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Tectonic control on the hydrogeology of the Nomia, Monemvasia Municipality, Southern-eastern Peloponnesus, Greece

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We investigate the role of the geometry and the cross-cut relationship between the fault structures in the distribution of groundwater compartmentalization for the aquifer system in the Nomia in southern-eastern Peloponnesus. The geometrical relationship of the various alpine tectonic units involved in the geological structure of the study area, the lithological variety and the deformation phases that the alpine rocks have undergone are the main controlling factors of groundwater flow in the alpine rocks, the distribution of the aquifers and the geometric characteristics of recharge areas.

The alpine rocks of the study area belong to two tectonic units. The lower one is the high-pressure metamorphic unit called Phyllites-Quartzites (PQ) Unit while the upper one is the non-metamorphic Tripolis Unit. The PQ Unit consists of mica schists and quartzites and have suffered at least four deformation phases. The upper Tripolis Unit consists of a volcanosedimentary sequence of Permio-Triassic age (Tyros Beds) followed by a thick carbonate sequence of limestones and dolomites of Mesozoic to Lower Tertiary age. Tripolis unit has mainly undergone three deformation phases. The first one produced low-angle thrust faults and folding and the two last ones are related to late-orogenic extension which caused the formation of high- and low-angle normal faults. Along the coastal area Quaternary marine and continental deposits cover unconformably the alpine rocks.

A low-angle normal fault (detachment fault) is the major fault structure in the study area. The fault exhibits a curved fault plane dipping to NE-E and a thick cataclastic zone. Its footwall consists of mica schists and quartzites of the PQ Unit. The Tripolis Unit forms the hanging wall and can be distinguished in smaller tectonic units separated by reverse or normal faults that also dip towards NE-E, truncated by the major low-angle normal fault. The geometry and the cross-cutting relationship of the different fault generations result in the creation of successive and independent carbonate masses separated by either the Tyros Beds or the PQ Unit. Locally confined aquifers are developed in the PQ Unit where the thickness and the lateral extension of the quarzites is big enough and are considered to be of good capacity, as the pumping volume reach 30m3/h. Above them, a karstic aquifer formed in carbonate rocks of Tripolis Unit is sandwiched between the PQ Unit and the Tyros Beds. Chemical analyses, drilling data and its table water level preclude communication with the sea to the east. On the contrary, the higher karstic aquifer, which has the largest recharge area, discharges into the sea and its water is brackish. In places this aquifer communicates laterally with the brackish porous aquifer developed in the Quaternary deposits.

The results of this study may have implications for water resource planners of the Monemvasia Municipality who have recently focused on groundwater resource development within the study area.