

Karsts in sandstones and quartzites of Minas Gerais, Brazil

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Abstract:

The state of Minas Gerais (Brazil) exhibits several major karst areas located in sandstone and quartzite terrains, that display a complex suite of underground and surface karstic forms. In the Espinhaço Ridge, central Minas Gerais, several caves, up to a few hundred metres long, occur in the surroundings of the town of Diamantina. Some of these caves, such as Salitre, represent swallow-holes and show dome pits. Other horizontal caves are characterized by corrosion forms generated into the phreatic zone. In some places, such as in the Rio Preto area, these phreatic forms have been overprinted by ceiling tubes, suggesting a polyphase karst evolution, prior to the draining of the cave. Relicts of passages, with circular cross section up to a metre in diameter, can be found amidst the residual tower-like surface landforms, which constitute a typical scenery in the landscape. Their dissection is due to a generalised karstification in the area, resulting in closed canyons, megakarrens and kamenitzas. In southern Minas Gerais, close to the Mantiqueira Ridge, the caves of the state park of Ibitipoca can extend 2 km in length. These caves are associated with a very large hanging geological syncline. Several of these caves contain active streams, that flow for hundreds of metres before disappearing in sand-choked passages. Keyhole cross sections characterize steeply descending passages in these caves, indicating a change from slow phreatic flow towards a faster vadose flow responsible for the vertical incision of the passage. Such change is probably related to base level lowering and/or to turn in the direction of the water flow. Several generations of wall-pockets, from a few centimetres to over a metre long, occur into the caves. These features are good indicators of the initial phase of speleogenesis, generating the initial conduits by their coalescence. This mechanism is also responsible for cut-off meanders. The main river in the area, which flows along the syncline axis, cuts through a rock barrier, generating a tunnel-like passage. This cave drains, through resurgences in its walls, part of the water that flows in other caves located in the flank of the syncline.

In many places, the walls of the cavities are hardened by a coat that penetrates the rock on some millimetres. This coat allowed the conservation of numerous alveoli developed in very crumbly metaquartzites. Essentially made of chemical elements coming from the surface weathering, it permits a chronological ordering of the genesis of different underground morphologies and to reconstitute polyphase karst systems.

The birth of the karst system would take place in depth, regardless of the conditions of surface, with a congruent dissolution of the rock. Some alveoli take place and can form initial conduits by coalescence. A second phase is bound to the crosscheck of the alveolar or conduits by forms due to the surface weathering (widened fractures...). The setting up of the coats partially strengthens the primary forms. The dewatering of the systems allows flows more and more rapids. The mechanical erosion becomes the dominant process in the shaping of the underground network. The dried networks developed in very crumbly lithology, evolve then essentially by downfalls.

The non-carbonate karst features observed in the state of Minas Gerais demonstrate the complex organisation of polyphase karst systems due to the linkage of underground and surface forms not previously connected. As in carbonate areas, these systems may play an important hydrological role.