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Deposits of a major Pleistocene tsunami in the Island of Maio (Cape Verde)

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The occurrence of coarse chaotic conglomerates containing marine fossils in the island of Maio, Cape Verde, is reported. Stratigraphically the conglomerates stand above most of the volcano-sedimentary sequence. Locally they are covered by Upper Pleistocene consolidated dunes and beach gravel, and by Holocene alluvial, beach or aeolian deposits. The conglomerates crop out almost continuously in the south, east and north coasts; in the west, where they are covered by salt flats (sabkha) and alluvial fans, the outcrops are discontinuous. The deposits occur from the shore up to 5 km inland, ranging in altitude from sea level to 40 m. One to three layers may be present, totalling up to 3 m thickness. The sedimentary structure of the layers is variable. Single layers are composed of massive unstratified conglomerate; when more layers occur, sandstones presenting well developed undulating bedding, supporting floating blocks, are usually present. The deposits have sharp erosional bases. The sediment presents bimodal granulometry, composed of a coarse fraction of cobbles, boulders and blocks set in a bioclastic sand matrix. The deposits may be either clast- or matrix-supported depending on clast/matrix proportion. The nature and rounding of the clasts varies from place to place, including all lithologies cropping out near the shore (basalt, gabbro, limestone, marl, calcarenite, mudstone, and sandstone) and presenting both well-rounded and angular shapes. Imbricated clasts are frequent, indicated both landward and seaward currents. In matrix supported conglomerates, flat clasts often show dominant orientations that may represent current direction during deposition. The matrix is medium-to-coarse sand composed of well-rounded bioclasts (mostly calcareous algae), less abundant angular to sub-angular mineroclasts (pyroxene), and rare angular lithoclasts (basalt and calcarenite). Foraminifera, although not abundant, are usually present in thin sections of the sand matrix. The sand grains are cemented by secondary sparitic calcite. Macro-fossil content is abundant and, like the matrix, indicates a marine origin for the conglomerates; it includes rodoliths, coral fragments, mollusc shells and echinoderms from shallow littoral environment. Closed bivalve shells are common at several localities.

Interpretation of these deposits must explain its sedimentary characteristics and geographical distribution, including the following aspects: mixed terrestrial and marine origin of the sediments; topographic position of the sediments above present sea-level (locally on steeply sloping surfaces) and areal distribution up to 5 km inland; erosional basal contacts and presence of rip-up clasts; occurrence of both seaward and landward current oriented or imbricated clasts. The only mechanism that can explain all described features is inundation of the littoral of Maio by a major tsunami. Variability in granulometry, clast/matrix proportion, clast lithology, rounding, and fossil content results from sediment availability in the coastal area, number and direction of waves inundating the island, lithologies cropping out, and loose surface rock material in sub-aerial inundated areas available to be entrained by the tsunami. Granulometry variation between successive layers may represent depletion of fine (sand) or coarse (cobbles, boulders) littoral sediments by successive waves. The presence of bivalve fossils with articulated valves in non-living position in the conglomerates is explained by entrainment of living endobenthic organisms, together with the sediment, by tsunami waves approaching the coast.

A probable source for such tsunami is the east flank collapse of Fogo Island. Because the island of Santiago stands between Fogo and Maio, the tsunami waves must have refracted around Santiago to hit Maio. Observation of similar deposits in Santiago is compatible with this hypothesis. Confirmation of the proposed triggering mechanism is dependent on the age of the deposits, modelling of the wave train produced by the Fogo event, and the expected run-up in both islands.

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