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Origin of Eclogites from the Sanbagawa Metamorphic Belt, Southwestern Japan: Geochemical and Sr-Nd Isotopic Evidence

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The Sanbagawa belt is a celebrated Cretaceous high-P/T metamorphic belt occurring in SW Japan. Although most metamorphic rocks from the Sanbagawa belt are non-eclogitic, several eclogite-facies metagabbro bodies are exposed in the Besshi area of the Shikoku island. These bodies were earlier recognized as tectonic blocks derived from the lower crust of the former hanging wall (= mantle wedge) in the subduction zone (Takasu et al., 1994). However, more recent studies of field occurrence and metamorphic petrology led to a suggestion that these bodies represent subducted oceanic materials along with their surrounding schists, but not tectonic blocks from mantle wedge (Ota et al., 2004; Terabayashi et al., 2005; Aoya et al., 2006). Furthermore, the protoliths of these eclogites were considered to have formed in a seamount (Aoya et al., 2006) or an oceanic plateau (Terabayashi et al., 2005). In this study, we aim to resolve the controversy about the protoliths and tectonic setting of eclogites and associated rocks using geochemical and Sr-Nd isotopic tracer techniques. All samples were collected from the Iratsu body, the best exposure of eclogitic rocks in the Besshi area.

Eclogites, garnet clinopyroxenites and garnet amphibolites from the Iratsu body have flat to LREE-enriched REE patterns, and show Nb and Zr-Hf depletion in the conventional spidergrams. They have Sr-Nd isotopic characteristics of OIB (epsilon Nd (t) = -1 - +4), hence are different from the surrounding mafic schists which are akin to MORB. The overall geochemical and isotopic signatures suggest that the protoliths of the Iratsu body formed in a subduction setting and were produced by melting of mixed sources between a depleted and an enriched mantle components. The geochemical feature of garnet clinopyroxenites (strong Zr-Hf depletion and Ti enrichment) may be explained by accumulation of clinopyroxene + plagioclase + magnetite. A relevant experimental study indicates that the mineral assemblage requires fractional crystallization under high fO2 and fH2O in the middle to lower crustal condition (Hamada and Fuii. 2008). Since the development of the Sanbagawa belt was hypothesized to take place in the continental margin of SE China during the Cretaceous (Isozaki, 1996), granulite xenoliths from SE China might be taken to represent the lower crust of the hanging wall of the Sanbagawa subduction zone. However, the study of Yu et al. (2003) showed a range of isotopic compositions (epsilon Nd (t) = +5 - +7 and -3 - -9) sufficiently different from that of the Iratsu body. Consequently, the idea of the Iratsu body as tectonic blocks from the hanging wall is not supported.

In view of the new geochemical and isotopic data, the most plausible tectonic setting for the Iratsu body is an oceanic island arc. Eclogites, garnet clinopyroxenites and garnet amphibolites probably represent the lower part of the oceanic island arc; whereas quartz eclogites of the marginal zone were likely the volcaniclastic deposit near the oceanic island arc.

References

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