

## PUMPING RESPONSE AND SUSTAINABLE WELL YIELD OF SOME HARD-ROCK AQUIFERS OF THE MEDITERRANEAN REGION

Antonella BAIOCCHI <sup>1</sup>, Francesca LOTTI <sup>2</sup>, Vincenzo PISCOPO <sup>1</sup>, Valentina SAMMASSIMO <sup>2</sup>

<sup>1</sup> *Department of Ecological and Biological Sciences, University of Tuscia, Largo Università -01100 Viterbo, Italy*

<sup>2</sup> *Kataclima srl, Largo F. Baracca 18, 01019 Vetralla (VT), Italy, f.lotti@kataclima.com*

The issue of sustainable yield of some wells drilled in hard rocks of the Mediterranean Region was examined. The objective of the study was to verify which information may be obtained from the results of pumping tests in order to define the long-term well functioning. Data on the behavior of these aquifers under pumping are scarcely available in the literature; on the other hand, these aquifers might play a strategic role in drinking and irrigation water supplies for the Mediterranean Region in a near future.

Data analyzed concern results of pumping tests performed in three areas with similar climate conditions, which differ in hard-rock type. The tests have interested Paleozoic granodioritic rocks, Paleozoic metasandstones and Eocenic granodioritic and andesitic rocks. In all these sites, the hard rocks are intensely fractured. The pumping data were interpreted with analytical techniques and commercial software. This allowed to recognize three main drawdown trends, coherent with three hydrogeological settings:

- i) delayed response coherent with the presence of double porosity;
- ii) rapid increase of drawdown coherent with the presence of a barrier boundary,
- iii) stabilization of the water level over time coherent with the presence of a recharge boundary.

On the basis of the identified trends and hydraulic parameters, different pumping scenarios were simulated through available analytical solutions, MLU software and finite difference flow model (MODFLOW).

The transmissivity values derived from the pumping tests cover two orders of magnitude and permit to categorize the hard rocks in the classes III and IV according to Krásný's classification, corresponding to rocks from low to intermediate transmissivity magnitude. The storativity is included in a wider range of values. The previous hydraulic properties, together with the simultaneous response to pumping of the drawdown for the piezometer (or piezometers) and the pumped well, may permit to treat the aquifer as a porous equivalent medium at the volume scale of the pumping test. All these properties, associated with an appreciable aquifer recharge, make these aquifers of interest for the local water supply. In this regard, some suggestions to define the sustainable yield of a single well may be derived from the comparison of results of pumping tests with the performed simulations. The results show that the long-term trend in the drawdown and the initial thickness of the aquifer constrain the sustainable yield of a well. In the worst cases examined, namely those related to an aquifer with a barrier boundary and a delayed response of the aquifer, the sustainable well yield is from 1 to 2 L/s. These well discharge values are significant if compared with those found in other regions of the world, and may be related to the dense network of the discontinuities which characterizes the sites.

