Eruptive History of the Barren Island Volcano During Last ~70 ka

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Barren Island (BI) in the Andaman Sea is India's only active volcano and the northernmost active volcano of the Indonesian Arc (IA). It is a stratovolcano formed by lava flows and volcaniclastic deposits of basalt and basaltic andesite. The caldera of the volcano exposes prehistoric, undated lava flows and volcaniclastic deposits [1]. The oldest available record reported activity between 1787–1832 and no dates for its formation and earlier eruptions in geological past are known. Earlier attempts to date the exposed older tephra have been unsuccessful.

With an objective to find the timing of major eruptions of the BI volcano by determining the age of the ash layers in marine sediment record, we collected a sediment core near the volcano at location (N 12°05.79'; E 94°05.30'), ~ 32 Km southeast from the volcano. The 4mlong core consists predominantly fine-grained terrigenous sediments, biogenic carbonates and seven volcanic ash layers. The ash layers contain unaltered black volcanic glass shards and primary magmatic minerals such as olivine and plagioclase. We believe that these layers represent explosive phases of the volcano during which large volumes of ash got injected into the atmosphere and subsequently fell through the water column. However, the possibility that some of the ash layers in the core represent other volcanic centers of the IA cannot be ruled out. We therefore used Sr and Nd isotopic ratios as tracers to determine the source of the ash. Radiocarbon dating of inorganic carbon on sediments that bracket these ash layers was utilized to arrive at the age of these layers.

Sr and Nd isotopic ratios of the ash layers (87 Sr/ 86 Sr 0.70395-0.70414 & $\varepsilon_{_{Nd}}$ 4.9-6.7) fall within the field of available data of BI volcano [2] and are different from those observed for other volcanoes in the IA [3], including Narcondum the nearest dormant volcano. This clearly establishes the genetic link between the ash layers and the BI volcano. Radiocarbon ages of sediments at 20-25, 45-50, 95-100 and 145-150 cm are found to be approximately 4, 8, 19, 35 and 41 ka, respectively. Interpolations based on these dates and extrapolations beyond 41 ka based on rates of sediment deposition we conclude that there have been at least 7 major explosive eruptions of the volcano during the past 70 ka, approximately at 9, 14, 18, 21, 57 and 65 ka prior to the ongoing activity since 1991. Keywords: Barren Island, Andaman Sea, Indonesian Arc, marine sediment core

References

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