Environmental Fate of Sulfur in Sulphur Creek, Valles Caldera, Nm: Implications for Water Quality and Metal Transport

Daniel Lavery¹, Laura J. Crossey¹ and Abdulmehdi Ali¹

¹University of New Mexico, 221 Yale Blvd NE, Albuquerque, NM, 87131, dlavery1@unm.edu

The 1.2 Ma Valles Caldera in northern New Mexico hosts a hydrothermal system that has been characterized by Goff and Janik, 2000 and references therein as consistent with a young igneous model. This study aims to determine the geochemical processes that govern the attenuation of chemical components released by hydrothermal activity in streams draining the Jemez mountains. The Sulphur Springs are the primary vents of the Valles acid-sulfate hydrothermal system, emitting waters with pH <3 and high concentrations of Al (60-800 mg/L) and SO₄²⁻ (1,800-10,000 mg/L). Sulphur Springs discharges into Sulphur Creek, imparting a similarly low-pH, high-Al, high-SO₄²⁻ signature. Further downstream, these signatures are attenuated by the interaction of Sulphur Creek with the similarly low-pH Redondo Creek and the circumneutral, snowmelt-fed Río San Antonio. The Sulphur Creek field area is a particularly useful natural laboratory to conduct this study due to the wide range of in-stream pH and salinity conditions. Additionally, Sulphur Creek waters mix with waters of diverse composition of both hydrothermal and meteoric origin at multiple confluences along its run. The wide range of conditions found in this field area make it possible to discriminate between many processes that control attenuation.

This study uses major ion and stable isotope compositions and field parameters of collected water samples as geochemical tracers to identify attenuation processes. Due to the low pH of many of the samples, charge balancing of the waters required additional steps, including partitioning total sulfate species into SO₄²⁻ and HSO₃⁻ and geochemical modelling using software such as PhreeQc. Data collected for this study suggests the importance of dilution and pH-changes in attenuating high concentrations of dissolved solids. Mixing analysis at the many confluences Sulphur Creek has along its flowpath is required to identify attenuation on a more granular level. Furthermore, additional investigation is needed to identify seasonal changes in the geochemistry of the system that may have an impact on the attenuation of the hydrothermal components. Hydrothermally-affected waters from the Yellowstone caldera are used for comparison with Valles waters in this study.

References:


Keywords:

Valles Caldera, acid-sulfate, geothermal, water quality, contaminant fate

pp. 60-61, https://doi.org/10.56577/SM-2023.2899

2023 New Mexico Geological Society Annual Spring Meeting
April 21, 2023, Macey Center, Socorro, NM
Online ISSN: 2834-5800