

Historical tsunamis in the volcanic
island complex of Thera (Santorini)
Greece: the AD 1650 tsunamis


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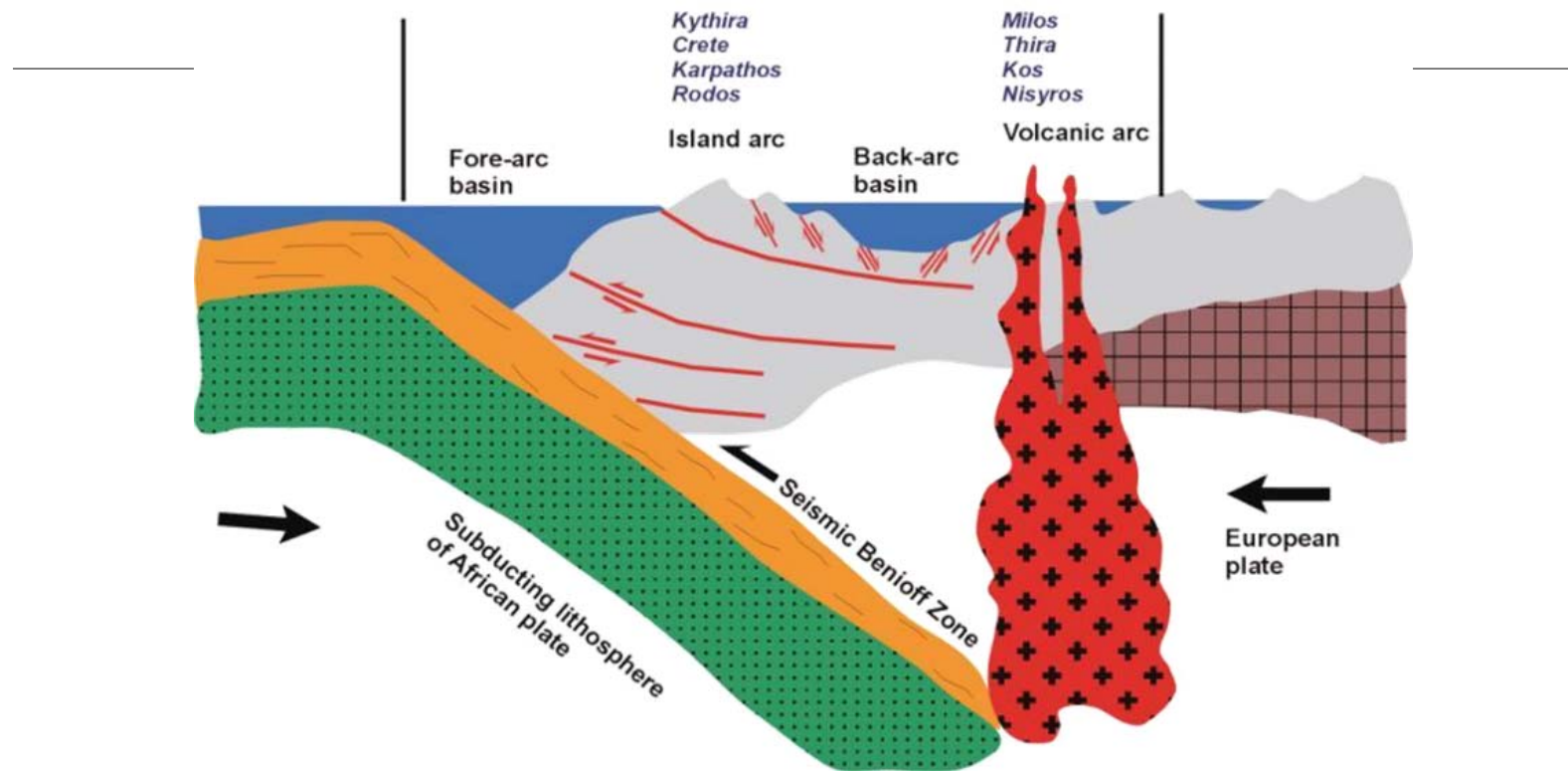
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Presentation Outline

- Geodynamic setting
 - Structure of the Kolumbo volcano
 - Historical eruptions of AD 1650
 - Tsunami documentation and impact: 29th Sept. 1650
 - The unknown tsunami of 4th Nov. 1650
 - Conclusions
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Geodynamic Setting

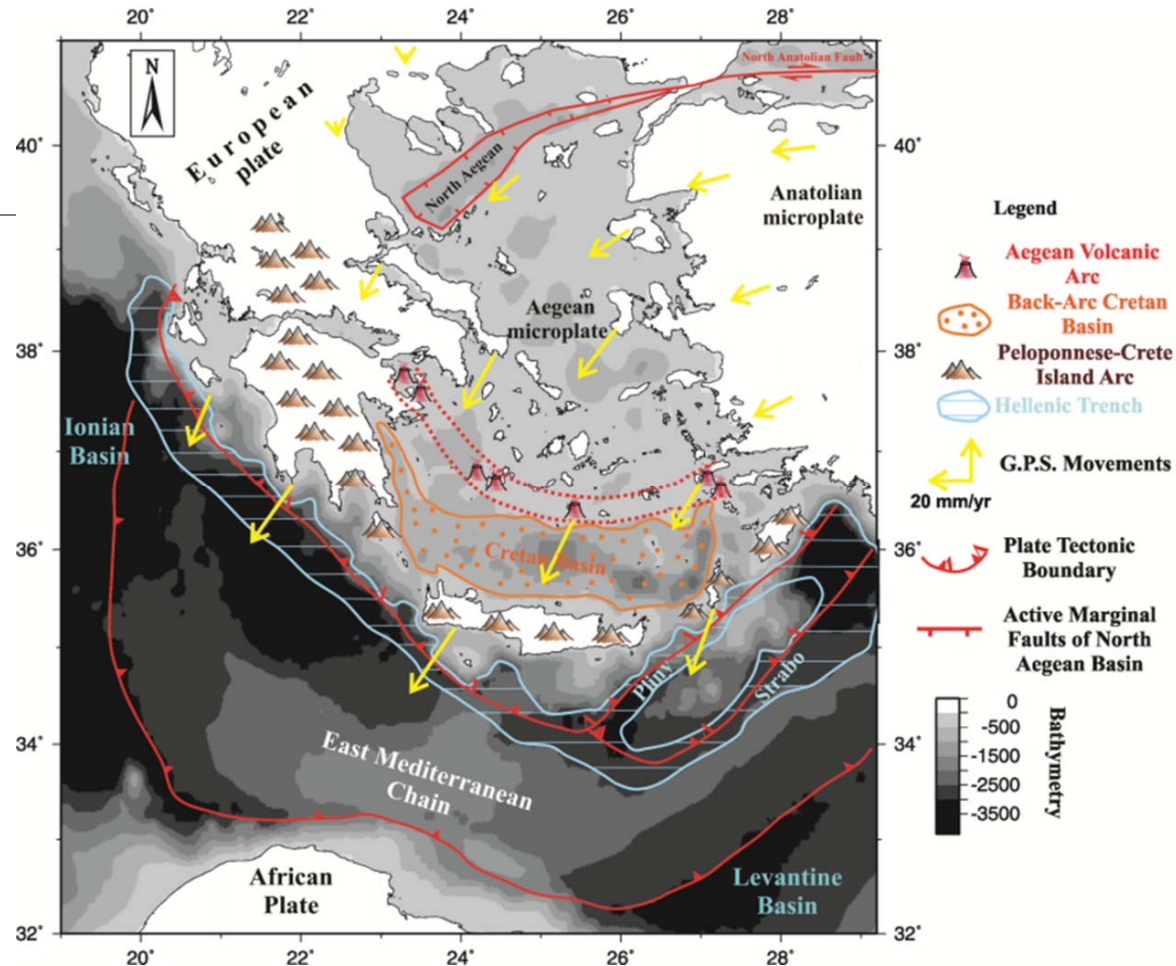
ACTIVE HELLENIC ARC



The volcanic arc of the South Aegean is the result of subduction of the African plate under the active Greek margin of the European lithospheric plate.

(Papanikolaou 1993)

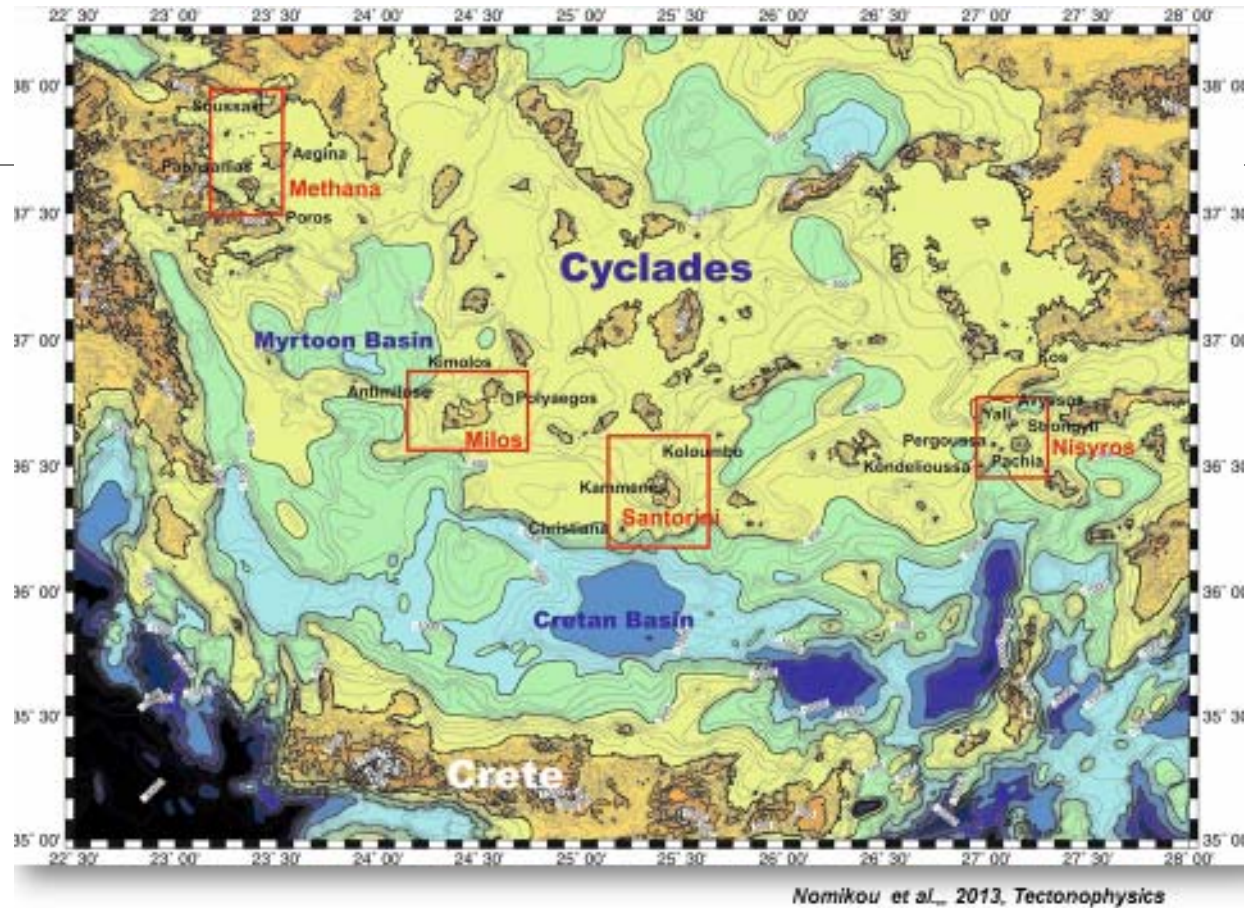
Geodynamic Setting



Regional lithospheric plate convergence along the Hellenic arc & trench dominates the Greek geodynamics

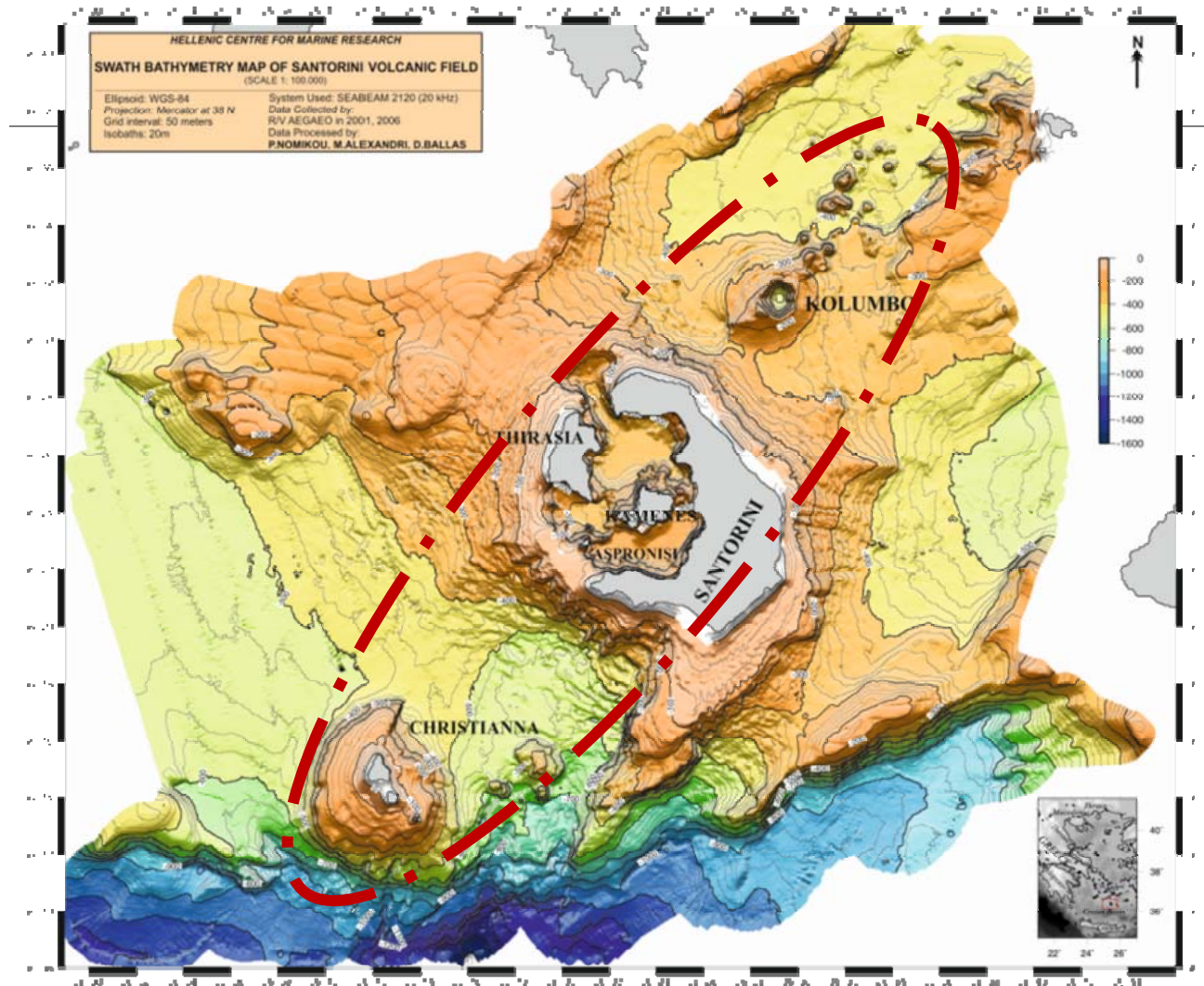
Nomikou et al., 2013

South Aegean Volcanic Centers



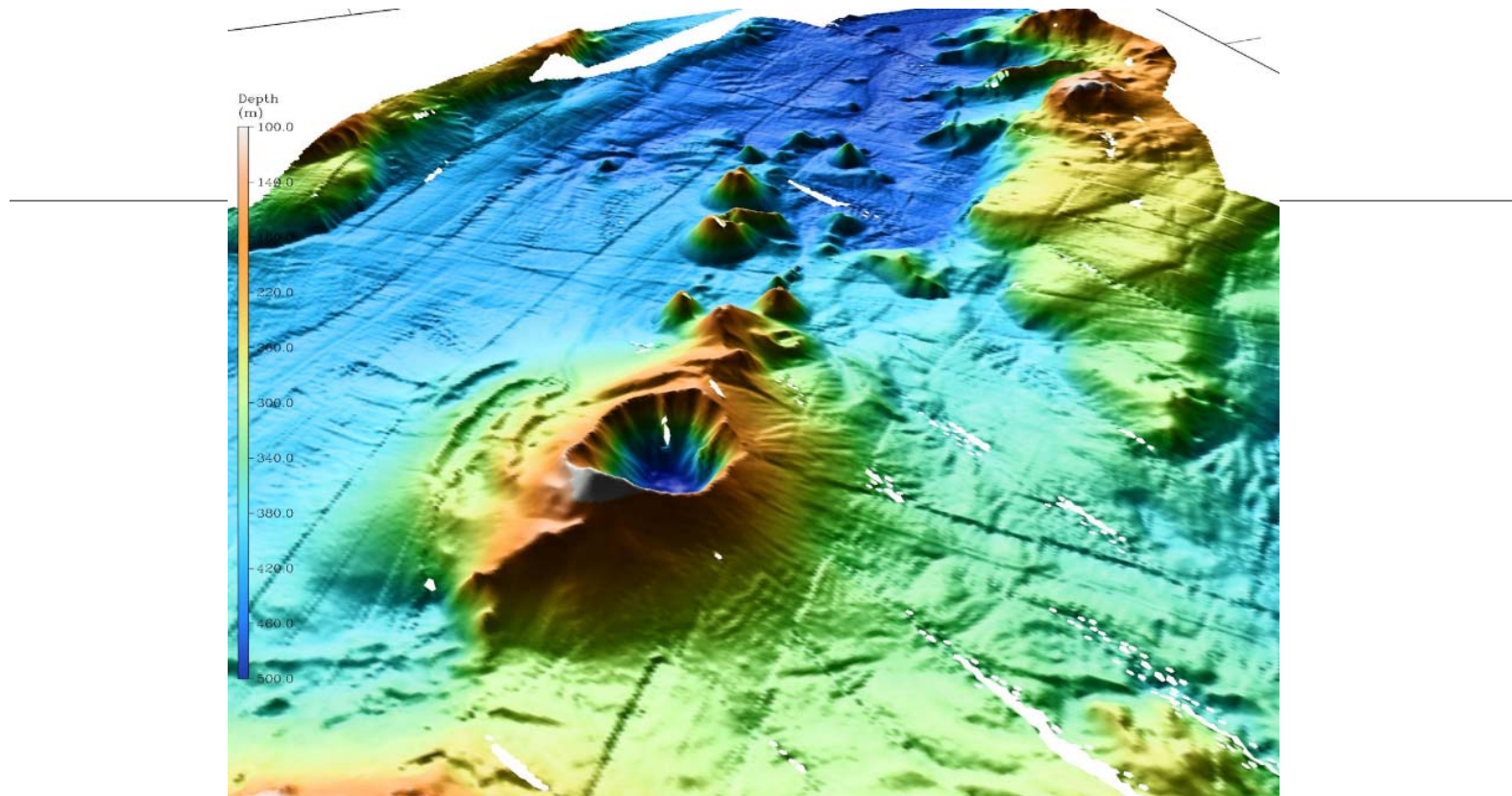
Four Quaternary onshore and offshore volcanic groups are indicated by red boxes: Methana group; Milos island complex; Santorini island complex (incl. Kolumbos); Nisyros volcanic center

SWATH bathymetry map of the Christiana-Santorini-Kolumbo volcanotectonic zone



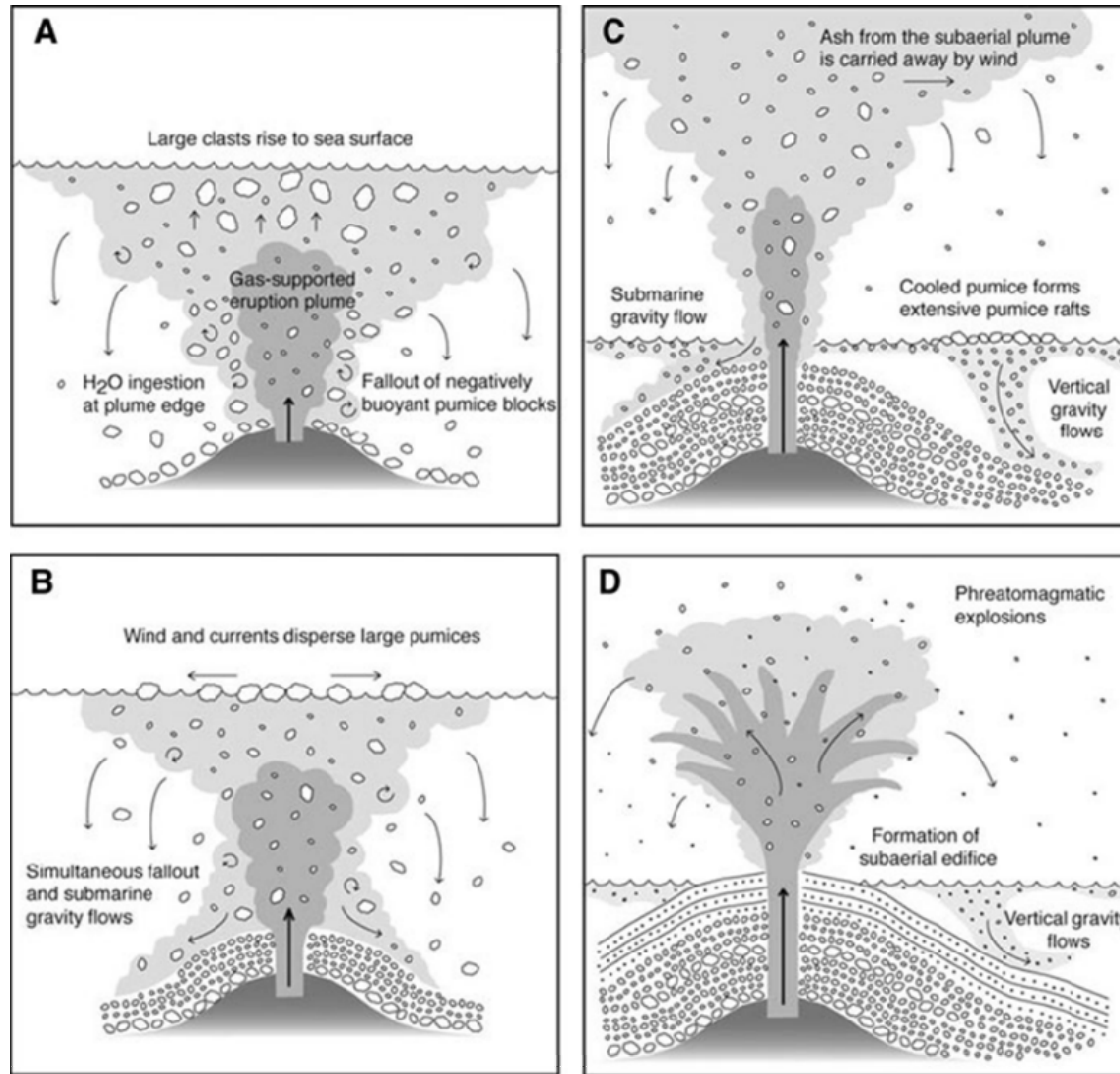
Nomikou et al., 2012

Kolumbo volcanic chain



The most prominent feature at the NE part of the CSK tectonic zone, is the Kolumbo submarine volcanic chain of length of 20 Km with several volcanic domes aligned along NE-SW direction (Nomikou et al., 2012)

Model of Kolumbo AD 1650 eruption based on the lithology & stratigraphy of the submarine pyroclastic deposits

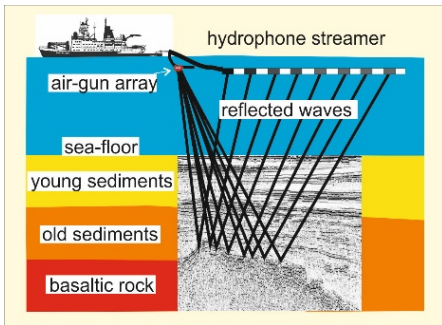
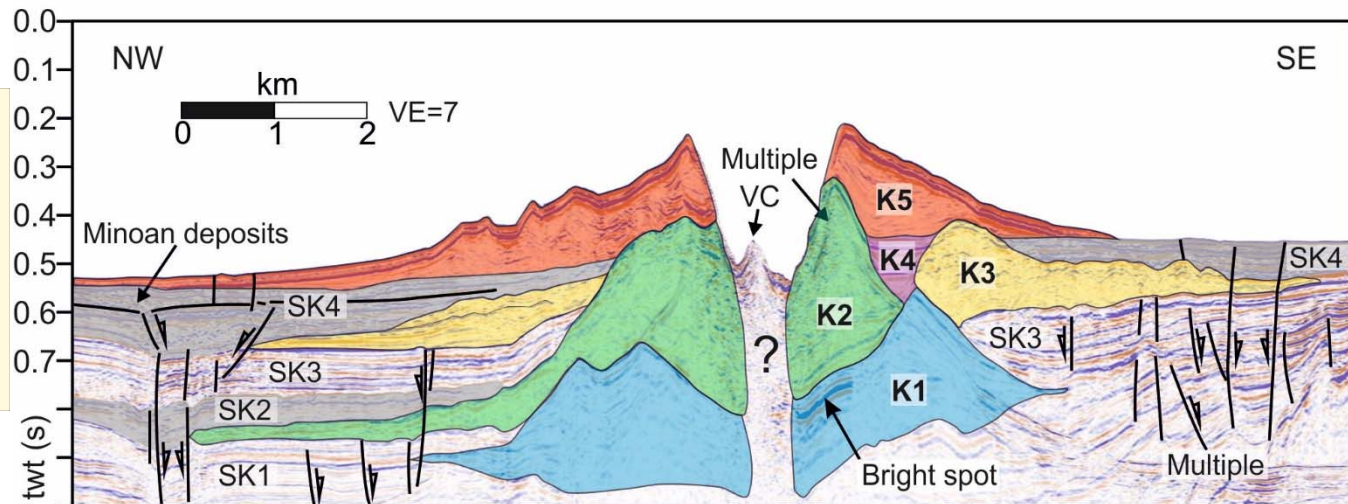
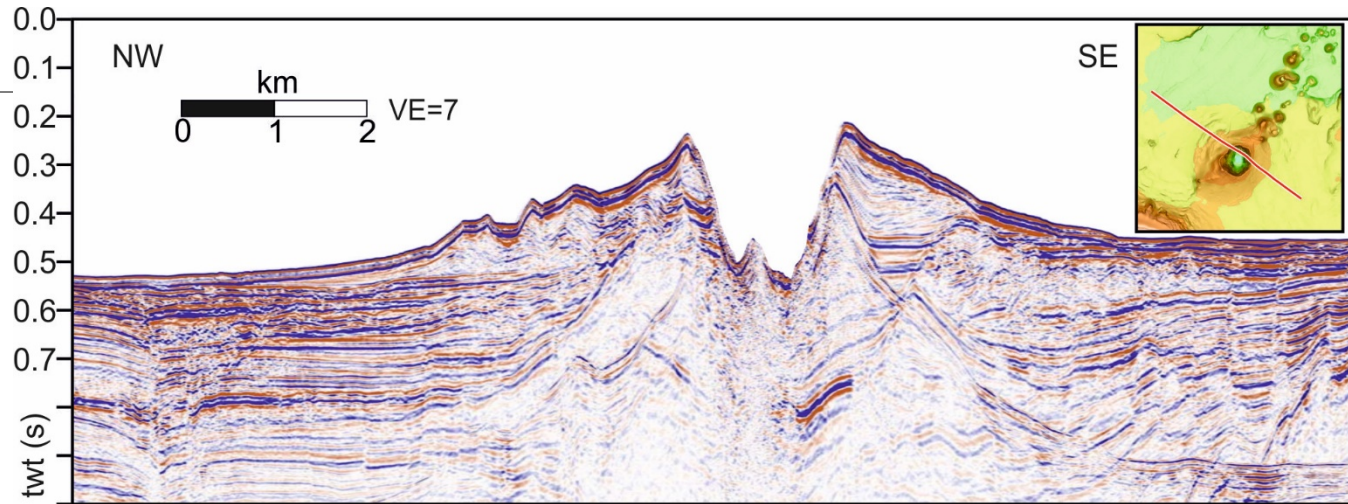


The eruption was characterized by two phases:

A-B: an initial submarine eruption during which the vent became shallower as pyroclastic material accumulated,

C-D: a dominantly subaerial phase with substantial fallout from a subaerial eruption plume.

Seismic and tectonic section of Kolumbo



Hübscher, Ruhnu, Nomikou (2015)

The Kolumbo Eruption and EQ's of AD 1650 : historical documentation

Many historical sources were used, including Richard (1657), Dapontes (1770), Vouros (1837), Serouios (1867), Assopios (1879), Zerlentis (1922).

Event sequence (dates in Old Style calendar)

Event 1: EQ activity was felt since 1649

Event 2: strong damaging EQ in March 1650: *Houses opened up in two pieces, big rocks detached and rolled down to the sea.*

Event 3: On 26th Sept. *“another very strong shock happened”*

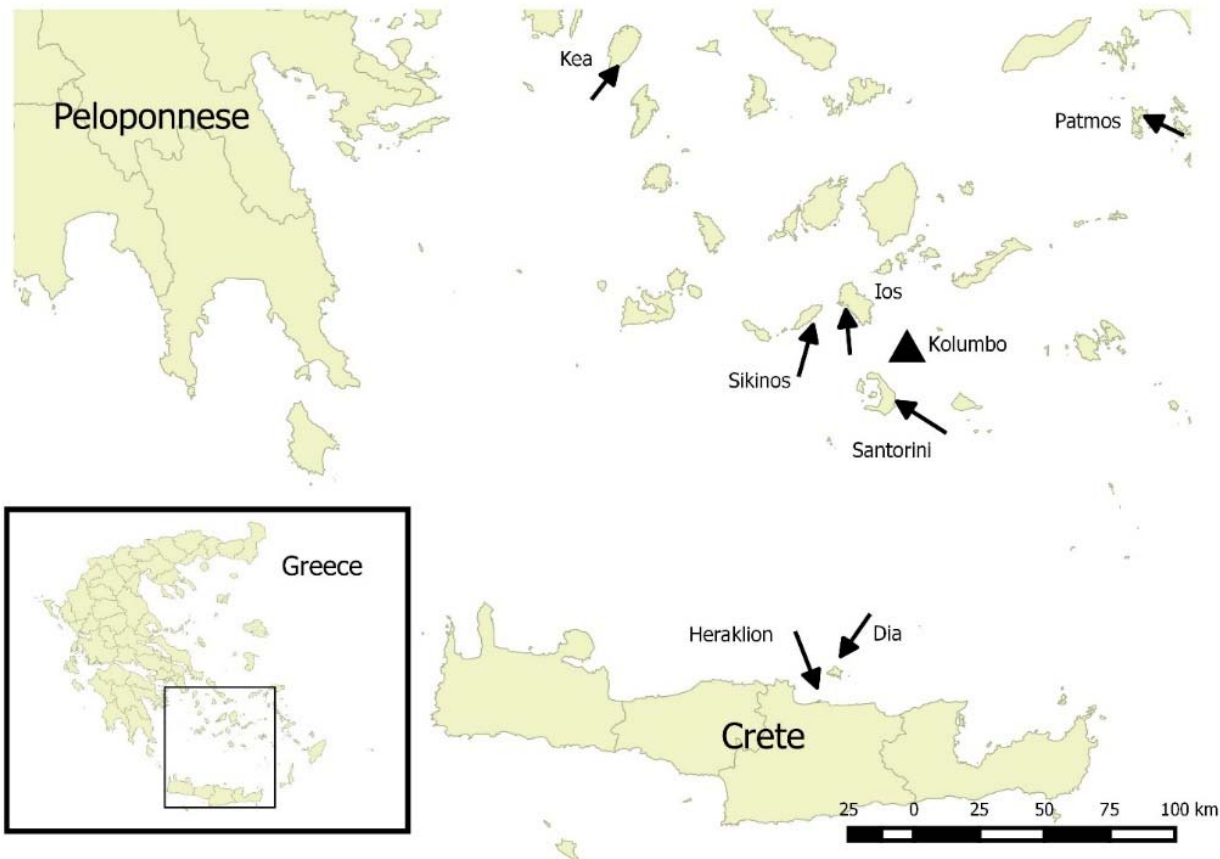
Event 4: The main eruption occurred from 27 to 29 Sept. 1650

Event 5: 29 Sept. 1650: *A great EQ occurred...and again another one...some houses destroyed burying people ...some other houses fissured... The EQ was felt in Naxos Isl.*

Event 6: On 29th a large tsunami hit Santorini after a pause of the EQ and volcanic activity



Impact of the AD 1650 tsunami



- The tsunami inundated violently in Santorini, Ios, Patmos, and Sikinos Isls.

- In Heraklion (Crete) fishing boats sunk when the wave overtopped the harbor walls of a height of ~ 4 m

Impact of the AD 1650 tsunami



- In Perissa, east coast of Santorini the wave swept away enclosures, boats, trees and agricultural land.
- Also churches, such as the one of St. Irini, were destroyed
- Large submarine boulders were removed onshore.

Evidence for tsunami sediment deposits



-Historical documentation indicates that the soil eroded by the tsunami and revealed an archaeological site in Perissa (~8th century AD).

- No tsunami deposits were found by an earlier study (Dominey-Howes et al., 2000)

-Very recently we found sediment deposits which very likely are of tsunami origin

Evidence for tsunami sediment deposits

Perissa, ~ 180 m inland



Possible tsunamigenic mechanism

Tsunamis from the AD 1650 were likely generated by a variety of mechanisms including

- shallow submarine explosions
- discharge of pyroclastic flows into the sea
- edifice collapse as a result of magma withdrawal from a shallow crustal magma chamber.

The last is our favoured mechanism as it comes out from the historical information that the tsunami appeared when the volcano was quiet.



An unknown second tsunami

- Careful reading through the original documents revealed that with the reactivation of the Kolumbo a second tsunami was generated on 4th November 1650.

“..and the sea inundated the island and then withdrawn back...”

- No damage was reported.
- We concluded that this tsunami was of smaller size than those of 29th September 1650

Conclusions

- Kolumbo erupted explosively in AD 1650 and caused significant damage and fatalities on the island of Santorini.
- The eruption was strong and was accompanied by earthquakes.
- An important consequence of the eruption was the generation of a large destructive tsunami which inundated the eastern coastal of Santorini as well as several south Aegean islands and the north coast of Crete on 29th Sept. 1650 (OS).
- The main destruction was observed in Perissa, Santorini east coast.
- A possible tsunami generation mechanism was the collapse of the volcanic cone.
- A second smaller tsunami was observed on 4th Nov. 1650.

Thank you for your attention!

