Anaerobic methane oxidation in cool, warm, and hot Guaymas Basin hydrothermal sediments

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Our 2008 R/V Atlantis cruise to the hydrothermal field of Guaymas Basin detected anaerobic oxidation of methane (AOM) in hydrothermal sediments, based on $\delta^{13}C$ signatures of CH_4, DIC, and porewater concentration profiles of CH_4 and sulfate. *In situ* temperature gradients in three selected sediment push cores, each from different Guaymas Basin locations, indicate that the temperature regime for the AOM zone was distinct for every core (15-20°C, 30-35°C, and 70-95°C). Sediment cores adjacent to each of these cool, warm, and hot AOM geochemistry cores were examined for 16S rRNA, *mcrA* and *dsrAB* genes. Clone libraries of archaeal 16S rRNA genes from the cool and hot AOM cores yielded similar groups of typical sediment Archaea, MCG, Thermoproteales, and ANME1, regardless of their different locations and divergent temperature regimes. We also detected an ANME1 subclade possibly specific to Guaymas. The warm AOM core, from an area with strong upward migration of hydrothermal subsurface fluid, hosted a different archaeal community of MBGD, MBGB, Methanosarcinales, and ANME2 archaea. 16S rRNA gene clone libraries with Euryarchaeota-specific primers supplemented the general primer findings with an increased detection of *Archaeoglobus* species in the cool and hot cores. A V6-tag high-throughput sequencing survey generally supported the clone library results while providing high-resolution detail on archaeal and bacterial community structure.

Detection of *mcrA* functional genes was congruent with 16S rRNA gene results; cool and hot AOM cores shared more sequences (ANME-1 type) with each other than either did with the warm AOM core, which was dominated by Methanosarcinales-affiliated mcrA. Functional genes from sulfate-reducing Bacteria and Archaea, *dsrAB*, show more overlap between all cores, regardless of the core temperature.

These results indicate that AOM and CH_4-oxidizing archaeal communities persist over a wide temperature range.

Chemical composition of apatite inclusions in corundum and spinel determined by LA-ICP-MS and its potential for authentication and provenance determination

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Apatites derived from different rock types have distinctive absolute and relative abundances of trace elements including rare-earth elements (REE). [1] In this study, apatite inclusions in natural gem-quality corundum and spinel were analysed. They originate from the world's most important mining areas including Myanmar, Vietnam, Sri Lanka, Madagascar and Africa. Bulk compositions of the apatite inclusions and the host-mineral were determined using LA-ICP-MS. Differences in LREE/HREE fractionation and Eu-anomalies in apatite were found. They can be compared with the variations of trace and minor element concentrations in the host-corundum and spinel. There is no significant difference in total REE concentration between apatites in corundum and in spinel. The most interesting observation is that only samples from Winza (Tanzania) show a positive Eu-anomaly (Fig.1), which was already found in pargasite and garnet inclusions of the same provenance. [2] All the other samples showed a negative Eu-anomaly or no anomaly. No anomaly was found in two samples from a new ruby mine in Mozambique.

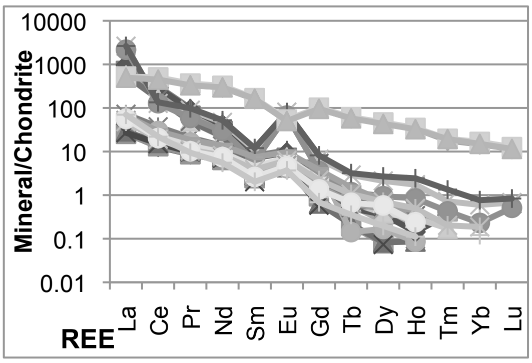

Figure 1: REE concentrations of apatite inclusions found in Winza-rubies (Tanzania), showing positive and one negative Eu-anomaly.

[1] Belousova *et al*. (2002) *J. Geochem. Exploration* **76**, 45–69. [2] Peretti *et al*. (2009) *Contrib. to Gemology* **7**, 87–92.