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## A 22,000-year tephrostratigraphy record of unidentified volcanic eruptions from Ternate and Tidore islands (North Maluku, Indonesia)

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Studying past eruptions provides a unique opportunity to improve understanding of volcanic hazards, especially in Indonesia, where volcanic eruptions are frequently deadly and destructive. As part of a recent approach to identifying and characterizing past volcanic events, we present the first reconstruction of the eruptive history of the Ternate and Tidore Islands (North Maluku, Indonesia) for the last 22,000 years cal. BP. This interdisciplinary study (geomorphology, tephrochronology, sedimentology, geochronology, geochemistry) consists of the first stratigraphic and chronological continuum from eruptive deposits established in a set of fifteen sections in Ternate, Tidore and Maitara islands. Sedimentological and geochemical data from tephrostratigraphy studies and radiocarbon dating suggest that these islands experienced at least four major explosive events from c. 22,000 to 740 years cal. BP. The earliest event is a Plinian eruption leading to the caldera formation of Telaga volcano on the island of Tidore, c. 22,000–17,500 cal. BP. The Gamalama volcano on Ternate, whose current eruptive activity is essentially strombolian or phreatomagmatic, experienced as well a pumice eruption dated to c. 18,000 cal BP. A third event dated to c. 14,500–13,000 cal. BP, associated with a succession of abundant pyroclastic deposits of scoria, pumice, and ash, is related with the phreatomagmatic eruption at the origin of the formation of the Ngade maar on Ternate Island. Although no eruptions of Kie Matubu volcano on Tidore Island have been filled out by people since their presence in the region from the 16th century, this survey identifies two late Holocene eruptions, c. 2500 cal BP and 740 cal BP. This chronostratigraphic framework from the late Pleistocene to recent eruptions in North Maluku region provides new perspectives in managing predictive and warning information for potential eruptions that may occur on these small, vulnerable volcanic islands in the future.