

Subsurface Fluid Geochemistry Shape Microbial Community Structure and Function at Solfatara-Pisciarelli Hydrothermal Systems, Italy.

IFEOMA R UGWUANYI¹, MIHAELA GLAMOCLIIA¹,
ANDREW STEELE², MARILYN FOGEL³, ROXANE
BOWDEN⁴, GIUSEPPE DE NATALE⁵, CLAUDIA TROISE⁶,
RENATO SOMMA⁵, MONICA PIOCHI⁶ AND ANGELA
MORMONE⁶

¹Rutgers University-Newark

²Carnegie Institution for Science

³University of California Riverside

⁴Carnegie Institution of Washington (former)

⁵Istituto Nazionale di Geofisica e Vulcanologia (INGV)

⁶Istituto Nazionale di Geofisica e Vulcanologia

Presenting Author: iru1@scarletmail.rutgers.edu

Geochemical differences in hydrothermal systems are strongly influenced by subsurface fluid circulations and mixing, and processes such as subsurface boiling, phase separation, and water-rock interaction influence the availability of electron donors/acceptors capable of supporting microbial metabolism in the hydrothermal systems. In this study, we investigate how geochemical variations that arise from subsurface fluid circulations drive the ecology of two adjacent hydrothermal systems. Solfatara Crater (Naples, Italy) contains active hydrothermal system, and on the outside wall of the crater is another active hydrothermal site, Pisciarelli. The geochemical differences in fluids among these systems is derived from subsurface water-rock interaction. Solfatara hydrothermal fluids produce an acidic and oxidizing (pH 1.0, Eh 198 to 330) environment while Pisciarelli is acidic and reducing (pH 1.5 to 3.0, Eh -628 to -485). Pisciarelli and Solfatara had average $\delta^{34}\text{S}$, $\delta^{13}\text{C}$, and $\delta^{15}\text{N}$ values that was indicative of a magmatic source for carbon, sulfur, and nitrogen. Overall, Pisciarelli contains three times more NH_4^+ and SO_4^{2-} than Solfatara. Principal Component Analysis (PCA) showed that Solfatara differed from Pisciarelli by Eh, NO_3^- and PO_4^{3-} . Metagenomic sequencing revealed that archaea were dominant in water and mud samples from Pisciarelli, while bacteria were dominant in soil samples from Pisciarelli and all the Solfatara samples. Functional genes showed differential abundance in Pisciarelli water and mud samples compared to all Solfatara samples and soil samples from Pisciarelli. Genes such as *aprB* and *nrf* involved in sulfur oxidation and nitrite reduction, respectively were abundant in Pisciarelli mud and water samples compared to all Solfatara samples and soil samples from Pisciarelli. Functional genes that were abundant in Solfatara samples and soil sample from Pisciarelli include *norB* and *fhs* involved in denitrification and acetate oxidation, respectively. Cluster analysis of functional genes from the three domains of life support this distinction of Pisciarelli water and mud communities from Pisciarelli soil and all the Solfatara samples. Overall, the geochemical difference we observed in hydrothermal fluids are likely responsible for the