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Temporal evolution of marine intrusion and other salinization processes in the volcanic-sedimentary aquifer of the east of Gran Canaria (Canary Islands, Spain)

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ABSTRACT

The coastal volcanic-sedimentary aquifer of the East of Gran Canaria has suffered a progressive salinization process since the 1960's that has been attributed to intensive exploitation. It is a sector of the insular aquifer characterized as a complex, heterogeneous and multilayer aquifer in which groundwater flows from the high parts if the island towards the coast. Discharge is mostly in diffuse form. Under natural conditions the aquifer discharged also as springs in the bottom of the main gullies, but currently this discharge has been substituted by exploitation wells (Cabrera y Custodio, 2004).

The study area is located at the East of Gran Canaria Island. The average rainfall is 345 mm, ranging from 900 mm in the upper part of the zone (1800 masl) to 100 mm in the coast, and the average yearly temperature is 24 ºC. This area has been traditionally dedicated to intensive, irrigated agriculture (mainly tomatoes in the 20th Century) with water from the upper part of the island and from the local aquifer, but the scarcity and progressive salinization of groundwater is the cause of agriculture abandoning.

Currently, the exploited materials in the area are mostly Miocene basalts and phonolites (Cabrera, 1995). Pliocene basalts (volcanic agglomerates and lava flows of the Roque Nublo Group) and Quaternary basalts (Recent Basalts) are locally exploited in some points at the upper part of the area. The unsaturated zone consists of Roque Nublo, Recent basalts and detritic formations in most of the area. These were the aquifer materials under natural conditions, before de water level drawdown.

There is an important hydrogeological data base that has been provided by the Water authorities of the island. It includes piezometric and chemical data (field measurements and laboratory water analysis) from 1970 to 1999. Three piezometric maps have been reconstructed (1970-76; 1980-89 and 1990-1999). Extensive areas with a drawdown to 60 m below sea level have been identified, corresponding with the more exploited areas (locally, some wells went down to 100 mbsl in 1992). The evolution of the watertable shows a progressive drawdown from 1970 to 1999, with the development of four sharp drawdown cones at the coastal plane.

The hydrogeochemical study has included the construction of several hydrogeochemical maps and the theoretical (closed system) water mixing calculations. Groundwater attains electrical conductivities up to 10 mS/cm at the south deep drawdown cones, but not at the north of the area. The analysis of hydrogeochemical information allows to

identify an active marine intrusion in the area, but also the existence of other salinization causes: return irrigation flows and the effect of weathering by volcanic CO_2 contributions in two localized areas. The contribution of brackish recharge waters due to the aridity of the zone must be also considered as a natural cause of salinity at the south of the area.

Water supply quality problems have been solved by means of reverse osmosis facilities in the more productive wells and the use of seawater desalination for population supply, but the aquifer salinization has not been arrested in the recent years. A wide study has been carried out by the Spanish Geological Survey (IGME) and the Water Authority of the Island in order to declare de aquifer as overexploited. It is considered in the Spanish Water Legislation that allows controlling the exploitation at the wells in coastal aquifers to minimize sea water intrusion. In this case, the difficult to characterize this process due to the complex geology and the existence of different salinity origins has prevented the declaration.

This abstract is based on the work of Hernández-Martín (2009), under the supervision of the other authors.

REFERENCES

Cabrera, M.C. 1995. Caracterización y funcionamiento hidrogeológico del acuífero costero de Telde (Gran Canaria), Doctoral Thesis, University of Salamanca, Spain.

Cabrera, M.C. and Custodio, E. 2004. Groundwater flow in a volcanic–sedimentary coastal aquifer: Telde area, Gran Canaria, Canary Islands, Spain. *Hydrogeology Journal*, 12: 305-320.

Hernández-Martín, J.A. 2009. Caracterización hidrogeoquímica y evolución temporal de la intrusión marina y otros procesos de salinización en el acuífero volcánico-sedimentario del Este de Gran Canaria. Engineering Geology Project for graduation. University of Alicante.

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