Geophysical Research Abstracts, Vol. 9, 10097, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10097

Four high-temperature hydrothermal systems in different geological settings at the MAR: Competitive influences of temperature, rock composition, and phase separation on the fluid geochemistry

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Within the framework of the German Special Priority Program 1144, the fluid geochemistry of four different vent fields along the MAR is investigated over a period of 6 years. The different vent field characteristics offer the unique opportunity to compare the individual influences of host rock composition, reaction temperature and phase separation on the fluid geochemistry. All fields are located in 3000 m water depth; two of them in a basaltic environment (Turtle Pits and Red Lion at 5˚S), the other two fields in an ultramafic setting (Nibelungen at 8˚S; Logatchev at 15˚N). Whereas Red Lion and Logatchev emanate 350˚C hot fluids, the highest measured temperature at Turtle Pits is 407˚C, the critical temperature with respect to phase separation in these depths. Although not measured, the temperature for the Nibelungen fluids is estimated to be >350-400˚C. By comparing the fluid geochemistry of the different vent fields, we are able to point out the influence of host rock composition (Red Lion and Logatchev), temperature (Nibelungen and Logatchev; Red Lion and Turtle Pits), and

phase separation (Turtle Pits compared to Red Lion).

The typical ultramafic signature at Nibelungen and Logatchev is characterized by high dissolved concentrations of hydrogen and methane, significantly lower concentrations of hydrogen sulfide, silica and lithium compared to the basaltic systems, more positive ΔD, and a depletion of boron compared to the seawater concentration.

Although only within 2 km distance, hydrothermal fluids from Turtle Pits and Red Lion show a very distinct composition, caused by phase separation under supercritical conditions at Turtle Pits. Elemental composition and stable isotopic signatures will be discussed. Varying temperature and heterogeneous chemical composition with respect to temperature-sensitive elements like Cu of the phase-separated Turtle Pits fluid could indicate mixing of separated vapor from various depths.