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Seafloor hydrothermal fluid evolution: a study of fluid inclusions from ODP/IODP Hole 1256D

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Fluid inclusions offer the only available samples of uncontaminated sub-seafloor fluids. To date, microthermometry of such fluid inclusions trapped in rocks of the ocean crust has revealed that there exist fluids of a wide range of salinities in fluids trapped in both modern and ancient hydrothermal systems. Here we report direct analyses of the chemistry of individual fluid inclusions using a Laser Ablation – Inductively Coupled Plasma – Mass Spectrometer (LA-ICP-MS). This method allows the assessment of multiple generations of fluids within the same sample, giving information on the full range of samples, rather than simply bulk compositional data obtained by crush-leach methods.

Samples from different levels in the hydrothermal systems in both the Troodos ophiolite, Cyprus and ODP/IODP Hole 1256D are being studied. Hole 1256D offers the first opportunity to study a complete section of *in situ* ocean crust which penetrates both the extrusive-dike and dike-plutonic boundaries. By studying ophiolitic and *in situ* ocean crust hydrothermal systems in tandem it is hoped that a greater understanding of fluid evolution will be reached through all levels of individual systems as well as establishing any further oceanic-ophiolitic similarities or differences.

Microthermometry of Troodos samples has so far revealed that there is a combination of fluids of black smoker vent salinity ($\sim$1.5 – 7 NaCl wt % eq.) and hyper-saline fluids ($\sim$25 – 45 NaCl wt % eq.) in the system, with some inclusions containing halite daughter crystals. Given the relatively good constraints on temperature and pressure in these systems it is evident that these fluids are not a simple phase separated pair, if assuming a purely seawater fluid source. Subsequent laser ablation of these fluid inclusions has provided a much more detailed insight into the nature of the fluids,

indicating that the fluids take up metals very efficiently and it is apparent that Mg loss from the seawater is slow, with it still being present in reasonable quantities at the base of the system.

Initial microthermometry on quartz-hosted fluid inclusions from a vein in the sheeted dike complex in Hole 1256D indicates very high temperature ($>$450degC) of some of the inclusions. This, combined with their hyper-salinity (as indicated by the presence of large daughter crystals at standard temperature and pressure) and the presence of hematite in some inclusions indicates that these fluids are possibly magmatic, being directly exsolved from the magma chamber.

Data acquisition from both sample suites is in progress and will be presented at the meeting.