Correlation between Ba and Si/N in the oceans

Y. KATO[1], M. KAMATA[2], Y. WATANABE[3] AND C. SAITO[4]

[1]School of Marine Science and Technology, Tokai University, Shizuoka 424-8610, Japan (ykato@scc.u-tokai.ac.jp)
[2]Marine Works Japan, Ltd., Yokohama 236-0031, Japan (kamata@mwj.co.jp)
[3]Graduate School of Environmental Earth Science, Hokkaido University, Sapporo 060-0810, Jpana (yywata@ees.hokudai.ac.jp)
[4]Japan Marine Science and Technology Center, Yokosuka 237-0061, Japan (saitoc@jamstec.go.jp)

Dissolved Ba was measured in seawaters obtained in the subarctic region of the North Pacific (WOCE-P1 revisit observation in 1999), Japan and Okhotsk Seas.

Generally, the vertical distribution of Ba grouped into bio-intermediate element is similar to those of nutrients. Using our data, however, the correlation plots of Ba vs silicate, as well as nitrate, lie off a straight line. This suggests that the regeneration of Ba is mainly due to the dissolution of barite ($BaSO_4$) composed in the plankton. It deduces that the higher concentration of Ba in the deep water of the North Pacific result from the deep sea storage of Ba dissolved from biogenic barite particles during the thermohaline circulation.

Our data from the North Pacific well demonstrate that there is a linear correlation between Ba and silicate/nitrate ratio as shown in Fig. 1, although it is not in the plot of Ba vs. each nutrient, as mentioned above. Comparatively, the plots using the data from Japan and Okhotsk Seas, including GEOSECS results, lie also well above the straight lines with somewhat different slopes, respectively. It is clear that the Ba-Si/N relationships reflect the mixing of water masses such as NPIW, NPDW, AABW and AAIW.

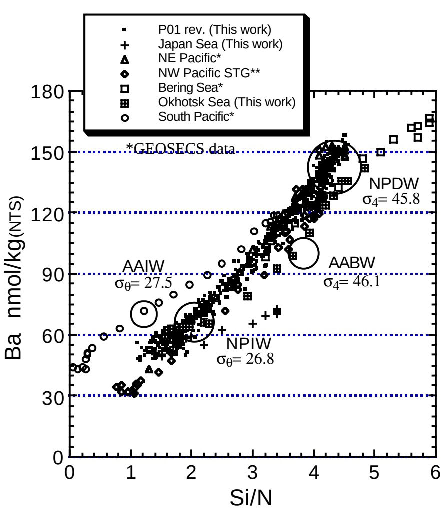

Fig. 1. Ba-Si/N diagram in the oceans.

Thermal expansion of Mg_2SiO_4 spinel in its stability field

T. KATSURA[1], S. YOKOSHI[1], M.-S. SONG[1], K. KAWABE[1], T. TSUJIMURA[1], A. KUBO[1], Y. TANGE[2] AND K. FUNAKOSHI[3]

[1]Institute for Study of the Earth's Interior, Okayama University, Misas, Tottori 682-0193, Japan tkatsura@misasa.okayama-u.ac.jp
[2]Department of Earth and Planetary Sciences, Tokyo Institute of Technology, Ookayama, Meguro-ku 152-8511, Japan.
[3]Japan Synchrotron Radiation Research Institute, Kouto, Hyogo 678-5198, Japan.

Heat is mainly transported by convection in the mantle, and the mantle geotherm should be adiabatic or slightly superadiabatic. The adiabatic geotherm $(dT/dz)_s$ is expressed as $(dT/dz)_s = \alpha g T / C_p$, where α is thermal expansion, g is gravitational acceleration, and C_p is heat capacity at constant pressure. Hence, knowledge of thermal expansion is essential to estimate the mantle geotherm.

Thermal expansion increases and decreases with increasing temperature and pressure, respectively. Therefore, thermal expansion has to be determined at the conditions relevant to the mantle. $(Mg,Fe)_2SiO_4$ spinel is an important consitutent in the mantle transition zone. Hence, thermal expansion of Mg_2SiO_4 spinel has been determined in its stability field in this study.

Volume measurement was conducted by means of high *P-T in situ* X-ray diffraction in a multi-anvil press with energy-dispersive X-ray diffraction at pressures around 21.5 GPa and temperatures of 300 to 2000 K. The starting material is Mg_2SiO_4 forsterite, which was converted to spinel at temperatures of 1500~1700 K. The unit cell parameters of Mg_2SiO_4 spinel were obtained from 13 diffraction lines of (220), (311), (400), (422), (511)+(333), (440), (620), (533), (444), (642), (553)+(731), (800) and (844). Pressures were estimated using an MgO pressure marker with an EoS proposed by Matsui *et al.* (2000). The isobaric isothermal thermal expansion is estimated by correcting the volumes by compression with pressure.

The thermal expansion of Mg_2SiO_4 spinel at 21.5 GPa was estimated to be α (/K) = $1.2*10^{-5} + 8*10^{-9} * T$ (K). These values are substantially smaller than those measured at lower pressure. The thermal expansion in the stability field of spinel in the mantle transition zone is about $1.5 * 10^{-5}$ (/K). The adiabatic geotherm in the mantle transition zone is about 0.2 km/s.