Volcanic history of the northern Izu arc-Submarine back-arc volcanoes and the Izu Peninsula -

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We present 40Ar/39Ar ages and geochemical data for submarine and subaerial lavas from the back-arc region of the northern Izu arc (33-36oN). The northern part of the Izu arc is distinct from the rest of the arc because; a) it lacks active rifting and b) there are Quaternary volcanoes behind the volcanic front (e.g. Niijima). Common features with the rest of the arc include the presence of the back-arc seamount chains and the distinct NE-SW volcanic ridges.

40Ar/39Ar dating of volcanic rocks from the western, submarine part of the arc, reveals that Quaternary volcanism is limited to within 40 km of the volcanic front. However, during the Miocene-Pliocene, active volcanism occurred in the back-arc seamounts and ridges as far as 120km west of the current volcanic front.

The Izu Peninsula can be regarded as a collided and uplifted equivalent of the back-arc seamounts in the central and northern part of the arc. Indeed, some remnant seamounts can be recognized in the southern part of the peninsula (the Shirahama group). At these remnant seamounts, limestone and conglomerate composed of well-rounded cobbles of beach or shallow sea origin overlie two pyroxene andesite lavas and intrusives. Submarine hydrothermal Mn mineralization also occurs as disseminations among the matrix of the conglomerate. This geological setting is very similar to that observed on the tops of the submarine back-arc seamounts (Ishizuka et al., 2002). 40Ar/39Ar dating of the lava of the remnant seamount returned a plateau age of 5 Ma, which is within the age range of the volcanism of the back-arc seamounts. These observations and age data support the view that Neogene submarine back-arc volcanoes are exposed in the southern part of the Izu Peninsula.

In the Pleistocene, volcanism in the peninsula became mainly subaerial. While evidence of Neogene volcanism is widely observed throughout the peninsula, the locus of volcanism seems to have been limited to the eastern and northern part of the peninsula, i.e., to the vicinity of the volcanic in the late Pleistocene and Holocene. This temporal variation of locus of volcanism is similar to the variation observed for the submarine part of the Izu back-arc.

There is a significant chemical difference between the Quaternary volcanic rocks from behind-the-front and the Neogene volcanism in the back-arc seamounts. High-alumina basalt and opx-cpx andesite (with occasional hornblende) are dominant in the back-arc seamounts, while in the Quaternary, behind-the-front volcanism is chemically bimodal. The isotopic and trace element data suggest that sediment melt from the subducting slab is an important component in the Neogene back-arc seamounts, whereas, the Quaternary volcanism behind the front shows little indication of sediment melt and is restricted to a contribution of fluid from altered oceanic crust.

One possible process to explain the observed temporal and spatial variations of volcanism and its source might be a change of an angle of subducting Pacific Plate with time. For example, if the Philippine Sea Plate is retreating to the NW, faster than the subduction hinge of the Pacific Plate, as proposed by Carlson and Melia (1984), the angle of the subducting slab could become steeper with time. In this case, the active zone of arc volcanism would be expected to become narrower along with the steepening of the slab.

Another possible process is that the pressure-temperature condition of the wedge mantle changed and volcanism only became active in the vicinity of the volcanic front. In this model, whilst there is no need to invoke a change of slab angle there was a cessation of the volcanism associated with the deeper parts of the subduction zone. This also means that volcanism associated with sediment melting disappeared and only the volcanism close to the front and with the slab-derived fluid contribution, remained active.