



Preliminary methodological application for estimating the natural concentrations of hazardous species in two groundwater bodies in Italy

Antonio Molinari (1), Laura Guadagnini (1), Marco Marcaccio (2), and Alberto Guadagnini (1)

(1) Politecnico di Milano, DIIAR, Piazza L. Da Vinci, 32 - 20133 Milano, Italy (ant.molinari2002@libero.it), (2) Arpa Emilia-Romagna, Largo Caduti del Lavoro, 6 - 40122 Bologna, Italy (mmarcaccio@arpa.emr.it)

ABSTRACT

Providing a proper estimate of the natural background concentration of hazardous species in groundwater bodies has become increasingly important after the adoption of the EU WFD (Water Framework Directive) 2000/60/CE and the GWDD (Ground Water Daughter Directive) 2006/118/CE. According to these directives, the identification of natural background levels (NBLs) is required. This should then lead to provide an estimate of the threshold values (TVs) of the concentrations of chemical species that might compromise the good chemical status of the system.

The choice of a proper methodology to estimate the natural background level depends on the type of available data and the objectives to be achieved. Amongst the different existing methodological approaches we select a framework which is based on the statistical analysis of the distribution of concentrations monitored over time. In this context, we analyze and compare the preliminary results associated with two different methodologies, i.e. Component Separation and Pre-Selection. Both frameworks start from monitored information within a given water body and provide estimates of the level of natural background concentration, and, finally, the threshold values of the target chemical species. Component separation evaluates the NBL by separating a natural and an anthropogenic contribution to detected concentration values upon identifying two probability density functions that can interpret the observed empirical distributions of data. Pre-selection estimates the NBL by excluding from the available time series the samples that could be considered as subject to human influence. These are assessed from indicator species associated with concentration above a certain value.

We applied these methods to two water bodies of the Emilia-Romagna region (Italy), using time series recorded at several monitoring locations included in the extensive network of observation wells managed by the "Agenzia Regionale per la Prevenzione e l'Ambiente dell'Emilia-Romagna" (ARPA – Regional Agency for Environmental Protection). The following species were analyzed: Arsenic, Boron and Ammonium. These were associated with significant concentrations in the samples examined.

The analysis of the estimated values of NBL and TV suggests that the two tested methodologies provide comparable results, rendering background concentrations and, consequently, threshold values of the same order of magnitude. We also observe that both methodologies lead to estimate a NBL value for arsenic that, in this preliminary study, is not consistent with the observation that the largest arsenic concentrations are found in the deep groundwater bodies and only to a minor extent in the upper aquifers. We conclude that the results of these statistical methodologies should be jointly considered with the knowledge of the physical processes that dominate the evolution in space-time (hydro-geo-chemical) of the species analyzed in the overall groundwater system.