The impact of subsurface life on ghost-rock karstification processes and cave formation

Guillaume Peugnet[‡], Céline Pisapia[‡], Laurent Bruxelles[§], Cédric Champollion[|], Philippe Vernant[|], Léna Lecourt[‡], Bénédicte Ménèz[‡], Emmanuelle Gérard[‡]

‡ IPGP, Paris, France
§ TRACES, Toulouse, France
| Géosciences, Montpellier, France

Corresponding author: Guillaume Peugnet (peugnet@ipgp.fr)

Abstract

Karst systems represent an important carbon and freshwater reservoirs. Although karst systems have been studied for many years, a new paradigm has emerged that suggests some of them could be formed by ghost-rock processes (Dubois et al. 2014*)*. Contrarily to the classical total karstification, ghost-rock karstification leaves in place a weathered rock, called the ghost-rock, that can constitute a microbial habitat (Spilde et al. 2005). The first results of a geomicrobiological study of the Sterkfontein's cave system in South Africa show that these ghost-rocks are mainly composed of iron and manganese oxides mixed with organic matter of putative microbial origin (Pisapia et al. in prep). To further understand the microbial community inhabiting these ghost-rocks, its specificity compared to groundwater, and its functional impact on the karst system of Sterkfontein, a metagenomic analysis from both ghost-rocks and groundwater samples was performed. It was completed by laser microdissection of the microorganisms attached to the mineral particles, followed by whole-genome amplification and transmission electron microscopy to analyze both the nature of the mineral particles and the microorganisms associated with them. The results highlight the differences in community between these two environments (with higher abundance of Actinobacteriota and Acidobacteriota in ghost-rock samples compared to ground water in particular), and suggest a high importance of microbe-minerals interactions in the ghost rocks, through metallophores production and extracellular electron transfer processes between bacteria and metallic ions.

Presenting author

Guillaume Peugnet

Presented at

I would like to present a poster at the "Cave, karst, and fractured rock" theme of the Part 1 "Natural Settings".

Conflicts of interest

The authors have declared that no competing interests exist.

References

- Dubois C, Quinif Y, Baele J-, Barriquand L, Bini A, Bruxelles L, Dandurand G, Havron C, Kaufmann O, Lans B, Maire R, Martin J, Rodet J, Rowberry MD, Tognini P, Vergari A (2014) The process of ghost-rock karstification and its role in the formation of cave systems. Earth-Science Reviews 131: 116-148. https://doi.org/10.1016/j.earscirev.2014.01.006
- Spilde M, Northup D, Boston P, Schelble R, Dano K, Crossey L, Dahm C (2005) Geomicrobiology of Cave Ferromanganese Deposits: A Field and Laboratory Investigation. Geomicrobiology Journal 22: 99-116. https://doi.org/10.1080/01490450590945889