

Connection and compartmenting of the Serra Geral and Guarani aquifer systems in central Paraná State (Paraná Basin, Brazil)

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ABSTRACT

Recent research projects on the Guarani Aquifer System (GAS-granular), Paraná Basin, Brazil, have evaluated the tectonic control of its hydrogeological potential, flow patterns, chemical properties, and environmental protection aspects. One such project is the present one, that has investigated a structured area in central Paraná State, delimited by coordinates 24°00'S, 25°00'S, 51°00'W and 53°00'W (Fig. 1). The study involves GIS integration of aerogeophysical, geological, structural lineament (DEM and Landsat imagery), hydrogeological and hydrochemical data. Basalts flows and diabase dykes (NW-SE) of the Serra Geral Formation (Lower Cretaceous) predominate in the area studied. These rocks correspond to the overlying Serra Geral Aquifer System (SGAS-fractured). The purpose of the study is to investigate the structural control of both flow and chemistry of SGAS groundwater and also to identify fractures that might represent hydraulic connection zones to the underlying granular GAS.

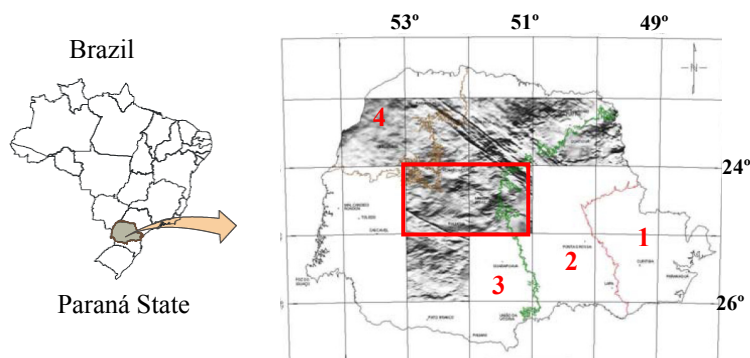


Fig. 1 – Localization of the study area (red) in the partial aeromagnetic map of the Paraná State, Brazil
1 – Precambrian basement, 2 – Paleozoic sedimentary rocks, 3 – Serra Geral Formation (Lower Cretaceous basalts and dykes - SGAS), 4 – Caiuá Group (Upper Cretaceous sandstones – Caiuá Aquifer System -CAS)

The processing and interpretation of aeromagnetic data using various techniques, useful for shallow sources, and the integration with others remote sensing and geological data permitted to outline the regional structural framework (Fig. 2). A mosaic of tectonic blocks delimited by NW-SE (diabase dykes) and NE-SW (Paraná Basin basement) structures was characterized. This new magnetic-structural framework was compared with the spatial distribution of hydrogeological (potentiometry, outflow and specific capacity) and hydrochemical parameters ($\text{Na}^+ + \text{K}^+$, Ca^{++} , Mg^{++} ; Cl^- , $\text{HCO}_3^- + \text{CO}_3^{--}$, SO_4^{--} ; total dissolved solids – TDS and pH). An integrated interpretation allowed the recognition of the structural control on hydrogeology, hydrochemistry and hydraulic connection zones of the SGAS and GAS as indicated by their differential water mixture rates. TDS and pH were complementary indicators of water provenance of the Serra Geral Aquifer System. In general, the SGAS typically shows average pH of 7.4 and TDS between 80-120 mg/L, average 100 mg/L. Values of pH and TDS respectively above 7.5 and 150 mg/L were interpreted as contamination by GAS water. Anions, cations, TDS and pH data, associated with the structural framework, have indicated places that are of typical SGAS waters and also places of SGAS/GAS connection waters. The former ones are bicarbonated calcic and bicarbonated calcic magnesian. The second ones are bicarbonated sodic and bicarbonated sodic calcic. The results, presented in a georeferenced map, show the principal connection zones of the SASG and SAG (Fig. 2).

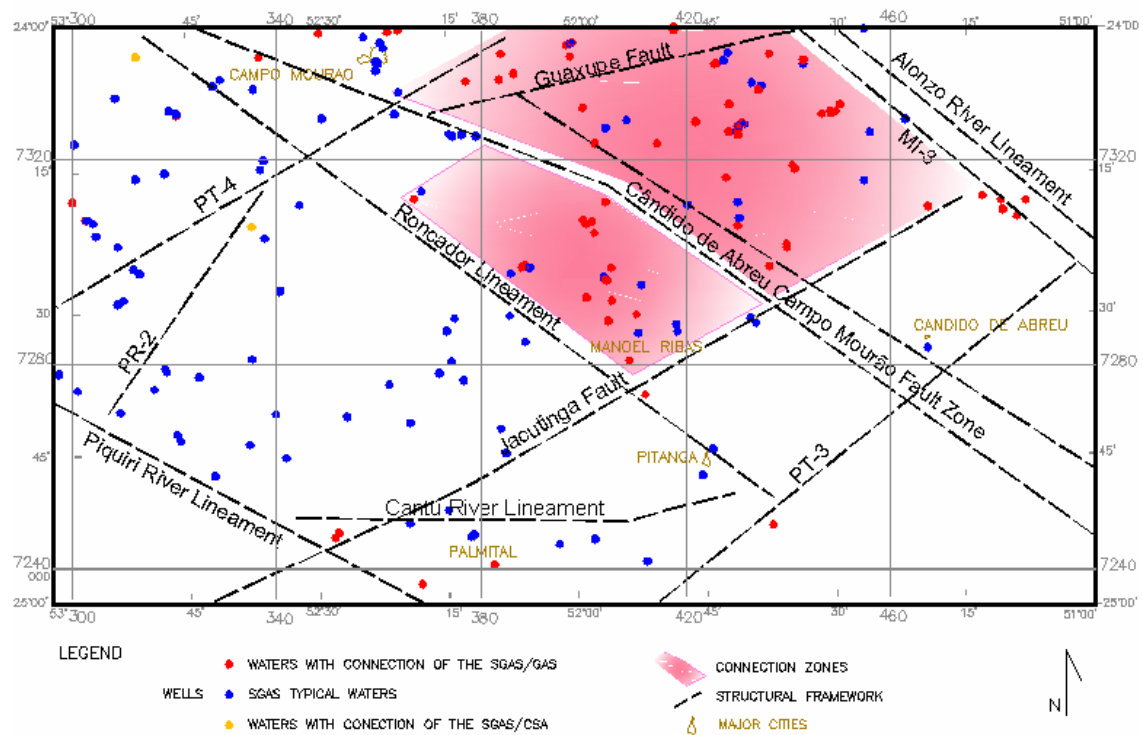


Fig. 2 – Localization map of the principal connection zones (red) of the Serra Geral and Guarani aquifers

Keywords: Guarani Aquifer System, Serra Geral Aquifer System, Paraná Basin, hydraulic connection, aeromagnetometry