Laser ablation Pt-Re-Os analysis and chronometry of mantle-derived minerals

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The Re-Os isotope system has proved an extremely important tracer and chronometer of mantle processes over the past two decades. In contrast, the Pt-Os isotope system has been far less utilised, due to the difficulties of analysing the low abundance ^{186}Os and ^{190}Pt isotopes and the long half-life of ^{190}Pt. Despite this the potential of the Pt-Os system in mantle geochemistry is clear and is ripe for further development [eg 1-2]. Applications of Pt-Os chronometry have been few but advances in mass spectrometry have allowed us to develop a method for rapid (40 seconds) and simultaneous acquisition of Re-Os and Pt-Os isotope data on individual Platinum Group Alloys (PGAs) by laser ablation MC-ICP-MS [3].

There is sufficient variation in Pt/Os ratios within mantle-derived micro-phases to exploit as a chronometer and so we have applied this to dating PGAs associated with ophiolite complexes, which have hitherto have been extremely difficult to date. Preliminary Pt-Os isotope data for detrital PGA grains from Borneo will be presented that yield a Pt-Os isochron age of 207.6±6.5Ma (MSWD 1.5), close to the best estimates for the Meratus ophiolite from which the grains are thought to derive. Calculated initial ^{186}Os/^{188}Os ratios are also entirely consistent with mantle values. Obvious caution must be exercised when interpreting isochron ages based on detrital PGAs which may be temporally or genetically unrelated and could be derived from multiple parent bodies. This ambiguity can be avoided by dating individual PGA grains containing exsolved phases or multi-mineral intergrowths. Data will also be presented for both multi-gain and the first ever single-grain Pt-Os ages for PGA grains associated with the Central Lapland Greenstone Belt (CLGB). We will also illustrate that where Re-Os and Pt-Os ages can be obtained on the same PGA grain or group of grains there is always an age discordance, with Re-Os always being the younger. This will be shown to be an analytical limitation of laser ablation Re-Os dating. Nonetheless, it is clear that Pt/Os chronometry has widespread application to the dating of mantle phases and rocks.

[1] Brandon *et al.* (1998) *Science* **280**, 1570-1573. [2] Luguet *et al.* (2008) *Science* **319**, 453-456. [3] Nowell *et al.* (2008 in press) *Chem. Geol.*

Insights into lithospheric mantle beneath Patagonia

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The lithospheric mantle beneath Patagonia (PTG), as can be inferred from studies on mantle xenoliths, is highly inhomogeneous. In northern PTG the majority of mantle xenoliths show evidences of cryptic metasomatism, except those from Comallo that have traces of amphibole. In contrast, in southern PTG, the lithospheric mantle beneath Gobernador Gregores (Gb) is heavily modal metasomatized by abundant amphibole and/or phlogopite.

In northern PTG, gt-bearing peridotites occur in Prahuaniyeu (Pr), close to the NW margin of the Somoncura large igneous povince. They are characterized by high T = 1100–1230 °C and low P = 19.5–24 kbar. Zr is enriched in garnets from fertile gt-peridotites and depleted in garnets from residual gt-peridotites. Ti-content in gt shows no variations and appears to be decoupled from the behaviour of Zr. The cpx trace element patterns from gt-peridotites always have negative Zr anomaly but no Ti anomaly. In contrast, worldwide cpx from sp-peridotites generally have negative Ti anomaly in PM-normalized trace element patterns. Therefore the presence or absence of negative Ti anomaly could reveal whether or not the peridotites have experienced melting processes in the gt-peridotite field. $Zr^{Dcpx/Dgt}$ ratios of about 1 from a group of Pr gt-peridotites cannot be explained by simple melting processes and require introduction of melts causing cryptic metasomatism responsible for Zr enrichments in cpx.

These gt-peridotites have experienced up to 8% partial melting and slight cryptic metasomatism under low P-high T conditions, suggesting an ascending mantle plume.

The heavily metasomatized sp-peridotites from Gb have abundant melt pockets that according to mass balance calculations represent breakdown and melting of amphiboles with minor contribution of external melts. Amph, glass and partly cpx are strongly enriched in incompatible elements. Mantle xenoliths from the southern PT localities Tres Lagos and Cerro Redondo, south of Gb, are more depleted in basaltic components and suggest a lithospheric mantle at this region practically unaffected by metasomatic processes. Those differences and, the fact that the crust at Gb is a metamorphic unit of latest Proterozoic age whereas at the other two localities it is younger (Palaeozoic), suggest a boundary between two different micro tectonic plates.