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3D hydrogeological model of the Lower Yarmouk Gorge, Jordan Rift Valley

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The Lower Yarmouk Gorge (LYG) lies on the eastern margin of the lower Jordan Rift Valley (JRV), bounded to the south by the Ajlun and to the north by the Golan Heights. It allows the outflow of the Yarmouk drainage basin and flow into the Jordan River, a few kilometers south of Lake Tiberias. The main aquifer system of the LYG is built mostly of Cretaceous sandstones and carbonates confined by Maastrichtian aquiclude. Fissures allow hydraulic connections between the major water-bearing formations from Quaternary to Upper Cretaceous age.
It is supposed that the gorge acts as the mixing zone of two crossing flow pathways: N-S from the Hermon Mountains and from the Ajlun Dome, and E-W from Jebel al Arab Mountain in Syria (also known as Huran Plateau or Yarmouk drainage basin). As a result, several springs can be found within the gorge. These are characterized by widespread temperatures (20 – 60 °C) which indicate that, beside the complex regional flow, also ascending thermal waters control the hydrologic behavior of the LYG. Previous simulations based on a conceptual simplified 3D model (Magri et al., 2016) showed that crossing flow paths result from the coexistence of convection, that can develop for example along NE-SW oriented faults within the gorge or in permeable aquifers below Maastrichtian aquiclude, and additional flow fields that are induced by the N-S topographic gradients.
Here we present the first 3D hydrogeological model of the entire LYG that includes structural features based on actual logs and interpreted seismic lines from both Israeli and Jordanian territories. The model distinguishes seven units from upper Eocene to the Lower Triassic, accounting for major aquifers, aquicludes and deep-cutting faults. Recharges are implemented based on the numerical representation developed by Shentsis (1990) that considers relationships between mean annual rain and topographic elevation. The model reveals that topography-driven N-S and E-W flows strongly control the location of discharge areas while the anomalous spring temperature is not necessarily linked to the presence of fault convection. Local permeability anisotropy due to aquifers folding or facies changes are features sufficient for the rising of hot fluids.

References

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