

Geochemical study of the groundwater in the Sibari Plain (Calabria, Southern Italy)

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Keywords: Geochemical study, Sibari Plain, Marine intrusion.

The Sibari Plain, located in northeastern Calabria (southern Italy), represents a large coastal alluvial plain with considerable agricultural and tourist development. The plain is crossed by secondary ephemeral rivers and by the Crati River, the main regional river. The area is characterized by low rainfall and by the presence of a shallow unconfined and outcropping aquifer lying on a confined aquifer.

A geochemical survey was carried out on 103 selected wells from June to September 2012 in the framework of the project PON01_02818 AMICUS to investigate the chemical and isotopic composition of local groundwaters of the both aquifers. In situ measurements of electrical conductivity show a mean value of 1.1 mS/cm and a maximum value of 4.2 mS/cm close to Crati Delta area. The interpretation of chemical data allows one to recognize 4 hydrochemical facies. The Ca-HCO₃ hydrochemical facies (70 samples) has a Total Ionic Salinity (TIS) comprised between 6 and 34 meq/L. It is probably generated by calcite dissolution, a mineral phase that dissolves very quickly and that is very frequent in the study area. The Na-HCO₃ waters (13 samples) have TIS of 11 to 46 meq/L partly overlapping or somewhat higher than the TIS range of Ca-HCO₃ ones. The origin of these groundwaters is probably due to reflow of Ca-HCO₃ groundwater in shallow aquifers, previously flooded with seawater and/or brackish water (freshening). The Na-Cl hydrochemical facies (14 samples) show a wide TIS range, from 22 to 80 meq/L, generally higher than that of Ca-HCO₃ water, but still below the TIS of 1210 meq/L of mean seawater. These waters are typically found in aquifers located near the coast and in the area of the Crati Delta. Close to the coastline, the origin of these waters can be related to ingress of seawater and/or brackish water within the sediments of the alluvial plain. This intrusion of seawater and/or brackish water takes place either directly (salt wedge), or through inflow of seawater along the riverbeds and subsequent infiltration into the surrounding shallow aquifers hosted in the alluvial deposits. This process may be favored by intense pumping from wells located near the riverbeds. The presence of Na-Cl waters in the inland area could be related to local upflow of deep brines (recorded in deep exploration boreholes) along tectonic discontinuities. The Ca-Cl type (3 samples) has TIS of 33-49 meq/L, exceeding that of the Ca-HCO₃ waters. This is a chemical composition generated by ionic exchange consequent to seawater ingress.

Furthermore, the average infiltration elevation for the groundwaters of the Sibari Plain was obtained by means of the d¹⁸O and d²H values of H₂O. The computed average infiltration elevations, supported by the results of the numerical groundwater modelling, suggest that the Sibari Plain aquifers system receives underground inflows from the surrounding Pollino and Sila massifs.