

Initiation and propagation of subduction along the Philippine Trench

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The Philippine Sea Plate is subducting westward under the Philippine archipelago along the Philippine Trench. Based on the distribution of volcanoes, earthquakes, and bathymetry, the southern part of the Philippine Trench is considered to have been propagating from north to south. In this study, K-Ar ages of volcanoes in the northern part of the volcanic arc were measured in order to constrain the timing of the initiation of subduction along the Philippine Trench. Dating results suggest earlier initiation of volcanism and subduction in the northern part at about 7 Ma than in the southern part.

There are two plates subducting under the Philippine archipelago, the Eurasia from the west and the Philippine Sea from the east. Subduction along trenches west of the archipelago (the Manila, Negros and Sulu from north to south) forms well-developed volcanic arcs. The East Luzon Trench and the Philippine Trench, from north to south, are located east of the archipelago. There is no volcanism along the East Luzon. The Philippine Trench forms volcanic arc along its northern part, but no volcanism is known in the southern part.

Major features of the Philippine Trench are as follows (Cardwell et al., 1980).

1. Most shallow seismic activity along the Philippine Trench stops north of Halmahera, but bathymetry indicates that the trench may be extending itself south past eastern Halmahera.
2. A volcanic chain formed by subduction along the Philippine Trench (Philippine Volcanic Arc, PVA) runs through Bicol peninsula of Luzon, Leyte, and northern tip of Mindanao from north to south, but no recent volcanism is known in area south of Mindanao.
3. There is an accretionary prism developed along the northern part of the trench, but little or no accretionary prism along the southern part.

These lines of evidence indicate that the southern part of the trench is younger than the northern part, and that the trench becomes younger to the south in the southern part. Based on the evidence mentioned above, Cardwell et al. (1980) insisted that the southern part of the trench has been propagating from north to south. Based on bathymetry, gravity anomaly, and length of Wadati-Benioff zone, Lallemand et al. (1998) insisted that the subduction along the Philippine Trench initiated between Leyte and Mindanao and that it propagated to both north and south. The oldest age of PVA in a certain area will constrain the youngest limit of the initiation of the subduction there. K-Ar ages were reported by Sajona et al. (1994) from Leyte and Mindanao, but few age data have been obtained in Bicol. Dating volcanoes in Bicol will better constrain the temporal and spatial distribution of the entire PVA, and thus evolution of the northern part of the Philippine Trench.

In this study, we measured K-Ar ages on 37 lava samples collected from eleven volcanoes covering the entire PVA in the Bicol peninsula. To minimize the influence of excess argon, we used ground mass for dating throughout. Measured K-Ar ages suggest that the arc volcanism started at about 7 Ma or earlier in the Bicol peninsula. Sajona et al. (1994) reported K-Ar ages of 2.53-0.09 Ma from volcanoes of PVA in Leyte and Mindanao. These data together suggest that the PVA started its activity first in the northern part and extended its activity to the south. It is consistent with a model that the Philippine Trench started subduction at northern end and propagated to the south.