Boron isotope geochemistry of subseafloor hydrothermal ore deposits, Agrokipia B, in Troodos ophiolite, Cyprus

H. KAWAHATA[1]*, K. YAMAOKA[2], S. MATSUKURA[1] AND T. ISHIKAWA[3]

[1]Atmosphere and Ocean Research Institute, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba, 277-8564 Japan (*correspondence: kawahata@aori.u-tokyo.ac.jp)
[2]Geological Survey of Japan, National institute of Advanced Industrial Science and Technology, 1-1-1 Higashi, Tsukuba, Ibaraki 305-8567 Japan
[3]Kochi Institute for Core Sample Research, JAMSTEC, 200 Monobe Otsu, Nankoku, Kochi, 783-8502 Japan

Cyprus-type ore deposits in many ophiolites are regarded as fossil examples of ore forming processes occurring at modern hydrothermal vent area. Hole CY2A was drilled into stockwork zone of the subseafloor Agrokipia B deposit. Boron is a useful tracer for understanding geochemical mechanism of fluid-related processes because of its chemical properties of high incompatibility and fluid mobility.

Basalts altered at low temperature (Zone A) are relatively enriched in boron (6.2–31.7 ppm) and give the average value of 21.1 ppm. On the other hand, mineralized basalts and dolerites altered at high temperature (Zones B, C, and D) have lower boron contents (0.92–17.0 ppm) and show no trend with stratigraphic depth. The $\delta^{11}B$ values of basalts from upper 450 m slightly increase with depth from 2.4 to 4.8‰, whereas those of basalts and dolerites below 450 m show a significant decrease with increasing depth. The lowermost dolerite and sulfide-enriched part of dolerite have as low as –6‰ of $\delta^{11}B$. We conclude that the rocks around Agrokipia B experienced relatively low temperature in recharge zone when Agrokipia A deposits was formed and that high temperature alterations overprinted boron content and isotopic composition of altered rocks to form the subseafloor Agrokipia B deposit. This demonstrates that boron is a good new proxy to analyze and trace hydrothermal alteration and its stages.

Continental materials around the bottom of the mantle transition zone

K. KAWAI[1], S. YAMAMOTO[2], H. ICHIKAWA[3], T. TSUCHIYA[4] AND S. MARUYAMA[5]

[1]Department of Earth and Planetary Sciences, Tokyo Institute of Technology, Tokyo, Japan (kenji@geo.titech.ac.jp)
[2]Department of Earth Science & Astronomy, The University of Tokyo, Tokyo, Japan (syamamot@ea.c.u-tokyo.ac.jp)
[3]Geodyanmics Research Center, Ehime University, Ehime, Japan (h-ichikawa@sci.ehime-u.ac.jp)
[4]Geodyanmics Research Center, Ehime University, Ehime, Japan (takut@sci.ehime-u.ac.jp)
[5]Department of Earth and Planetary Sciences, Tokyo Institute of Technology, Tokyo Japan (smaruyam@geo.titech.ac.jp)

Recent progress in our understanding of the consuming plate boundary indicates the ubiquitous occurrence of tectonic erosion of the hanging wall of the continental margin, sediment-trapped subduction, and direct subduction of immature oceanic arcs into deep mantle. Geological studies have estimated the volume of subducted tonalite–trondhjemite–granodiorite (TTG) materials to about seven times the surface total volume of continental crust. To reveal the fate of subducted crusts and how they recycle within the Earth, we studied high-pressure densities and elastic properties of TTG by means of the first principles computation method and compared them to those of peridotite. We found that TTG is gravitationally stable and its seismic velocities are remarkably faster than peridotite in the depth range from 270 to 800 km, especially from 300 to 670 km. We, therefore, propose SiO_2-rich second continents around the bottom of the mantle transition zone, which used to form the TTG crust on the Earth's surface. Our proposed model may provide reasonable explanations of seismological observations such as the splitting of the 670 km discontinuity and seismic scatterers in the uppermost part of the lower mantle. The difference in seismic velocities between PREM model and experimental results in the lower part of the transition zone can be explained by 25 volumetric% of TTG, which would correspond to about several times the present volume of the continental crust. Formation and dynamics of those second continents would have controlled the Earth's thermal history over geologic time.