

# The microbial mats of Vonarskarð, Iceland

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## The project

The caldera of the Vonarskard central volcano, located in Central Iceland, hosts a geothermal system that is unique in many aspects, with unusual abundance of visible microbial mats and geothermal surface features characterized by extremely high runoff of thermal water. Diverse and thick microbial mats are observed, many of which are vividly colored due to both light harvesting pigments and alteration mineralogy. Three microbial mats were selected for examination of geochemistry and microbial diversity. The aim is to integrate results from the different approaches to delineate the ecosystems and infer the interrelation of the mat communities and geothermal processes. Analysis of the microbial communities and thermodynamics is underway to quantify the energy sources derived from inorganic redox reactions, and to compare those reactions to the metabolic pathways used by the microbial communities.

## White mat

The most prominent mat in Vonarskarð is white and exceptionally dense. It forms at about 70°C and at extremely high concentration of H<sub>2</sub>S at the outflow of a thermal stream. The mat extends downhill for over hundred meters with successions of green at lower temperatures. SEM-EDS revealed the presence of both elemental sulfur and extensive networks with embedded microorganisms. Sulfate-reducing bacteria belonging to *Thermodesulfobacteria* and sulfur-oxidizing bacteria such as of the genera *Thiofaba* and *Thiomonas* were detected in high ratios.

## Black & white mat

The second mat investigated formed around a hot spring at 83°C. Black material was observed around the source and was found by SEM-EDS to contain iron sulfide mineralization as well as slender filaments and spherical cells. Community analysis revealed the dominance of the S- and H<sub>2</sub>-oxidizing *Thermocrinis albus*, which is known to form filaments in Icelandic hot springs. The black material was encircled by a white mat below 73°C, which contained abundant sulfur as well as various cell forms. Bacteria related to *Thermodesulfovibrio*, *Caldiserica* and *Thermus* were found to proliferate in the white mat.

## Red & green mat

The third examined mat was found in a thermal stream at oxidized conditions with very low H<sub>2</sub>S and iron in the Fe<sup>III</sup> oxidation state. The mat formed at a temperature gradient of <40 to 63°C and was characterized by photosynthetic organisms. It was green and orange-red at temperatures below and above 55°C, respectively. SEM-EDS and community analysis revealed the dominance of cyanobacteria belonging to the genus *Chlorogloeopsis* throughout the mat. Filaments were observed on the surface of the green part whereas the surface of the orange-red part was covered with sheaths encrusted in iron silicates, composed of amorphous silica and iron oxyhydroxides.

