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Source of the tsunami generated by the 1650 AD eruption of Kolumbo submarine volcano (Aegean Sea, Greece)

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The 1650 AD explosive eruption of Kolumbo submarine volcano (Aegean Sea, Greece) generated a destructive tsunami. In this paper we propose a source mechanism of this poorly documented tsunami using both geological investigations and numerical simulations. Sedimentary evidences of the 1650 AD tsunami were found along the coast of Santorini Island at maximum altitudes ranging between 3.5 m a.s.l. (Perissa, southern coast) and 20 m a.s.l. (Monolithos, eastern coast), corresponding to a minimum inundation of 360 and 630 m respectively. Tsunami deposits correspond to an irregular 5 to 30 cm thick layer of dark grey sand intercalated in soil at depths between 30 and 50 cm. Composition of the tsunami sand is similar to the composition of the present-day beach and clearly differs from the pumiceous gravelly soil. Spatial distribution of the tsunami deposits was confronted to available historical records and to the results of numerical simulations of tsunami inundation. Different scenarios of source mechanism were tested: earthquakes, underwater explosions, caldera collapse, and pyroclastic flows. The most probable source of the 1650 AD Kolumbo tsunami is a 250 m high water surface displacement generated by underwater explosion with an energy of $\sim$2 E15 J at water depths between 20 and 150 m. The tsunamigenic explosion(s) occurred on September 29, 1650 during the transition between submarine and subaerial phases. Caldera subsidence is not an efficient source of tsunami, as short (and probably unrealistic) collapse durations (< 5 minutes) are needed. Pyroclastic flows cannot be discarded, but the required flux (E6 to E7 m^3.s-1) is exceptionally high compared to the magnitude of the eruption.