Production of archaeal lipid biomarkers in stable isotope labeled incubations of MCG-rich sediments

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The Miscellaneous Crenarchaeota Group (MCG) exhibit a global-distribution in anoxic, aquatic sediments and occur throughout a variety of distinct geochemical sediment regimes [1]. Several researchers have proposed that MCG live heterotrophically on organic carbon sources that are buried in the seafloor [1, 2], and Lloyd *et al*. [3] recently identified peptidases within the MCG genome; however, there is still no direct evidence of the metabolic strategy employed by these archaea. We incubated MCG-rich sediments from the White Oak River estuary anaerobically with deuterated (D) water and ^{13}C-bicarbonate [cf. 4], and determined the growth response of the MCG community in response to the addition of various organic substratres by quantifying the production of archaeal intact polar lipid (IPL) biomarkers, including compounds thought to be specific for MCG.

After a period of 145 days, evidence of D uptake into IPLs containing crenarchaeol indicated that several substrates stimulated benthic Crenarchaeota, which was supported by increases in the relative abundance of MCG clones in archaeal 16s rRNA clone libraries by up to 30%. The incubations amended with monosaccharides, peptone, or with yeast extract and acetate showed the highest label incorporations, translating into an ~ 5-fold increase in cell production rate, relative to a control incubation with no substrate ammendment. Given that only minimal ^{13}C was incorporated into archaeal lipids, our data are consistent with heterotrophic growth by MCG. Furthermore, these findings provide new evidence for the benthic production of crenarchaeol, likely by MCG, which is in conflict with the presumed planktonic source of this biomarker [e.g., 5].

[1] Kubo *et al*. (2012) *ISME J*. **10**, 1949-65. [2] Biddle *et al*. (2006) *PNAS* **103**, 3846-51. [3] Lloyd *et al*. (2013) *Nature* doi.10.1038/nature12033. [4] Wegener *et al*. (2012) *Environ. Microbiol*. **14**, 1517-27. [5] Sinninghe-Damsté (2002) *J. Lipid Res*. **43**, 1641-51.

Reconstructing the magma feeding system of the Cappadocian ignimbrites (Turkey) through amphibole thermobarometry

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The Cappadocia area of Central Turkey superbly exposes a succession of Neogene dacitic to rhyolitic ignimbrites and fallout deposits, recording 10 Ma of magmatic activity. This provides an excellent example of long-lived, relatively low frequency magmatic system, with a low average magma production rate (about 10^{-3} km^3/a), but short-lived large eruptions (up to 300 km^3 for the Cemilköy ignimbrite). Most of the ignimbritic and fallout units share a very similar, low-variance, phenocryst mineralogy (plagioclase + biotite + amphibole + magnetite + quartz), which makes them perfect targets for Al-in amphibole barometry.

An accurate Al-in hornblende barometer has been recalibrated from literature data and new experiments on the Kızilkaya ignimbrite. This new barometer takes into account the effect of both edenite and Tschermack substitutions on Al concentrations. Our data, combined with existing litterature data, show a very good pressure-dependence of the Tschermack substitution (correlation coefficient of 0.95) for amphibole in equilibrium with biotite, plagioclase and quartz. Our new barometer reproduces experimental pressures with an average error of 36 MPa in the 100-400 MPa range. More experiments are underway to improve the barometer's accuracy.

Pre-eruptive temperatures are relatively stable for most units, between 700 and 760 °C. Amphiboles crystallized in the upper crust, between 9 and 14 km depth, hinting at a constant depth of magma storage beneath the Cappadocian ignimbrite field. Detailed investigation of one of the youngest unit, the Kizilkaya ignimbrite, produces a tight unimodal pressure distribution at 260 ± 20 MPa (9.8 ± 0.8 km depth), with a maximum data dispersion lower than the 2σ uncertainty of the barometer. If the erupted reservoir was homogeneous, as suggested by the absence of magma mixing, and amphibole was present in the entire reservoir, the aspect ratio of the magma chamber would be relatively low, with a minimum diameter of 7.5 km and a 1.5 km maximum height.

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