ABSTRACT FINAL ID: T44D-04;

TITLE: Tracing the sublithospheric sources of continental flood basalts: multi-elemental isotopic studies on the recently found ferropicrites and meimechites from the Karoo large igneous province.

SESSION TYPE: Oral

SESSION TITLE: T44D. The Origin of Intraplate Volcanism: Hotspots, Nonhotspots, and Large Igneous Provinces II

AUTHORS (FIRST NAME, LAST NAME): Jussi S Heinonen[1, 2], Richard W Carlson[2], Arto V Luttinen[1]

INSTITUTIONS (ALL): 1. Finnish Museum of Natural History, University of Helsinki, Helsinki, Finland.
2. Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, DC, United States.

Title of Team:

ABSTRACT BODY: There is a substantial debate on the mantle sources and ultimate origins of continental flood basalts (CFBs), e.g., whether they are related to deep-seated thermal upwellings (i.e. mantle plumes) or not. The Karoo CFB province that was emplaced on the juxtaposed land masses of Africa and Antarctica during the early stages of the breakup of the Gondwana supercontinent ~180 Ma ago has played a central role in this debate. Although most of the structural analyses, geochemical affinities, and temporal relationships of Karoo-related rocks point to a strong control of lithosphere on the magmatism, paleostress estimates for some of the Karoo dikes and high mantle potential temperatures estimated for the sources of recently found highly magnesian rocks from Antarctica are compatible with the plume theory.

Volcanic rocks that do not show evidence of lithospheric influence in their geochemistry are extremely rare in the African part of the Karoo province. Here we present high-precision isotopic (Sr, Nd, Pb, and Os) whole-rock data on some primitive dike rocks (ferropicrites and meimechites) associated with its Antarctic extension. The isotopic data together with trace element data show that the parental melts of the studied rocks sampled two distinctive geochemical reservoirs in the deep sub-Gondwanan mantle. The isotopic signatures of the relatively depleted types show evidence of extensive melt extraction in the past and are indistinguishable from those of mid-ocean ridge basalts (MORBs) of the SW Indian Ridge, the modern successor of the Jurassic Africa-Antarctica rift. On the other hand, the relatively enriched type isotopically resembles modern oceanic island basalts (OIBs) and may sample pyroxenitic sources either formed by melt infiltration in the upper mantle or by reaction of peridotite with recycled oceanic crustal components. Recent Ar-Ar datings of the depleted types indicate that they are related to the main phase of Karoo magmatism ~180 Ma ago. Moreover, preliminary modeling implies that many of the Antarctic Karoo flood basalts originated from the same mantle source with the depleted types prior to being contaminated by lithospheric materials.

Although the anomalously hot mantle sources (mantle potential temperatures >1600 °C) estimated for the depleted types are compatible with a plume origin, their MORB-like isotopic characteristics are

unusual for plume-derived rocks. Instead, our findings are more concordant with a recent model that suggests the generation of the Karoo CFBs in an extensive melting episode caused largely by internal heating of the upper mantle beneath the Gondwana supercontinent. The story is not complete, however: the next phases of geochemical research will concentrate on He, Li, and B isotopic signatures of these extraordinary rocks. Helium will hopefully shed more light on the plume problem and Li and B are expected to reveal if the sub-Gondwanan mantle entrained subduction-related geochemical signatures.

KEYWORDS: [1009] GEOCHEMISTRY / Geochemical modeling, [1033] GEOCHEMISTRY / Intra-plate processes, [1038] GEOCHEMISTRY / Mantle processes, [1040] GEOCHEMISTRY / Radiogenic isotope geochemistry.

(No Image Selected)

(No Table Selected)

SPONSOR NAME: Jussi Heinonen

Additional Details

Previously Presented Material: 75% Chemical Geology

Contact Details

CONTACT (NAME ONLY): Jussi Heinonen

CONTACT (E-MAIL ONLY): jussi.s.heinonen@helsinki.fi