Ge/Si atomic ratio of siliceous deposit formed from geothermal water: as an indicator of silica source of BIF

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The source of iron and silica in BIF has been argued for a long period. For the source of iron (Fe^{2+}) of BIF, most of the geoscientists agree with the submarine hydrothermal activity. For the source of silica, however, there are different ideas based on the difference in Ge/Si atomic ratio: whether it is hydrothermal or is continental in origin. Hamade *et al*. found that the Ge/Si atomic ratios of iron-poor silica layer in the Brockman BIFs are essentially identical to present-day seawater (~0.8 x 10^{-6}), suggesting that the silica in Fe-poor layers formed from silica derived from the weathering of continental crust (input from river) rather than from hydrothermal fluids [1]. On the other hand, the Ge/Si atomic ratios in the Fe-rich layers are as high as ~20 x 10^{-6}, which are similar to those in MOR hydrothermal fluids. In order to well-establish the reliability of Ge/Si atomic ratio as an indicator for the source of silica in Fe-poor layer in BIF, it is essential to show the relationship between Ge/Si atomic ratios in hydrothermal fluid and in siliceous deposit which precipitated directly from the fluid. In this study, we measured the Ge/Si atomic ratios of geothermal waters and siliceous deposits at geothermal power plants.

The distribution ratio of Ge into siliceous deposit from geothermal water was low. The Ge/Si atomic ratio of siliceous deposits formed in geothermal water in the aging tank at the Hatchobaru geothermal power plant was in the range from 3.72 to 5.42 x 10^{-6}. This values of Ge/Si atomic ratio can be considered to be an indicator showing the hydrothermal origin. The Ge/Si atomic ratio of iron-poor silica layer of Temagami BIF was in the range from 3.3 to 7.9 x 10^{-6}, suggesting hydrothermal origin.

[1] Hamade *et al*., Geology, 31, 35-38 (2003)

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^{142}Nd isotope anomaly in chondrite revisited

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Chondrites and differentiated meteorites possess isotope differences from the terrestrial composition for some heavy elements, suggesting heterogeneous isotope distribution in the early Solar System. For Nd, carboneceous chondrites have $^{142}Nd/^{144}Nd$ ratios >20 ppm lower than the terrestrial [1]. The finding most likely suggests the occurrence of a large scale silicate differentiation that fractionated Sm-Nd in early history of the Earth when short-lived ^{146}Sm existed. However, most of the Nd isotope data in chondrites were obtained using incomplete sample digestion that could not dissolve acid resistant, isotopically anomalous presolar grains, resulting in variable $^{145,148,150}Nd/^{144}Nd$ ratios [2]. To resolve this issue, we have developed a new method for determining Nd isotope ratios in meteorites with ultra-high precision using a TIMS (TRITON plus at Tokyo Tech), coupled with complete sample decomposition technique using a pressure digestion system (DAB-2, Berghof, Germany). Meteorite samples were put in Teflon inserts together with a mixture of HF, HNO_3 and H_2SO_4. The insert was placed in a stainless jacket and heated at 240 ºC for >12 hours under high pressure. The existence of H_2SO_4 facilitated digestion of acid resistant presolar SiC. The resulting solution was dried and dissolved in 1M HCl, and passed through cation exchange resin and Ln spec to isolate Nd. In the TIMS analysis, we monitored ^{140}Ce interference using a compact discrete dynode, resulting in an excellent analytical precision of $^{142}Nd/^{144}Nd$ (2 ppm, 2SD) for repeated analysis of 500 ng of JNdi-1 standard. Using the technique, we determined Nd isotope compositions in four chondrites; Murchison (CM2), Saratov (L4), Chergach (H5) and NWA 4814 (R4), as well as terrestrial samples. These chondrites have $^{142}Nd/^{144}Nd$ ratios of 23±3ppm lower than the terrestrial samples, although the $^{145,148,150}Nd/^{144}Nd$ ratios were not resolvable from the terrestrial. This indicates that Nd isotopes were homogenously distributed in the early Solar System. Our result supports the existence of an enriched hidden reservoir in the Earth's mantle whose chemical composition is complementary with a depleted mantle that was produced by silicate differentiation in the early history of the Earth while ^{146}Sm existed.

[1] Boyet and Carlson (2005) Science 309, 576. [2] Carlson *et al*. (2007) Science 316, 1175.

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