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Groundwater dynamic in a coastal aquifer using statistical analysis and geochemical modeling

A. Garone , M. Battistel , M. Barbieri , and B. Parisse
La Sapienza di Roma, Scienze della Terra, Roma, Italy (angelica.garone@libero.it)

Coastal aquifers are natural environments particularly vulnerable and seriously threatened. Coastal areas are densely populated and this leads to a massive withdrawal of groundwater.
These conditions may induce a salinization process of groundwater, due to the change of the balances that govern the coexistence between fresh and salt water.

Hydrochemical data from well water samples collected during a year of monitoring in Palo Laziale area are used to evaluate water quality and to determine processes that control water chemistry. Geochemical ratios (EC vs rCl; Na vs Cl; rCl/rBr vs Cl) give information about mixing, cation exchange and salinity acquisition process. Multivariate statistical approach and geochemical modeling are adopted to assist the interpretation of the geochemical data, particularly cluster analysis and Principal Component Analysis. Software PHREEQC was used for geochemical modeling and data processing.
In add to determining chemical components and some chemical-physical properties (T, pH,electrical conductivity, TDS) the studied provided following: statistical analysis of data, thermodynamic equilibrium of aquifer with quantitative analysis of the saturation index and the speciation of trace and minor elements.
According to statistical analysis is possible to identify two different groups of water: typical of domestic wells in Palo SIC area and external wells.
PCA analysis suggests that Palo Laziale SIC is located in an area of interface between fresh and salt water and there is a significant amount of water recharge (the monitoring of the area occurred in a year particularly rainy).
Calculation of saturation indices (SI) for primary minerals (aragonite, calcite a dolomite-d) was carried out to obtain a quantitative estimate of the instability of these phases. The result of the calculation of saturation indices allow to define a sequence of instability of minerals: calcite > dolomite > aragonite. The order of solubility indicates that during the leaching process, calcite and aragonite are characterized by a kinetics faster than the dissolution of dolomite.
A combination of statistic and geochemical techniques proved to be a reliable tool in the interpretation of hydrogeochemical dynamic of a coastal area.