

Nd concentration and isotopic ratio in the waters of the Pacific Ocean

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Four vertical profiles of dissolved Nd concentration and isotopic ratio were determined in the northwest Pacific near the Japanese Islands.

As for the stations in the Kuroshio Current regime (LM2, LM6/11), depth profiles of Nd isotopic ratio is not so smooth. The depth profiles at LM2 (29°N, 143°E) and LM6/11 (34°N, 142°E) have two minima at ~250m ($\epsilon_{Nd} = -7.4$ for LM2, -8.7 for LM6/11) and ~2000m ($\epsilon_{Nd} = -6 \sim -5$) and one maximum around 800 ~ 1000m. The stations in the Oyashio Current regime (LM9, CM5) show less complicated Nd isotopic vertical profiles compared with those in the Kuroshio. Within the depth range of 800 ~ 1000m, LM9 (40°N, 145°E) and CM5 (40°N, 155°E) show almost same values as those at LM2 and LM6/11, which seems to be due to the influence of the North Pacific Intermediate Water (NPIW) to both the Kuroshio and Oyashio Current regimes. Except for the surface, the profile of CM5 is almost as same as that of the previously reported subarctic site, TPS 47 39-1 (Piepgras and Jacobsen (1988)). On the other hand, below 1000m, LM9, located in the southern edge of the Oyashio Current regime, shows less radiogenic values compared with CM5 and TPS 47 39-1.

The shallow Nd isotopic minimum observed in the Kuroshio Current region is due to the contribution of the North Pacific Tropical Water (NPTW), which might be supplied large amount of the continental derived Nd from the South China Sea or East China Sea. As the samples from the depths around NPTW do not show any characteristic REE patterns, the Nd isotopic ratios are the only indicators for the water mass.

Within the depth range of 1000 to 5000m, the Nd isotopic profile at CM5 shows the slight but clear radiogenic ratios compared with LM stations. This strongly suggests the limited deep water exchange between CM5 and those at LM stations. The vertical processes might play a key role in the formation of the water mass with high Nd isotopic ratio in the subarctic area.

Overall, the combined Nd isotopic and Nd concentration (REE pattern) study gives the various information on the water circulation and vertical processes in the ocean.

References

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Pb isotopic dating of chondrules

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Introduction

Chondritic meteorites consist of three major components: Ca, Al-rich inclusions (CAIs), ferromagnesian silicate chondrules, and fine-grained matrix. The timing of chondrule formation and time interval between the formation of CAIs and chondrules could provide important constraints on their origin and solar nebula evolution, but remain unknown.

Short-lived isotope chronometers ²⁶Al-²⁶Mg, ⁵³Mn-⁵³Cr and ¹²⁹I-¹²⁹Xe allow precise dating of chondrules, but depend on assumptions about the distribution and initial abundances of parent radioactive isotopes, and give relative ages only. Radiogenic ²⁰⁷Pb/²⁰⁶Pb ratios provide absolute ages with a similar precision of $\pm 1-2$ m.y. or better. The precision and accuracy depend on effective removal of common Pb, and on establishing high quality Pb-Pb isochron relationships. With modern low-blank (1-2 pg) techniques for Pb isotope analyses it is possible to obtain precise and highly radiogenic Pb isotopic ratios from 1-10 mg of chondrule silicates, large single chondrules, or groups of several smaller chondrules.

Results

Pb isotope data for the CR2 chondrite Acfer 059 illustrate the potential and problems of chondrule dating. Twenty seven silicate fractions from this meteorite yielded ²⁰⁶Pb/²⁰⁴Pb ratios between 11.09 (matrix) and 2200 (one of acid-washed chondrules). Pb-Pb "errorchron" regression of all data yields 4562.8 ± 3.4 Ma with MSWD=52. Data for all 23 acid-washed and unwashed chondrules with ²⁰⁶Pb/²⁰⁴Pb ≥ 17.8 yield an "errorchron" date of 4563.3 ± 1.9 Ma (MSWD=19). The six most radiogenic Pb isotope data points from acid-washed chondrules with ²⁰⁶Pb/²⁰⁴Pb ≥ 395 define an isochron with an age of 4564.7 ± 0.6 Ma, MSWD=0.5 (Amelin and Krot 2002). Increasing scatter for less radiogenic data suggests that the common Pb isotopic heterogeneity is the main threat to precision of Pb isotope dating.

The efficiency of acid washing for minimising common Pb content varies between meteorites, and the precision of chondrule dates varies accordingly. Nine chondrules with ²⁰⁶Pb/²⁰⁴Pb ratios between 50-171 from the CV3 chondrite Allende yielded an isochron with an age of 4566.8 ± 1.6 Ma (MSWD=1.3). Tentative less radiogenic data from the CR2 chondrite Renazzo and LL3.1 chondrite Krymka define less precise "errorchrons" giving the dates of 4564 ± 12 Ma, MSWD=11.5, and 4576 ± 18 Ma, MSWD=10.7.

References

Amelin Y. and Krot A. N. (2002) Submitted to the Annual Meeting of the Meteoritical Society.