Mobility of Au in the mantle

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Sulfides are the main host for Au in the silicate earth [1,2], but there are few reliable analyses of Au in mantle sulfides. As both a chalcophile and a highly siderophile element, Au is an important tracer of differentiation/ metasomatism in the mantle. Sulfides melt incongruently in the mantle, and are mobile in a range of melts and fluids; thus this component is readily modified during mantle processes. *In-situ* analyses are important for unravelling these processes, because multiple generations of sulfides are commonly present in mantle xenoliths [2, 3, 4].

We have analysed Au in sulfides hosted in peridotite xenoliths from eastern Australia, southeastern China and Spitsbergen (Arctic Norway). These data have been used to assess the average abundance of Au in mantle sulfides, and investigate how mantle processes affect their Au content. The variety of metasomatic characteristics, in terms of style and strength of metasomatism, in the three sample sets makes it ideal for understanding how Au behaves in the mantle.

The Au content in sulfides in mantle peridotites across all datasets is 1.3±4.1 ppm. This is similar to the limited data in the literature (global average Au=1.5±4 ppm). Both this study, and the data in the literature indicate that sulfides in the continental lithospheric mantle contain less Au than would be calculated using whole-rock PUM values (~2.5 ppm). The pyroxenites studied have even lower Au contents (average Au = 0.08±0.10 ppm). This difference has important implications for the ability of mantle melts to transport Au, and as metasomatic agents.

While globally, mantle sulfides hosted in peridotites have a similar average and range of Au concentrations, there are important differences at local scales. This study shows the relationship between mantle metasomatism, as defined by silicate chemistry, and Au concentration in mantle sulfides. A significant amount of metasomatic sulfides can be introduced associated with the modification of the silicates, and these typically have a reduced Au content, similar to the low concentration observed in the pyroxenite melts analysed.

[1] Mitchell & Keays (1981) *GCA* **45**, 2425-2442. [2] Alard *et al.*, (2000) *Nature* **407**, 891-894 [3] Alard *et al.*, (2002) *EPSL* **203**, 651 – 663. [4] Griffin *et al.*, (2012) *Lithos*, **149**, 115- 135.

Radiolyis and life in deep subseafloor sediment of the South Pacific Gyre

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The nature of the energy yielding mechanisms in the low-energy organic-poor sedimentary environment underlying the South Pacific Gyre (SPG) is not fully constrained. We used the approach of Wang *et al.* (2008) to quantify rates of organic-fuelled metabolic activities at most IODP Expedition 329 Sites (U1365 through U1370). At Site U1366 and U1370 net rates of oxygen-reducing organic oxidation averaged 1.77E-2 and 1.64E-3 fmol O_2 cell^{-1} yr^{-1}, respectively, representing a tremendously low cellular metabolism. At Site U1370, we observe net oxygen reduction throughout the entire sediment column. At Site U1366, statistically significant net oxygen reduction is not detected at depths greater than 11 meters below seafloor. Despite these low rates of organic oxidation, most cell counts are above the minimum detection limit throughout the entire sequence at both sites.

Hydrogen from natural radioactive splitting of water has been hypothesized to be a significant electron donor in organic-poor sediment of the SPG. Becauses water radiolysis produces H_2 and ½ O_2 simultaneously, oxidation of this H_2 does not contribute to net O_2 reduction in the sediment. Our calculation of radiolytic H_2 production, based on radioactive element content and sediment physical properties, indicate that on average 5.63E-1 and 9.79E-2 fmol H_2 yr^{-1} cell^{-1} is available throughout the sequence at Sites U1366 and U1370, respectively. Despite these relatively high production rates, dissolved H_2 abundances are below detection at both sites. These results suggest that H_2 from in situ water radiolysis fuels the predominant energy-yielding pathway for microbes in SPG sediment.

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