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Fore-arc mantle peridotites and back-arc basin basalts from the Izu-Bonin-Mariana subduction factory (ODP LEGs 125 and 195): a modern analogue for Mediterranean ophiolites

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Serpentinites, basaltic lavas and calc-alkaline volcanoclastic sequences sampled during recent Ocean Drilling Program cruises in the western Pacific Ocean allow comparisons with ophiolites from eastern Mediterranean area, which are believed to be related to marginal seas characterised by rapidly propagating back-arc extension and slab rollback (e.g. Albania and Cyprus).

Serpentinites recovered at the Torishima, Conical and South Chamorro Seamounts (ODP Legs 125 and 195), located on the Izu-Bonin-Mariana (IBM) forearc, still record complex petrochemical features acquired during their high-T mantle evolution. This latter has been referred to a three-stages-model, involving in chronological sequence: 1) adiabatic mantle upwelling accompanied by 20-25% polybaric partial melting; 2) local depletion in modal orthopyroxene determined by reactive melt migration; 3) late interstitial crystallisation of ultra-depleted to depleted melts.

The record of the first stage is preserved in the less-refractory IBM forearc peridotites, which compositions lie on trends describing the decompression melting of uprising asthenospheric mantle. During this stage, the peridotites were actual melt sources. The large average degree of depletion suggests that partial melting events were assisted by particularly hot geotherms.

The second stage occurred at relatively lower pressures, according to the large orthopyroxene dissolution, and is guessed to be firmly related to arc volcanism. Nevertheless, the progressive change of oxidation state of the mantle minerals, which decreases from the Torishima (N Izu-Bonin forearc) through the Conical (N Mariana forearc) to the South Chamorro Seamount (S Mariana forearc), highlights a marked gradient in terms of contribution to the uprising melts from slab-derived component. It is argued that the melt compositions changed from boninitic (at Torishima) to depleted-MORB at (South Chamorro).

The third stage determined the petrographic and mineralogical features occurring in all IBM forearc peridotites (e.g. crystallisation of late cpx, embayment of opx porphyroclasts), and likely marks the accretion of the mantle sequence to the thermal boundary layer. It was accompanied by the devolopment of transient geochemical gradients in the migrating liquids mainly governed by chromatographic-type chemical exchange with the peridotite.

The West Philippine Basin (WPB) is a back-arc basin that opened in the Philippine Sea Plate (PSP) between the current position of the Palau-Kyushu Ridge (PKR) and the margin of East Asia. Spreading occurred at the Central Basin Fault (CBF) from 54 to 30 Ma. The PKR was active since ∼48 to 35 Ma constituting a single volcanic arc with the Izu-Bonin-Mariana Arc. ODP Leg 195 Site 1201 is located in the WPB, ∼100 km west of the PKR, on 49 Ma basaltic crust formed by NE-SW spreading at the CBF. From ∼35 to 30 Ma, pelagic sedimentation at Site 1201 was followed by turbidite sedimentation, fed mostly by early Mariana Arc (PKR)-derived volcanic clasts. These volcanics are calc-alkaline, whereas PKR rocks from literature have mostly boninitic and arc tholeiitic affinity; the WPB basement basalts have MORB to arc-like affinity, as expected for a back-arc basin. Sr, Nd, Pb and Hf isotope data highlight the Indian Ocean MORB-like character of WPB basement basalts, suggesting an upper mantle domain distinct from that underlying the Pacific Plate. The geochemical and isotopic features of PKR volcanics reflect higher amounts of subduction-derived components, added mostly as siliceous melts, in the source of arc magmas relative to that of basement basalts. In that respect, Site 1201 PKR volcanics resemble calc-alkaline volcanics of the currently active Mariana Arc. In addition, their calc-alkaline affinity, unradiogenic

neodymium, and inferred Middle Oligocene age, suggest they might represent an evolved stage of arc volcanism at Palau-Kyushu Ridge, perhaps shortly before the end of its activity.