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# MILLION-YEAR SCALE EVOLUTION AND CONCEPTUAL FLOW MODEL OF A SANDSTONE COVERED KARST AQUIFER IN NE BRAZIL

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Karst areas in Central Brazil are typically developed within Neoproterozoic limestone covered by Cretaceous sandstone. The groundwater flow interaction between these two rock units is poorly understood and quantified, making it difficult to assess precise groundwater budgets and support environmental management decisions in an area where aquifers are highly affected by deforestation and extensive agriculture in one of the world's largest soy plantations. In this context, a multi-method approach to groundwater conceptual flow modeling was adopted to investigate the São Desidério karst area, where solution conduits in the limestone started to develop in an interstratal (sandstone buried) stage, and are now receiving both diffuse recharge from the sandstone and punctual recharge from sinkholes and blind-valleys in the partially exposed limestone. Spring inventory, hydrochemical and geochemical analysis, cave passage morphology, karst landscape features and geochronological data from cave deposits (cosmogenic $^{26}$Al and $^{10}$Be, OSL, and U-Th series) are discussed. The major karst spring catchment area receives a perennial and proximal recharge from the sandstone, while intermittent pulses triggered by extreme rain events may connect the system to an upstream watershed, forming a potentially > 80 km long and > 300 m deep groundwater flow route. Where the limestone is exposed to the surface, convergent (dendritic) conduit systems connect allogenic and autogenic streams to alluviated and non-alluviated karst springs close to the base level rivers. Local processes include a rare perennial rhythmic karst spring and sulfuric acid dissolution in the vadose zone by the oxidation of pyrite. The major phases of karst aquifer evolution are: (1) interstratal dissolution at the limestone-sandstone contact since modern regional scale plateau landscape was well stablished in the Oligocene-Miocene transition (≈ 23 Ma); (2) sandstone cover erosive retreat and limestone exposure, leading to the major cave development stage in the Pliocene; (3) base level fluctuations driven by changes in sediment supply, vegetation cover and climate over the last 3 Ma, and consequent burial and alluviation of karst springs; (4) groundwater level fluctuations with > 40 m vertical amplitude and the development of giant groundwater lakes (≈ 12,000 m$^2$) and subaquatic speleothems over the last 6,000 yr.

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Back to: T97. New Frontiers in Cave and Karst Science

<< Previous Abstract | Next Abstract >>