In situ fluid inclusion analysis: Why bother?

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In situ studies of solutions in fluid inclusions, both natural and synthetic, are becoming increasingly popular, mostly due to technical advances in recent years. We are now, for the first time, able to directly measure inclusions of hydrous fluids, as well as silicate, sulfide, carbonatite and salt melts. Synchrotron XRF and PIXE allow elemental compositions of individual inclusion, but are strongly dependant upon independent estimates of inclusion geometries and depths. LA-ICPMS provides high precision elemental ratios of inclusion compositions, but requires a priori knowledge of one element within each inclusion as an internal standard. Thus synchrotron XRF, PIXE and LA-ICPMS all have specific difficulties that are rarely admitted publicly.

Synchrotron absorption studies provide the only means to measure oxidation states and bonding within inclusions at high P and T. This technique, although not straightforward, is likely to be the only way to directly measure molecules in melts and hydrous solutions. The small sample size of individual fluid inclusions, however, may limit how much information we can extract from them. Hydrothermal cells and diamond anvils may provide better data due to longer path lengths through solutions, but absorption by window materials may be a limiting factor here.

We are only now getting to the point where we can routinely measure inclusion compositions. But what will we really learn with this new capability? If one cannot connect a specific inclusion to a geological event, what is the point? So far, most studies have concentrated on highly saline brines, which contain very high metal contents. However, most ore-forming fluids contain very low levels of dissolved metals, and until we can detect these, we may not be unravelling ore-forming processes, which is our obvious goal.

Characterisation of Methanotrophic bacteria in volcanic soils through time-series $^{13}CH_4$ PLFA labelling

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Methanotrophs are a unique group of microorganisms in the Earth system acting as both a sink for atmospheric CH_4 (high affinity methanotrophs) and a robust barrier against CH_4 flux to the troposphere from anoxic environments (low affinity methanotrophs). As they have yet to be successfully cultured few details are known about high affinity methanotrophs with the main evidence supporting their activity from indirect CH_4 oxidation rate studies. Moreover, the fate of methanotrophically fixed carbon in the extensive range of natural and anthropogenic environments that they inhabit is unknown.

Through the use of compound-specific ^{13}C stable isotope analysis of microbial biomarker PLFAs we have simultaneously assessed high affinity methanotrophic biomass and taxonomic identity from a range of different mineral soils under atmospherically relevant CH_4 concentrations (Maxfield *et al*., 2006). This paper presents the first detailed investigation of high affinity methanotrophs in volcanic soils (andisols) from Tenerife. The results show substantial levels of ^{13}C incorporation following incubation under 2 ppmv $^{13}CH_4$ indicating an extremely high abundance of methanotrophic bacteria in these environments. This suggests that Andisols, a previously unstudied soil class with respect to methanotrophic bacteria, may oxidise significant amounts of atmospheric methane despite their low areal coverage globally. The preliminary fate of methane-derived carbon in soils will also be considered, as will the relationship between these findings and previously studied temperate soils (Evershed *et al*., 2006).

References

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