Origin of UHP garnet lherzolite and serpentinised harzburgites from Pohorje, Eastern Alps, Slovenia

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The presence of former mantle rocks in continental crust sections from orogenic terrains may give important clues on the tectonic history of the region. The Slovenska Bistrica ultramafic complex (SBUC; Eastern Alps, Slovenia) occupies the south-eastern most part of the Pohorje mountains, which represent an extruded piece of continental crust subducted during the Cretaceous Eo-Alpine orogeny. The SBUC is the only known occurrence of ultramafic rocks within this nappe system apart from a few dismembered pieces in the near vicinity. The main body is composed of serpentinised harzburgites with local occurrences of garnet lherzolite, and as a whole it records a complex history of melt depletion, metasomatism, subduction and exhumation.

The harzburgites are highly depleted following melting within the spinel stability field, as exemplified by high whole-rock MgO, low Sc, Lu_N, and Gd_N/Yb_N, and high Cr# of Cr-spinel. Fluid-immobile trace elements (Th, Ti, Zr, Sc, V, HREE) correlate well and are consistent with a melt depletion trend. Other incompatible elements show little correlation and are probably strongly modified by the serpentinisation process. However, comparable LREE enrichment of all samples suggests that this piece of mantle was already metasomatised by melts or fluids before serpentinisation. In lherzolite CaO and Al_2O_3 contents were high enough to form garnet after spinel thus recording an UHP stage (4 GPa, 900°C) not visible in the harzburgites. Because of the evidence of an earlier lower pressure stage within the spinel stability field, the SBUC represents a piece of subducted mantle.

As subduction was intra-continental, the most obvious source of the SBUC is subcontinental lithosphere from the overlying continental slab, but this is in conflict with the strongly depleted nature of the rocks. Alternatively, it may have been part of the oceanic lithosphere after rifting of the N Apulia passive margin. This fits better with the geochemistry of the rocks, including negative Ce and positive Li and U anomalies - typical of weathering at the sea floor and commonly observed in abyssal peridotites. However, it is unclear how much these features are affected by serpentinization processes. A third possibility is that the SBUC represents subduction-modified depleted mantle from the hanging wall composed of S Apulia subcontinental mantle. A Re-Os isotope study is underway to obtain additional constraints on the origin of this piece of mantle.

Investigating the source of continental flood basalts: Insights from intra-lava flow osmium isotope variations

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Geochemical debates over the source of continental flood basalts usually assume that individual lava flows represent compositionally uniform and rapidly erupted products of large well-mixed magma reservoirs. This study presents an examination of intra-lava flow chemical and isotopic variations in relation to eruption sequence, which provide insights into the mechanisms of flood basalt petrogenesis.

The temporal variations implicated by the pahoehoe inflation model (Self *et.al.* 1997) have been applied to a flow field, formed by a single flood basalt eruption, both vertically within each sheet lobe and laterally between the constituent lobes. This framework provides insight into sequential magmatic evolution during the timescale of one eruption.

We present results from a 2,660 km^3 flow field formed during a single eruption in the Columbia River Basalt Province, USA. Our findings show that small but statistically significant major and trace element intra-lobe variations were present at the time of emplacement e.g. MgO 3.09-4.55 wt%, Ni 17.5-25.6 ppm, indicative of fractional crystallisation. However, such data does not reveal other processes such as source variations and/or crustal contamination. In contrast, Re-Os isotopes indicate progressive crustal contamination of the magma over the timescale of a single flood basalt eruption. Initial $^{187}Os/^{188}Os$ ratios range from 0.287 (lava core) to 1.569 (lava crust) within a single 35m thick sheet lobe. These values are more radiogenic than any known enriched sources (normative mantle ~0.127, HIMU ~0.15) consistent with previous data for CRBs (Chesley and Ruiz, 1998) indicating that neither an enriched source nor the SCLM can be the cause of the radiogenic values. Preliminary data for an individual lava from the Deccan Traps indicate a similar process of contamination. These data have important implications for flood basalt genesis and the nature of their source, and indicate that uniformity of individual lavas cannot be assumed.

References

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