

Is High Salinity in Coastal Aquifers Only Due to Marine Intrusion?
Example of the Structural Control in the Mahafaly Karstic Aquifer
(SW, Madagascar)

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The southwestern coast of Madagascar is characterized by semiarid climate and low fresh water resources, which slow down the economic development. The studied area, located South of Toliara, is separated into a western coast of eolian dunes and sandstones where most of people live and the eastern almost unoccupied calcareous Mahafaly plateau.

The coastal aquifer is dominated by salted water. The conductivity, closed to 6000 μ S/cm in the North, decrease to 3000 μ S/cm to the South. Coastal plain is bordered to the East by the highly karstified Cenozoic limestone, separated by a north-south cliff corresponding to the Toliara fault scarp. Surveys in coastal wells and in karstic aquifers clearly point out some tidal influence on piezometric level and on conductivity. To the North, the limestone cliff is directly in contact with the sea, which water contaminates the karstic aquifer according to cycles and intensities that can be correlated to tidal variations. To the south, 5 km westward from the plateau, fresh water flows out on the beach by resurgences in the Quaternary sandstones, probably connected to the Eocene limestones. Drillings and exploration of some avens on the plateau permitted the access to the ground water table. It displays various conductivities from 1500 μ S/cm, to 5000 μ S/cm, unusual for a karstic aquifer faraway from the seacoast. The mapping of such conductivities suggests more complex phenomena than only marine intrusion in the different aquifer systems. Chemical and isotopic analyses show an obvious seawater intrusion and evaporation influence for the coastal aquifer but in the karstic aquifer trace element analyses evoke contamination by upwelling of deep mineralized water. Salty water is frequent eastward on the basement and in the Mesozoic formations too.

Present day, fracture zones in either the coastal sandstones and in the Cenozoic limestone units control ground water circulations. Such fractures result from the paleoextensional stress history. The surface joint directions N-S, NE-SW and NW-SE reflect the deep-seated horst and graben structures. Microtectonic analyses give evidence of a post-Eocene WNW-ESE extension and recent seismic data define an E-W extensional regime. According to the current stress field, the major joint pattern is especially well oriented for water flow. Paleotectonic, neotectonic, anomalies in conductivity and chemical data argue for connection of coastal and karstic aquifers with the deep formations trough N-S structures belonging to the Toliara's fault system. This could explain abnormal salinities in the karstic system, faraway from the coast.

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