REEs in Al-rich chondrules: Clues to their origin

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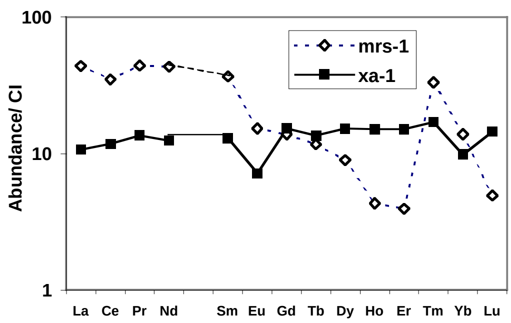
Introduction: CAIs are now widely thought to have a single source followed by distribution throughout the chondrite groups; these data are compatible with formation near an active Sun and subsequent transport to the asteroidal regions in an x-wind [1,2]. However, it is not clear whether chondrules have a similar remote origin. We are undertaking a project to measure REEs in Al-rich chondrules to investigate their origins. These objects are in some respects intermediate in properties between CAIs and ferromagnesian chondrules. Samples, from the CV3 Allende, were measured using LA-ICP-MS.

Results: MRS-1 is composed of anorthite laths with interstitial diopside and abundant Mg-spinel phenocrysts. XA-1 has a core remarkably similar to MRS-1; however it exhibits a mantle of finer-grained pyroxene and anorthite.

MRS-1 contains bulk REEs at 4-40xCI, and exhibits a fractionation pattern similar to CAIs' Group II patterns. XA-1 has bulk REE abundances approximately ~10xCI and exhibits a pattern similar to the Group III patterns in CAIs. For both chondrules, anorthite is poorer in REEs than diopside, and exhibits a complementary Eu anomaly.



Conclusions: These results suggest that this type of object formed from similar materials to CAIs, although their bulk composition is less refractory than Type B CAIs suggesting they were removed from their formation region at a lower temperature. Typically, chondrules of this type have lower initial ^{26}Al contents than Type B CAIs. These objects may have formed close to the Sun, but further out than CAIs, in a region that experienced less irradiation than the CAI-forming region.

[1] Shu et al. (1996) *Science* **271** 1545. [2] McKeegan et al. (2000) *Science* **289** 842.

Agulhas Leakage variability from Sr isotopes in South Atlantic detritus

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Thermohaline ocean circulation is an important mechanism for the transport of heat around the Earth. Here we show that the terrigenous clastic contributions from the Agulhas Leakage to the Cape Basin waxed and waned over the last glacial cycle in concert with changes in deep ocean δ^{13}C and $\varepsilon_{Nd,}$ tracers of North Atlantic Deep Water (NADW) flux. Thus the detrital Sr isotopes provide a means to link changes in the contribution of Agulhas water to the Atlantic Ocean during cold stages with NADW flux and northern hemisphere glaciation.

Detrital ^{87}Sr/^{86}Sr ratios in cores TNO57-21 (41°8′S, 8° 34′E, 4,981m) and RC11-83 (40°36′S, 9°34′E, 4,718m) from the Cape Basin, South Atlantic, vary between cold stage lows and warm stage highs. The source of the high ^{87}Sr/^{86}Sr detritus is particulates from the SW Indian Ocean carried to the South Atlantic by the Agulhas Leakage.

Possible explanations for lower ^{87}Sr/^{86}Sr ratios during cold stages include a decreased Agulhas flux, or enhanced input of the low ^{87}Sr/^{86}Sr endmember through high glacial fluxes of Patagonian dust. In order to address this issue we have compared the <2 µm fraction of TNO57-21 samples with the <63 µm fraction. ^{87}Sr/^{86}Sr ratios show a strong correlation, indicating binary mixing, with the <2 µm fraction consistently higher than the <63 µm fraction. The data show that lower bulk sediment ^{87}Sr/^{86}Sr ratios during cold stages reflect a decrease in the contribution from the fine particulate fraction.

Eolian dust from Patagonia dust is characterized by fine grain size and low ^{87}Sr/^{86}Sr ratios, thus it can be ruled out as driving the isotopic variability during cold stages. Rather, the lower cold stage values reflect a reduced input of the Agulhas end-member. Thus the climatically coherent changes in the terrigenous clastic ^{87}Sr/^{86}Sr ratios in the Cape Basin are best explained by variability of the Agulhas Leakage. This means that Sr isotopic variations in SE Atlantic sediment can be a sensitive indicator of the return flow of the conveyor. The results have implications for future studies of climate forcing. Through comparison with proxies of NADW strength in the same cores, the timing changes in tropical (Agulhas) inputs to the South Atlantic and global deep ocean circulation can be assessed.