

## A biomarker-based approach to assess the microbial diversity and functioning in an extreme acidic environment: The Río Tinto, Spain

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Understanding life in extreme environments may provide insight into the limits of life and its possible origin. An example of an extreme environment is the Río Tinto in Spain. The river water has a pH value around 2.2 and high concentrations of heavy metals, both maintained by the metabolism of the inhabiting bacteria and the strong buffer capacity of the iron, abundantly present in the river water [1]. To describe the microbial community along the Tinto River, a combined biomarker approach was applied including the investigation of intact polar lipids (IPLs) and polar lipid fatty acids, together with an exploratory stable isotope labeling experiment. Sediment and biofilm samples from Río Tinto showed distinct IPL diversity, with betaine lipids and phosphatidylethanolamine (PE) being most abundant, followed by phosphatidyl-(N)-methylethanolamine (PME), ornithine lipids, phosphatidylcholine (PC), phosphatidylglycerol (PG), monoglycosyldiacylglycerol (Gly-DAG), and diglycosyldiacylglycerol (2Gly-DAG). Furthermore, the IPL distribution of the predominant bacterial species *Acidithiobacillus ferrooxidans*, *Leptospirillum ferrooxidans*, and *Acidiphilium* spp. were investigated and compared with the environmental samples. Previous investigations revealed a higher eukaryotic than bacterial diversity in Río Tinto in spite of the extreme conditions, with eukaryotic organisms also being the principal contributors of biomass [1, 2], a finding that we could support with our IPL data. Polyunsaturated fatty acids indicated the presence of abundant algal and fungal communities, whereas the fatty acid *cycC*<sub>19:0</sub> revealed the presence of acid-producing bacteria. <sup>13</sup>C-labeled bicarbonate suggested that photoautotrophy by eukaryotic algae is the dominant carbon fixation pathway.

[1] Lopez-Archilla *et al.* (2001) *Microb. Ecol.* **41**, 20-35.

[2] Amaral Zettler *et al.* (2002) *Nature* **417**, 137-137.

## Towards a better understanding of the origin and evolution of kimberlite melts using melt phase relations in CMAS-CO<sub>2</sub>-H<sub>2</sub>O-K<sub>2</sub>O

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Kimberlites are rare potassium-rich volcanic rocks. They are generally considered to be of ultrabasic (<35% SiO<sub>2</sub>) nature, have low viscosity (0.1-1 Pa s), and contain a high volatile content (CO<sub>2</sub> and H<sub>2</sub>O). The deep origin of kimberlite magmas enables us to have direct insight into the composition of the upper mantle. Models for the generation of kimberlitic - and related carbonatitic - magmas show that volatiles play an important role (eg. CO<sub>2</sub>). Furthermore, these models indicate possible petrogenetic links between carbonatites and kimberlites in the CO<sub>2</sub>-bearing mantle source region due to very small degrees of partial melting (<2%) rather than by immiscibility and/or fractional crystallisation.

The melting phase relations of a model lherzolite system - CMAS-CO<sub>2</sub>-H<sub>2</sub>O-K<sub>2</sub>O - are investigated at upper mantle conditions (3 - 9GPa) to better understand the role of potassium (K) in the evolution and origin of kimberlitic melts. By choosing a bulk composition that will maximise the amount of each phase within the system, one is able to arbitrarily change the proportions of phases without changing the phase equilibria. Once sufficient phase equilibrium data is gathered, the isobaric melting paths of any mantle composition in a given system is calculated by employing the linear algebraic approaches (Korzhinskii, 1959). Employing this philosophy, the melting behaviour of lherzolite compositions as a function of pressure, temperature and bulk composition can be calculated. Therefore the melting phase relations are continuous on pressure-temperature projections.

Here we present recent results at 3GPa where all 7 phases have been stabilised (ie. univariant melting) over a temperature range of 150°C.