Helium and trace element geochemical signals in the southwest Indian Ocean

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The South West Indian Ridge (SWIR) has one of the slowest spreading rate among the global oceanic ridge system. Homogenization of different mantle components should therefore be limited during melting and this should give access to mantle isotopic components. For this purpose, helium isotopes, major and trace elements were measured on 53 glass samples from this ridge from 32 to 68°E. The $^4He/^3He$ isotopic ratio presents three spike-like variations, with values down to 68,000 and up to 114,000, clearly out of the average for mid-ocean ridges away from hot spots (90,000±10,000). For the first time in MORB, and far from any hot spot, strong positive correlations are observed between He isotopes and enrichment proxies like K/Ti or La/Sm. These relations can be explained by ternary mixing between two enriched components and a depleted component with a surprisingly low, or primitive-like, $^4He/^3He$ signature. We propose that the Indian mantle has been enriched in incompatible elements by subduction-related fluid metasomatism before Gondwana opening 200Ma ago, and that, after the opening, from 1 to 6% DUPAL material, has been admixed to this metasomatized ambient mantle. Correlation with geophysical data indicates that the largest He primitive spike (50°E) is associated with a thermal anomaly. We suggest that the Indian Ocean opening and the Rodriguez Triple Junction (RTJ) drifting have triggered the rise of plumes in the upper mantle. The data contradict a model where upper mantle portions, more depleted in U and Th than He, keep low $^4He/^3He$ ratios. Incorporation of 0.2wt% lower mantle by these upper mantle plumes, without any recycled material, is preferable.

Provenance of Late Pleistocene megaflood and Late Ordovician Cordilleran passive margin sedimentary deposits by LA-ICPMS detrital zircon analysis

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Introduction and Methodology

Laser Ablation (LA)-ICPMS analysis of detrital zircons is used to discriminate provenance of Late Pleistocene megaflood event beds in the Columbia Basin, Washington, and Late Ordovician Laurentian Cordilleran passive margin deposits. These studies are testing hypotheses of alternative water sources for the Channeled Scabland [1] and whether the Peace River Arch was the sole source for Late Ordovician Laurentian passive margin sedimentary strata [2].

Stratigraphically constrained samples were collected, their zircons separated and analyzed on the LA-ICPMS housed in the WSU GeoAnalytical Laboratory. 120 grains [3] were analyzed from each sample following a standard method [4].

Discussion of Results

The oldest slackwater deposits in the southernmost Sanpoil River valley, Washington record repeated megafloods into Lake Columbia from glacial Lake Missoula. These megafloods transported prominent Archean, Paleoproterozic and Late Mesozoic-Early Cenozoic detrital zircons derived from source rocks in western Montana, northern Idaho, and northeastern Washington. Younger slackwater sedimentary deposits from a tributary of the Sanpoil River contain a solely Late Mesozoic to Early Cenozoic detrital zircon population attributed primarily to retreating Cordilleran Ice Sheet melt waters.

Spatially constrained detrital zircons from Late Ordovician Eureka Quartzite (and equivalent) samples in Idaho, Wyoming, Utah, and Nevada indicate that the Peace River Arch, the Talson-Thelon orogen, and local bedrock sources all provided sediment to this passive margin. Further sampling in a regional, temporally constrained framework will clarify provenance variations in this unit.

[1] Shaw *et al.* (1999) *Geology* **27,** 605-608. [2] Gehrels *et al.* (1995) *Geology* **23,** 831-834. [3] Vermeesch (2004) *Earth Planet. Sci. Lett.* **224,** 441-451. [4] Chang *et al.* (2006) *Geochem. Geophys. Geosyst.* **7**, Q05009, doi,10.1029/2005GC001100.