The first presolar corundum in an enstatite chondrite: A NanoSIMS study

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Introduction

All presolar oxide grains found in meteorites to date are either from carbonaceous or from ordinary chondrites. In enstatite chondrites, no grain was confirmed presolar by precise isotopic measurements. Here, we report the first finding of a presolar corundum in the Sahara 97166 EH3.

Experimental

Of 3 presolar candidate oxide grains from Sahara 97166 found by low-mass resolution ion imaging with an IMS3f ion microprobe, a 4 µm-sized corundum grain (Sah-602-4) was relocated in the NanoSIMS and analyzed for O-isotopes. With a < 1pA Cs^+ beam of ~50nm in size, 7 O ion raster images ($5x5\mu m^2$) of the Sah-602-4 grain were acquired.

Results and discussion

The results show that Sah-602-4 is anomalously enriched in ^{17}O and depleted in ^{18}O (Fig. 1). The $\delta^{17}O$ and $\delta^{18}O$ values are 1037±27‰, and -287±5‰, respectively, indicating a presolar origin. No apparent heterogeneities of O-isotopic ratios are shown within the grain (Fig. 1). This is the first finding of a presolar oxide grain in an enstatite chondrite. The grain belongs to the group 1 of presolar oxide grains which most likely formed in low or intermediate mass red giants and asymptotic giant branch (AGB) stars. The study of the two other presolar candidate grains is now in progress.

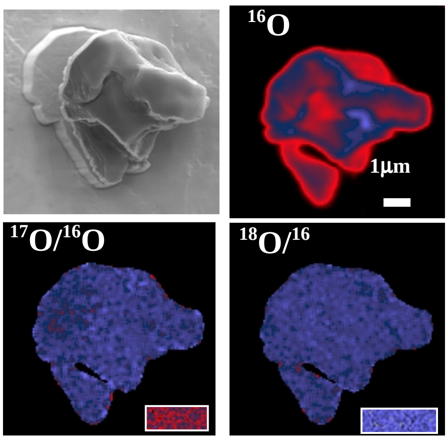

Fig.1: SEM-BSE and NanoSIMS O-isotopic images of Sah-602-4. Rectangular boxes are colors for solar O-isotopic ratios. Color code: black (min)-red-blue-yellow-white (max).

References

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Deep Fluids from the Subducting Pacific Plate and Associated Extremophilic Microbial Activity on a Mariana Forearc Serpentine Seamount, ODP Leg 195

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As the Pacific Plate subducts beneath the non-accretionary Mariana forearc its crust emits water that hydrates the mantle of the overriding plate. The resulting serpentinite rises through faults to the seafloor, along with partially altered harzburgite and the excess volatiles, to form a belt of serpentine mud volcanoes that have cold springs at their summits. This mass flux through the forearc represents one of the earliest returns of subducted material to the oceans. To assess this flux, Ocean Drilling Program Site 1200 was drilled on the summit of one of these mud volcanoes. S. Chamorro seamount lies near 14 deg.N, 85 km landward of the trench and 26.5 km above the top of the subducting plate. Cold springs at its summit are populated by mussels, tubeworms, whelks, and galatheid crabs. We recovered pore waters from three holes drilled <10, 20, and 80 m from one of these springs. Composition-depth profiles for these pore waters, to a maximum depth of 71 mbsf, verify that water is upwelling through serpentinite to feed the springs. The ascending water has a clear signature of a deep-slab origin. It is highly enriched in chemical species that are virtually absent in the partially serpentinized, depleted harzburgite, including (mainly carbonate) alkalinity (60; all units in mmol/kg), Na (610), Na/Cl (1.2), K (19), B (3.2), ammonia (0.22), methane (2), and C2 through C6 hydrocarbons. The fluids have a pH of 12.5. They are highly depleted in Mg, Ca, Sr, and Li, and have low concentrations of Si, Mn, Fe, Ba, and phosphate. They are slightly depleted in chloride (510 vs. 545 in seawater) and enriched in sulfate (by 7% relative to chloride). These deep fluids feed an active microbial community within the upper 20 mbsf that is oxidizing light hydrocarbons from the fluid while reducing sulfate. At pH 12.5, this is a true extremophile community. Microbes are most active at two levels, reducing sulfate from seawater at 3 mbsf and from the ascending fluid at 13 mbsf.