Off-axis shallow-sea venting of alkaline, H_2 and CH_4 enriched fluids: The Strýtan Hydrothermal Field (SHF), Eyjafjörður, Iceland

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The Strýtan Hydrothermal Field (SHF), located in Eyjafjord, northern Iceland, exhibits a 55 meter high mineralized tower as a result of off-axis, alkaline (pH ~ 10), warm (up to 78°C), submarine hydrothermal venting. These characteristics are similar to other important submarine alkaline vent sites (e.g., the Lost City Hydrothermal Field), but underlying rocks are mafic basalt, not ultramafic peridotite. A detailed geochemical characterization of hydrothermal fluids from three sites within the SHF indicate fluid pH ranged from 9.16 to 10.22, temperatures ranged from 66 to 78 °C, and were moderately reducing. Salinity was low, ranging from 0.5 to 14.5 % seawater, suggesting a meteoric source. DIC concentrations were low (avg. = 0.46 μM), but CH_4, H_2, and CO concentrations were all elevated relative to normal seawater, ranging to as high as 1.41, 5.19, and 0.13 μM, respectively. While most samples had near-seawater $\delta^{13}C$-CH_4 (-30.7 to -53.1 ‰), several fluids had heavier values (-8.0 to -13.6 ‰), falling within the range of abiotic formation. We suggest that low temperature alteration of plagioclase, pyroxene and olivine in basalt, along with precipitation of calcite, takes place in a closed system which removes most atmospheric CO_2. This explains the observed high pH, variable Ca concentrations, and low DIC values. Weathering of pyroxene may produce H_2, which subsequently reduces CO_2 to form abiotic CH_4. However, the underlying processes are variable across sites, and further research is needed before the abiotic nature of the CH_4 can be confirmed. Although the underlying rocks and suggested reactions differ from those at Lost City, the abiotic production of H_2 and CH_4 along with high pH fluids in the SHF is intriguing, as it broadens the range of potential origin of life environments.