

Bacteria mediated acidification in a carbonate coastal aquifer

Vallejos, A.¹, Sola, F.¹, Molina, L.¹ and Pulido-Bosch, A.¹

¹Water Resources and Environmental Geology – University of Almería, Spain

ABSTRACT

Mixing zones between freshwater and saltwater are areas where lots of bio-geochemical processes happen. In this work, a carbonate coastal aquifer sited in the Aguadulce cliffs (Almería, SE Spain) has been studied. Several EC and temperature log, in combination with samples taken at different depth have been performed. EC profile shows a narrow freshwater zone that overlaps a mixing-zone of 10 m thickness. pH in the freshwater layer is significantly alkaline, reaching values up to 9. Nonetheless, the transition zone between freshwater and seawater shows a water with a low pH (6 to 5.14). With these data, we have calculated the mineral SIs of the main carbonate phases (calcite, aragonite and dolomite). All of them are positive in the freshwater zone and clearly negative in the transition zone.

These results have been compared with a fossil Upper Pleistocene discharge zone located in these carbonate cliffs. In this area, the dolomite bedrock is deeply dissolved with a Swiss-cheese dissolution pattern. In the voids resulting of this dissolution some mineral phases have precipitated. These mineral phases, from the bedrock to the surface, are: 1) manganese-iron oxides; 2) botryoidal calcite and 3) acicular aragonite. The precipitation of manganese oxides may not have happened under purely geochemical conditions due to these mineral phases have a very negative SI, both in freshwater and in saltwater. Biological processes often accompany the chemical processes, adding to the complexity. Bacteria have been found to play an important role in both the weathering and precipitation of minerals. There are some studies where microbial processes are thought to control the precipitation of Mn oxides, with accompanying acidification of the media. This acidification reaction would be responsible for the anomalous low pH measured in the observation borehole and the dissolution of the bedrock. On the other hand, the alkaline pH measured in the freshwater conditions the precipitation of the carbonate mineral phases.

Acknowledgements

This work takes part of the general research lines promoted by the CEI-MAR Campus of International Excellence and it was supported by MINECO and FEDER, through Project CGL2015-67273-R.

Contact Information: Ángela Vallejos. Water Resources and Environmental Geology. University of Almería, 04120 Almería, Spain.
Email: avallejo@ual.es