Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 478

Ultra-depleted Hafnium Isotopes from Australian-Antarctic Discordance MORB

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The Australian-Antarctic Discordance (AAD), one of the deepest sections of the global MOR spreading system, is the location of a sharp boundary between Indian-type and Pacific-type upper mantle provinces (Klein et al, 1988). The Indian-Pacific mantle boundary, defined by Sr, Nd and Pb isotopes, is abrupt and has migrated westward within the last 3-4 Myr, across the easternmost segment (B5) of the AAD (Pyle et al., 1992). The deep axial depth of the AAD reflects cold underlying mantle, low melt supply and thin oceanic crust that produces a chaotic sea-floor topography. Coincident with migration of the isotopic boundary is the displacement of chaotic seafloor by normal, ridge-parallel, high melt supply, seafloor accretion (Christie et al., 1998). Here we present new Hf and high precision Pb isotope data for zero age (Pyle et al., 1992) and off-axis AAD MORB glass (Christie et al., 1998) to characterize the Hf isotopic systematics of the mantle boundary and to constrain theories for the AAD origin.

Hf and Pb isotope ratios were obtained by multi-collector plasma source mass spectrometry on the VG Plasma 54 at the Ecole Normale Supérieure de Lyon. $^{176}Hf/^{177}Hf$ ranges from 0.283121-0.283174 for the Pacific MORB (segments A1, A2), 0.283141-0.283589 for the Indian MORB (B2, B3, B4), and 0.283164-0.283199 for the transitional ridge segment B5 (Fig. 1). The Indian MORB from AAD ridge segment B4 are ultra-depleted, with $^{176}Hf/^{177}Hf$ ranging 0.283401-0.283589 and $^{143}Nd/^{144}Nd$= 0.513184-0.513349. Indian-type mantle has higher $^{176}Hf/^{177}Hf$ for a given $^{143}Nd/^{144}Nd$ than Pacific-type, defining separate fields in Nd-Hf isotope space. Two exceptions are: (1) segment B5 samples define a negative trend between the two fields; and (2), a single Pacific-type sample from segment A1 that plots inside the Indian field. In the Hf-Pb, Nd-Pb, and Pb-Pb diagrams all samples from east of the AAD (segments A1 and A2) define distinct fields that represent Pacific mantle. Samples from the AAD (B2, B3, B4) west of the transitional segment B5 plot in separate fields with less radiogenic Pb, Nd, and Hf isotopes relative to the Pacific-type samples. Segment B5 forms a linear trend between the Pacific and Indian fields in the wake of westward Pacific mantle migration. Sr isotopes for AAD MORB glass are more radiogenic than those of Zone A, and B5 glasses are intermediate. Similar evidence for mantle heterogeneity and mixing between Pacific and Indian mantle is illustrated in the Hf-Pb isotope diagram (Fig. 1). The Pacific mantle defines a tight field with low $^{176}Hf/^{177}Hf$ and relatively radiogenic $^{206}Pb/^{204}Pb$. The Indian mantle defines a negative trend with a regular spatial variation from high $^{206}Pb/^{204}Pb$ and low $^{176}Hf/^{177}Hf$ in the west (segments B2, B3) to lower $^{206}Pb/^{204}Pb$ and higher $^{176}Hf/^{177}Hf$ towards the east (B4). Segment B5 defines a transitional trend between the Pacific and Indian fields. It intersects the Indian trend at low $^{176}Hf/^{177}Hf$, close to the segment B3 composition. MORB with similar isotope characteristics occur at 2-7 S on the MAR, from inter-transform spreading in the EPR Garrett FZ, and the Rodriguez triple junction (RTJ) (Hanan et al., 1986; Patchett and Tatsumoto, 1980; Salters, 1996). These areas represent the most depleted MORB mantle sources known. The ultra-depleted MORB from segment B4 fall along and extend the binary-like linear radiogenic isotope trends for Indian MORB to more depleted values. This suggests that the AAD MORB mantle source does not represent an exotic slab or subcontinental mantle fragment. Melt extraction from previously melted Indian mantle like that currently beneath segments B2 and B3, possibly related to the recent ridge jumps of segment B4 adequately accounts for the isotope data.

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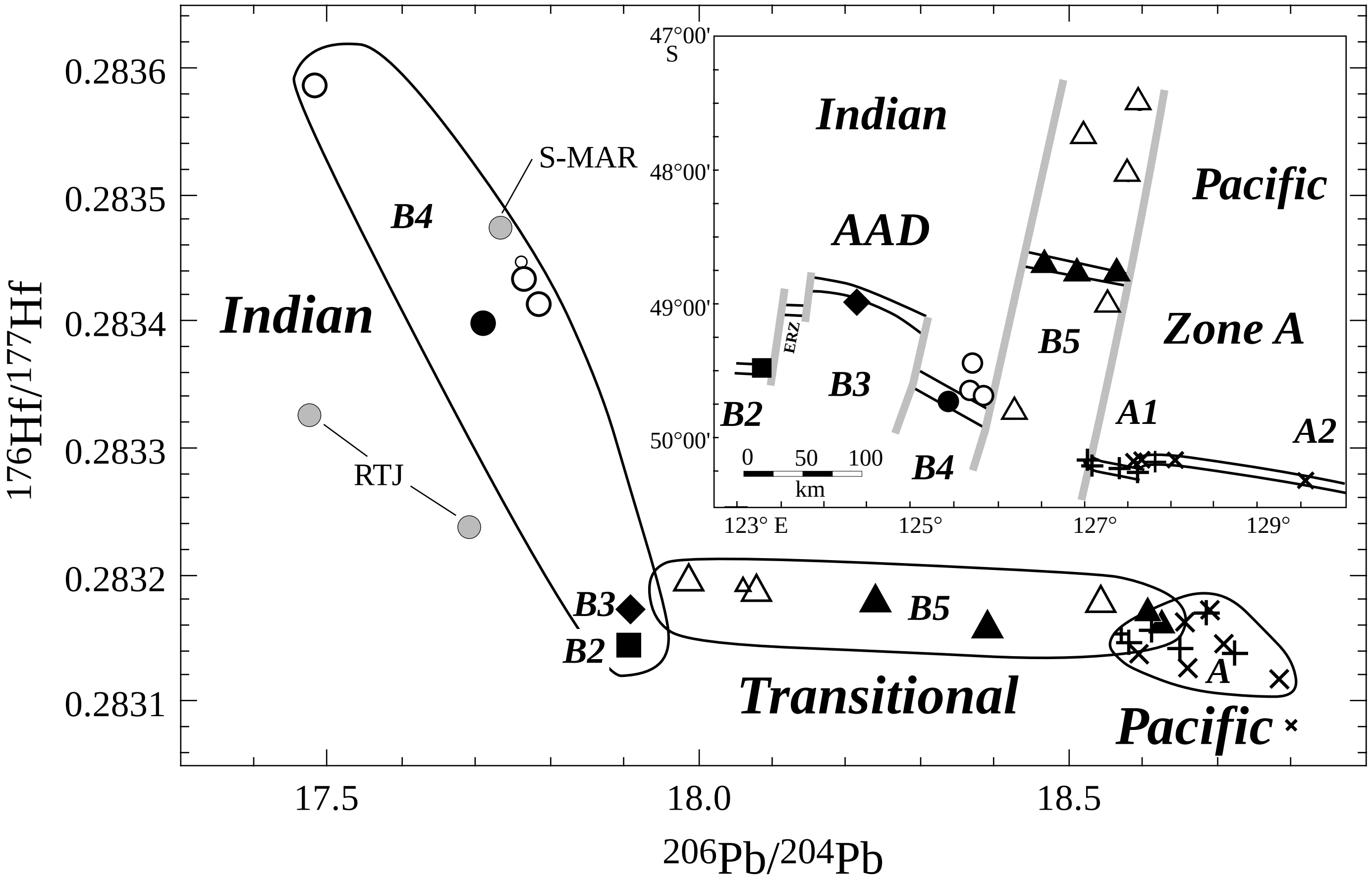

Figure 1. Hf-Pb isotope variation for AAD zero age (solid symbols) and off-axis (open symbols) basalt glasses. Small symbols are from Patchett and Tatsumoto, 1980 (S-MAR) & Salters, 1996 (RTJ and AAD).

Christie, DM, West, BP, Pyle, DG & Hanan, BB, *Nature*, **394**, 637-644, (1998).

Hanan, BB, Kingsley, RH & Schilling, J-G, *Nature*, **322**, 137-144, (1986).

Klein, EM Langmuir, CH, Zindler, A, Staudigel, H & Hamelin, B, *Nature*, **333**, 623-629, (1988).

Patchett, PJ & Tatsumoto, M, *Geophysical Research Letters*, **7**, 1077-1080, (1980).

Pyle, DG, Christie, DM & Mahoney, JJ, *Earth and Planetary Science Letters*, **112**, 161-178, (1992).

Salters, VJM, *Earth and Planetary Science Letters*, **141**, 109-123, (1996).