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Hydrogeophysical characterization of the basaltic aquifer of Djibouti.

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The Republic of Djibouti faces a steadily increasing demand for drinking water due to rapid urbanization and population growth, from 273,974 inhabitants in 1983 to more than 1 million in 2023, with 73% of the population living in the capital. Water supply relies mainly on groundwater abstracted from the coastal hosted in basaltic formations interbedded with paleosols layers, which constitute the geological framework of the study area. Surface water resources are extremely limited, apart from a few reservoirs, and groundwater recharge mainly occurs during episodic flooding of wadis.

Limited recharge, intensive groundwater pumping, and the proximity of the aquifer to the coastline have led to a progressive degradation of groundwater quality over recent decades, particularly through salinization. The Djibouti plain is characterized by heterogeneous relief, intense fracturing, and a complex volcanic geology. Basaltic formations of different ages and origins overlap discordantly and are locally associated with rhyolitic units, while Quaternary marine sedimentary deposits are present in the coastal zone. Despite the strategic importance of this aquifer, the internal structure of the fractured basalt system remains poorly constrained, limiting the understanding of groundwater flow and freshwater-saltwater interactions. In this study we present the results of more than 30electrical resistivity tomography (ERT) profiles, ranging from 600 to 1200 m in length, acquired in the Djibouti plain. These profiles are used to investigate the lateral and vertical variability of subsurface resistivity and to identify structural and lithological heterogeneities within the basaltic formations. The ERT results are interpreted in combination with available hydrogeological data in order to improve the characterization of the aquifer structure and to provide new constraints on groundwater circulation and recharge processes.