Two distinct mantle convection systems and reservoirs in the West Pacific

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Debates persisted over decades as to the convection style of the mantle. Geochemists favor a layered convection model in which the upper and lower mantle convect separately and may have distinct chemical hints, whereas geophysists put forward a whole mantle convection model. Such two distinct convections do (co-)exist in the West Pacific. To west of the IZU-Bonin-Mariana (IBM) arc, the subducting Pacific slab does not penetrate the mantle transition zone (MTZ), it rather becomes flat-lying within the MTZ, separating two convection systems in the upper and lower mantle respectively. Given the presence of the large-scale stagnant slab within the MTZ, the overlying mantle above the MTZ underneath eastern Asia is referred as to the big mantle wedge (BMW). On-going studies revealed that the BMW is a large reservoir of water, carbon and recycled crustal components. Interaction between the BMW and underlying slab within the MTZ is one of the key factors in triggering mantle heterogeneity, deep carbon cycling and intraplate volcanism. To east of the IZU-Bonin-Mariana (IBM) arc, the most striking feature is the presence of the large low sheared velocity province (LLSVP) at the core-mantle boundary, which forms the root of a number of mantle plumes, and thousands of oceanic islands in the Pacific. Studies on these oceanic islands identified a number of ingredients, i.e., EMI, EMII, HIMU and FOZO, disseminated in the mantle, and some primordial components, residing at the very deep interior of the earth. Despite some controversies, it is widely believed that the formation of these components is related to recycling of subducted material and interaction/exchange of different reservoirs. Furthermore, the IBM represents a global-scale physical and chemical boundary separating the Pacific and Indian mantle domains. Geodynamic and recycling processes leading to formation of these two major domains in the West Pacific deserve further investigation.