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Assessment of the chemical status of the alluvial aquifer in the Aosta Plain: an example of the implementation of the Water Framework Directive in Italy

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The Italian Legislative Decree 30/09 (D.Lgs. 30/09) implements the EU Water Framework Directive (WFD) providing some technical guidelines to assess the chemical status of groundwater bodies. This work presents the estimation of the chemical status of the shallow aquifer in the Aosta Plain (Aosta Valley Region, NW Alpine sector, Italy) on the basis of the D.Lgs. 30/09.
The study area covers ∼40 km2 along the Dora Baltea River basin. The Aosta Plain hosts an alluvial aquifer formed of lacustrine, glacial, fluvio-glacial and fan deposits of Pleistocene and Holocene ages. The unconfined aquifer features a depth of ∼80 m in the western part of the plain and ∼20 in the eastern part due to the intercalation of a silty lacustrine layer. The aquifer is mainly recharged by precipitation, surface water and ice and snow melt. Previous studies revealed that SO4, Fe, Mn, Ni, Cr(VI) and PCE represent potential threats for groundwater quality in the Aosta Plain.
The chemical status was calculated using the data collected during the 2012 by the Regional Environmental Protection Agency of the Aosta Valley Region from its groundwater quality monitoring network that includes 38 points. Each point was sampled up to four times. Since the D.Lgs. 30/09 excludes Fe and Mn from the assessment of the groundwater chemical status, the present work deals with SO4, Ni, Cr(VI) and PCE. Threshold values (TVs) were estimated on the basis of natural background levels (NBLs) for SO4, Ni and Cr(VI) whereas, for PCE, the reference value (REF) reported by the D.Lgs. 30/09 (i.e. 1.1 μg/L) was used as TV. The NBLs were calculated using the two approaches suggested by the EU research project BRIDGE, that are the pre-selection and the component separation. The TVs were evaluated using the following criteria: (a) if NBL < REF, then TV = (REF+NBL)/2 and (b) if NBL $\geq$ REF, then TV = NBL. The average between the NBL resulted from the pre-selection and the component separation was used in the TV estimation. Finally, the chemical status was defined comparing the annual average concentration in each monitoring point to the TV: if more than 20% of sampling points exceeded the TV for at least one chemical parameter then the chemical status was defined as poor, otherwise the status was defined as good.
The NBLs resulted of 10.1 μg/L, 1.8 μg/L and 115 mg/L from pre-selection and 9.4 μg/L, 2.3 μg/L and 148 mg/L from component separation for Ni, Cr(VI) and SO4, respectively. The TVs calculated are 15 μg/L, 3.6 μg/L and 191 mg/L for Ni, Cr(VI) and SO4, respectively. The percentages of sampling points exceeding the TV were 5.3, 23.7, 5.3 and 2.7 for Ni, Cr(VI), SO4 and PCE, therefore the groundwater chemical status in the Aosta Plain in 2012 resulted poor due to the high concentration of Cr(VI).
This work underlines the necessity for remediation strategies to reduce the Cr(VI) pollution in the Aosta Plain in order to achieve the good chemical status as required by the WFD.