Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37496

First description of gas, fluid, and sediment geochemistry of the Lake Kleifarvatn Hydrothermal Field, southwest Iceland.

ROY E PRICE[1], VAUGHN HAMILL[2], MARIA JESUS HERRERO PEREZ[3], TIMOTHY D. GLOTCH[4], DOUGLAS LAROWE[5], ANDRI STEFÁNSSON[6], MICHAEL TERRANCE THORPE[7], LAURA WEHRMANN[4] AND AMY WILLIAMS[2]

[1]SUNY Stony Brook/School of Marine and Atmospheric Sciences
[2]University of Florida
[3]Rensselaer Polytechnic Institute
[4]Stony Brook University
[5]Southern Methodist University
[6]University of Iceland/Institute of Earth Sciences
[7]UNIVERSITY OF MARYLAND AT COLLEGE PARK

Most studies of hydrothermal systems have focused on on-land hot springs, deep-sea vents or occasionally their shallow-sea equivalents. However, very few investigations have focused on vents occurring in lakes, even though they can provide important and sometimes unique insights into subsurface processes, sediment biogeochemistry, microbiology and planetary habitability.

Hydrothermal venting in the Kleifarvatn Hydrothermal Field (KHF), Reykjanes Peninsula, Iceland (Fig 1), is manifested as abundant sulfur- and iron-rich patches consisting of mineral precipitates and microbial biofilms (Fig 2). Site 1 and the Badlands (~2-4 m deep) are quite similar to the Heart site (0.5-1 m deep), with hot (25-115°C), anoxic, sulfide-rich, acidic (pH 4-6) hydrothermal fluids discharging through sandy sediment. The Crater site has similar fluid chemistry but is unique in that it covers a large area with many "pockmark" or mud pot craters, possibly enlarged by "washing out" of clays (alternation products); the bottom of one of these craters was 12 meters below the lakebed!

Alteration assemblages were dominated by hydrated clay minerals, including nontronite and montmorillonite with dispersed but abundant pyrite. Hydrothermal fluid enrichments over lake water included Mg, Si, K, Mn, Fe, Na, Ca, Sr, Al, Li, Rb, Cs, and H_2S; SO_4 was depleted. Gases were dominated by CO_2 (typically 80-90 mol%) and contained H_2 (1-29 mol%) and CH_4 (1-10 mol%) with lower concentrations of N_2, O_2 and H_2S. The fluid and gas compositions are likely strongly influenced by decompression boiling at depth followed by mixing with and condensation in shallow, likely non-thermal groundwater and lake water. H_2S has likely undergone oxidation, thus reducing its concentration in the vapor phase. N_2 appears to be largely from shallow, non-thermal recharge or air entrainment, whereas H_2 and CH_4 are of geothermal origin and more representative of deeper processes.

This presentation will summarize these initial data along with our evaluation of the subsurface processes leading to vent fluid compositions, fluid-sediment interactions and resulting mineral precipitates/alteration products. Furthermore, we will discuss our "HabMars" project objective to evaluate bioenergetic potential of heterotrophic metabolisms in the lake as an analog to similar systems that may have occurred on early Mars.

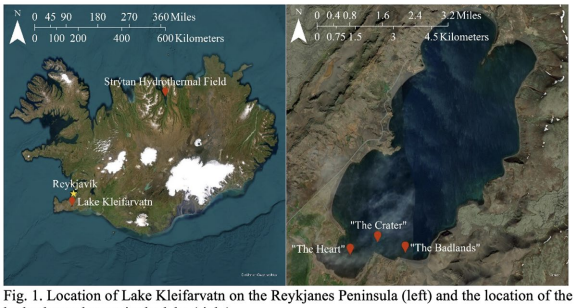

Fig. 1. Location of Lake Kleifarvatn on the Reykjanes Peninsula (left) and the location of the hydrothermal areas in the lake (right).

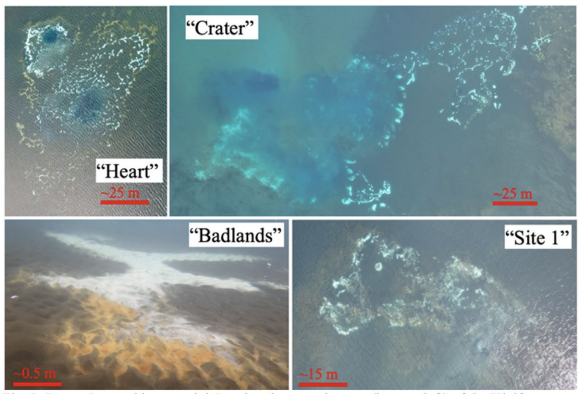

Fig. 2. Drone (top and bottom right) and underwater images (bottom left) of the Kleifarvatn Hydrothermal Field, southwest Iceland