Slab melting: Its contribution to continental crust formation and mantle evolution

Y. TATSUMI

Institute for Frontier Research on Earth Evolution (IFREE), Japan Marine Science and Technology Center (JAMSTEC), Yokosuka Japan (tatsumi@jamstec.go.jp)

Foundering of the oceanic lithosphere into the mantle has provided profound effects on the chemical evolution of the solid Earth. Magmatism in subduction zones; the residual slab materials have further transported to deeper parts of the Earth and may have formed mantle components with compositions different from the original mantle. Although the subducting oceanic crust does not melt in most "normal" subduction zones on the modern Earth, slab melting may have existed more widely during Earth's early history and possibly contributed to formation of andesitic continental crust.

The mechanism, including slab-melting and subsequent melt-mantle interaction, was examined by geochemical formulation of partial melting and melt-solid reactions. The modeling results suggest that such a process can reasonably explain the major and trace element compositions of the andesitic bulk continental crust. However, the Sr-Nd-Pb isotopic compositions of melting residues in the subducting slab, which may have foundered and been stored in the deep mantle, do not match those of any proposed geochemical reservoir. This may lead to the conclusion that the slab melting did not play the major role in the continental crust formation during the Archean.

On the other hand, continental crust formation, through slab-dehydration, creation/anatexis of initial basaltic arc crust, mixing of mantle-derived basalt and crust-derived felsic magmas, and subsequent restite delamination, can reasonably explain continental crust formation and complementary accumulation of the EMI reservoir in the deep mantle.

Pb isotope constraints on the source of boninite and arc magmatism in the Bonin islands, Japan

REX N. TAYLOR[1], O. ISHIZUKA[2] AND C. MACPHERSON[3]

[1]Southampton Oceanography Centre, European way, Southampton, SO14 3ZH, United Kingdom. rex@soc.soton.ac.uk

[2]Institute of Geoscience, Geological Survey of Japan/AIST Central 7, 1-1-1 Higashi, Tsukuba, Ibaraki, 305-8567, Japan.

[3]Department of Geological Sciences, University of Durham, Durham, DH1 3LE, United Kingdom

The high precision Pb isotope ratios attainable by the double spike technique are used in this study to investigate the interaction between subduction zone input and mantle wedge compontents in the Eocene forearc of the Bonin Islands. We also present Sr and Nd isotopic data and Ar-Ar dating results from the Bonin island volcanics.

Samples from the boninite series volcanics from the Marubewan Formation (46-48Ma) form tight linear trends on $^{206}Pb/^{204}Pb$-$^{208}Pb/^{204}Pb$ and $^{206}Pb/^{204}Pb$-$^{207}Pb/^{204}Pb$ diagrams (e.g. Fig. 1). These trends can be extrapolated accurately to radiogenic Pb, and vector towards $\Delta 7/4$ =9 and $\Delta 8/4$ =40 at $^{206}Pb/^{204}Pb$=19. Interestingly, $^{87}Sr/^{86}Sr$ decreases with more radiogenic Pb. The overlying Mikazukiyama formation volcaniclastics (45Ma) have more radiogenic Pb isotopes but compositions are more scattered toward the NHRL. Samples from adjacent islands Hahajima (44Ma arc tholeiite) and Mukojima (boninite) have similar Pb isotope compositions, but form distinct, sub-parallel trends in Pb isotope space.

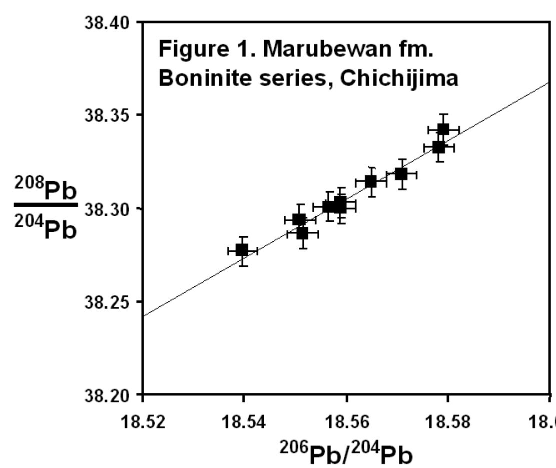

Figure 1. Marubewan fm. Boninite series, Chichijima

In light of the isotopic data, we examine potential contributions to the Eocene forearc magmatism, which include subducted sediment/ocean crust, the depleted mantle wedge, and enriched mantle components. With the isotopic data now available from the length of the Izu-Bonin arc-trench system and spanning some 48Ma, it is possible to examine the evolution of the inputs from subduction and the composition of the mantle wedge through time and space.