

Sulfuric acid weathering underground

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Sedimentary rocks are subject to sulfuric acid as well as carbonic acid weathering. Sources of S for this weathering process include volcanic and hydrothermal emissions, sedimentary pyrite including coal, sulfur-rich hydrocarbons, and marine evaporites. Mixing between groundwaters with different redox status can mobilize and recycle S from the original sedimentary source or facilitate sulfuric acid production in place, often with the involvement of microbial communities that leave isotopic and other potential biosignatures [1]. Sulfuric acid weathering processes in caves serve as windows into processes that we expect are widespread but more diffuse in the subsurface. Spectacular examples can be found in Italy and have been studied by our group for more than a decade [2,3]. Microbial communities associated with sulfuric acid production include extreme acidophiles with taxonomic affiliations to acid mine drainage populations [4,5]. Although the extreme acidophiles have been relatively well studied, neutrophilic and mildly acidophilic sulfuric acid producers are poorly characterized and may be more widespread than extreme acidophiles in soil and subsurface environments. I will present genetic, geochemical, and mineralogical evidence for sulfuric and nitric acid production by neutrophiles in a cave intersected by a deep aquifer containing H₂S and NH₃. The presence of these organisms in other environments may serve as a bioindicator of cryptic sulfuric acid weathering processes that could be further investigated using isotopic and other geochemical approaches.

[1] Galdenzi & Maruoka (2003) *J. Cave Karst Stud.* 65(2): 111-125. [2] Macalady et al. (2006) *Appl. Environ. Microbiol.* 72(8):5596-5609. [3] Jones et al. (2015) *Chem. Geol.* 410:21-27. [4] Jones et al. (2012) *ISME J.* 6:158-170. [5] Jones et al. (2014) *Geomicrobiol. J.* 31(3):194-204.