Origin and Provenance of Ophiolitic Rocks in Luzon, Philippines: An isotope Study

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The isotopic study of the basement rocks in Luzon has an important bearing on the mantle dynamics and tectonic reconstruction of the Western Pacific. Previous paleontological and few radiometric dating show that the basement rocks in Luzon fall into two age groups, Early to Late Cretaceous and Eocene, implying at least two periods of oceanic crust generation. Basement rocks belonging to both age groups were sampled for this study. The results show that there is a difference in isotopic and chemical compositions between the younger and older basement rocks. The Eocene basement rocks have higher age-corrected 207Pb/204Pb (15.50-15.57) for a given 206Pb/204Pb (17.59-18.28) similar to the other western Pacific basin of the same age, suggesting a common mantle source. They differ from the older ophiolites in having a suprasubduction chemical signature. These results appear to support suggestions (Encarnacion et al., 1993; 2004) that they are not transported to their present positions but are products of crust generation by back-arc spreading of older oceanic crust and could have tapped the same mantle source that formed the adjacent Philippine Sea crust. On the other hand, the Cretaceous basement rocks have age-corrected 206Pb/204Pb (17.44-18.21), epsilon Nd(t) (7.2-9.9), and 207Pb/204Pb (15.42-15.53) similar to that of old (110-50 Ma) Indian Ocean ridge basalts. They share the Indian-ocean-type signature of the Eocene basement rocks except that they have generally lower 206Pb/204Pb and lack the suprasubduction signature present in younger basement rocks. The Indian-ocean-type isotopic signature in these rocks is consistent with suggestions of their southerly origin (Pubellier et al., 2003; 2004) because this mantle type is believed to have originated predominantly from the Southern Hemisphere. However, in the absence of supporting paleomagnetic evidence and more detailed radiometric dating, the possibility that these rocks were formed relatively close to where they are today cannot be completely ruled out. If this scenario is correct, then (1) the Indian MORB type signature of the older rocks imply that this mantle component may be present in the sub-Philippine mantle since the Cretaceous, suggesting that such mantle could be endogenous to the region; or (2) that the Cretaceous basement rocks represent portions of Indian Ocean mantle crust trapped at the leading edge of the Indo-Australian and the Pacific plates before the formation of the Philippine Sea Plate (c.f. Pubellier et al., 2003).