



# **1 Using stable isotope analyses ( $\delta^{18}\text{O}$ ) and geochemistry monitoring of mountain springs (Friuli Venezia Giulia, Northern Italy)**

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Optimum protection and management of water resources is a priority objective in industrialized northern Italy. Reconciling environmental protection with human needs requires an accurate and up-to-date assessment of the available resources. In this light, the ARPA FVG (Regional Environmental Protection Unit) and the GGACI of the University of Trieste have created a monitoring network for thirteen mountain springs that have been recognized as general indications of the water sources for the Region. These water springs are located at altitudes that range from 35 m a.s.l. to 885 m a.s.l. and have mean discharges varying from l/s to m<sup>3</sup>/s. These springs are fairly variable for local importance, water discharges and geological nature but has been chosen as indicative of all the springs of the Region. From September 2004 samples have been collected on a monthly basis both from the water springs and from local precipitations in order to get the isotopic and physical and chemical water signatures. In addition, a geological survey of the thirteen areas, has been done to delineate the hydro-structural influences on spring locations.

Isotopical analyses ( $\delta^{18}\text{O}$ ) have been measured by mass spectrometric techniques at the University of Trieste and the conventional values ( $\delta$ ) are reported as per mil devia-

tions from the V-SMOW standard. Chemical analyses were done by atomic absorption spectrophotometry and HCL titration for carbonate. The physical and chemical parameters recorded are water temperature, EC, pH, TH, anion ( $\text{HCO}_3$ ,  $\text{NO}_3$ ,  $\text{Cl}$ ,  $\text{SO}_4$ ,  $\text{F}$ ,  $\text{SiO}_3$ ) and cation ( $\text{K}$ ,  $\text{Na}$ ,  $\text{Mg}$ ,  $\text{Ca}$ ,  $\text{NH}_4$ ) concentrations as well as Si contents. Chemical interpretations have been elaborate using the Aquachem software, while for spatial data ArcGis has been used.

The isotopical data has delineate the springs that have fast water circulations or superficial and that therefore are more vulnerable to pollution and has given the altitudes of the recharging areas. The chemical analyses have detected that all the monitored water springs of the Region belong to the  $\text{HCO}_3$ -Ca-Mg facies (according to Piper diagram) whereas 3 of them have tendency to  $\text{SO}_4$  facies. From the Piper diagram the interaction with different types of rocks has been detected, in particular with carbonatic (calcareous or dolomitic) or  $\text{SO}_4$ - rich layers. The combination of the isotopical and chemical data has distinguished the springs that have mostly karst, fractured or superficial aquifers.

In addition, water quality has been assigned to the monitored water springs according to water chemical parameters followings the guidelines of the Italian Law. Ten water springs have good quality waters whereas 3 water springs have medium water quality because of high concentrations in the  $\text{SO}_4$  or in TH.