Sulfur and oxygen isotopes: evidence of H₂S spring sources, southern Mexico

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Anomalously high H₂S concentrations up to 240 ppm exhale from springs on the surface and in caves in Tabasco-Chiapas states, Mexico. The proposed source are basinal fluids [1] and gas from an active volcano [2]. The spring water composition may potentially increase limestone porosity in an oil-rich region and has a rich biological environment associated. Further regional sampling of spring water seeks to elucidate the extent of the H₂S generation and its relation to the subsurface evaporites [4]. Although δD-δ¹⁸O analysis suggests that meteoric water is the main water-source of the H₂S-springs, the water composition ranges from 1400 to 6600 mg/l TDS (brackish water). This composition may be reached by interaction of groundwater with Late Jurassic salt and Lower Cretaceous anhydrite through lateral faults and anticline axis fractures. The similarities of the δ³⁴S and δ¹⁸O between the spring soluble sulfate, the brine-related oil sulfate, and the subsurface anhydrite propose a common origin. These isotopes do not show any evidence of a volcanic H₂S input to the springs. A relatively constant fractionation from 28 to 45‰ δ³⁴S-VCDT between the aqueous sulfides and sulfates of the H₂S springs points to an equilibrium sulfate reduction fractionation process. These values are inside the sulfate-sulfide fractionation range reported for microbial [4] sulfate reduction suggesting this mechanism can be producing the H₂S. The driving force for reduction, (temperature, pH, or the presence of organic matter) is not yet defined. The near neutral pH of the water (6.4 to 7.5) and a temperature at most three degrees Celsius above atmospheric temperature, points to the latter. The lack of change in the sulfate suggests there is an infinite reservoir of this compound. The produced H₂S re-oxidizes to H₂SO₄, reacting with the limestone host rock in caves to produce gypsum/selenite with the same isotopic signature as the precursor H₂S. Further data is being collected to clarify the H₂S source.


Biographical sketch:
Laura Rosales Lagarde was born in Mexico City, Mexico. She received her Master degree in Geology at the Geology Institute at Universidad Nacional Autónoma de México, Mexico City. She is a Ph.D. Geology student in the Cave and Karst Studies Program and anticipates graduating by December 2008. Her dissertation theme is: “Investigation of the geological controls on the spring water chemistry, Southern Tabasco and Northern Chiapas, Mexico”