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Environmental and geotechnical problems in karstic terrains crossed by tunnels. A case study

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The construction of one of the high-speed railway tunnels between Malaga and Cordoba (South Spain) beneath the Abdalajís mountains occasioned a series of hydrogeological problems with geotechnical and environmental impacts. The double tunnel, 7300 m in length, runs south to north across several small calcareous lines of mountains that are highly complex in structure. Beneath the Jurassic limestones lie Triassic clays and evaporites. Overlying the limestones is an essentially marly and limestone-marl Cretaceous series, which culminates with Miocene marls that contains a certain amount of organic matter. These mountain alignments generate springs that are used for urban water supply and irrigation, as well as maintain a water culture in the surrounding villages. The initial water level in the aquifer series varied from 400 m to 650 m above sea level. After drilling approximately 2900 metres, and intercepting a fracture zone within the carbonate rocks, a sudden outpouring of water occurred that reached a peak flow of 800 L/s. After a short while, the spring discharges dried up, leading to a public protest in response. In this paper, we describe the geological and hydrogeological settings, the development of the aquifer as the drilling operation proceeded, the measures adopted and the responses subsequent to completion of the tunnel, including the effect of rainfall on the recovery of water levels. Lastly, a generalized estimate is made of how the system functions and a forecast is made for recovery of its equilibrium.