The Texel-Schneeberg boundary in the Pfossen valley (Merano, NE Italy): geological-structural map and explanatory notes

Stefano Zanchetta (*)

ABSTRACT

The Schneeberg Complex (Merano, NE Italy) was traditionally distinguished from the surrounding Austroalpine basement on the base of its peculiar lithological association made of garnet-rich metapelites, calc-schists, paragonite amphibolites and garnet-amphibole schists, locally with megablasts of garnet and amphibole. As the Schneeberg Complex is considered to be a monometamorphic unit with Alpine metamorphism only, its southern boundary with the polymetamorphic Texel Complex is a key-element in deciphering the tectono-metamorphic evolution of the Austroalpine basement in the western sector of the Eastern Alps.

On the base of the field structural analyses the two units display a common structural evolution at least from the Alpine amphibolite facies event (D_2 in our reconstruction). In the upper Pfossen valley the marbles, amphibolites and garnet mica schists succession forming the external part of the Schneeberg Complex are folded together with the Texel metapelites in tight structures with step axes, known as «Schlingen» folds. These peculiar structures are due to the D_2-D_3 folds interference pattern. The results of the structural analysis in the study area are almost coherent with recent interpretations that propose the entire Schneeberg Complex to represent a greenschist facies crustal scale shear zone (SNFZ, Schneeberg Normal Fault Zone) along which the Texel Complex, containing rocks with eclogitic relics of Alpine age, have been exhumed with a SE direction, starting from the late Cretaceous times.

KEY WORDS: *Schneeberg Complex, Texel Complex, structural correlation.*

RIASSUNTO

Il limite fra il Complesso di Monteneve e il Complesso di Tessa nell'alta Val di Fosse (Merano, NE Italia): carta geologico-strutturale e note illustrative.

Il Complesso di Schneeberg (o Monteneve, Merano, NE Italia) è stato tradizionalmente distinto dal circostante basamento metamorfico Austroalpino sulla base della sua peculiare associazione litologica costituita da micascisti a granato, calcescisti, anfiboliti a paragonite e scisti anfibolici a granato, localmente caratterizzati da porfiroblasti di granato ed anfibolo di grana notevole (fino a 10-15 cm). Il limite meridionale del Complesso di Monteneve con il basamento polimetamorfico del Complesso di Texel (o Tessa) riveste un'importanza fondamentale nel contesto dell'evoluzione Alpina di questo settore di catena delle Alpi Orientali dato che, sulla base degli studi fino ad ora esistenti, il Complesso di Schneeberg è stato fino ad ora considerato come un'unità monometamorfica, con metamorfismo di età Alpina.

Le analisi strutturali svolte sul terreno, a corredo della carta geologica allegata, hanno evidenziato un'evoluzione strutturale in comune alle due unità almeno a partire dall'evento metamorfico in facies anfibolitica (associato alla fase deformativa D_2 nella presente ricostruzione) di età Alpina. In contemporanea all'evento in facies anfibolitica e alla fase D_2, le due unità sono state tettonicamente ac-

coppiate, come evidenziato dalla presenza di miloniti sin-D_2 al contatto meridionale fra Schneeberg e Texel. Nel settore superiore della valle di Fosse la parte marginale del Complesso di Schneeberg, è stata successivamente ripiegata insieme al basamento di Tessa a formare pieghe a laccio ad asse quasi-verticale, note come «Schlingen». Queste particolari strutture risultano dall'interferenza fra i sistemi di pieghe D_2 e D_3. I risultati derivanti dalle analisi strutturali si inseriscono coerentemente nei modelli recentementi proposti che interpretano l'intero Complesso di Monteneve come una zona di taglio estensionale sviluppata su scala crostale (Schneeberg Normal Fault Zone, SNFZ), lungo la quale il sottostante basamento dell'unità di Texel, contenente eclogiti di età Alpina, è stato esumato in direzione SE a partire dal Tardo Cretaceo.

TERMINI CHIAVE: *Complesso di Schneeberg, Complesso di Texel, correlazione strutturale.*

INTRODUCTION

Since the works of HAMMER (1912) and SANDER (1921) the southern boundary between the crystalline basement of the Texel Complex (TC), in those times considered part of the Ötztal-Stubai complex, and the Schneeberg Complex (SC) has been strongly debated. While the northern boundary of the SC is almost clear, locally characterised by brittle structures indicating the presence of a normal fault between the SC and the Ötztal-Stubai basement to the north, the southern one is not well defined and the Schneeberg Complex was traditionally distinguished form the surrounding Austro-alpine polymetamorphic basement on the base of petrographic criteria (MAURACHER, 1981; HOINKES *et alii*, 1987 for a review).

Recently SÖLVA *et alii* (2005) proposed the existence of a crustal scale extensional shear zone (SNFZ: Schneeberg Normal Fault Zone), including the whole SC, responsible for the SE-directed extrusion of the eclogites-bearing Texel Complex during the Late Cretaceous. Some evidence of such shear zone are present along the northern slope of the Pfelders valley whereas, moving westward, the shear zone disappears and the TC-SC boundary is highlighted only by the peculiar lithologies of the external part of the SC.

The aim of this work is to analyse in detail the tectonic evolution of the two units close to the SW termination of the SC (upper Pfossen, Lazins, Ziel and Pfelders valleys) where the existence of complex fold interference pattern highlighted by reliable structural markers (marbles, calc-schists and amphibolites layers interbedded with gneiss and mica schists) give the opportunities to solve the structural relationships and the succession of deformation events that affected the two units.

(*) Dipartimento di Scienze Geologiche e Geotecnologie - Università degli Studi di Milano Bicocca - Piazza della Scienza, 4 - 20126 Milano, Italy. Tel.: +39 0264482063 - e-mail: stefano.zanchetta@unimib.it

Fig. 1 - Tectonic scheme of the Alpine orogenic belt (*a*) and of the western sector of the Eastern Alps with the study area. SLG u.: San Leonhard-Jaufen unit; C.u.: Cervina unit; SV u.: Schenna-Verdins unit; MTS: Marlengo Tectonic Slice; SNFZ: Schneeberg Normal Fault Zone; PSCB SZ: Pennes-Stilves-Corno Bianco Shear Zone; MSZ: Masul Shear Zone; PL: Periadriatic Lineament; NGL: North Giudicarie Line. Grey striped area are ductile to brittle shear zones.
– *Schema tettonico della catena Alpina* (b) e del settore occidentale delle Alpi Orientali. SLG u.: unità di San Leonardo-Giovo; C.u.: unità di Punta Cervina; SV u.: unità di Scena-Verdins; MTS: Scaglia Tettonica di Marlengo; SNFZ: zona di taglio estensionale di Schneeberg (Monteneve); PSCBSZ: zona di shear di Pennes-Stilves-Corno Bianco; MSZ: zona di taglio di Rio Masul; PL: Lineamento Periadriatico; NGL: Linea delle Giudicarie Nord. In barrato grigio le zone di taglio fragili/duttili.
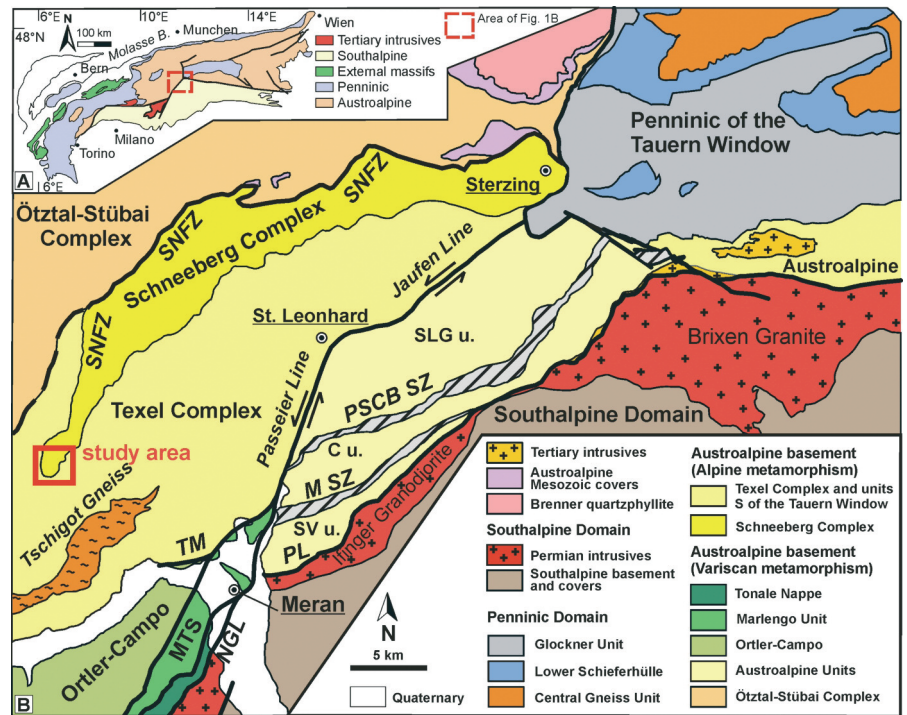
GEOLOGICAL OUTLINE

The Schneeberg and the Texel complexes belong to the basement units of the southern Austroalpine domain of the Eastern Alps (fig. 1a and 1b). In the area comprised between the Tauern Window to the west, the Engadine Window to the east and the North Giudicarie Fault to the south, the Austroalpine domain consists of a series of tectono-metamorphic units with distinct evolutions and age of metamorphism. In its southern portion it consists of several subunits comprised between the northern boundary of the Schneeberg Complex (SÖLVA *et alii*, 2005) and the Periadriatic Lineament to the south. The Tertiary Passeier and Jaufen lines (SPIESS, 1995; HOINKES *et alii*, 1999; VIOLA *et alii*, 2001) separate basement units with a pre-Alpine age of metamorphism to the east and south east and basement units with a dominant Alpine metamorphism to the west.

The fault system separating basement with Variscan metamorphism only and units with an Alpine overprint extends towards the east with the Deferrengen-Antholz-Vals lines (DAV) and represents, south and west of the Tauern Window, the Southern limit of Alpine Metamorphism (SAM; HOINKES *et alii*, 1999). The pre-Alpine basement east of the Passeier Line and south of the Jaufen Line is composed by several NE-SW trending units with different metamorphic imprint. From north to south they are: the San Leonhard-Jaufen (San Leonardo-Giovo) Unit, the Hirzer (Cervina) Unit and the Schenna-Verdins (Scena-Verdins) Unit. The San Leonhard basement chiefly consists of partly retrogressed garnet-staurolite gneisses, in part derived from a granitic protolith; this unit is bound to the north by the normal sinistral strike-slip Jaufen fault and to the south by the Pennes-Stilves-Corno Bianco shear zone, a several hundreds of metre-thick mylonitic-cataclastic shear zone with entrapped slices of unmetamorphosed Permo-Mesozoic sediments. Within the Pennes-Stilves-Corno Bianco shear zone a

level of muscovite-biotite gneisses with peculiar rounded albite porphyroblasts of several centimetres in diameter occurs. The Hirzer Unit consists of garnet-kyanite-staurolite gneisses, with minor mica schists, amphibolites and granitic gneisses. The Hirzer basement is bound to the south by the Rio Masul shear zone, composed of muscovitic schists, banded gneisses, leucocratic gneisses and minor amphibolites, marbles and pegmatites, all of them displaying mylonitic fabric and locally interested by cataclastic fault zones. The Rio Masul shear zone turns from an WSW-ENE trend close to the Passeier Line to a SW-NE direction moving eastwards, finally joining to the Periadriatic Lineament about 12 km east of the Passeier valley. The basement comprised between the Rio Masul shear zone to the north and the Periadriatic Lineament to the south is here referred as the Schenna-Verdins Unit. It is mainly composed of garnet-staurolite-sillimanite gneisses and mica schists with minor amphibolites, amphibolic gneisses and marbles. The presence of sillimanite replacing garnet and of K-feldspar within garnet-biotite gneisses, indicates the attainment of higher temperatures with respect to the Hirzer and the S. Leonhard units during the Variscan evolution.

The Austroalpine basement comprised between the Schneeberg Complex to the north, the Passeier and Jaufen lines to the east (VIOLA *et alii*, 2001) and the Vinschgau Shear Zone (SCHMID & HAAS, 1989) to the south, is referred as the Texel Complex (TC) or Texel Group (SÖLVA *et alii*, 2005). The Texel Complex displays a polyorogenic metamorphic evolution with dominant amphibolite facies imprint of Alpine age (SPALLA, 1993; HOINKES *et alii*, 1999; SÖLVA *et alii*, 2005 and ref. incl.). The basement of the TC consists mainly of garnet-staurolite-kyanite mica schists and gneisses with minor amphibolites and marbles. Eclogites are preserved as small boudins within garnet amphibolites in several localities, e.g. Saltaus (HOINKES *et alii*, 1991; HABLER *et alii*, 2006), Moos (POLI, 1991) and Ulfas (ZANCHETTA, 2007). Addi-
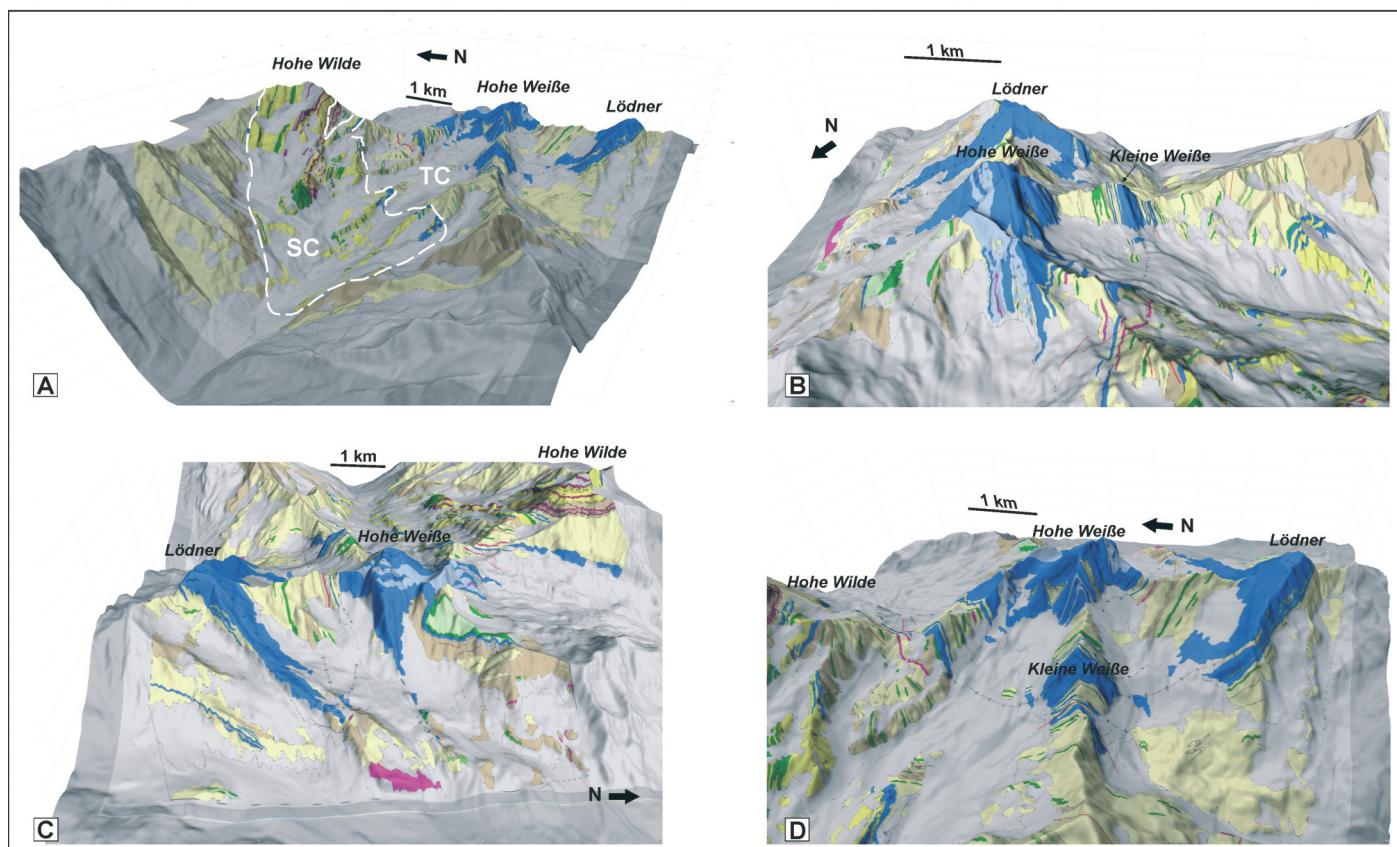
Fig. 2 - The geological map draped on 2.5 m resolution DTM (Digital Terrain Model, courtesy of Provinz Autonome Bozen): (*a*) View of the whole area with, in white, the inferred boundary between the Schneeberg (SC) and Texel (TC) complexes; (*b*) The Lödner-Hohe Weiße structure highlighted by the marble layers, view from North; (*c*) The upper Lazins valley, view from East; (*d*) The upper Pfossen and Tel valleys, view from West.
– *Carta geologica drappeggiata sul DTM con risoluzione a 2.5 m (Modello Digitale del Terreno, per concessione della Provincia Autonoma di Bolzano):* (a) *Vista dell'intera area con, in bianco, il limite interpretato fra il Complesso di Schneeberg (SC) e il Complesso di Texel (TC);* (b) *La struttura Cima Fiammante-Cima Bianca Grande evidenziata dall'andamento dei livelli di marmi, vista da Nord;* (c) *La parte superiore della valle di Lazins, vista da Est;* (d) *La parte superiore delle valli di Fosse e Tel, vista da Ovest.*

tionally, garnet amphibolites containing diopside+plagioclase or amphibole+plagioclase symplectites are widespread throughout the complex. HOINKES *et alii* (1991) indicate minimum pressures of 1.1-1.2 GPa at 500-550 °C; higher temperatures (700 °C) were suggested by POLI (1991). SPALLA (1993) reported a high pressure event also within the metapelites of the Texel Complex in the upper Spronser valley, where pressure of 1.1-1.2 GPa and temperature of 640-680 °C are suggested for the syn-D_1 metamorphic event. Recent U-Pb data on zircon (ZANCHETTA *et alii*, 2007) and garnet Sm-Nd data (HABLER *et alii*, 2006) constrain the eclogite facies event at 85 ± 4 Ma and 84 ± 5, respectively.

The Schneeberg Complex includes quartz-rich mica schists with centimetric garnets, garnet and carbonate amphibolites, calc-schists, graphite-rich schists, amphibolic schists with centimetric hornblende crystals («Garbenschiefer» Auct.), marbles levels several metres thick and garnet-bearing quartzites. The transition between the Texel and the Schneeberg Complexes is marked by the so called «Laas Serie», due to its similarity to the rocks serie cropping out north of Lasa, in the Vinschgau valley. The Laas Serie (HOINKES *et alii*, 1987) is made of massive marble layers, up to 150-200 metres thick, garnet-staurolite mica schists, paragneisses and minor amphibolites and quartzites. The rocks of the Laas Serie have been pre-

viously alternatively attributed to the Schneeberg Complex or the Texel Complex.

The SC has been traditionally considered as a monometamorphic unit, derived from an autochthonous Paleozoic sedimentary sequence of the Ötztal-Stübai domain, that experienced Alpine metamorphism only (HOINKES *et alii*, 1987), with peak metamorphic conditions close to the eclogite-amphibolite facies boundary at 0.8-1.0 GPa and 550-600 °C (KONZETT & HOINKES, 1996).

METHODS AND GEOLOGIC MAPPING CRITERIA

The study area has been mapped at a 1:5.000 scale. The results of the field work are summarized in the attached geological-structural map at the 1:10000 scale (plate 1) and in the 3D representation of the study area in fig. 2. Structural analysis at the meso-scale has been performed to unravel the tectonic sequence of events (TURNER & WEISS, 1963; HOBBS *et alii*, 1976; RAMSAY & HUBER, 1987). In complex areas of an orogen axial belt, where large scale deformation took place, finite strain distribution can result extremely heterogeneous and it is not always possible to determine one single sense of displacement and the prevailing deformation mechanism at local scale, as a result of polyphase tectonic imprints.

Therefore the reconstruction of the structural pattern of the area and of the relative succession of the different deformation events, requires the individuation of different structural domains where the signatures of prevailing progressive shortening (pure shear) or prevailing progressive shearing (simple shear) are dominant. Finite strain partitioning in a poly-deformed area may result in domains where the oldest deformation structures occur and domains where the successive transpositions due to the late deformation events have completely obliterated the imprints of earlier stages; the individuation of such domains is the key-step in the reconstruction of the structural evolution.

Lithologies have been classified and consequently mapped using macroscopic mineralogical and structural characters, with no use of differentiations based on microscopic features.

LITHOLOGY

In the following paragraphs a field description of the mapped lithogies is provided, comprehensive of all the characters directly observable in the field. A brief description of the relations between mineral growth and fabric elements as determined through microstructural analysis is given for the metapelites of the Schneeberg and Texel complexes.

TEXEL COMPLEX

In the study area the polymetamorphic basement of the Texel Complex consists of mica schists and paragneiss, with minor amphibolites, amphibole gneisses, quartzites, calc-schists and marbles. The lithologic association of interbedded marbles, calc-schists and mica schists was referred as the «Laas Serie» or «Laaser Serie» since the work of HAMMER (1912) due to its similarity to the Ortler-Campo basement in the area of Laas (Vinschgau valley). In the literature marbles and mica schists of the *Laas Serie* have been usually attributed to the SC, mainly on the base of the presence of marbles and calc-schists that represent common lithologies in the external part of the SC, while they are rare in the TC. In this work we chose to attribute the rocks of the *Laas Serie* Auct. to the TC as their petrographic features, particularly in metapelites and metapsammites, and recorded structural evolution, closely match the ones of the Texel basement and present important differences with the SC ones. Moreover, in the eastern part of the study area, the TC-SC boundary is clearly marked by a ductile shear zone, developed at amphibolite facies conditions, that separates mica schists and marbles of the TC from the peculiar lithological assemblage of the external part of the SC.

Mica schists

Mica schists are medium to fine grained rocks, with garnet and biotite phorpyroblasts embedded in a sericitic matrix. Garnet, biotite, white mica, plagioclase, quartz, tourmaline and rare staurolite are well recognizable in the field. The mineralogy, determined in thin sections, is: white mica, biotite, quartz, plagioclase, garnet, staurolite, kyanite, chlorite and accessory phases such as tourmaline, apatite, rutile, ilmenite and zircon. The mica schists

display a S-tectonitic fabric, with a pervasive axial plane foliation, marked by the shape preferred orientation of white mica and biotite. Refolded centimetre-thick quartz layers and lenses are quite common, attaining in some outcrops 15% of the total volume of the rock. Within D_3 fold hinge zones a strong crenulation of the S_2 foliation occurs, associated with a well developed crenulation lineation in phyllosilicate-rich layers. Garnet forms euhedral and sub-euhedral phorpyroblasts usually with diameter of a few millimetres. Close to the SC-TC boundary a generation of ellipsoidal garnets is found in the Texel rocks; in thin sections these garnets result to be formed by agglomerates of small, often submillimetric, rounded garnet crystals (SPIESS *et alii*, 2001). Within D_4 decimetre-thick shear zones and kink bands, garnets are almost completely replaced by chlorite. Biotite porphyroblasts reach 2-3 mm in size. Tourmaline crystals are quite rare; they are 7-8 mm in length, always laying on the S_2 plane and are frequently boudinaged; rare small sub-millimetric garnets are included within tourmaline porphyroblasts.

The relationships between minerals growth and deformation events have been reconstructed by a microstructural study of thin sections. As previously discussed, the most pervasive fabric element at the micro- and mesoscale is the S_2 axial plane foliation marked by Bt_{II} and Wm_{II} (mineral abbreviation as in KRETZ, 1983, except for Wm: white mica). Kyanite and staurolite are seen to be stable during all the D_2 deformation event with Ky growing early- to syn-S_2, whereas St was observed to be mainly syn- to post-S_2. Garnet porphyroblasts display a polyphase growth, with an inner, inclusion-rich, pre-D_2 core (Grt_I) surrounded by an overgrowth rim (Grt_{II}) developed syn-kinematically to S_2.

Typical mica schists outcrops occur in the Lazins valley and along the southern slope of the Pfossen valley.

Paragneisses

The two mica paragneisses are the most widespread lithology in the TC. The paragneisses are medium to fine grained, usually characterised by a banded texture, due to a mineralogical layering formed by alternating quartz-feldspar and mica-rich layers. Millimetric porphyroblasts of garnet and tourmaline are quite common, whereas staurolite is rare and often recognizable only in thin sections. Chlorite replaces biotite and garnet porphyroblasts whitin post-D_3 shear zones.

The mineralogy is made of quartz, plagioclase, biotite, white mica, garnet, staurolite, chlorite and minor apatite, rutile, ilmenite and zircon. Small crystals of kyanite occur in a few samples. The relationships between fabric elements and mineral growth are similar to those described for the mica schists, with garnet displaying a poly-phase growth during two main stages (pre-D_2 and syn-D_2). Kyanite and staurolite are syn-D_2, except for a couple of sample where pre-D_2 kyanite crystals were observed. White mica and biotite mainly grow syn-kinematically during D_2 (Wm_{II} and Bt_{II}). Wm_I and Bt_I crystals are commonly observed as porphyroclasts within S_2, with (001) cleavage traces at a high angle with S_2. No pervasive foliation is associated to the D_3 fold system; only in some cases (upper Lazins valley) a poorly defined cleavage derived from the de-crenulation of S_2 (stage 3 to 4 of BELL & RUBENACH, 1983; BELL, 1986) was observed, defined by newly formed Wm_{III} and Bt_{III}.
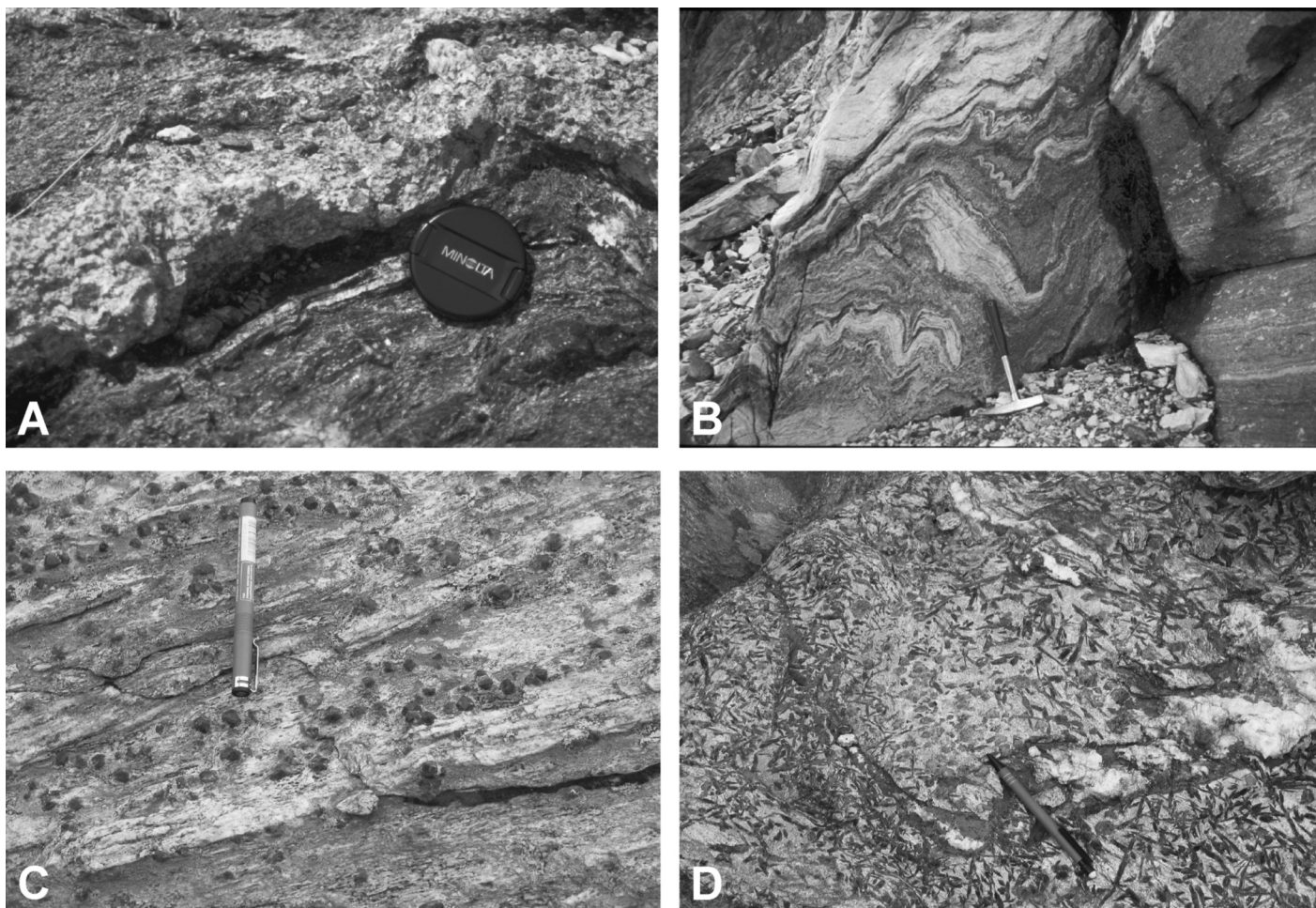
Fig. 3 - Example of common lithologies cropping out in the study area: (*a*) Amphibolic gneiss of the Texel Complex with typical plagioclase-garnet layers, upper Lazins valley; (*b*) Calc-schists of the Texel Complex interested by D$_3$ folds, with interbedded carbonates and phyllosilicates-rich layers, Grafen Peak; (*c*) Schneeberg mica schists containing centimetre-sized garnet porphyroblasts with idiomorphic habit; (*d*) Post-D$_2$ growth of garnet and amphibole porphyroblasts at the contact between mica schists and carbonate amphibolites of the Schneeberg Complex. – *Alcuni esempi dei principali litotipi affioranti nell'area di studio:* (a) *Gneiss anfibolici del Complesso di Texel con caratteristici livelli a soli plagioclasio e granato, alta valle di Lazins;* (b) *Calcescisti del Complesso di Texel con livelli a carbonati e livelli ricchi in fillosilicati, l'alternanza rende ben visibili le pieghe D$_3$ che interessano l'affioramento, Cima Grava;* (c) *Micascisti del Complesso di Schneeberg con porfiroblasti centimetrici di granato avente abito idiomorfo;* (d) *Crescita statica post-D$_2$ di granato ed anfibolo al contatto fra i micascisti e le anfiboliti a granato del Complesso di Schneeberg.*

Quartzites

Quartzites occur as some metres thick layers, mainly interbedded with mica schists. Small amounts of submillimetric white mica, together with chlorite, plagioclase and oxides, are usually present. The quartzites display a S-tectonitic fabric with a locally well developed SPO (shape preferred orientation) of quartz crystals and iso-orientation of white mica along the main foliation planes.

Amphibolites and garnet amphibolites

The amphibolites are medium to fine grained rocks with a typical banded texture due to the mineralogical layering consisting in alternating amphibole- and plagioclase-rich bands. The mineralogy consist of: amphibole, plagioclase, clinozoisite/zoisite, biotite, titanite, rutile, apatite and rare zircon. Garnet porphyroblasts reaching 10 mm in diameter are present in some levels. Within the amphibole-rich levels the S$_2$ regional foliation is marked by a preferred orientation of amphibole and biotite; the S$_2$ foliation is always parallel to the banding except in some boudins where a small angle is observed between the mineralogical layering of amphibolites and the external S$_2$ of mica schists or paragneisses wrapping around the boudins, suggesting that foliation and mineralogical layering within amphibolites levels possibly represents a re-orientation of pre-D$_2$ structures. Garnet amphibolites show the same textural characters of the previous rock types. A metasomatic corona made of plagioclase and garnet marks the contact between the amphibolites and the surrounding paragneisses and mica schists.

Amphibole schists

The amphibole schists crop out NE of the Grafen Peak, interbedded with calc-schists, mica schists and garnet amphibolites. The mineralogical association includes amphibole, plagioclase, garnet, biotite, quartz and minor amounts of white mica and rutile. The rock is medium- to fine-grained with porphyroblasts of amphibole and garnet reaching size of some millimetres. 5 to 10 centimetre-thick plagioclase and garnet layers locally occur (fig. 3a).

The main foliation (S_2) is marked by the preferred orientation of amphibole and biotite.

Calc-schists

Calc-schists and marbles are characteristic of the *Laas Serie* Auct. The calc-schists crop out in some decimetre- to several tens of metre-thick layers, alternated with marbles, mica schists and amphibolites. They constitute most of the Grafen Peak in the NE part of the area and are interbedded with the marble layers of the Höhe Weiße. The calc-schists are characterized by alternating calcite-rich and mica-rich layers (fig. 3b); within carbonate levels epidote and diopside are common accessory minerals, while plagioclase, chlorite, tremolitic amphibole and quartz are present in the mica-rich layers.

On the south face of Grafen peak, within the calc-schists, some metric boudins of peculiar calcsilicate rocks occur. These rocks are coarse grained and composed of diopside, titanite, quartz, amphibole and garnet. Single idioblastic crystal of titanite with a barrel-shaped crystallographic habit reach 5-6 cm in length.

Marbles

Several hundreds of metre-thick marble layers form the summits of the Höhe Weiße, Kleine Weiße and Lödner peaks. The marbles are mainly calcitic; some decimetre-thick, light pink coloured, dolomitic layers occur on the SE face of the Lödner Peak in the upper Lazins valley. White mica, quartz, chlorite and epidote are common accessory mineralogical phases.

SCHNEEBERG COMPLEX

The Schneeberg Complex or «*Schneeberger Geisteinzug*» (SANDER, 1921), was traditionally distinguished from the surrounding Austroalpine basement for its peculiar lithological assemblages, especially in the the so called «*Heterogeneous Marginal Zone*» or «*Bunte Serie*» (MAURACHER, 1981), where interbedded coarse grained amphibolites, mica schists with gigantic garnets, calc-schists, marbles and garnet quartzites occur. The central part of the complex is instead made of sericitic mica schists (the «*Monotonous Serie*» Auct.), locally resembling phyllites with a dark grey colour. Most of the lithologies cropping out in the study area belong to the external part of the SC.

Mica schists

The mica schists belonging to the SC are medium to coarse grained, with centimetric porphyroblasts of garnet, biotite and, locally, amphibole. The mineralogy consists of white mica, biotite, quartz, plagioclase, garnet, staurolite, kyanite, epidote/allanite, rutile, graphite, ± titanite, ± amphibole, ± calcite, ± apatite. The fabric is S-tectonitic, with a pervasive foliation (S_2) marked by biotite and white mica. The centimetre-sized (over 2 cm in diameter) porphyroblasts of garnet are usually euhedral, often showing a rombododecahedric crystallographic habit. Garnets are abundant, often constituting the 7-8% in volume of the whole rock. Within 2-3 m from the contact between the mica schists and the garnet amphibolite boudins, centimetric, up to 10 cm long, amphibole porphyroblasts grow

post-kinematically with respect to the main (S_2) foliation (fig. 3b and fig. 3c). The presence of amphiboles within the mica schists is often accompanied by calcite and small crystals of titanite, sometimes replaced by epidote + rutile + quartz aggregates. The amphibole- and garnet-rich mica schists are known in the literature as «*Garbenschiefer*» or «*Horneblendegarbenschiefer*». Commonly biotite (Bt_{IV}) is seen to replace former amphibole porphyroblasts.

White mica (Wm_I) and Bt (Bt_I) porphyroclasts are preserved as relics generally oriented parallel to S_2 but with (001) cleavage planes at high a angle with respect to the foliation. Undulose extinction, kink bands and dissolved rims are common features both for Wm_I and Bt_I. Submillimetric white micas are also present as rare inclusions within pre-D_2 garnet cores, together with allanite, rutile, quartz and apatite. A second generation of white mica (Wm_{II}) and biotite (Bt_{II}) defines the S_2 foliation. A spaced axial plane foliation (S_3) associated to D_3 folds is locally developed and its growth is accompanied by the de-crenulation of the S_2 foliation (stage 3-4 of BELL & RUBENACH, 1983; BELL, 1986). The S_3 cleavage is mainly defined by the preferred orientation of sericitic white mica (Wm_{III}), in a few samples associated with a third generation of biotite, Bt_{III}. Staurolite and kyanite grow syn-kinematically with S_2 and usually display a shape preferred orientation parallel to the S_2 foliation. Inclusion trails of quartz, ilmenite and rare white mica, continuous with the external S_2 are a common feature in staurolite porphyroblasts, whereas kyanite is mainly inclusion-free. Garnet porphyroblasts show a complex growth history with at least three distinct stages. Almost inclusion-free garnet core (Grt_I) with irregular boundaries have been found in a few samples. Such cores are surrounded by a portion (Grt_{II}), usually representing more than 60% in volume of the porphyroblasts, that is rich in inclusions of rutile, quartz and graphite, with minor white mica (Wm_I) and allanite. The inclusions define an internal foliation, tentatively assumed to correspond to S_1, at a high angle with respect to the external S_2. Grt_{II} displays an euhedral to subeuhedral habit with the outer rim highlighted by concentration of randomly oriented rutile, quartz and graphite. An outer rim (Grt_{III}), almost inclusion-free, is often present. The relations between the S_2 foliation and the Grt_{III} rim of garnet porphyroblasts suggests a late- to post-D_2 growth of Grt_{III}.

The Schneeberg mica schists crop out widely on the northern slope of the Pfossen valley, while the garnet- and amphibole-rich ones are visible along the path running at the bottom of the valley, between 2300 m and 2450 m.

Graphitic schists

Graphite rich schists are common in the *Bunte Serie* or «*Heterogeneous Marginal Zone*» of the SC (MAURACHER, 1981). They are composed mainly of quartz, plagioclase, white mica and biotite, garnets are rare. Finely dispersed submillimetric clusters of graphite attribute a dark grey colour to the rock. The graphitic schists crop out in several metres thick layers in Pian del Catino, south west of the Höhe Wilde.

Garnet quartzites

Quartzites levels are interbedded with the Schneeberg mica schists and the graphitic schists. Small amounts of submillimetric white mica, together with chlorite, plagioclase
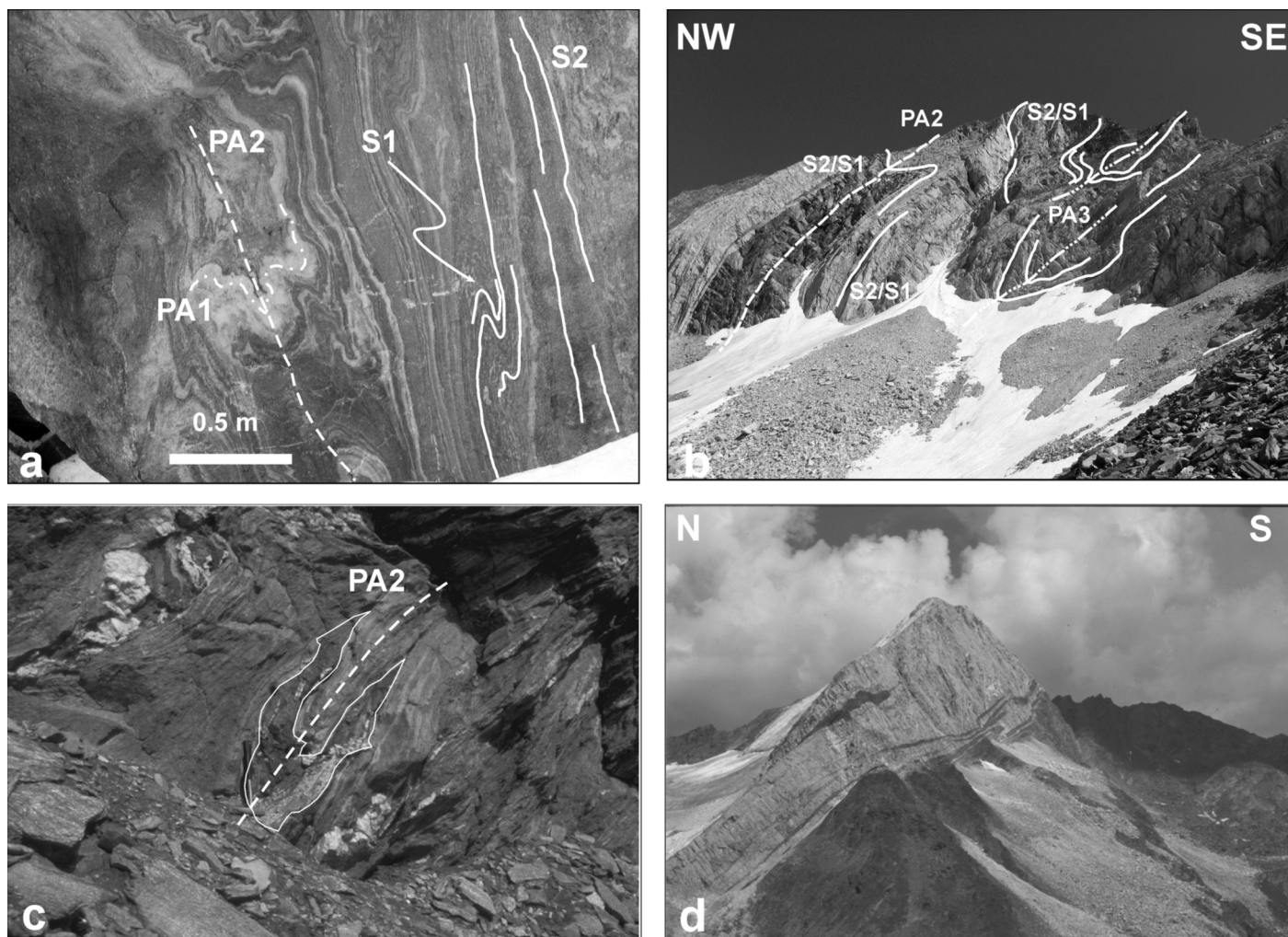
Fig. 4 - (*a*) Relict D_1 folds and S_1 axial plane foliation within the main foliation S_2. D_1 relics are well recognizable in mica-poor lithologies and calcschists, like in this case; (*b*) SW face of the Hohe Weiße. D_1 and D_2 structures are responsible for the lithological layering, later refolded by SE-vergent D_3 folds; (*c*) An amphibolite boudin interested by a D_2 fold; (*d*) Complex D_1-D_2 structures on the SW face of the Lodner Peak. The mica schists layers, several metres thick, interbedded within the massive marbles underline the D_1 folds refolded during the D_2 event.
– (a) *Pieghe D_1 e foliazione S_1 relitte preservate all'interno della foliazione principale S_2;* (b) *Parete SW della Cima Bianca Grande. Le strutture D_1 e D_2 sono responsabili della ristrutturazione del layering litologico, successivamente ripiegato dal sistema di pieghe D_3 vergente verso SE;* (c) *Boudin di anfiboliti deformato da una piega D_2;* (d) *Complesse figure di interferenza D_1-D_2 sulla parete SW della Cima Fiammante. I livelli di micascisti, spessi alcuni metri, intercalati ai massivi livelli di marmo individuano i relitti delle strutture D_1.*

and oxides, are usually present. The main characteristic is the presence of euhedral garnet porphyroblasts up to 10-15 mm in diameter. The garnet quartzites crop out just below the summit of the Höhe Wilde and in the Pian del Catino area.

Amphibolites and garnet amphibolites

The amphibolites of the SC differ form the TC ones for being usually coarse grained, with garnet and amphibole porphyroblasts reaching size up to 2-3 cm for garnet and up to 10 cm for amphibole. Another difference is the presence of thin (1 to 20 mm thick) carbonatic layers alternating with amphibole- and plagioclase-rich ones. The mineralogy of the amphibolites is constituted by: amphibole, plagioclase, biotite, titanite, ± garnet, ± epidote, ± rutile, ± white mica.

Marbles and Calc-schists

Some metres thick marbles layers define the outer rim of the SC. The marbles are almost pure with only minor white mica and quartz. Calc-schists occur in small lenses and several centimetres to 1-2 metre-thick layers within garnet amphibolites and mica schists. Within calc-schists white mica, epidote, biotite and chlorite are present and often mesoscopically recognizable in the field.

FOLD, CLEAVAGE AND FAULT ANALYSES IN THE STUDY AREA

The SC is interpreted as a Paleozoic sedimentary succession with an Alpine tectono-metamorphic imprint (HOINKES *et alii*, 1987). Several radiometric data support this interpretation and constrain the age of the Eo-Alpine metamorphic event in the SC rocks around 85 Ma (KONZETT & HOINKES, 1996). However the structural relationship between the ÖSC, the TC and the SC, in the upper Pfelders and Pfossen valleys are still unclear. Eastward of the studied area GREGNANIN *et alii* (1995) proposed the existence of a tectonic structure, the Zermaid-
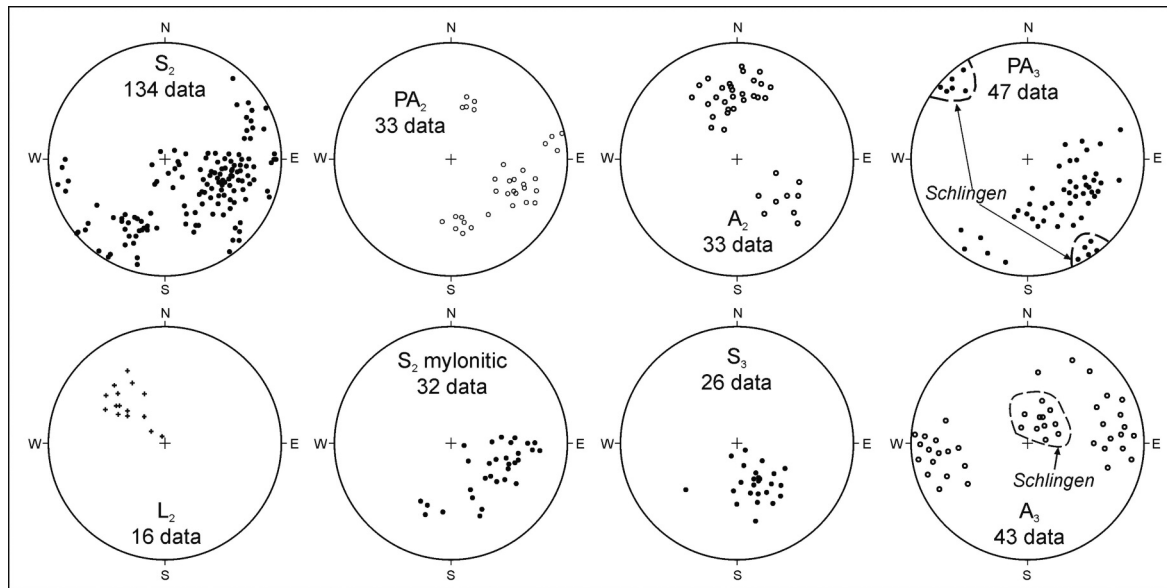
Fig. 5 - Equiareal stereographic projection of structural data, lower emisphere. Axial planes and foliations are projected as poles to planes. Data related to the «Schlingen» D_3 folds with steep axes of the SW termination of the Schneeberg Complex are highlighted. Structural data are referred to the whole study area.
– *Proiezioni stereografiche equiareali, emisfero inferiore, dei dati giaciturali dei principali elementi strutturali. Le foliazioni e piani assiali di pieghe sono rappresentati come poli ai piani. I dati relativi alle pieghe D_3 a «Schlingen» caratteristiche della terminazione SW del Complesso di Schneeberg sono evidenziati. I dati strutturali si riferiscono all'intera area cartografata.*

Weissen line, along which the SC overthrusted the TC basement with a prevalent «top-to-S-SE» direction. West of Moos the Zermaid-Weissen line vanishes and no evident tectonic lineaments are present at the SC-TC boundary. A recent work (SÖLVA *et alii*, 2005) suggests the existence of a thick normal fault zone, the Schneeberg Normal Fault Zone (SNFZ), which was active from pressure-dominated amphibolite facies (KONZETT & HOINKES, 1996) to brittle conditions. Along such a fault zone, affecting the whole of the SC, the eclogite facies rocks cropping out in the Texelgruppe have been exhumed with a «top-to-WNW» shear sense, that have been inferred on the base of the dominant asymmetry of structures (asymmetric clasts, flanking folds).

FOLD SYSTEMS AND CLEAVAGE ANALYSIS

At least four distinctive ductile deformation phases have been recognized. Three of these phases (D_1, D_2 and D_3) are associated with metamorphism.

D_1 – The D_1 structures, within the Texel Complex, occur as isoclinal folds up to decimetric in size or as a relic foliation preserved in the D_2 fold hinge zones.

The D_1 structures have been almost completely dissected and passively rotated by the subsequent deformation phases, without preservation of the original orientation. At the outcrop scale the transposition of D_1 structures by D_2 is visible in the alternating silicate-rich and carbonate-rich layers in calc-schists (fig. 4a).

Kilometre scale structures produced by the interference pattern of D_1 and D_2 folds are exposed near the summit of the Höhe Weiße and on its SE face in the upper Lazins valley. The interference pattern between D_1 and D_2 folds is of type 3 of RAMSAY & HUBER (1987), with almost parallel D_1-D_2 axes and axial planes at high angles. D_1 folds relics are also recognized on the SW face of the Löd-

ner Peak, where they are marked by thin mica schists layers interbedded within massive marbles (fig. 4d). The S_1 foliation, developed at amphibolite facies conditions, is marked by biotite and muscovite in mica schists, amphibole and biotite in mafic rocks, epidote and muscovite in calc-schists. Relics of S_1 are best preserved in mica poor lithologies, such quarzites, amphibolites and calc-schists, whereas they were not recognized, except at the scale of thin sections, in mica schists. Amphibolite boudins are locally deformed by D_2 folds, suggesting that boudinage is probably due to D_1 deformation event (fig. 4c).

In the basement rocks of the SC the pre-D_2 structures are hardly recognizable as the continuous S_2 foliation, locally mylonitic, tends to obliterate all pre-existing structures. Relics of a S_1 foliation are rarely preserved within D_2-folds hinge zone and rootless S_1 folds have been seldom observed within quartz-rich mica schist layers.

Along D_2 folds limbs the S_2 foliation in mica schists forms a small angle with lithological boundaries (S_L) of marble and quartzite levels. The continuity of the litostratigraphic boundaries is often interrupted as an effect of superposed D_1 and D_2 deformation structures.

From field analysis of fold systems and cleavages, a direct correlation between the S_1 relic structures of the TC and SC is not possible, and the D_1 deformational phase could be diachronous in the two basement units.

D_2 – The D_2 deformation phase is responsible for the development of isoclinal folds from outcrop to regional scale. An axial plane foliation, namely S_2, developed at amphibolite facies conditions, is the most pervasive fabric at the meso and micro scale. S_2 has a prevalent WNW dip direction with dip angles ranging from 30° to 90°. D_2 fold axes (A_2) show a trend between NW and NNE with highly variable plunges. The scattering of S_2 and A_2 attitudes is related to the reorientation effect of subsequent deformation phases, mainly to D_3 (fig. 5).
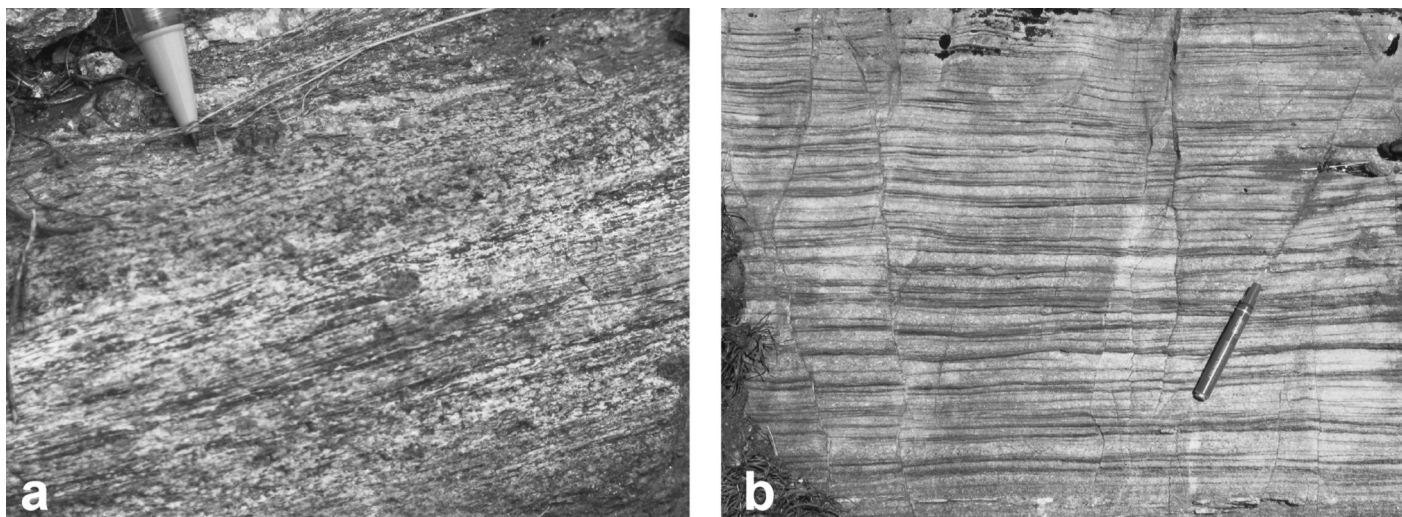
Fig. 6 - (a) Garnet-staurolite paragneiss of the Texel Complex with a mylonitic fabric. Shear zone close to the Texel-Schneeberg boundary, SW of the Hohe Wilde; (b) Mylonitic marbles. The thin black layers are mainly formed by white mica and quartz. NW of the Stettiner Hütte, along the path to the Hohe Wilde.
– (a) *Paragneiss a granato e staurolite del Complesso di Texel con fabric milonitico, zona di taglio in prossimità del limite Texel-Schneeberg, a SW dell'Altissima;* (b) *Marmi a silicati con foliazione milonitica. I livelletti neri sono formati prevalentemente da mica bianca e quarzo. NW del Rifugio Petrarca, lungo il sentiero per l'Altissima.*

The lithological layering, outside fold hinge zones, is parallel to S_2 and it is thought to have developed in response to the superposition of D_1 and D_2 deformational events.

Several mega scale structures belong to the D_2 fold systems, the most evident is the kilometre scale D_2 synform traced by the marbles of the Kleine Weiße and Lödner Peak (Zanchi *et alii*, 2009). Other megascopic D_2 structures are well visible on the SW and NW faces of the Höhe Weiße where interbedded mica schists and calc-schists form the core of an approximatively N-S trending antiform, later refolded during the D_3 event.

The S_2 foliation within the TC is marked by the preferred orientation of white mica and biotite in mica schists and paragneisses, biotite and amphibole in metabasites, epidote, white mica and rare diopside in calc-schists. The lithological layering (S_L) in massive amphibolites, paragneisses and calc-schists is parallel to the S_2 foliation.

Within SC garnet mica schist sericitic white mica grow syn-kinematically with S_2 together with the outer rim of garnet porphyroblasts and minor biotite. In the amphibole-bearing mica schists («*Horneblendegarben-schiefer*» Auct.) biotite replaced amphibole porphyroblasts during S_2 development, whereas a new generation of amphibole is seen to has grown late- to post-S_2.

The S_2 foliation displays a mylonitic character close to the TC-SC contact, on the northern slope of the Pfossen valley. Where the S_2 foliation becomes mylonitic a poorly developed L_2 mineralogical lineation is locally visible. L_2 is either marked by biotite millimetric flakes (q 2675 m, near Eisjochl) or by the iso-orientation of centimetric amphiboles in garnet amphibolites (between 2350 and 2450 m on the path running along the bottom of the Pfossen valley). L_2 is set at a very small, but clearly distinguishable, angle with the D_3 crenulation axes. The L_2 trend is roughly constant around 310°, with plunge ranging from 35° to 90° (fig. 5).

Several mylonitic shear zones, up to 5-10 metres thick and related to the D_2 deformational phase, are present also within the SC basement (Pian del Catino and south ridge of Höhe Wilde). The mylonitic shear zones display transitional boundaries with surrounding rocks preserving a S-tectonitic fabric (fig. 6a). Thin, some centimetre-thick, mylonites are present also within marble levels and are recognizable from their lighter colour and fine grain size, sometimes accompanied by submillimetric mica-rich layers, produced by mineralogical differentiation processes during mylonitization (fig. 6b). A poorly prominent NW trending lineation is visible on some outcrops, located just above the Stettiner Hutte. Similar centimetre-thick shear zones occurring within mica schists are faintly visible and discontinuous.

Sin-D_2 mylonites from both TC ans SC rocks display a strong grain size reduction and it is often difficult to recognize their protolith. Mylonitic foliation dip directions range between 300° and 355°; the stretching lineation trends about 300° with plunges of 40°-50° (fig. 5). Locally s-c and s-c' structures occur, suggesting an extensional kinematic with a «top-to-NW» displacement. The mylonitic foliation is marked by biotite and white mica, consistent with P-T conditions of the D_2 stage. Rarely garnet and biotite porphyroblasts are partly replaced by chlorite aggregates, suggesting greenschists facies re-activation of such shear zones during post-D_2 evolution.

D_3 – The D_3 deformation phase deeply influenced the previous structural pattern. It is responsible for S- to SE-verging asymmetric folds (fig. 5), developed from the outcrop to the regional scale. D_3 folds are moderately to very tight, with interlimb angles around 40°. The S-verging orientation of D_3 folds, together with a prevalent «Z» asymmetry produces the dominance of long limbs of the mesoscopic folds. This feature is widespread in the area between the SC to the north and the Passeier valley to the south (Gregnanin *et alii*, 1995). A centimetre spaced D_3 crenulation is present in mica-rich lithologies and calc-schists of both SC and TC (Schrotterwand, Schwarzwand, upper Lazins valley). The S_3 foliation is marked by the preferred orientation of biotite and white mica in mica schists and
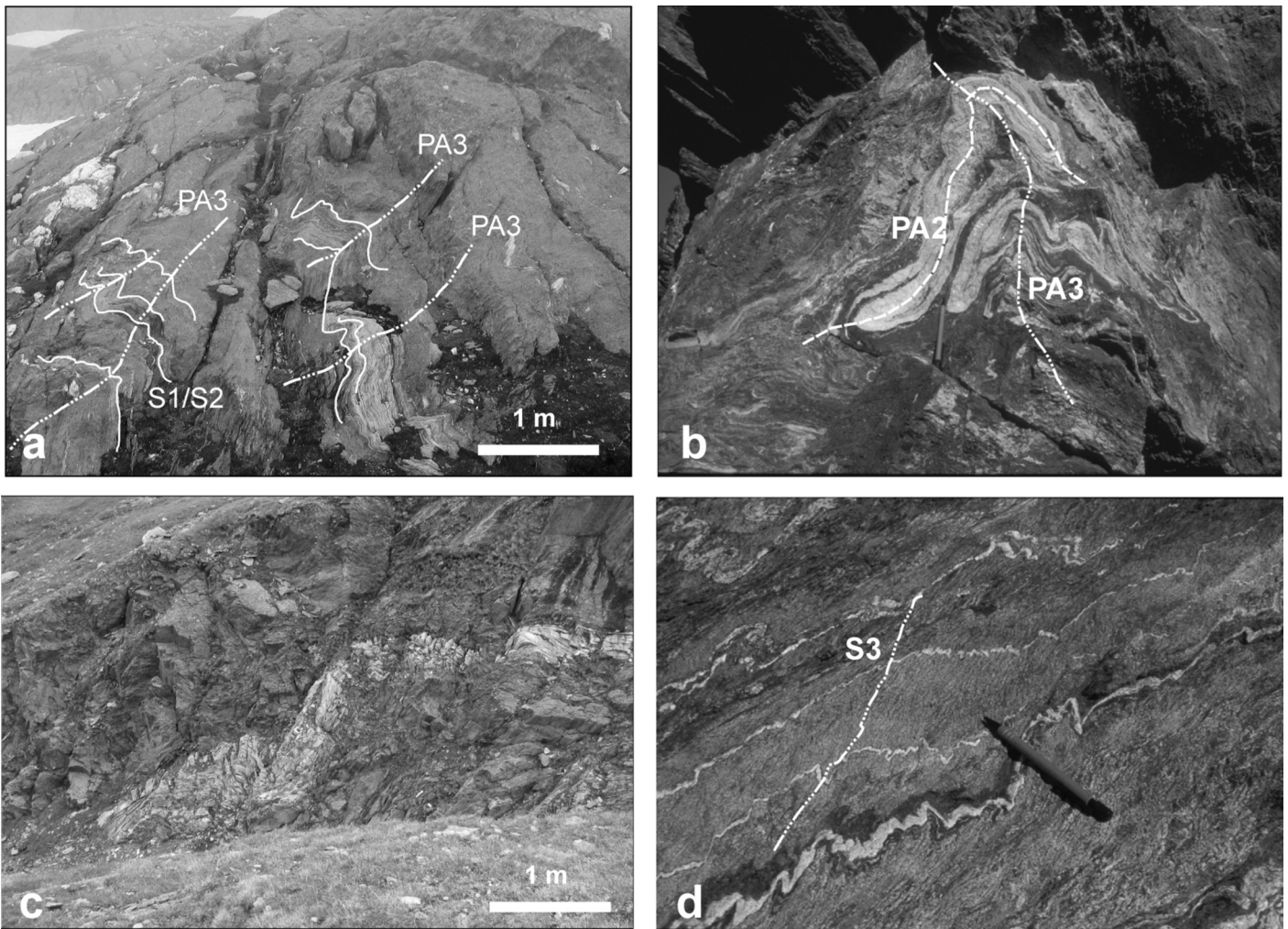
Fig. 7 - (a) D_3 folds crenulating S_2 foliation within Texel mica schists; upper Tel valley; (b) Superposed D_2 and D_3 folds, the interference pattern is of the type 3 of RAMSAY & HUBER (1987), with parallel fold axes and perpendicular axial planes; (c) D_3 folds in the marble layers close the Texel-Schneeberg boundary, Pfossen valley; (d) S_3 developed in amphibolic schists; Lazins valley.
– (a) *Crenulazione D_3 che interessa la foliazione S_2 nei micascisti del Complesso di Texel, alta valle di Tel;* (b) *Figure di interferenza del tipo 3 (RAMSAY & HUBER, 1987) date dalla sovrapposizione di pieghe D_2 e D_3, i due sistemi sono coassiali con piani assiali perpendicolari fra loro;* (c) *Pieghe D_3 nei marmi in prossimità del contatto fra i complessi di Texel e Schneeberg, Val di Fosse;* (d) *Foliazione S_3 negli scisti anfibolici, alta Val di Lazins.*

paragneisses, and actinolitic amphibole in amphibolic schists (fig. 6d). Mineral assemblages related to D_3 suggest that an upper greenschist to epidote amphibolite facies metamorphic conditions was assisting this deformation.

A L_3 crenulation lineation is well developed in mica-rich lithologies and follows the same trend as D_3 fold axes. D_3 structures show a progressive steepening moving westward from the Höhe Wilde to the lower Pfossen valley, culminating in a zone, NW of Schrotterwand, with near-vertical fold axes and axial planes developed over a neat lithostratigraphy, forming the so called «Schlingen» (SANDER, 1921) (fig. 8d). The D_3 axial planes in the «Schlingen» zone trend between NW-SE to WNW-ESE. SCHMIDEGG (1933) interpreted these structures as characteristic of middle crust conditions. Our structural analysis suggest s that they have been produced by the interference of D_2-D_3 folds, as previous envisaged by others authors (VAN GOOL *et alii*, 1987) and are not directly connected with any particular P-T conditions.

D_4 – The D_4 deformation phase led to the development of centimetre to metre-scale kink-bands and shear zones.

The analyses of D_2 and D_3 structural data on stereographic projections together with foliations and axial planes traces on structural map (plate 1), indicate the existence of D_4 folds developed at kilometre scale, responsible for trend variation of S_2 and D_3 axial planes. A possible D_4 vertical dipping axial plane runs along the bottom of the Pfossen valley, with an approximately E-W trend. D_4 structures are not easily observable in the study area, whereas they are more recognizable in the neighbouring areas, especially moving southward. They consist in metric to kilometre-sized open folds with subvertical axial planes, trending approximatively E-W, which often show fracture cleavage in hinge zones and rarely a poor developed foliation marked by chlorite and white mica.

D_5 – The later stages of deformation occurred at low P and low T, mainly under brittle conditions. Faults accompanied by centimetre- to metre-thick cataclastic zones, with a dominant NE-SW trend, are widespread in the whole area, more abundant in the NE part of the study area. The cataclastic zones are often superposed on D_2 mylonites, displaying the same trend but with a nearly vertical dip. Where vis-
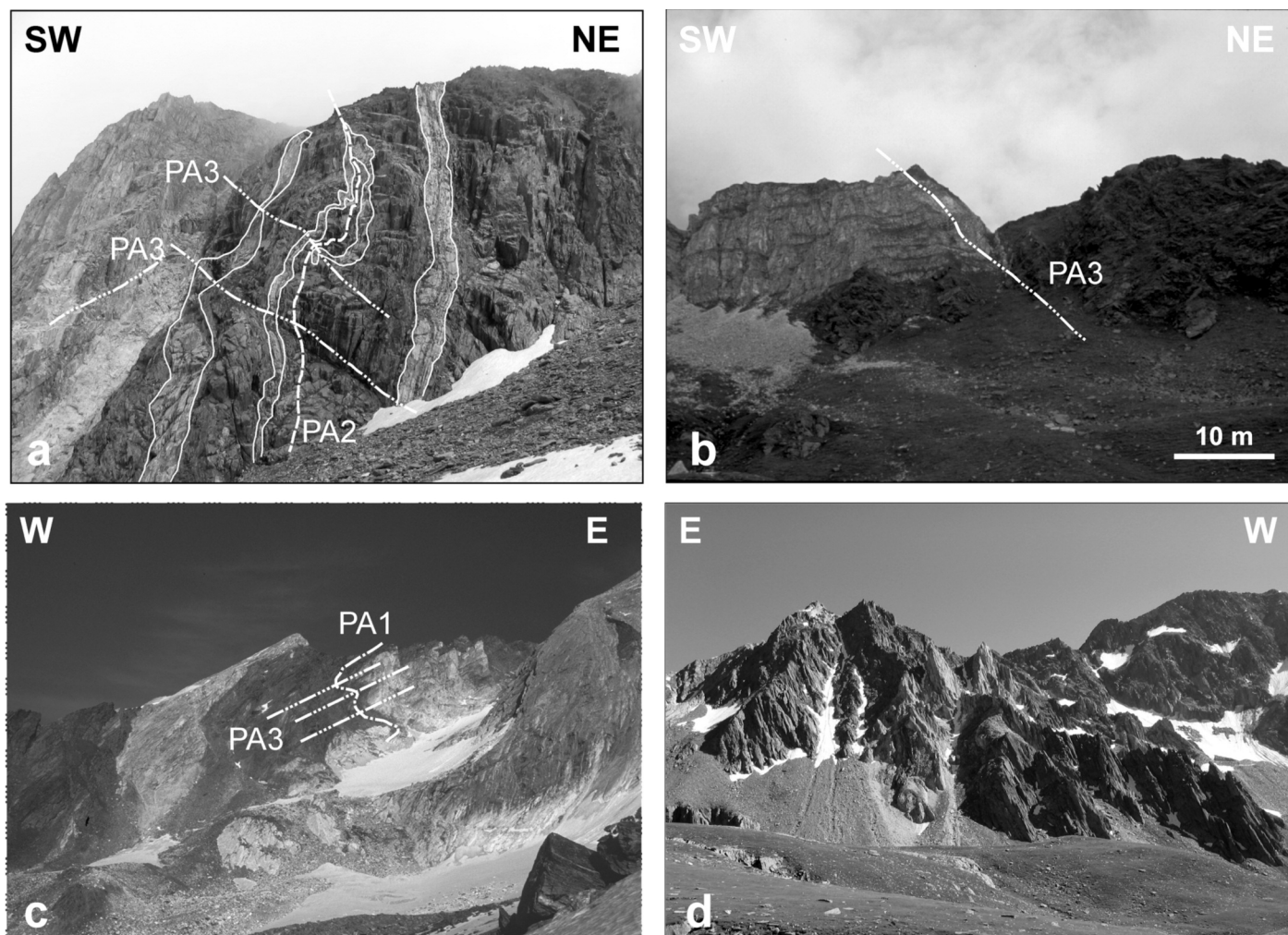
Fig. 8 - (*a*) D₂ and D₃ folds in marble layers on the S face of the Kleine Weiße; Tel valley; (*b*) D₃ fold at the closure of the marble layer of the Lodner peak; Lazins valley; (*c*) D₃ structures crosscutting D₁ ones in calcschists and marbles on the S face of Grava peak; (*d*) D₃ «Schlingen» folds in marbles and micaschists of the Schrotter peak, at the SW termination of the Schneeberg Complex, note the near vertical dipping of the marbles/gneisses lithological contact, that represents also the Texel-Schneeberg boundary.
– (a) *Pieghe D₂ e D₃ nei livelli di marmo della parete S della Cima Bianca Piccola;* (b) *Piega D₃ che interessa la chiusura della sinforme D₂ dei marmi della Cima Fiammante;* (c) *Pieghe D₃ sovraimposte a strutture D₁ sulla parete S della Cima Grava;* (d) *Pieghe D₃ a laccio ad assi quasi-verticali («Schlingen») che interessano i livelli di marmo e calcescisti alla base della Croda Rotta. Si noti la giacitura vicino al verticale del contatto fra marmi e gneiss, che rappresenta anche il limite fra il Complesso di Texel e quello di Schneeberg.*

ible, slickensides point to a dominant left-lateral kinematic, locally with an extensional component.

Another fault system, with no direct correlation with the previous, trends NNE-SSW and includes some relevant structures such as the Johannes Schartl fault (fig. 8b). It is an oblique fault with a NNE-SSW trending fault plane which dips to the W with angle around 75°. The vertical offset is around 100 m. Some minor structures, belonging to the same fault system are present at the Grava Schartl and 700 m W of Eisjochl; in both cases the vertical and horizontal offset is around 10-20 m.

SUMMARY AND CONCLUSIONS

On the base of field observations, the structural pattern of the study area is substantially homogeneous.

Four distinctive ductile deformational phases have been recognized, three of which accompanied by metamorphic recrystallisation.

The D₁ structures in the Texel Complex are well recognisable as a relict foliation (S₁) and rootless folds, preferably preserved within mica-poor lithologies. S₁ and S₂ are virtually indistinguishable in the D₂ fold limbs, at least in the field, because the D₂ event has intensively dissected and reoriented all the previous structures. Complex superposed folding, attributed to D₁ and D₂ interference, occur on the SE face of the Höhe Weiße, on the S face of the Grafen peak and on the SW face of the Lodner peak. The fold interference pattern between D₁ and D₂ folds is of type 3 of RAMSAY & HUBER (1987).

In the Schneeberg Complex the pre-D₂ structures are less well preserved than in the TC. Relict foliation and small rootless folds are rarely preserved only within mica-poor lithologies. On the base of field evidence a direct correlation between the D₁ structures of the TC and the pre-D₂ relics in the SC is not possible. Moreover the suggested P-T conditions of the metamorphism accompanying the D₁ event in the Schneeberg and Texel basement are slightly different, with higher temperature

for the TC. In the Spronser valley area, just a few kilometres to the south and south east of the study area, inferred P-T conditions of the syn-D_1 metamorphic event in the TC are of 640-680 °C and 0.9-1.0 GPa (SPALLA, 1993), whereas KONZETT & HOINKES (1996) report 550-600 °C and 0.8-1.0 GPa for the syn-D1 metamorphic in the SC basement of Seeber valley (few kilometres to the north east of the Pfossen valley).

During the D_2 event an axial plane foliation, S_2, developed both in the Schneeberg and Texel basement. The S_2 foliation tends to become mylonitic close to the contact between the two units, suggesting that during, or in the late stages of the D_2 phase, the tectonic coupling of the Texel and Schneeberg complexes took place.

Syn-D_2 P-T conditions for the TC ranges between 550-580 °C, 0.6-0.75 GPa (SPALLA, 1993) and 640-680 °C, 0.5-0.7 GPa (ZANCHETTA, 2002). The syn-D2 metamorphism in the basement rocks of the SC took place at similar pressure and temperature of 520-560 °C and 0.7-1.0 GPa (LANGONE, 2008). A late- to post-D_2 temperature increase (580-620 °C at 0.5-0.8 GPa) within the SC was envisaged by the presence of sillimanite growing after kyanite porphyroblasts parallel to the S_2 foliation in the garnet mica schists of the Seeber valley (ZANCHETTA et alii, 2007; LANGONE, 2008).

The D_3 event is responsible for the development of asymmetric S- to SE-vergent folds both at the outcrop and regional scale. Peculiar folds with subvertical axes, «schlingen», occur in the Pfossen valley and have been attributed to the D_2-D_3 interference pattern. The geometrical characteristic and orientation of the D_3 structures are almost constant from the SC to the Passeier Line, as confirmed by structural analyses performed in this work and by previous authors (SPALLA, 1993; GREGNANIN et alii, 1995; GREGNANIN & VALLE, 1995; SÖLVA et alii, 2001; SÖLVA et alii, 2005; ZANCHETTA, 2002). The D_3 event occurred at upper greenschists facies conditions with T < 500 °C and P < 0.4 GPa (HOINKES et alii, 1987; ZANCHETTA, 2002; SÖLVA et alii, 2005).

D_4 folds and successive brittle structures affected the existing structural pattern only in a lesser extent.

Field relations and structural analysis of fabric elements at the meso- and micro-scale suggest that the Texel and the Schneeberg complexes experienced a common tectonic evolution at least since the D_2 deformational phase under amphibolite facies conditions. The syn-D_2 mylonites at the TC-SC contact and within the SC itself testify the presence of a major extensional shear zone, identified by SÖLVA et alii (2005) with the whole SC (SNFZ: Schneeberg Normal Fault Zone), along which the SC moved to the NW with respect to the TC. Fold style and S to SE sense of asymmetry of the D_3 structures are coherent with the progressive extrusion of the TC basement in the footwall of the SC.

A major problem of this interpretation is tracing the continuation of the extensional shear zone between the SC and the TC to the west of the Pfossen valley, where the SC dies out and the polymetamorphic basement, with a dominant Variscan metamorphic imprint, of the Ötztal-Stübai Complex directly overlies the Texel Complex. Evidence of such shear zone progressively disappear already close to the SW termination of the SC (Schrottner peak), still in the study area of this work, possibly due to a stronger recrystallization of S_2 fabric during D_3 deformation.

To conclude: still more research with detailed structural analyses, most of all focussed on the contact between the Texel basement and the Ötztal-Stübai Complex, are needed to test the previous interpretation. The relationships between the D_2-D_3 deformational event and the thrusting of the Ötztal-Stübai over the tectono-metamorphic units of the SC and TC with their metamorphism of alpine age are still poorly investigated. Unravelling such relations is of fundamental importance in the definition of the exhumation history and mechanisms of the Schneeberg and Texel complexes and could give important clues for the interpretation of the alpine geodynamic evolution of this sector of the Eastern Alps.

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