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► To cite this version:

Vincent Bailly-Comte, Eglantine Husson, Elisabeth Legoff, Hubert Camus, Coline Ariagno, et al.. A karstogenetic model to understand the karstic functioning of the Causse Méjean, France. Eurokarst 2022, Jun 2022, Malaga, Spain. hal-03648843

HAL Id: hal-03648843

<https://hal-brgm.archives-ouvertes.fr/hal-03648843>

Submitted on 22 Apr 2022

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A karstogenetic model to understand the karstic functioning of the Causse Méjean, France

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The Cevennes national Park (PnC) and the French Geological survey (BRGM) have worked together to study the karst groundwater resources of the Causse Méjean, France. This karstic plateau is made up of Jurassic carbonate sediments (Lias, Dogger, Malm).). Except the liasic marls (Toarcian and the Domerian), it is made of limestones and dolomites that gives a typical karst landscape all over the Causse and its adjacent valleys.

The Causse Méjean has undergone a long period of weathering under cover, producing deep corridors that are mostly still filled with alterites (dolomitic sands). In the western part of the Causse , discharge monitoring shows that this ghost rocks karstification controls the highly inertial hydrodynamic behavior of the phreatic zone. However, the current karstic functioning exports these alterites, which allows the rapid development of a limited number but well-developed karstic networks. This explains the predominance of convective transport revealed by tracer tests within these pseudo-endokarsts. To the East, the karstification was enhanced thanks to allochthonous recharge from surface stream draining the Cevennes mountains. Associated with the dip of the layers towards the West, this configuration explains the paleo-direction of the karst drainage revealed by tracer tests that reach the Tarn River. This major direction of flows was then modified due to the deepening of the Tarn, the Jonte and finally the Tarnon rivers. The deepening of the Tarn River allows the emergence of karst springs that reorganize the karst drainage to the North (i.e. Castelbouc Sp). The deepening of the Jonte River explains the relatively limited karstic drainage of the Causse Méjean towards the Douzes sp., which is mostly recharged by swallow holes in the Jonte riverbed. Finally, the deepening of the Tarnon river through all the Jurassic sedimentary sequence explains the emergence of the Pêcher Sp. in contact with the substratum. Results of 22 tracer tests conducted during the project validate this karstogenetic evolution. In addition, the deepening of the Tarnon river has also hydraulically disconnected fluviokarst streams and polje systems from their Cevennes watershed. Materials of Cevennes origin still remain in karst depressions and filled the vadose and phreatic zone of the karst systems. Geochemical water-rock interactions with these materials explain radiogenic anomalies of Sr isotopes. This interpretation has been used to better understand the origin of the water flowing to the Pêcher spring, and to assess the relative contribution of the Jonte River to the discharge of the Douze Sp.

This study shows how knowledge of the geological and geomorphological evolution of the Causse Mejean can be used to build a karstogenetic model to be challenged by other hydrogeological tools and methods. This end up with a consistent representation of the structure and the hydrological functioning of the karst systems at the scale of the Causse Méjean.