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Regional hydrogeochemical groundwater characterization and Natural Arsenic occurrence in Upper Valtellina Valley (Central Italian Alps, Italy)

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The aim of the research is the characterization of the alpine Upper Valtellina Valley (central Italian Alps, 800 km2) aquifers by means of hydrogeological, hydrogeochemical, As speciation, isotopic and whole-rock analyses. In particular, the main focus of the study was the understanding of the processes responsible for As release and mobilization into the groundwater.
Historical chemical data from springs, wells, lakes, rivers and public fountains were collected from the Lombardy Region Health Agency (ASL) and implemented into a geodatabase. The available groundwater chemistry analyses (3050) from five municipalities (Bormio, Livigno, Valdidentro, Valdisotto and Valfurva) cover a relatively long time span between 1996 and 2011. Moreover, samples across the entire study area and covering one full hydrologic year 2012-2013 were collected during four different campaigns (June 2012, October 2012, May 2013, and September 2013) and analyzed . During these campaigns, water samples have been collected from both cold springs and thermal springs. The hydrogeochemistry of aquifers and superficial waters through the hydrologic year, and the long-term regional As distribution and time variability were analyzed.
Although the studied springs belong to different catchments with different hydrochemical and lithological conditions, they present some typical characteristics: (1) the water types are dominated by dissolution of the main ions Ca – Mg and SO4-HCO_3; (2) the Cl concentration is always very low, and poorly correlated with other ions; (3) the circulation time obtained from isotopic data ranges between 5 and 10 years for thermal springs and it is lower than 2 years for cold springs; (4) the average yearly temperatures (about 12°C for cold springs, and between 18°C and 42° for thermal springs) are nearly constant through the year; (5) dominant oxidizing environments have been observed for most of the cold springs and also for the thermal springs; (6) anthropogenic contamination is absent, while natural contamination of Arsenic affects most of the springs, with a natural background level for the entire UVV of 33 μg/L; (7) both As (V) and As (III) are present in all the springs analyzed, with a marked prevalence of As (V) among the cold springs. These conditions suggest that the cold springs in the UVV belong to recent aquifers, hydrochemically immature, where the presence of Arsenic is mostly related to alkali desorption and sulphide oxidation, while the thermal springs derive from the rapid uprise of deep-circulation water, with a high concentration of geothermal arsenic.