11:45-12:00	18: Anya Reading East Antarctica's lithospheric heterogeneity, and influence on ice sheets from beneath	10: Laura De Santis Cook and Ninnis glaciers (East Antarctica) and Ocean interaction in the Pleistocene from marine geological records
12:00-12:15	19: Maximilian Lowe Automated data processing and equivalent source inversion to homogenise magnetic airborne surveys in Antarctica flown on irregular line spacing, heights and decades	16: Karsten Gohl West Antarctic Ice Sheet dynamics shows major shift from Miocene to Pliocene/Pleistocene in the Bellingshausen Sea and Amundsen Sea sectors
12:15-12:30	21: Erica Maletic The Polar Rock Repository: furthering Antarctic Earth Science using legacy collections	26: Erica Guerreiro Antarctic Greening: Global Warming Impacts
12:30-12:45	22: Ian Dalziel The Ellsworth-Coats Land (Antarctic) Promontory of Laurentia	27: Timo Muehlberger-Krauss Past depositional environments and ice sheet dynamics from seismic reflection data of Vincennes Bay, East Antarctica
12:45-13:00		32: Lingyan Luo Pliocene–Pleistocene Variability of the Antarctic Peninsula Ice Sheet Based on a refined Seismic Stratigraphy
13:00 14:30	Lunch	

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Poster session 14:30 – 16:10

Room 3 Poster 1: No ID	Presenting		Sessions 1 and 2
9	Laura	Crispini	New evidence of submarine magmatism offshore northern Victoria Land reveals key tectonic clues from the Antarctic margin
13	Marcio	Francelino	Permafrost Behavior Under the Influence of Research Station Construction
24	Andreas	Richter	Geodetic constraints on tidal anelasticity in the Antarctic Peninsula
28	Liang	Gao	New Paleomagnetic and 40Ar/39Ar Geochronological Results for the Cape Melville of King George Island, West Antarctica, and Their Tectonic Implications
33	Felipe	Napoleoni	Investigating Subglacial Drainage Dynamics and Ice–Bed Interactions at Thwaites Glacier: New Insights from Radio-Echo Sounding
34	Niam	Askey-Doran	Data-Driven Tectonic Segmentation and Implications for Glacial Isostatic Adjustment
37	Fernando	Bohoyo	The Shackleton Fracture Zone (Drake Passage, Antarctica): a major fault zone that connects continents and separates plates and oceans.
38	Adolfo	Maestro-González	Elongation of volcanic edifices in the abyssal plain of the Drake Passage as indicators of paleostresses during the Cenozoic
39	Adolfo	Maestro-González	Elongation of volcanic edifices in the abyssal plain of the Drake Passage as indicators of paleostresses during the Cenozoic
44	Mirko	Scheinert	Advancing geodynamic research in Antarctica: Reprocessing GNSS data to infer consistent coordinate time series(GIANT-REGAIN)
45	RASHMI	Gupta	Reconstructing the Dynamics of Marine-Based East Antarctic Ice Sheet Sectors During Past Warm Periods: Insights from Glaciomarine Sediments
47	Gabriela	Quispe Sanchez	Estimación del balance de masa en el Glaciar Zongo (Bolivia) mediante el modelo conceptual semidistribuido MCS.
50	Fiorenza	Torricella	Sorting centre of the national Antarctic museum - Trieste sectional Italian repository for marine geological materials collected in Antarctica
51	Sofía	Palacios	Influence of the Margarita Submarine Canyon on the intrusion of UCDW over the Continental Shelf of the West Antarctic Peninsula
53	Lauren	Lamson	Characterizing the timing and source of glacial flow in the Quartermain Range, Antarctica

55	Sophia	Lopez	Constraining the Age and Provenance of Glacial Tills in Lower Wright Valley, Antarctica
61	Sofía	Palacios	Influence of the Margarita Submarine Canyon on the intrusion of UCDW over the Continental Shelf of the West Antarctic Peninsula
62	Claudio	Tapia	Sedimentological and Sequence Stratigraphic analysis of the Early Miocene Cape Melville Formation from West Antarctica
63	Philip	Kyle	Geologic history of Cape Barne and the origin and significance of trachyte from Mount Cis, a moraine deposit on Ross Island, Antarctica
70	Marco	Fioraso	Unveiling the long-term landscape evolution of the Transantarctic Mountains
72	Lourdes	Gonzalez-Castillo	Magnetotelluric investigation of the Glacial Isostatic Adjustment influence on the asthenospheric mantle electrical structure in Antarctica.
73	Lourdes	Gonzalez-Castillo	Magnetotelluric exploration of the Deception Island active volcano (Antarctica)
91	Matias	Peña	First record of Fault-Slip data in the Lions Rump: Integration with regional deformation and tectonic evolution of King George Island.
92	Mukut Singha	Konwar	Insights into spatial variability of surface mass balance and ice-dynamics over the Larsemann sub-basin, East Antarctica using ground based observations
93	Deepak Yuvraj	Gajbhiye	Ground-Based and Remote sensing Assessing on Ice Dynamics and Mass Flux in Central Dronning Maud Land, East Antarctica: Climatic Implications for Ice Sheet Stability
96	Luca	Zurli	Gravel composition and distribution at KIS3: Preliminary results from the SWAIS2C project
100	Ricardo	Leon	The Pacific Margin of the South Shetland Islands: Evidence of major recent deformation in a supposedly extinct accretionary prism
101	ismael	escobar	MONITORING OF ICEBERGS AND SEA ICE IN THE ANTARCTIC PENINSULA USING SENTINEL 1
102	Leslie	Manriquez	Unveiling Paleocene Hydroclimate Dynamics in Antarctica: Evidence from Seymour Island Sediments
109	Alexandra	Jurkiw	Semi-Automated Geomorphological Mapping and Characterisation of the Antarctic Seabed
133	Gabriela	Abarca Sepúlveda	Purification and biochemical characterization of a catalase from a psychrophilic microorganism of the genus Flavobacterium

137	Rodrigo	Fernández	Small bays, big trouble: The role of lateral ice drainage during the retreat of the Pine Island Ice Stream following the Last Glacial Maximum
140	Luisa	Runho Lucarelli	Background of Nutrients in Bransfield Strait - Summer 1983 (PROANTAR-III)
142	Giselle Lujan	Marincovich	Carbonaceous aerosols in Sub-Antarctic and Antarctic sites: observations from Ushuaia and Marambio
154	Giulia Matilde	Ferrante	Antarctic Geologic Evolution (AGE): SCAR Science Program Planning Group to Unveil the 4D Lithospheric Architecture and Dynamics of Antarctica
158	Carolina	Silva	Stratigraphic analysis of the Eocene-Oligocene transition exposed on Lions Rump-Polonez Cove area (King George Island, Antarctic Peninsula)
165	Luis	Lara	40Ar/39Ar geochronology and geochemistry of Paulet Volcano: insights into the Larsen rift at Antarctic peninsula
179	Manuel	Schilling	Geological heritage sites of the Antarctic Peninsula: challenges for their conservation and their potential to promote scientific research, education, and geotourism
185	Giulia Matilde	Ferrante	Provenance and sediment dynamics in the Ross Sea:a multi-disciplinary approach for IODP Site U1523
189	Yocelyn	Carrasco	Análisis de la evolución de la cubierta glaciar y su impacto en las subcuencas Río Duqueco y Río Laja Alto: Estimación del deshielo del Glaciar Sierra Velluda a través de teledetección, Región del Biobío, Chile
199	Mauricio	Calderón	Timing of high-P/T metamorphism in southern Patagonian and Fuegian Andes

16:10-16:30	Coffee break

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Chair	Room 1 S5	Room 2 S2
	Chair: Jorge Carrasco	**Chair: Karsten Gohl**
16:30-16:45	3: Edythe Weeks Power Imbalances in the Global Earth System and Cultural Hegemony in a Transforming Antarctica	35: Karla Pamela Cordova Morales Análisis de la línea de costa en las proximidades de la Estación Científica Antártica Machu Picchu, Punta Crepín, Isla Rey Jorge, Antártida
16:45-17:00	5; Edythe Weeks Manifesting Antarctic Cooperation: Transcending Conflict Assumptions in Our Changing Earth System	36: Maria Constanza Manassero Unravelling the Dynamics of Denman Glacier, East Antarctica: Insights from MT and Integrated Geophysical Investigations
17:00-17:15	25: Deniz Bozkurt Extreme weather disruption of Antarctic fieldwork: atmospheric rivers and large-scale circulation linkages	42: Guillaume Duclaux Data collection recommendations to optimize the performance of gravity inversions for bathymetry beneaenza th Antarctic ice shelves
17:15-17:30	58: Victoria Valdivia Cerda Protecting Antarctica's Dark and Quiet Skies: A Missing Link Between Space Governance and Antarctic Environmental Protection.	49: Fiorenza Torricella New Insights into Circumpolar Deep Water Pathways and Ice Shelf Evolution from High-Resolution Records in the Bassi Channel, George V Land (East Antarctica).

SIDE EVENTS

14:00 15:00	SCAR Geoscience Group	Room 1

17:30 19:30	SE7: EXHAG Chile's Antarctic geosciences and international collaboration	Room 1

20:00 22:00	Icebreaker

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Tuesday

09:00-09:45	Plenary lecture 2 Laura De Santis Geological boundary conditions are important drivers of ice sheet stability
09:45-10:30	Plenary lecture 3 Marcelo Leppe The life, passion and death of *Nothofagus* in Antarctica
10:30-11:00	Coffee break

	Room 1 S1	Room 2 S5
Chair	Chair: Lorena Rebolledo	Chair: Daniz Bozkurt
11:00-11:15	40: Mark Fanning Cretaceous to Eocene magmatic evolution in the retreating convergent margin of the northern Antarctic Peninsula: U-Pb age and Hf-O isotope variations	
11:15-11:30	43: Devsamridhi Arora Geothermal Heat Flow in Princess Elizabeth Land, East Antarctica: A Geological Perspective	68: Victor Neira Rairez Chilean Surveillance of HPAI H5N1, 2024-2025 Season
11:30-11:45	46: Luca Zurli Evolution of the Transantarctic Basin in Victoria Land: insights from quantitative sandstone petrography	138: Garry Wilson Beneath the Permafrost: Tracing the Origins of Greenhouse Gas Emissions in Antarctica
11:45-12:00	48: Yingchum Cui The petrogenesis of Starr Nunatak granite	162: Jorge Carrasco Evaluating the performance of new CMIP6 simulations at King George Island, Antarctic Peninsula
12:00-12:15	60: Staci Loewy Coats Land Antarctica, a Tectonic Tracer for Southwestern Laurentia	175: Francisco Cereceda Ground-Based Tropospheric Ozone Measurements in the Western Antarctic Peninsula Across Nine Antarctic Sites During ECA-61, 2025

12:15-12:30	75: Jesús Galindo-Zaldivar New insights on cascading geological hazards in Bransfield Strait (Antarctic Peninsula)	178: Francisco Cereceda Measurements of Aerosols in the Western Antarctic Peninsula Across Four Sites During ECA-61 in 2025
12:30-12:45	97: Roger Urgeles Methane seeping along the upslope limit of gas hydrate occurrence off the Antarctic Peninsula facilitated by major crustal fault	193: Francisco Cereceda Absorption Ångström exponent based on Black Carbon aethalometer measurements on the Antarctic Peninsula
12:45-13:00	98: Marco Fioraso Structural architecture and thermochronological constraints of rift flank faulting in the Transantarctic Mountains	196: Francisco Sanchez Information technologies and the development of a new understanding of Antarctica
13:00 14:30	Lunch	

Poster session 14:30 – 16:10

Room 3	**Poster 2: Tuesday**		**Sessions 3, 4 and 5**
No ID	**Presenting**		
1	**Michael**	**Stieber**	Between Expectation and Reality: On the Limitations of Generalised Leadership Models in ICE Environments
11	**Kutsal**	**Bozkurt**	Investigating the relationship between algal blooms and temperature in the Antarctic Peninsula
12	**Marcio**	**Francelino**	CO_2 Dynamics in Antarctic Oasis Soils
17	**Rebekah**	**Stanton**	An investigation into how microbial communities are influenced by and change over geologic time in the Transantarctic Mountains, Antarctica.
29	**Francesca**	**Battaglia**	HIGHLAND Holocene Insights Gained from High-resolution drilling in North Victoria Land
31	**Anya**	**Reading**	GRIT Deployments and Collaboration: Understanding East Antarctica's Tectonic Structure and Outlet Glaciers

54	Marisol	Juarez Rivera	Major microbial mat disruption in Lake Fryxell, Antarctica linked to an increased irradiance event
66	Nicole	Cortez Salvo	Viridicatin isolated from the antarctic fungus Penicillium sp. shows neuroprotective effect on HMC-3 microglia cells under H2O2 oxidative stress
69	victor manuel	Neira Ramirez	Antarctic Avian Avulaviruses: A Continuing Threat to Wildlife
74	victor manuel	Neira Ramirez	Mass Mortality in South Polar Skuas by HPAI H5N1 2.3.4.4b in Horseshoe and Dismal Islands, 2025
82	Thomas	Mörs	Comparative analysis of enamel microstructure in Eocene Sparnotheriodontidae (Litopterna, Mammalia) from Antarctica and southern South America
85	Andre	Belem	A Time-Variable Spectral Index for Penguin Guano Detection: Toward Satellite-Based Monitoring of Antarctic Colonies
86	Andre	Belem	Tracking Greening Trends in the Antarctic Peninsula Using Sentinel-2 Time Series and Spectral Indices
87	Andre	Belem	Bringing Antarctica to Hand: 3D-Printed Models as Tools for Outreach and Public Engagement
103	Daniela	Accettella	Supporting Antarctic Observations Navigating under the Southern Cross with Laura Bassi — the MIMOSA Initiative
104	Elaine Cristina	Araújo	Atmospheric Concentrations of CO_2 and CH_4 in the Antarctic: A Case Study in Admiralty Bay
119	Benjamín	Urra Pacheco	Addressing Data Gaps in Antarctic Geomagnetic Monitoring: A Comparative Study of SAMBA and Vernadsky Observatory
125	Cristine	Trevisan	Implementation of a Micro-CT Experimental Platform to Advance Fossil Imaging Protocols in the CPAP Collection
128	Mónica	Acuña Martínez	Green Nanotechnology in Extreme Environments: Rare Earth Nanoparticle Biosynthesis by Antarctic microorganism Geobacillus sp. ID17
129	Antonia	Gonzalez Riquelme	Obtaining recombinant antifreeze protein from Antartic psychrophilic microorganisms for use in the agricultural industry.
132	Leandro	Martinez	Fossil leaves and wood remain from Potter Peninsula, King George Island (25 de Mayo Island), Antarctica

135	Marina	Quiñe	Spatio-temporal variability of echinoderm assemblages in soft-bottom habitats of Mackellar Inlet (Antarctica): A decade of monitoring (2010-2024)
139	Iveth	Chavez	Assessing the microplastic density in marine surface water surrounding the Machu Picchu Antarctic Scientific Station – Mackellar Inlet, King George Island during Austral summer 2020.
148	Lotse	Blamey	Exploring the antimicrobial potential of biologically synthetized silver, copper and zinc nanoparticles by the thermophilic Antarctic bacterium Geobacillus
149	Javier	Norambuena Leiva	Enhancing Antarctic Research Visibility and Collaboration through a Current Research Information System (CRIS)
150	Magdalena	Márquez	Development of geospatial web services to bring the conservation and protection of ZAEPs closer to different audiences
152	Ian	Hogg	Monitoring Antarctic near-shore and terrestrial areas with ANTOS
155	Jorge	Sánchez	Isolation, Identification and Functional Screening of Microorganisms from Subglacial Sediments of King George Island, Antarctica
156	Cole	Kelleher	FRIDGE: Empowering Polar Research with Dynamic Access to High-Resolution Satellite Imagery and Digital Elevation Models
157	Rafael	Délano	Evaluating ERA5 Reanalysis Performance over King George Island, Antarctic Peninsula, Using Radiosonde Observations: Insights into Temperature, Humidity and Wind Representation
159	Christan	Szott	Evidence and Challenges of Climate Change in Chile: An Integrated Scientific Analysis from IPCC Reports and the National Reality
160	Iván	Opazo Aballay	Lost before found? Accelerating drug discovery from Antarctica's climate endangered flora by applying effect-directed analysis coupled to planar
161	Natalia	Valenzuela-Aedo	Application of SAR Interferometry with Sentinel-1 for the Temporal Analysis of Glacier Displacements on King George Island, Antarctica (2021–2023).
163	Heaven	Biotech	Metabolitos bioactivos de líquenes antárticos marítimos: una ventana a la adaptación química a entornos extremos
164	Daniela	Schmitz	Vegetation effects on soil thermal regime in Cryosols from Elephant Island, Maritime Antarctica
170	Cathleen	Torres Parisian	From Elevation to Evolution: Enabling 4D Polar Observation with REMA

174	Tiare	Medina	Microbial adaptations to subantarctic conditions in modern microbialites from Tierra del Fuego, Chile
182	Catalina	Ramos Orellana	Review of microbial control in lakes of southernmost Chile in the Magallanes and Chilean Antarctic Region: Functional adaptations and paleoenvironmental records
184	Pamela	Fletcher	Gathering stakeholder input to inform science-enabling subsea telecommunications infrastructure
186	Cinthya	Bello	UAV and GPR data integration to measure ice thickness distribution of Znosko glacier (King George Island, Antarctica)
188	Bella	Romero Ortega	Fungal diversity in ice-free sediments along a coast-to-glacier gradient in Livingston Island, Antarctica
192	Rebeca	Fernández	Glacial Chronology and Provenance Analysis of Deschampsia antarctica in Moraines of the Bellingshausen Glacier Dome, King George Island, Antarctica, and Its Potential Distribution.
200	Felipe	Gallardo	Fablab Umag: A key space for the development of research and innovation in the Antarctic and subantarctic context

16:10-16:30	Coffee break

Chair	Room 1 S1	Room 2 S2
	Chair: Roger Urgeles	Chair: Ricardo Jaña
16:30-16:45	107: Liang Gao The Antarctic Peninsula-Scotia Sea coastal orogenesis triggered reorganization of global ocean-climate system in the Cenozoic	59: Mika Bighin Soluble salt evidence for large paleo-lakes in Wright and Victoria Valleys, McMurdo Dry Valleys
16:45-17:00	113: Guillaume Duclaux Advancing Geological Mapping in Antarctica: Overcoming Challenges with Digital Tools	65: David Giovannetti Preliminary Insights from the Mineralogy of Glendonite Pseudomorphs after Ikaite in Miers Valley, Antarctica
17:00-17:15	114: Terry Wilson	79: Giulia Ferrante

	Active intraplate deformation in Antarctica: Constraints from GNSS	Seismic Oceanography offshore Wilkes Land (East Antarctica)
17:15-17:30	116: Guillaume Duclaux Reassessing the Terre Adélie Craton: A Key to Proterozoic Geodynamics in East Antarctica	84: Marco Rabassi RITA: Raman non-destructive Ice cores analysis of visible Tephra layers in Antarctica

SIDE EVENTS

17:30 19:30	RINGS Action Group	ROOM 1

Wednesday

09:00-09:45	Plenary lecture 4 Gao Ling Tectonic pulses of the Drake Passage controlled Cenozoic million-year-scale ocean-climate cycles
09:45-10:30	Plenary lecture 5 Sebastián Marinsek Antarctica and the Global Earth System: Interdisciplinary connections, present and future challenges
10:30-11:00	Coffee break

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	Room 1 S1	Room 2 S2
Chair	**Chair: Jesús Galindo**	**Chair: Rodrigo Fernández**
11:00-11:15	122: Audrey Huerta Cretaceous formation of Southern TAM, followed by Paleogene down-dropping of Ross Sea	90: Yogest Ray Glacial Moraines as Reliable Indicators of Deglaciation History: A Case Study from Schirmacher Oasis, East Antarctica
11:15-11:30	144: Alexander Golynsky Enhanced Aeromagnetic Coverage of Antarctica towards ADMAP-3	95: Javier Maldonado Ugarte Composition of surface sediments and sedimentary records offshore Wilkes Land (60–150°E), East Antarctica: applicability to reconstruct changes
11:30-11:45	146: Joachim Jacobs U-Pb zircon provenance analyses of (meta-) sedimentary rocks of the Shackleton Range, East Antarctica: significance for paleogeographic reconstructions of parts of East Antarctica in Columbia, Rodinia and Gondwana.	99: Asmara Lehrmann Tidally influenced interactions between a glacier base and the seafloor substrate recorded by channels and sedimentary ribs in a paleo-grounding zone
11:45-12:00	151: Douglas Wiens The Thermal and Chemical Structure of the Antarctic Upper Mantle	106: Martín Arbieto Different marine environments across the K-Pg boundary in Antarctica: evidence from palynological and sedimentological data
12:00-12:15	153: Chengcheng Wang Isotopic composition and evolution of Mesoproterozoic Maud Belt in Dronning Maud Land and implications for the lateral termination of the Grenville	110: Cliff Atkins Aeolian sediment sources and transport pathways in the SW Ross Sea, Antarctica
12:15-12:30	168: Fausto Ferracciolli Linking geothermal heat flux heterogeneity unveiled from aeromagnetic data with crustal provinces and processes	111: Ana Amaral Wesielesky Water mass variability and trends across the New Zealand–Antarctica chokepoint
12:30-12:45	172: Aissha Al Suwaidi Ferrar Large Igneous Province Link and impact on Early Jurassic Climate and Environment	112: Masao Iwai Collapse of Western Antarctic Ice Seat (WAIS) leaded that of EAIS during the warm Pliocene? – Diatom evidence from Amundsen Sea Site U1532 and Wilkes Land Site U1361

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12:45-13:00	180: Piotr Król Archean Assembly of the Napier Complex, east Antarctica: Insights from U–Pb Zircon Geochronology and Hf–O Isotopes	115: Terry Wilson Intensifying ice mass change in coastal West Antarctica documented by accelerating bedrock uplift
13:00 14:30	Lunch	
	Room1 S3	**Room 2 S2**
	Chair: Ingrid Hebel	**Chair: Cliff Atkins**
14:30-14:45	23: Anne Grunow The Polar Rock Repository: an underutilized, cross-disciplinary resource for biodiversity studies	117: Paul Winberry Passive Seismic Imaging of Subglacial Conditions on Thwaites Glacier
14:45-15:00	30: Lara Vimercati Unique Antarctic stromatolites reveal diverse taxa and metabolic complexity: implications for the early evolution of life	124: Jonathan Oberreuter Ice-thickness measurements from a 2023 Antarctic Peninsula airborne radar survey: Preliminary results
15:00-15:15	57: Tyler Mackey Microbial mat indicators of ecosystem resilience in Antarctic perennially ice covered lakes	130: Rebecca Totten A first look at newly ice-free environments of the Amundsen Sea, Antarctica: Multiproxy analysis of seafloor samples from the Thwaites Offshore
15:15-15:30	71: Peter Convey Regionalisation and palaeoendemism typify most Antarctic terrestrial fauna across Antarctic Conservation Biogeographic regions and beyond	
15:30-16:00	Coffee break	

SIDE EVENTS

16:00 18:00	SE8: EG GEOCON	ROOM 1

16:00 18:00	SE2: SCAR - Groundwater action group meeting	ROOM 2

Thursday

09:00-09:45	Plenary lecture 6 Naresh Chandra Pant GeoEAIS- Exploring Subice geology of Amery Ice Shelf, East Antarctica
09:45-10:30	Plenary lecture 7 Linda Ambrecht Reading the ancient ocean: How sedimentary ancient DNA (sedaDNA) can be used to characterise Antarctic ecosystems
10:30-11:00	Coffee break

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	Room 1 S3	Saloon 2 S2
Chair	**Chair: Peter Convey**	**Chair: Francisco Fernandoy**
11:00-11:15	78: Saurav Dutta Isotopic and Morphological Responses to the Eocene-Oligocene Transition in Antarctic Shelf Molluscs	141: Jennifer Villarroel Characterization of Tidal Currents in the Western Antarctic Peninsula: An Integrated Approach Combining Numerical Modeling and Observations
11:15-11:30	80: Javier Gelfo Assesing Biases and patterns between the Antarctic and Patagonian land-mammal fossil records	167: Kirsty Tinto Geological controls on ice sheet flow from combined onshore-offshore assessment of geophysical data in the Amundsen Sea.
11:30-11:45	88: Carolina Acosta Meet the Antarctic giant: The world's largest penguin skull ever discovered	
11:45-12:00	105: Carla Salinas Environmental DNA Metabarcoding Reveals Biodiversity and Potential Non-Native Species in a Warming Antarctic Coastal Ecosystem	173: María Paz Escalona Antarctic Monitoring and Modeling of the Meteorological Service of the Chilean Navy
12:00-12:15	121: Luzmila Rodriguez Spatial Variability of Chlorophyll-a in the Bransfield Strait, Antarctica, During the Austral Summers of 2024 and 2025	183: Bemer Relating sea surface temperature changes to the reduction of glacial cover on the Arrowsmith Peninsula, Antarctica, between 1991 and 2023
12:15-12:30	123: Catalina Pardo Pre-epidemic long-term influenza virus surveillance in the Chilean-Antarctic axis reveals the dynamic circulation of endemic and introduced strains	187: Natalia Varela Multiproxy Detection of Subglacial Meltwater Plumes offshore of East Antarctica
12:30-12:45	132: Leandro Martinez Fossil leaves and woods remains from Potter Peninsula, King George Island (25 de Mayo), Antarctica	
12:45-13:00	135: Maeva Sanchez	

	Spatio-temporal variability of echinoderm assemblages in soft-bottom habitats of Mackellar Inlet (Antarctica): A decade of monitoring (2010-2024)	
13:00 14:30	Lunch	
	Room 1 S4	**Room 2 S2**
	Chair: Jorge Carrasco	**Chair: Cristobal Emifork**
14:30-14:45	143: Albert Wang Visible Light Communications Facilitating Antarctic Earth Sciences and Ecosystem	190: Ricardo Jaña ConGlaBe: Contrasting glacier behaviour in southernmost South America and northernmost Antarctica in response to climate change
14:45-15:00	2: Ajay Kumar Sentinel-1A and SBAS-InSAR Reveal Accelerating Permafrost Degradation in Rock Glaciers	194: Kenichi Matsuoka Quantifying Knowledge Gaps in Subglacial Topography to Refine Subglacial Hydrology and Ice Discharge Estimates, and Survey Requirements for Antarctic RINGS Missions at the Ice Sheet Margin
15:00-15:15	52: Patrick Schwarzbach Updates of the International Bathymetric Chart of the Southern Ocean (IBCSO)	195: Kenichi Matsuoka Ice sheet discharge constrained by RINGS airborne surveys of bed topography in Dronning Maud Land and Enderby Land
15:15-15:30	64: Uday Sharma Permafrost dynamics in Schirmacher Oasis, cDML, Eastern Antarctica – Inferences from inhouse developed low cost Thermoprobe based monitoring system	197: Francisco Fernandoy Current state and partial collapse of Müller Ice Shelf, Antarctic Peninsula Visible Light Communications Facilitating Antarctic Earth Sciences and Ecosystem
15:30-16:00	Coffee break	

SIDE EVENTS

16:00 18:00	SE3: SCAR action group ICEPRO	Room 1

16:00 18:00	SE4: SCAR action group PRAMSO (ocean drilling)	Room 2

18:00 20:30	SE6 - AGE	ROOM 1

Friday

09:00-09:45	Plenary lecture 8 Weisen Shen Listening to the Frozen Continent: Dense Seismic Arrays, Hidden Waters, and a Vision for a Continental-Scale Network
09:45-10:30	Plenary lecture 9 Joaquín Bastías The tectonomagmatic evolution of the Antarctic Peninsula

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10:30-10:45	Closing Ceremony
10:45-11:15	Coffee break

	Room 1 S4	Room 1 S3
Chair	**Chair: Felipe Napoleoni**	**Chair: Catalina Pardo**
11:15-11:30	126: Manuel Bravo Sepúlveda Observations of Ionospheric Disturbances over King George Island, Antarctica, and Concepción, Chile: 1986–1991	136: Aziz Khan Effect of Extreme Environment and Isolation on Subjective Time Estimation in Antarctica During Summer: A Cross-Sectional Investigation
11:30-11:45	131: Lorena Rebolledo The Importance of Long-Term Monitoring in the Subantarctic and Antarctic Zones	145: Zambrano Extreme cold to frozen temperatures during the Early Cretaceous, evidenced by the discovery of glendonite in the Zapata Formation, southernmost Chile.
11:45-12:00	191: Hongjie Xie Detection of multi-year ex-fast ice in the Weddell Sea, Antarctica, using ICESat-2 satellite altimeter data	177: Marcelo Leppe Cretaceous Climate Shifts, Angiosperm Dominance, and the Fate of Southern Biotas
12:00-12:15	198: Sebastián Marinsek Glacier and climate real-time monitoring with 3g/4g and satellite devices	181: Ingrid Hebel Do Two Species of the Dicranaceae Family Relate to Recently Deglaciated Areas in Fildes Peninsula, Maritime Antarctica?
12:15-12:30		
12:30-12:45		
12:45-13:00		
13:00	Lunch	

XIV International Symposium on Antarctic Earth Sciences

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