Unfolding the Spatial Heterogeneity of the Natural Background Level of Arsenic in Groundwater at the Meso-Scale

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The geogenic contamination by arsenic in groundwater is a common issue in many areas of the globe due to peculiar geological conditions prompting arsenic mobility. In these geological settings, the Natural Background Level (NBL) plays a key role in order to discriminate between natural or anthropogenic contamination. The evaluation of a reliable NBL that can be effectively exploited at the scale of a polluted site often requires site-specific studies. Conventional regional scale distributions of contaminant NBL in groundwater are indeed limited in their ability to capture natural heterogeneities that affect contaminant mobility at smaller scales.

The aim of this project is to define a strategy to unfold the spatial heterogeneity of the arsenic NBL at the meso-scale (100-1000 km2), considering the crucial role of geological and geochemical heterogeneities. Arsenic concentration data will be collected from monitoring networks of sites under remediation. These networks represent a pervasive source of information in urbanized/industrialized areas, offering a spatial and temporal resolution of data higher than that of large-scale monitoring networks for groundwater quality control. Potential anthropogenic influences on the concentration data will be managed through an accurate pre-treatment procedure supported by the conceptual model of the area of interest. Relying on a geostatistical approach, the most suitable method will be identified to unfold the spatial distribution of the NBL while incorporating the natural heterogeneities as secondary variables. Different methods, such as stratified kriging and co-kriging, will be examined and tested on a proper dataset.

An optimal strategy will be investigated on a pilot area in the eastern Po Plain (Emilia-Romagna Region, Italy) affected by geogenic arsenic contamination in groundwater. Eventually, the same protocol will be tested on a different area, with a forecasting approach of NBL assessment.

The resulting continuous distribution of arsenic concentration at the meso-scale will provide a useful practical tool for groundwater contamination management. In fact, distribution maps of NBL heterogeneities at the meso-scale will allow overcoming the issue of over- or under-estimation of NBL caused by regional scale data and the issue of cost and time consume of site-specific studies.