

Discovery of a 2.4 Ma, VEI 5 Plinian eruption on Guadeloupe

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Reconstructing the history of island arc volcanoes is important for determining the threat they pose. Such studies are difficult to undertake, however, because erosion, later eruptions, etc., obscure and destroy the record of individual volcanic centers, with much of the erupted material being rapidly transported to the oceans. Hence, cores of marine sediment can provide a more complete history of an arc volcano than subaerial exposures. This approach requires identification of the depositional mode of marine tephra layers (flow versus fallout deposits) and their precise origin from closely spaced volcanic islands. We show here how high precision Pb isotope ratios and trace elements can be used to fingerprint tephra sources from individual volcanic islands in the Lesser Antilles, and how detailed component analyses of tephra can be used to determine their depositional mode. Using these techniques, we have been able to identify an ~18 cm thick tephra layer comprising an upper 6 cm layer and a lower 12 cm layer) from IODP Site U1396 as having originated from Guadeloupe (~80 km to the east) and the fact that it was emplaced as an airfall deposit. Models of tephra deposition indicate that the lower layer was part of a ~10 km³ tephra deposit formed from a VEI 5 Plinian eruption from Basse-Terre, Guadeloupe 2.36 Ma. This is the largest eruption ever discovered in the Northern Lesser Antilles and has important implications for our understanding of volcanic hazards in the region as well as providing information concerning the evolution of volcanic centers in island arc settings.