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Benoît Viguier, Hervé Jourde, Gonzalo Yáñez, Elias S. Lira, Véronique Leonardi, Claudio E. Moya, Tiaren García Pérez, José Maringue, Elisabeth Lictevout

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Multidisciplinary study for the assessment of the geometry, boundaries and preferential recharge zones of an overexploited aquifer in the Atacama Desert (Pampa del Tamarugal, Northern Chile).

Benoît Viguier [(1)] *, Hervé Jourde [(1)], Gonzalo Yáñez [(2,3)], Elias S Lira [(2)], Véronique Leonardi [(1)], Claudio E. Moya [(4, 5, 6)], Tiaren García Pérez [(2)], José Maringue [(2)], Elisabeth Lictevout [(4, 7)]

1. HydroSciences Montpellier Univ. Montpellier, France
300 Avenue du Professeur Emile Jeanbrau, 34090 Montpellier
* Corresponding author: benoit.viguier@hotmail.fr; +336 84 97 23 11

2. Pontificia Universidad Católica de Chile, Santiago, Chile
Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860 Macul. Santiago.

3. Centro de Excelencia en Geotermia de los Andes (CEGA), Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago, Chile

4. CONICYT Regional/CIDERH, Centro de Investigación y Desarrollo en Recursos Hídricos (R09I1001); CIDERH, Vivar 493, Iquique, Chile

5. Universidad Arturo Prat, Iquique, Chile

6. Golder Associates S.A., Santiago, Chile

7. Facultad de Ciencias Forestales, Universidad de Concepción, Concepción, Chile.

Abstract:

Overexploited aquifers in drylands require a thorough assessment in order to get the best insight possible of their hydrogeological behavior and groundwater resource. With this aim we develop an integrated methodology, using the northern part of the Pampa del Tamarugal Aquifer (PTA), at the Atacama Desert, Northern Chile, as testing site. This multidisciplinary assessment was completed including 34 direct piezometric measurements in boreholes, 92 geophysical soundings (TDEM) and 9 stream gauging. Main results show strong correlation between a well-defined contrast of resistivity and the water-table of the unconfined aquifer (dry unsaturated zone $\geq$ 100 Ω.m *vs* saline groundwater in the saturated zone $\approx$ 10 Ω.m). TDEM results helped to map the piezometric levels and reassess the limits of the PTA. The eastern limit of the aquifer, delimited up to now by the basin floor, is repositioned from 10 to 50 km eastward in the Andean Piedmont, indicating larger groundwater reserves than those described previously. A high-resistivity anomaly (~200 Ω.m) in the apex of alluvial fans reveals that frequent flood events cause rapid flows through the coarse permeable deposits leaching the vadose zone and contributing to recharge the aquifer (temporary recharge process). However, the updated piezometric map indicates the piedmont as the area where most of the aquifer recharge takes place. In the piedmont, at the downstream of tectonic