

Gravity Geophysical Analysis of Spring Locations in a Karstic Desert Basin, Cuatro Ciénegas Basin, Coahuila, Mexico

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ABSTRACT

This research uses land gravity geophysical surveys to infer subsurface geologic controls on springs in the Cuatro Ciénegas Basin of Coahuila, Mexico. Cuatro Ciénegas Basin is a National Biosphere Reserve that contains groundwater dependent ecosystems with high species endemism (over 70 local species) in an arid climate. Groundwater discharge from dozens of springs supplies irrigated agriculture and municipal water requirements and links the basin to the Rio Grande. Most Rio Grande flow originates from tributaries in Mexico during droughts in the Rocky Mountains. Effective water resources management depends on sustainable Mexican and Texan transboundary water resource development.

Previous studies in the Cuatro Ciénegas Basin investigated biologic resources and reconnaissance level hydrogeology, but did not explain hydrogeologic controls on spring locations. Springs occur in lines on either side of the Sierra San Marcos carbonate anticline with both hot and cold springs discharging in close proximity. Hydrogeologic cross sections enable the use of classical hydrogeologic models to understand controls on groundwater discharge in regional flow systems like the Cuatro Ciénegas Basin.

This study uses geophysics to infer subsurface geology beneath Cuatro Ciénegas Basin springs to test the hypothesis that spring locations are controlled by subsurface geology. Our initial gravity survey results conducted in January 2006 suggest that groundwater flows along normal faults in some locations and that permeability differences between valley-fill alluvium, alluvial fans, and underlying carbonates is another controlling factor.