



Analysis of the hydrochemical data and the stable isotopes (D-¹⁸O) to characterise the recharge of the Madonna del Pollino carbonate aquifer, Southern Italy.

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The contribution of stable isotopes in hydrogeological research is well known; indeed, the use of oxygen and hydrogen isotopic composition has proved to be a useful tool to explain the recharge process of groundwater. The aim of the study is to assess the potential of stable isotope (D-¹⁸O) analysis to refine the understanding on recharge processes of the Madonna del Pollino aquifer system (Southern Italy).

The study area is placed along the northern hillside of the Monte Pollino massif, close to the high valley of the Frido River. The area is characterized by a complex geomorphological framework, function of the lithostratigraphic and structural characteristics of the outcropping rocks.

Two separate geological Units outcrop almost always, showing tectonic contacts: the "Pollino Unit" and the "Frido Unit". The successions of the "Pollino Unit" consist of a lower term represented by carbonate formation outcropping in monoclinical structures, following the Pleistocene transcurrent and extensional tectonics. The "Frido Unit" limits the Madonna del Pollino carbonatic morphostructure and is constituted by metamorphic terms, as clay shale, and formations afferent to terrigenous ophiolites units. The western hillside of "Madonna del Pollino" is bordered by faults that brought this carbonate structure to tectonically overlie the terms of the "Frido Unit".

Groundwaters of the “Madonna del Pollino” aquifer outflow in correspondence of a front, at about 1040 m a.s.l., constituted from at least ten main springs, in part captured for drinking water supply of a vast area of the Basilicata region. The spring front is situated in correspondence of the tectonic contact between the permeable Mesozoic limestones and the clayey-marly formations of the “Frido Unit”.

The study has been supported by a wide collection of geological and hydrogeological data, which has allowed the evaluation of the hydrogeological balance and of the recognition of the main groundwater circuits. The up-to-date groundwater budget of the “Madonna del Pollino” aquifer was thus evaluated and the depletion curve of the Frido springs was generated, up to 2005, for determining the depletion coefficient and the underground storage.

Groundwater samples were collected and a hydrochemical and isotopic study was carried out on spring waters present on the area, from the recharge zone to the discharge area at the Frido springs. In the absence of pluviometers homogeneously distributed on the study area, several small springs characterized by short and relatively rapid flow path were selected. Stable isotope data of such springs were used to recognize the elevation of the main recharge areas of Frido springs (by the relationship $\delta^{18}\text{O}$ – elevation). Stable isotope data were also compared with precipitation stable isotope composition from literature data.

The interpretation of the whole chemical and stable isotope composition of groundwaters from Frido springs, in terms of seasonal and elevation effects show the existence of a certain degree of directional anisotropy in groundwater flow and that recharge occurs by rapid infiltration with little evapotranspiration prior to recharge; the groundwater flow, in this complex carbonate system, proceed along different drainage axes.