Nd isotopic compositions in the central Indian Ocean

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Nd isotopic composition in seawater is controlled by input from surrounding terrestrial sources, boundary exchange process, lateral transportation, and mixing water masses. During global thermohaline circulation, the Indian Ocean receives deep waters originated from the Southern Ocean, and its warm and salty surface waters return to the Atlantic Ocean via Southern Ocean. Low-salinity waters of the North Pacific origin are injected at the eastern side of the Indian Ocean via the Indonesian Throughflow. The fingerprints of the Pacific waters might be traced in the intermediate water in the southeastern Atlantic Ocean. On the other hand, Nd isotope data are too scarce to precisely describe Nd isotopic signatures of the main water masses in the Indian Ocean. In this study, vertical profiles of Nd isotopic compositions in the ceantral Indian Ocean are presented.

Seawater samples were obtained both with Teflon coated X-type Niskin samplers with CTD-carosel multi-sampling system and the PVC large volume sampler during R/V Hakuho-Maru KH-09-5 cruise (2009. 11. 6 - 2010. 1. 12). From each 10L of seawater, rare earth elements (REEs) were preconcentrated by Fe coprecipitation. After removal Fe by di-isopropyl ether, REEs were purified with ion exchange resin. Further Nd separation was performed by TRU Resin and Ln Resin (Eichrom Tec.). Nd isotopic compositions were measured by thermal ionization mass spectrometer (Finnigan MAT 262).

In the sampling station, ER-10 (19°59′ S, 72°33′E, 4343m), of the central Indian Ocean, wide ranges of Nd isotopic composition were observed. The ε_{Nd} values decreased from surface (ε_{Nd} = -5.7) to high salinity Subantarctic Mode Water at 600 m depth (ε_{Nd} = -9.3). Antarctic Intermediate Water showed also relatively low ε_{Nd} values, though the water mass between 1000 m and 1500 m depth, whose salinity and oxygen concentration were low, had higher ε_{Nd} values (-6.3 - -5.9). This radiogenic Nd signal could be derived from the Indonesian Throughflow and affect the Nd compositions of Antarcitc and Atlantic intermediate water.

Ubiquitous subaerial weathering during emersion of the Fortescue Late Archean igneous province, Western Australia

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The 2.77Gy old Mount Roe paleosol at Whim Creek, Fortescue Group, Western Australia, is a reference weathering profile, used for constraining maximum concentrations of atmospheric oxygen and greenhouse gases (CO_2, CH_4) during the Late Archean. Inferences on Early Earth atmospheric composition, however, are based on the interpretation of reconstructed chemical profiles which are not supported by direct mineralogical observations. This in turn resulted in a number of controversies that remain to be solved. The Whim Creek paleosol occurs at the top of a vesicular, subaerial basaltic flow exposed along two km-scale outcrops located about 5 km away from each other. It mainly consists of fresh footwall basalt progressively grading to a 5 meters thick brecciated chloritic-rich zone showing evidence of corestone weathering, overlain by a 5 to 20 meters thick sericitic-rich zone. Clastic sediments are often inter-bedded between the top sericite zone and the overlying basaltic flow. This is consistent with a significant time gap between deposition of footwall and hanging wall lava flows, a required condition to develop a thick weathering profile. Similar weathering profiles have been identified both along the same stratigraphic level some 100 km away from the Whim Creek locality (Sherlock River) and in the younger 2.74 Gyr old Kylena Formation. This indicates that basalt weathering was a long-lasting process of wide geographic influence.

Meter scale blue-greenish titanite-rich bodies containing primary weathering-related phyllosilicates (Berthierine, Smectite) were found as hard cores within the sericite zone at both Whim Creek and Sherlock River localities. In addition, remnants of bedded-parallel diaspore/pyrophyllite deposits containing carbonaceous material were found in the Whim Creek sericite zone. Field and petrological investigations indicate that both the phyllosilicates and diaspore horizons predate sericitization.

These occurrences are the first relic testimony of the original weathering profiles documented in rocks older than 2.2 Gyr, thus representing unvaluable new means for inventorying the Late Archean paleoclimatic conditions.