

Upper Crustal Structure of Santorini Volcano

Ben Heath



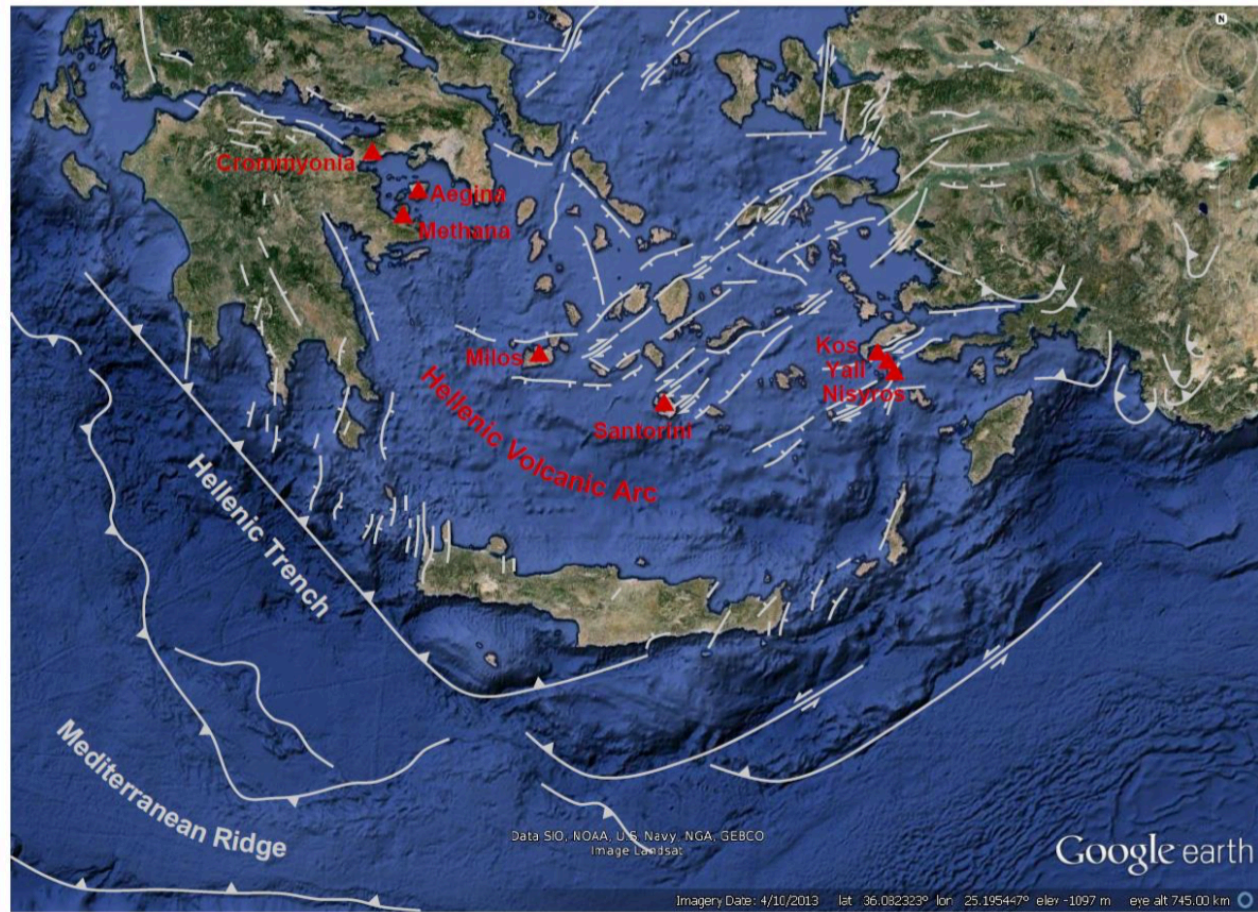
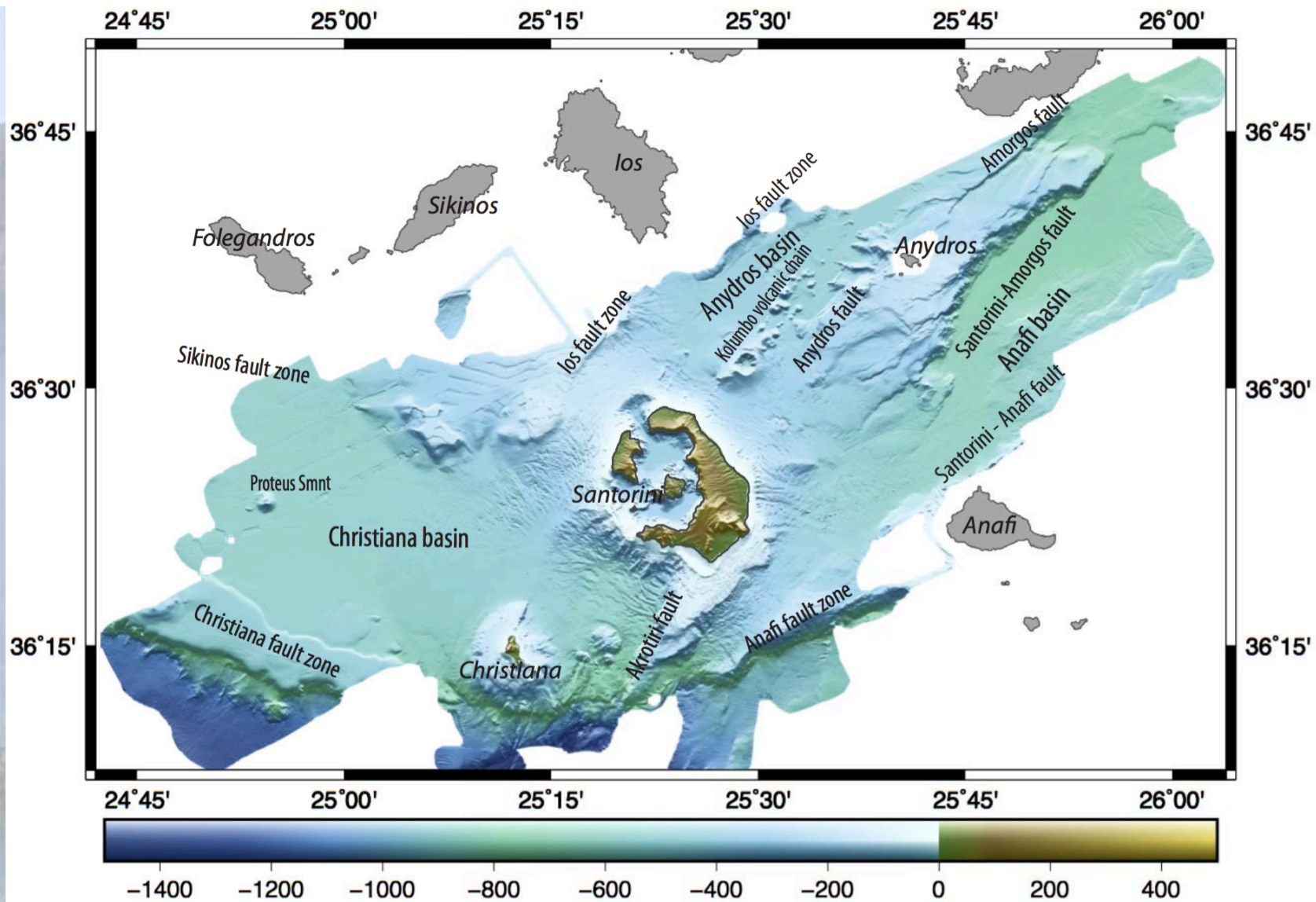
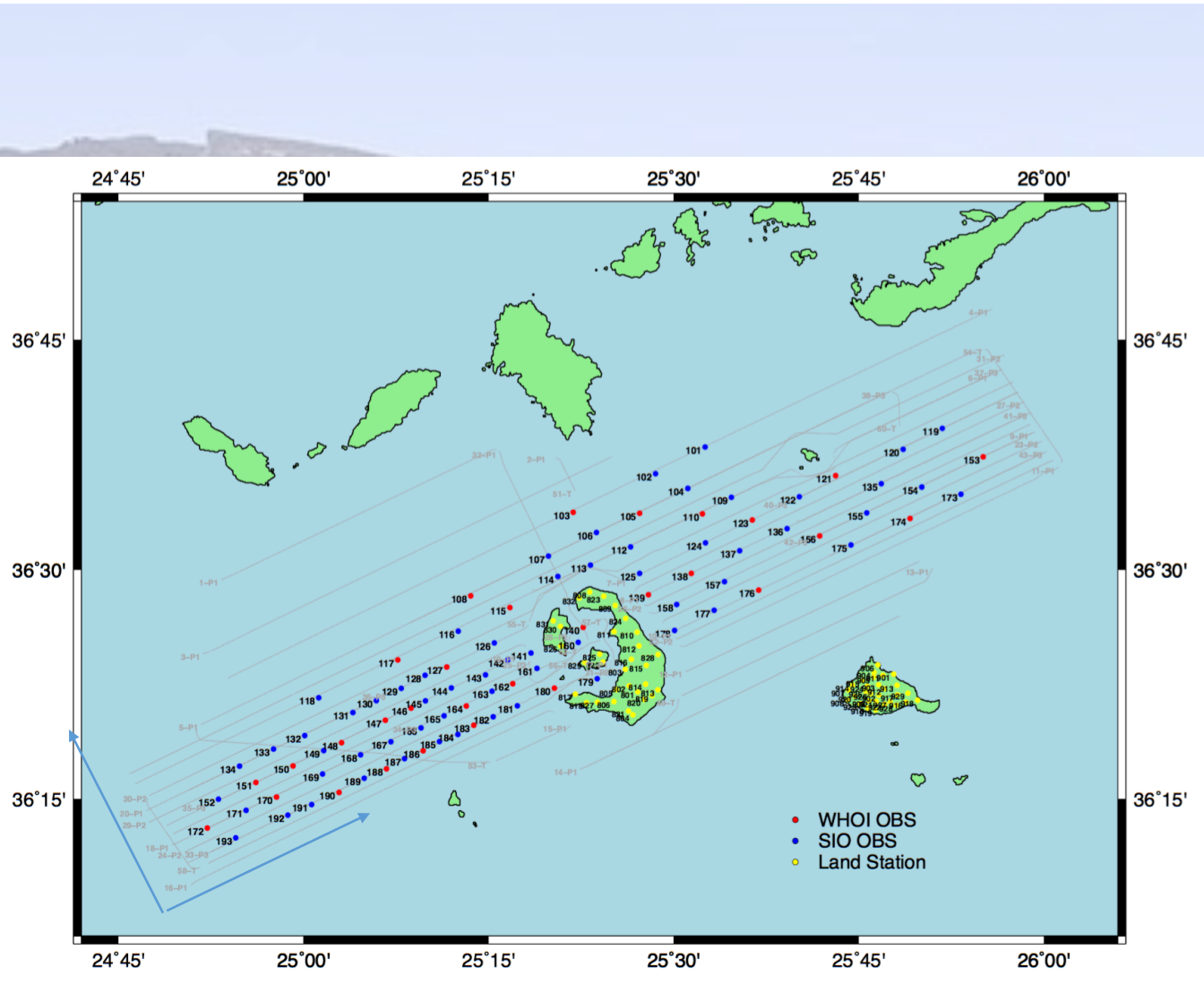


Figure 2. Map of the southern Aegean Sea. Volcanoes of the Hellenic arc are shown in red. Major faults compiled from Jackson (1994), Jolivet and Brun (2010) and Kokkalas and Aydin (2013).



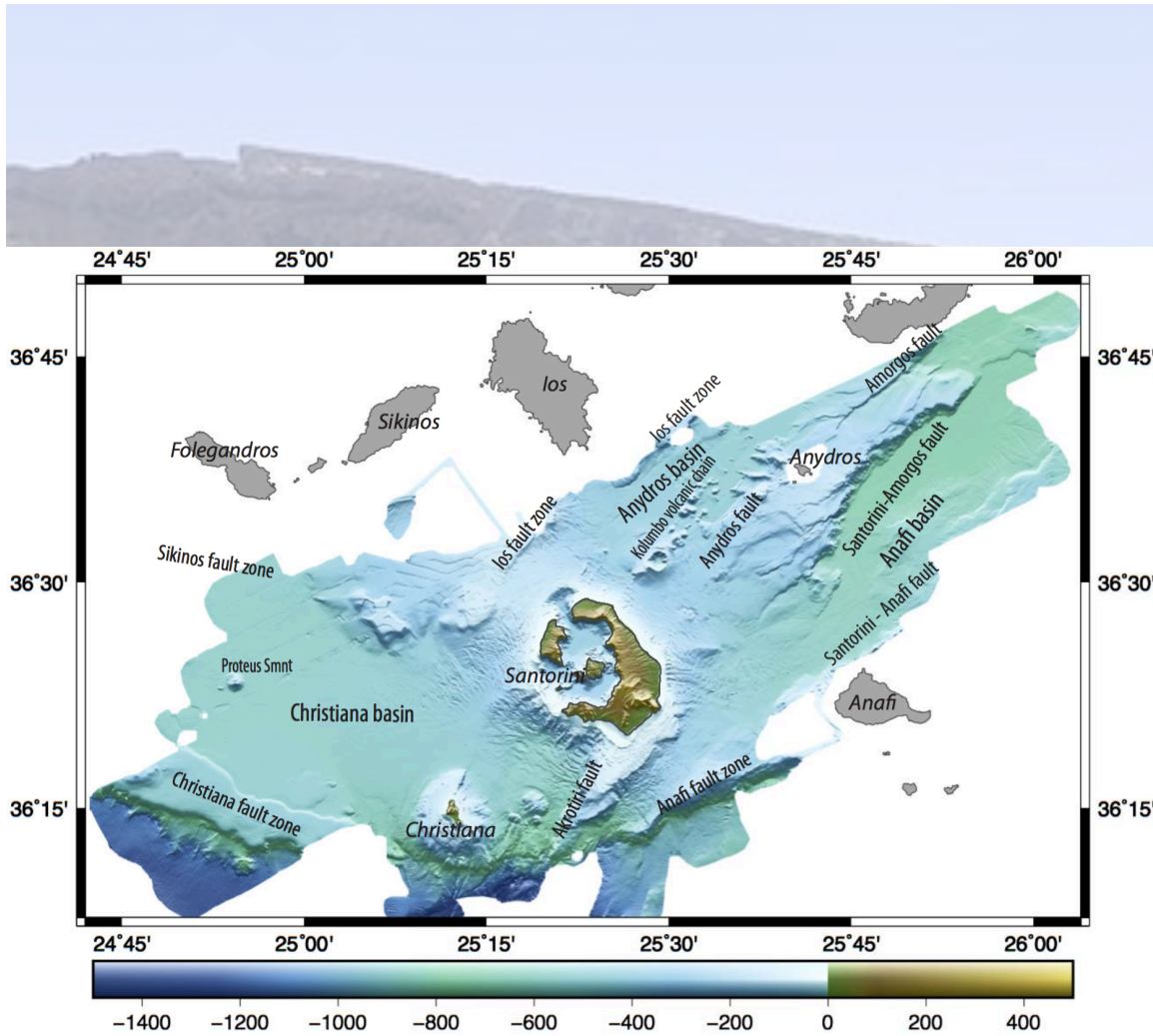


Experiment

~14000 active source
shots and over 100
seismometers

Goal

Image the magmatic
plumbing system
using travel time
tomography and full
waveform inversion



Why Santorini?

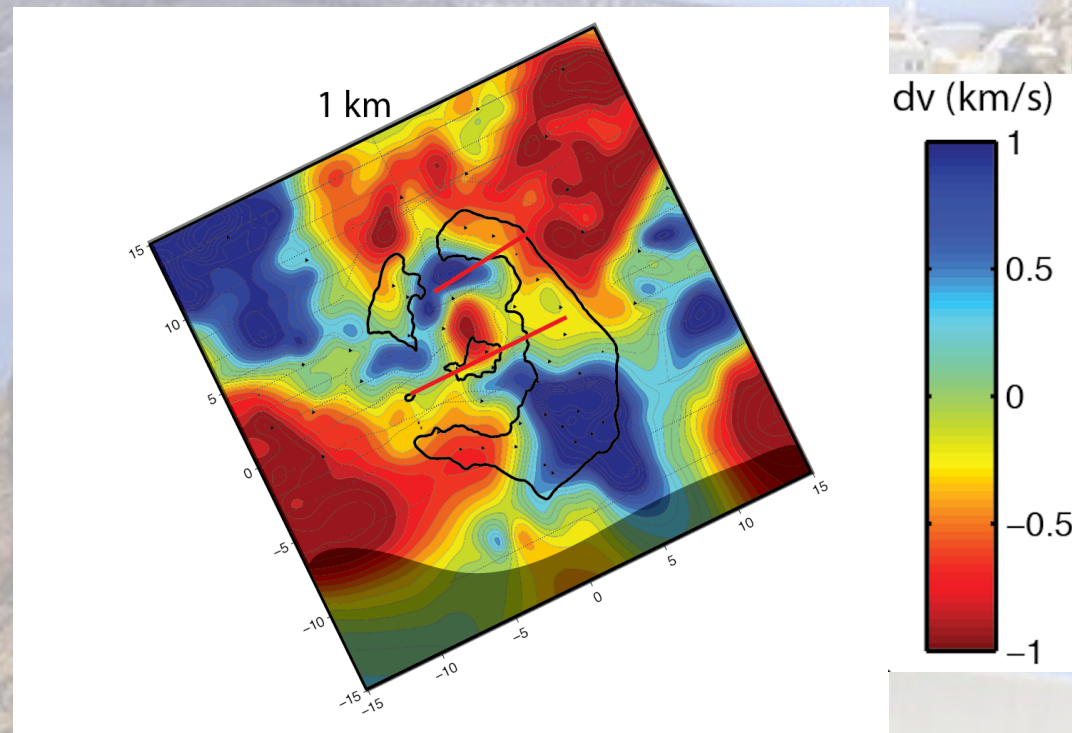
Santorini has been historically and geologically active

Santorini is well studied geologically and geochemically

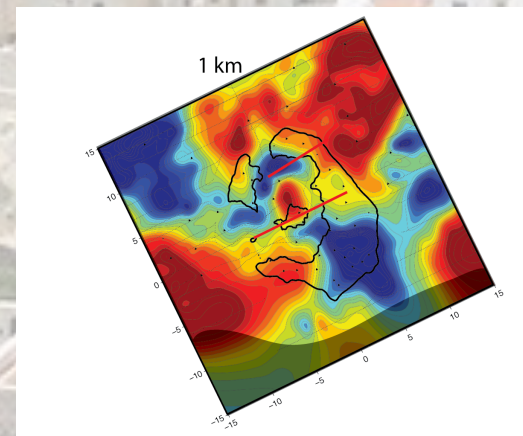
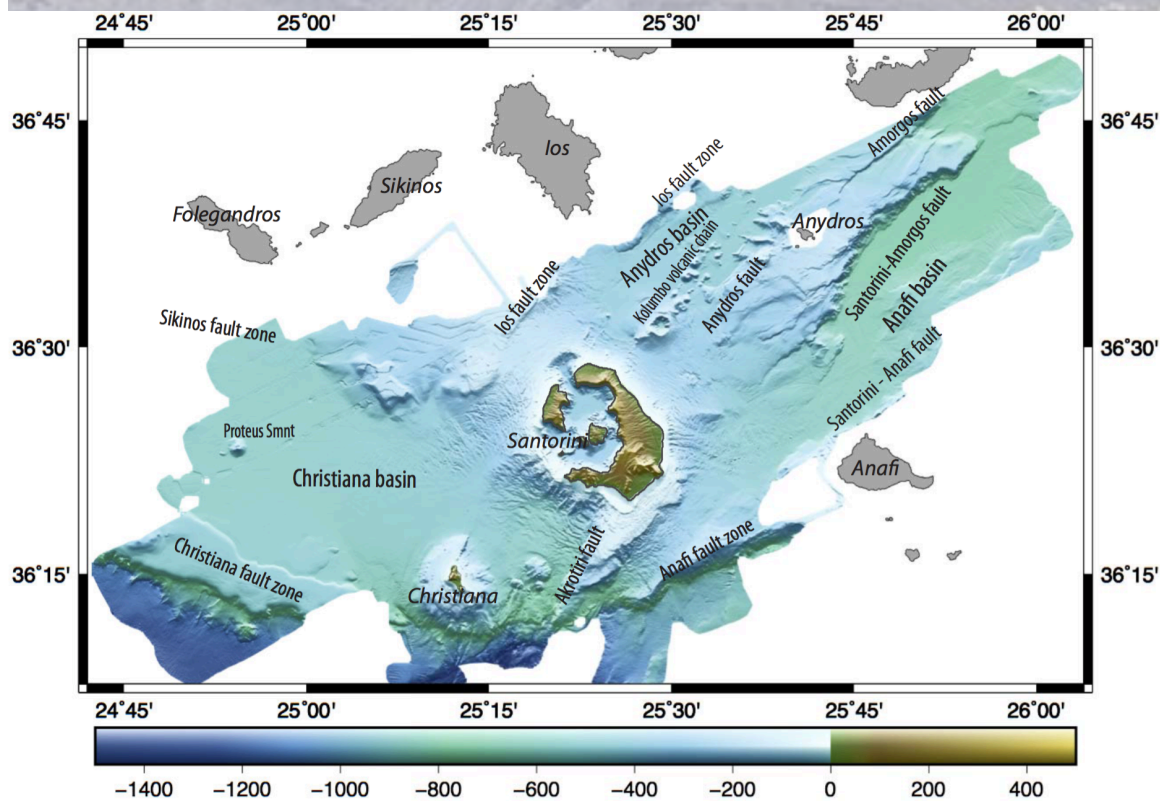
Santorini is located on thinned continental crust

Santorini is surrounded by water

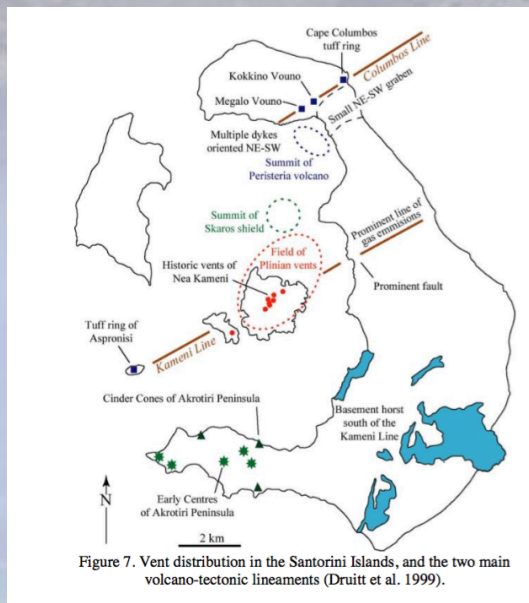
P wave velocity perturbations at 1 km depth



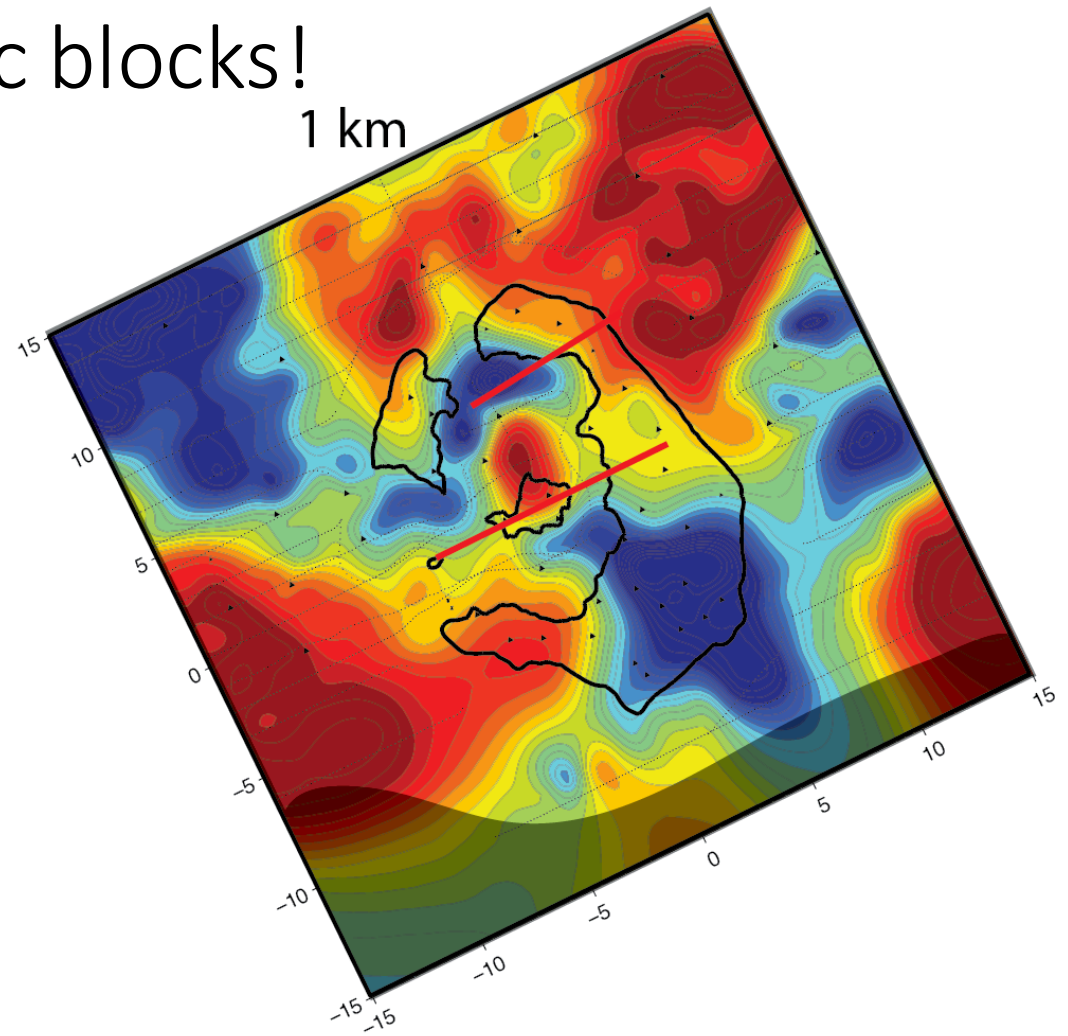
We See Basins and Ridges!



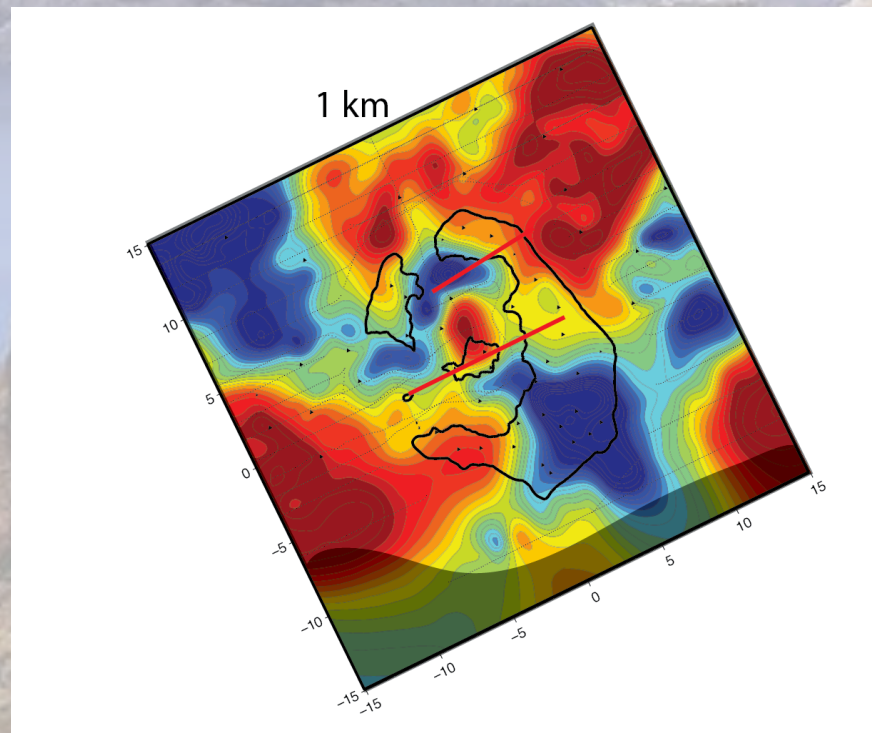
We see metamorphic blocks!



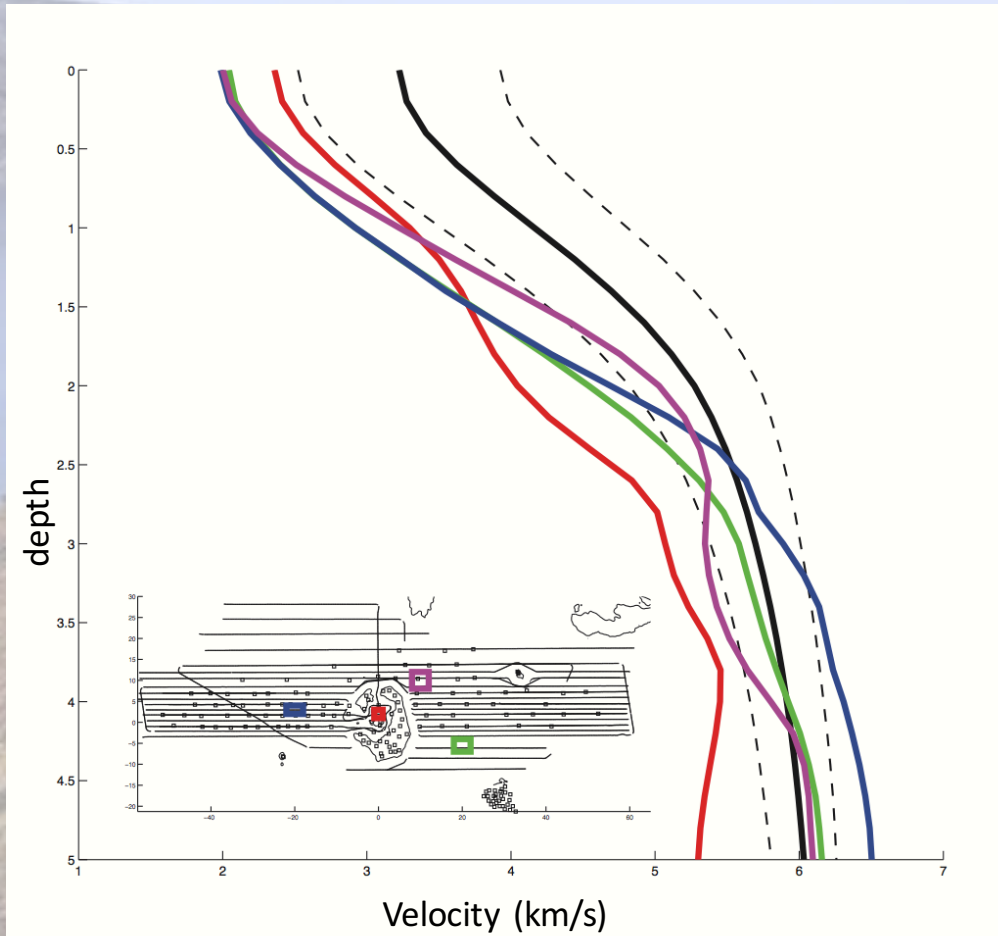
Druitt, Field Guide



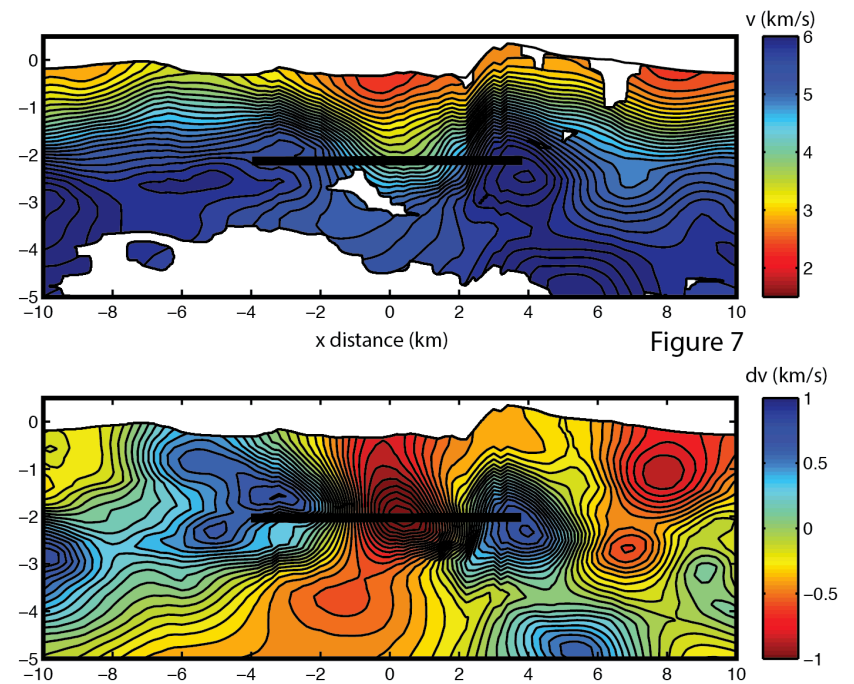
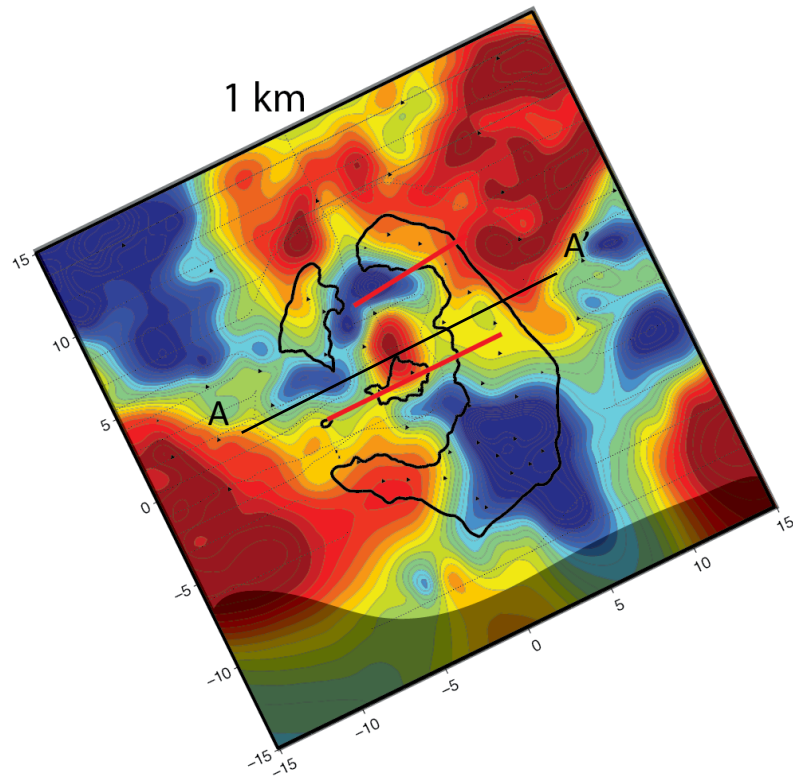
What's the bullseye?



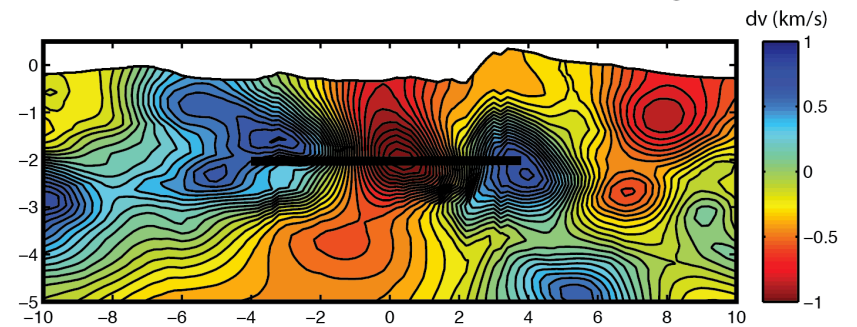
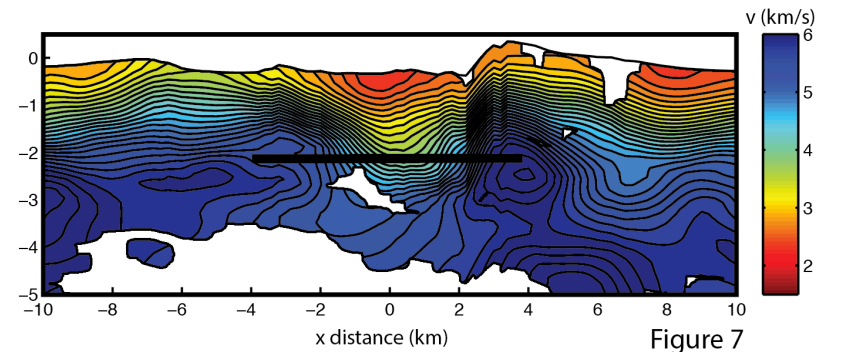
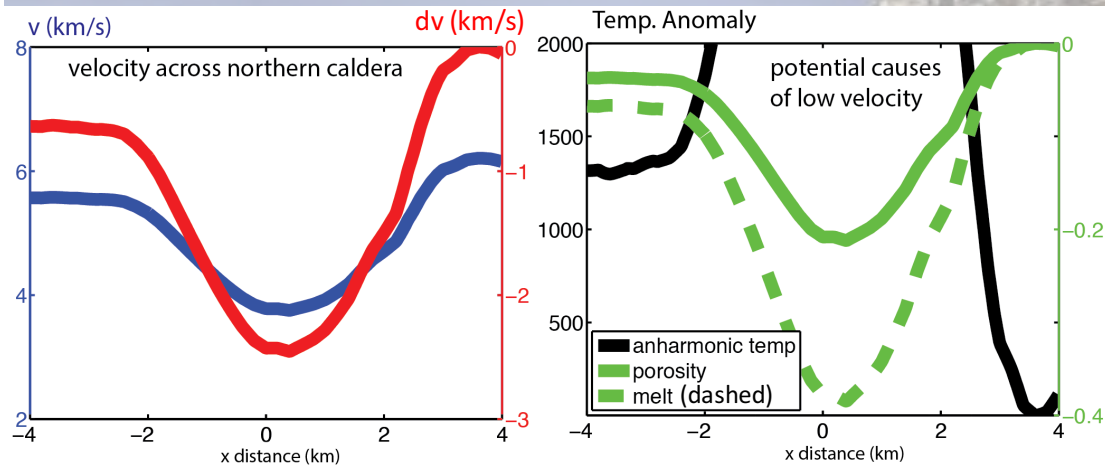
Maybe just a basin ...

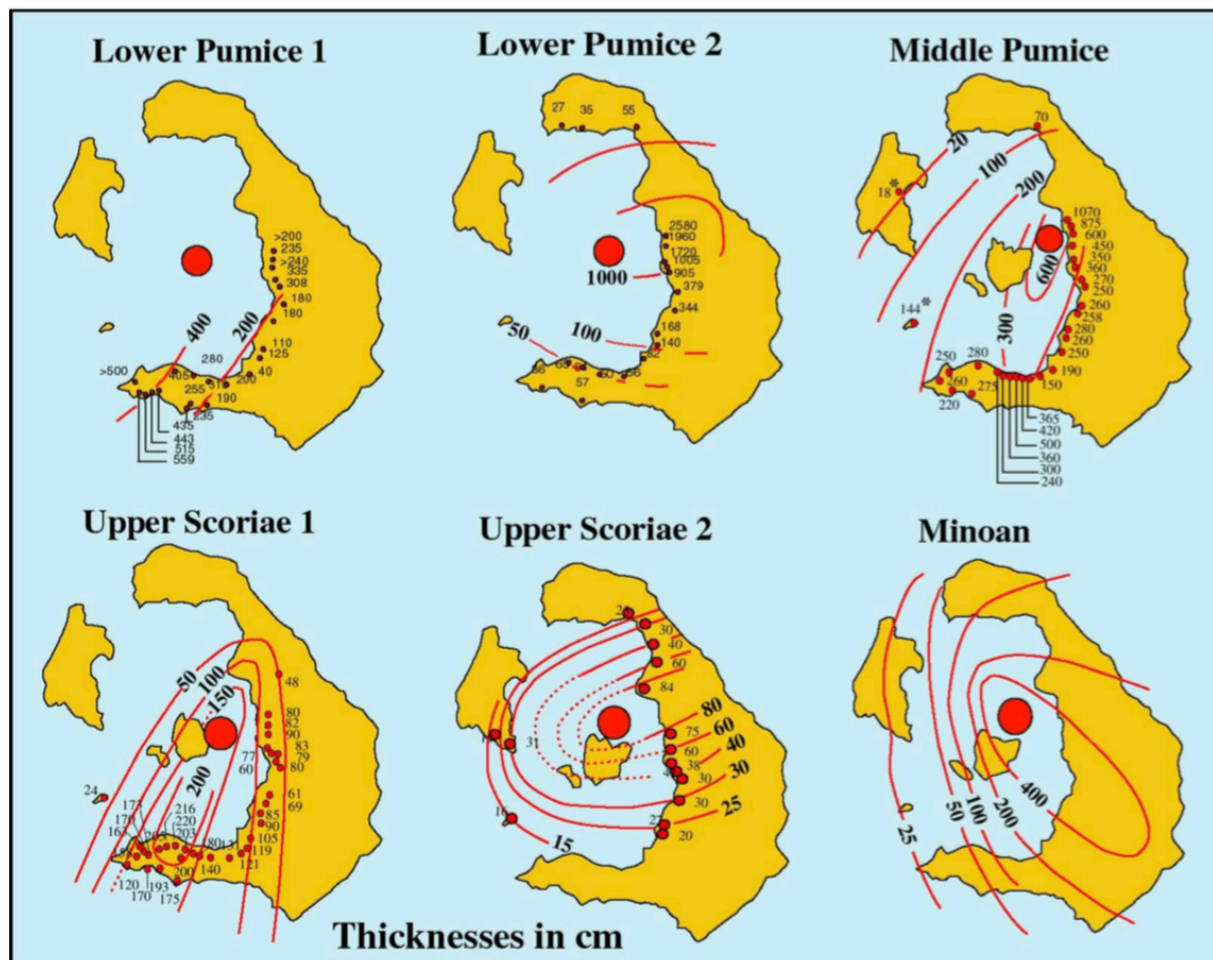


Composition, Temperature, Porosity or Melt?



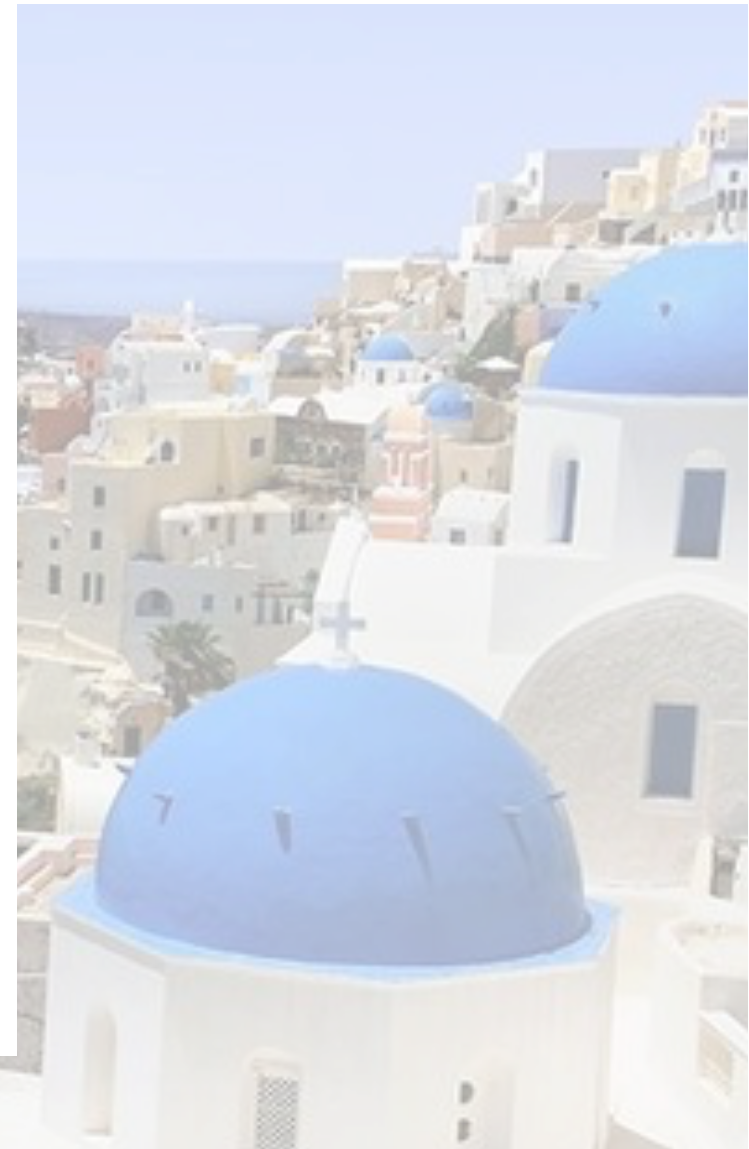
Composition, Temperature, Melt, or Porosity?





Druitt, Field Guide

Figure 17. Isopachs of pumice-fall deposits of six pyroclastic eruptions (Druitt et al. 1989; 1999).



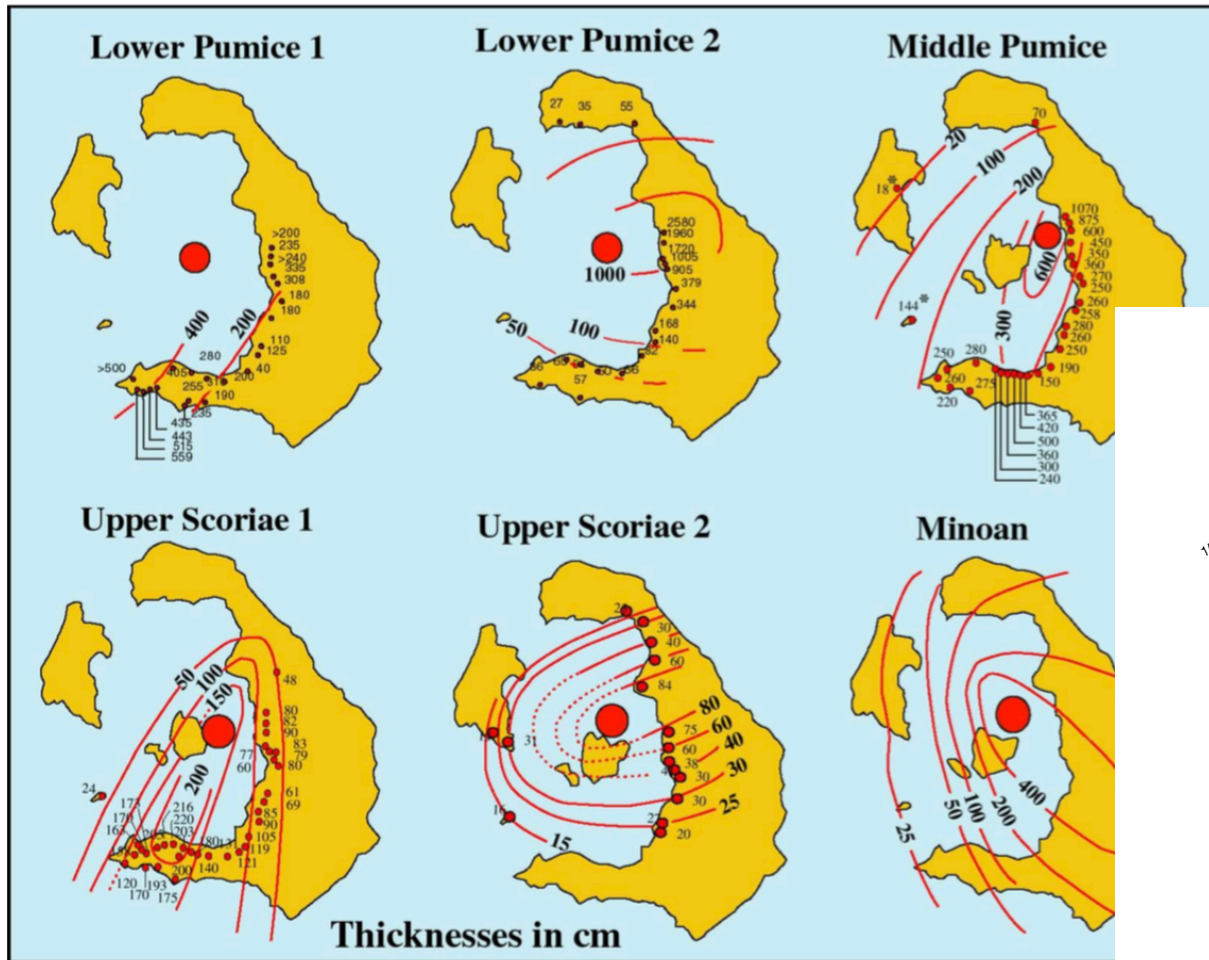
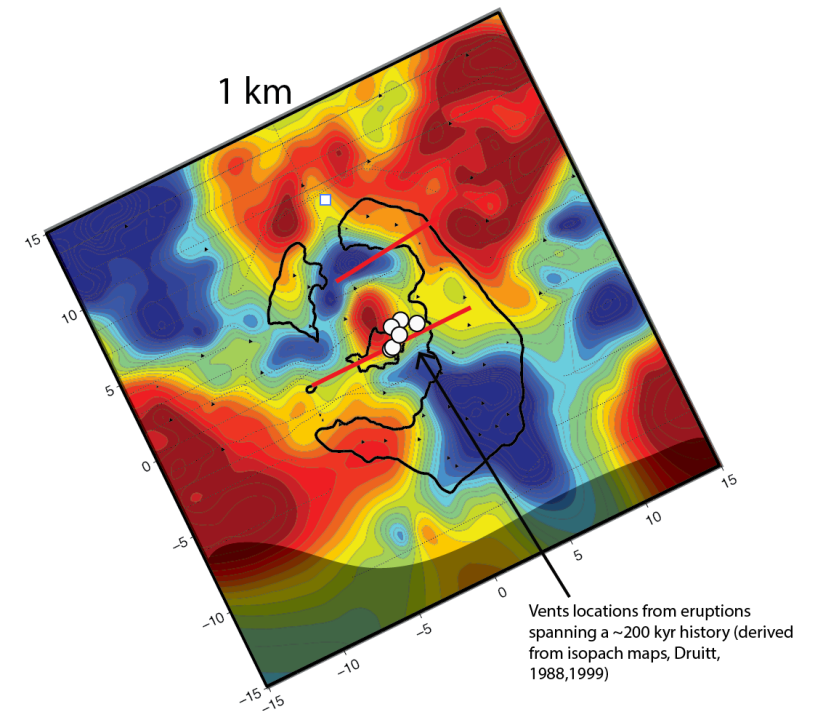
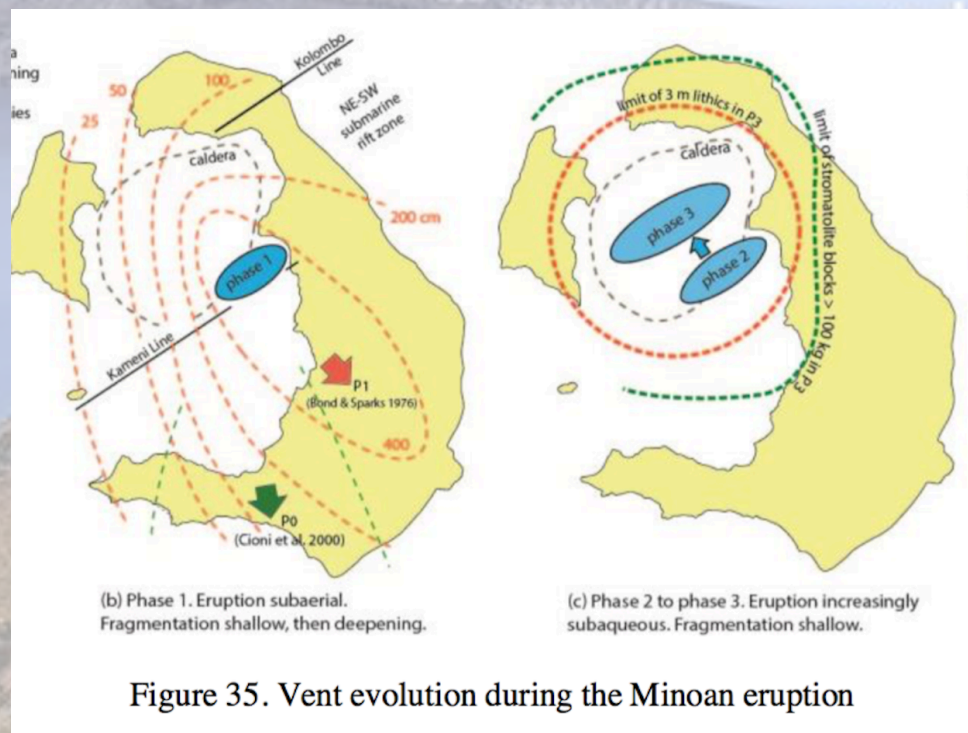


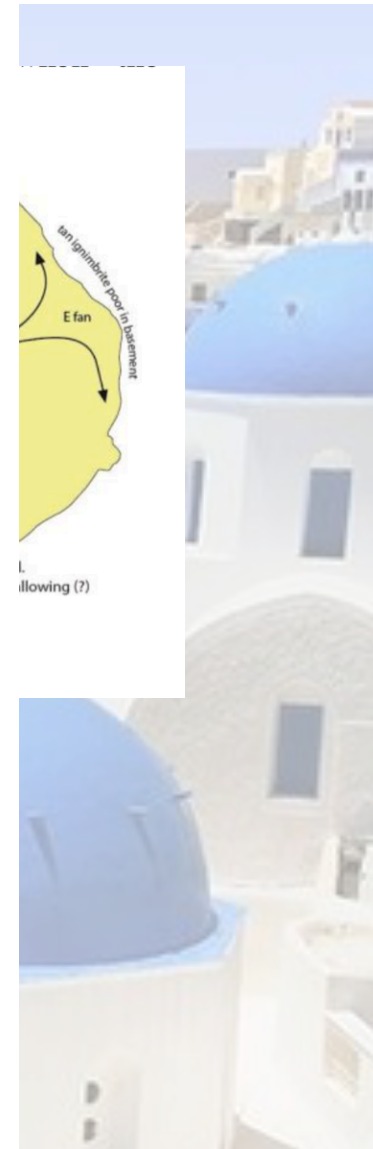
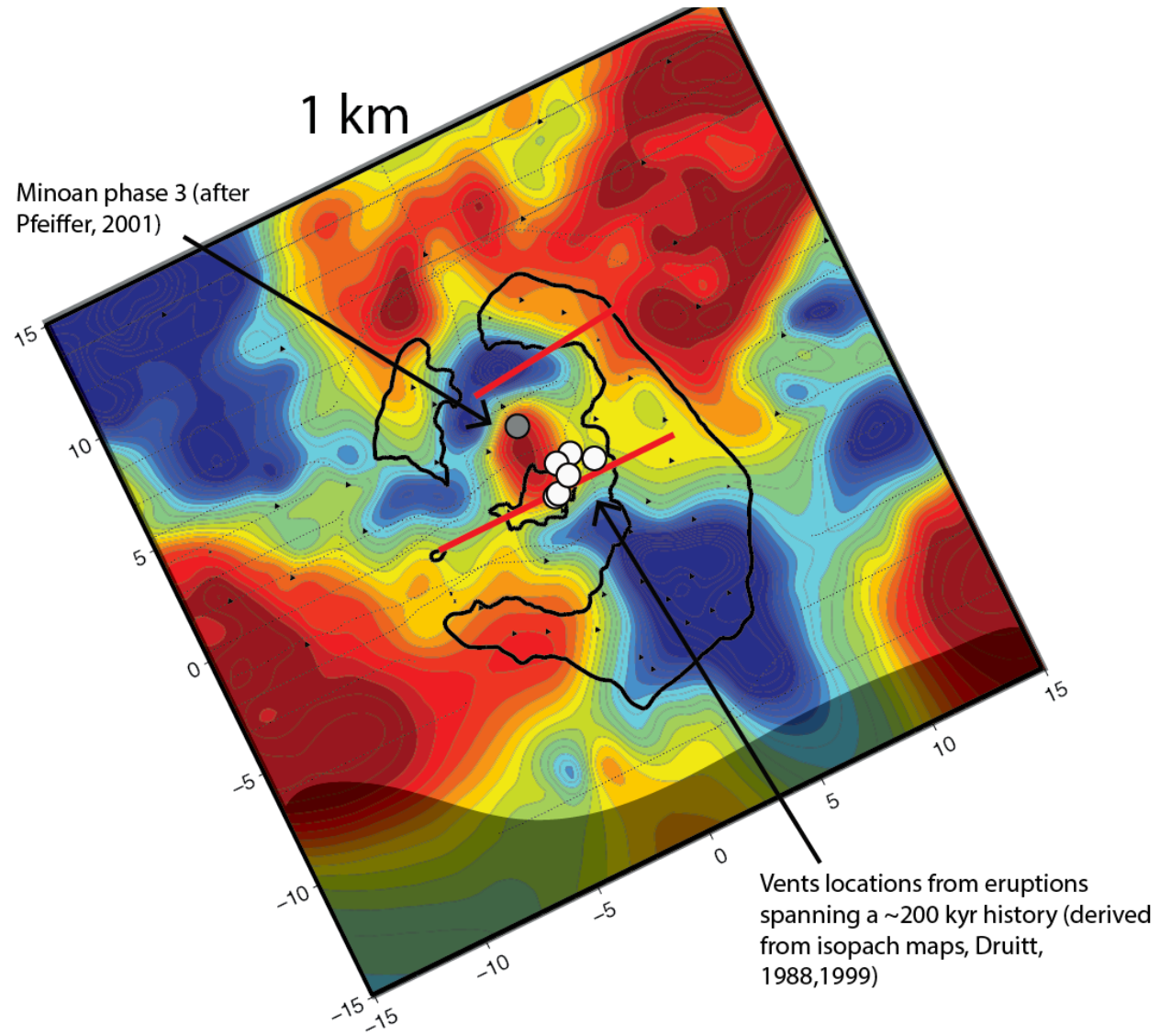
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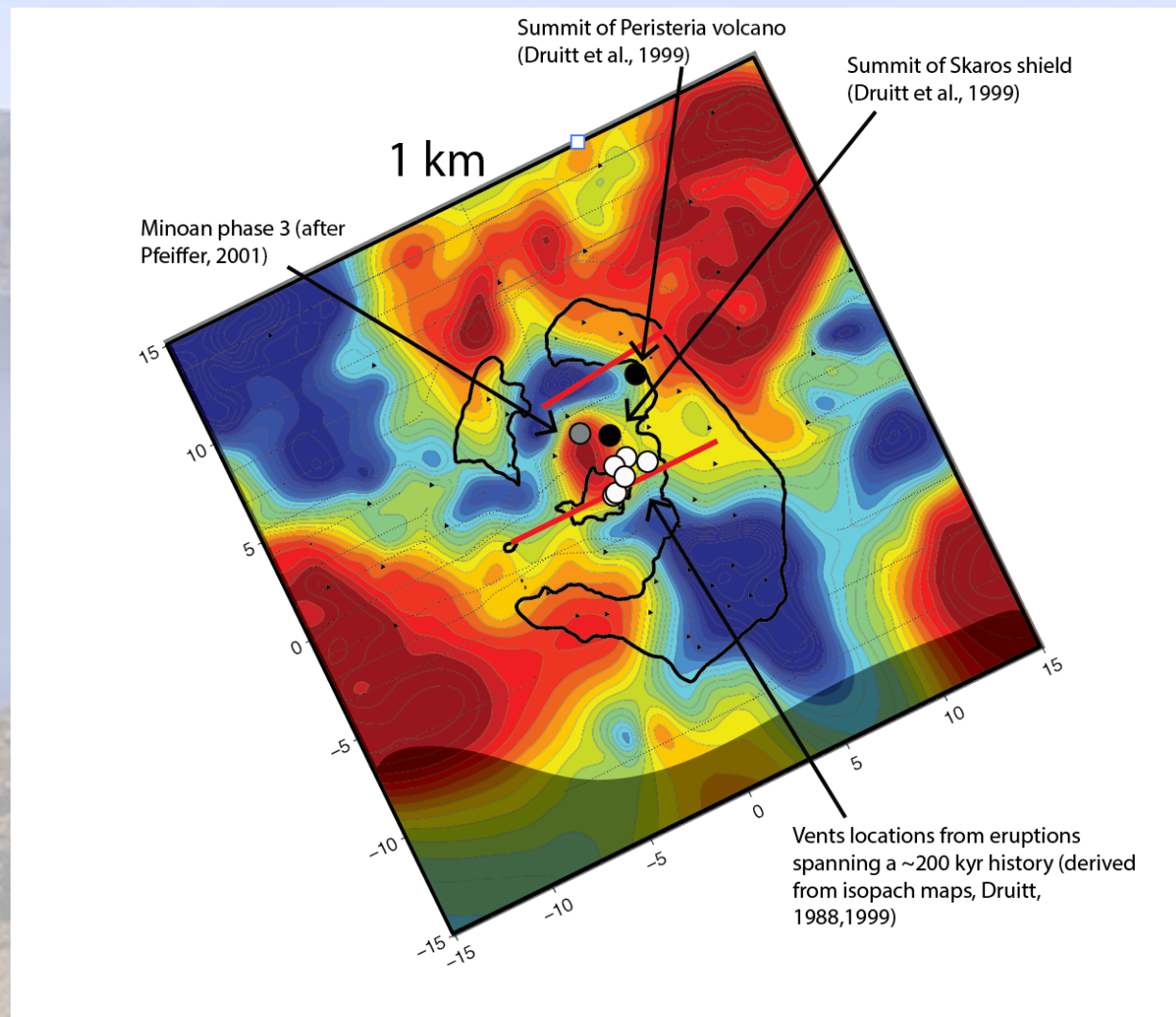


Minoan Vent Location: Different phases

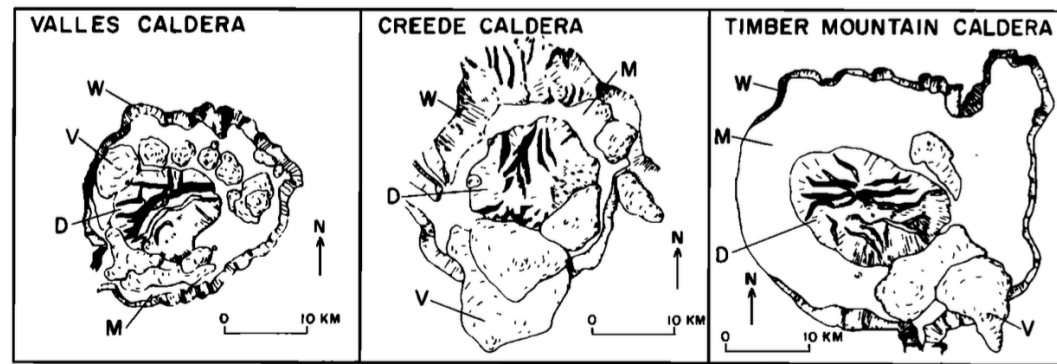


Druitt, Field Guide

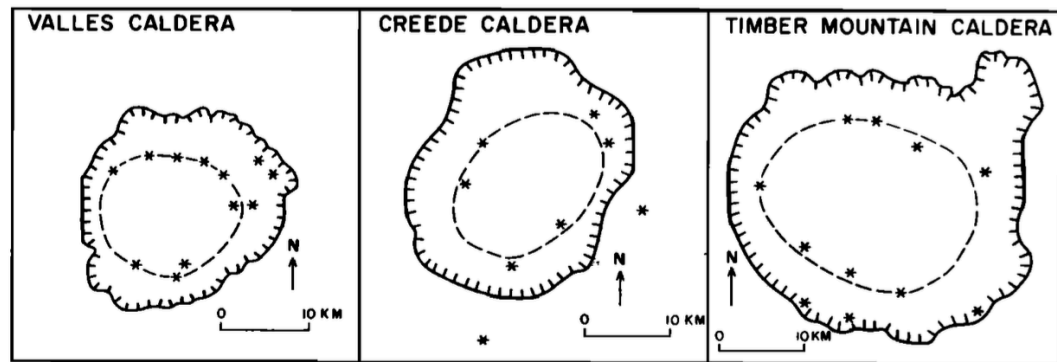




Vents do not coincide with topographic caldera wall, vents localized in semi-circular pattern



A. Physiographic sketches



B. Structural relations

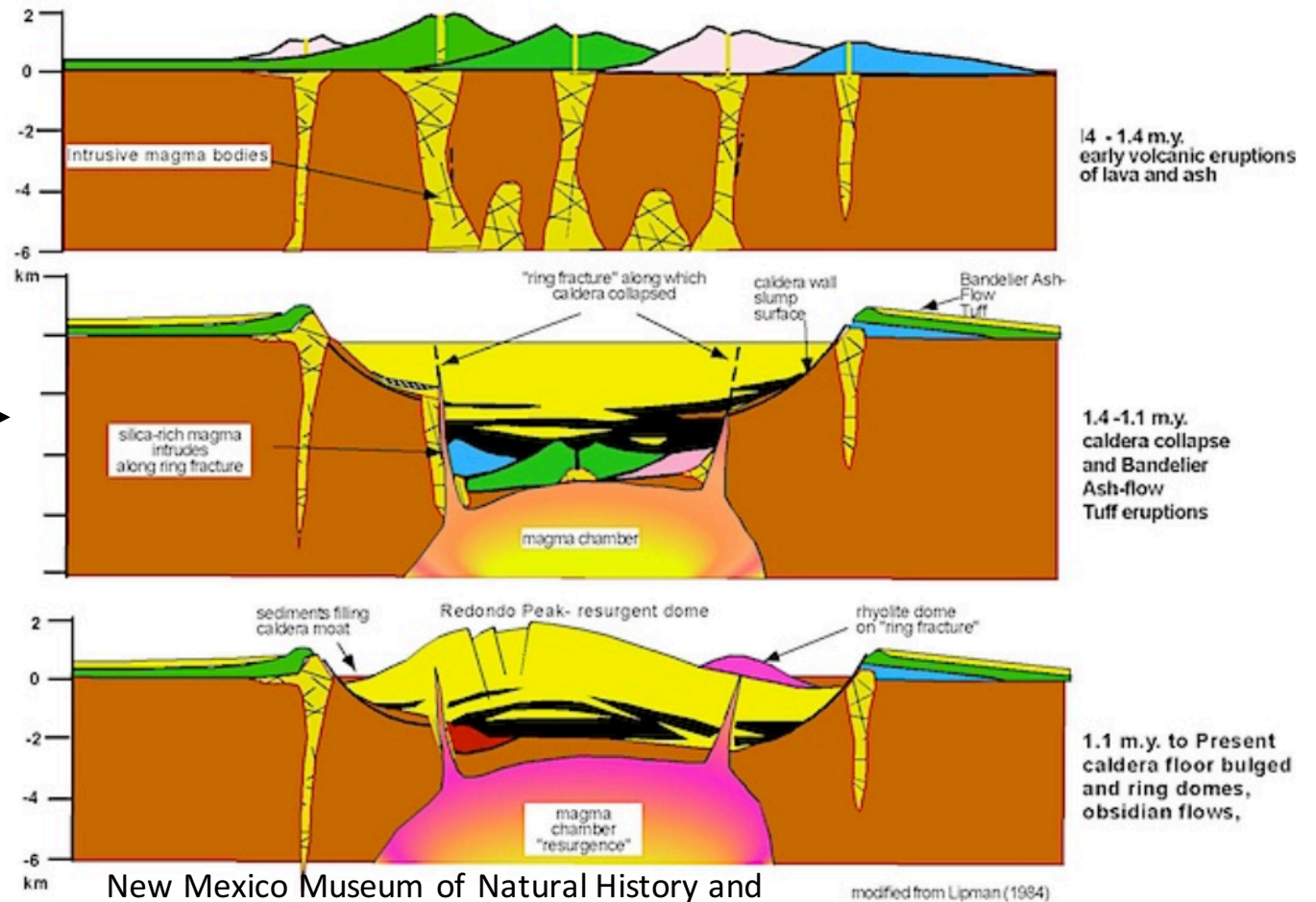
EXPLANATION

- * Postcollapse volcanic center
- Rim of topographic wall
- Inferred position of buried ring fault

Lipman, 1984

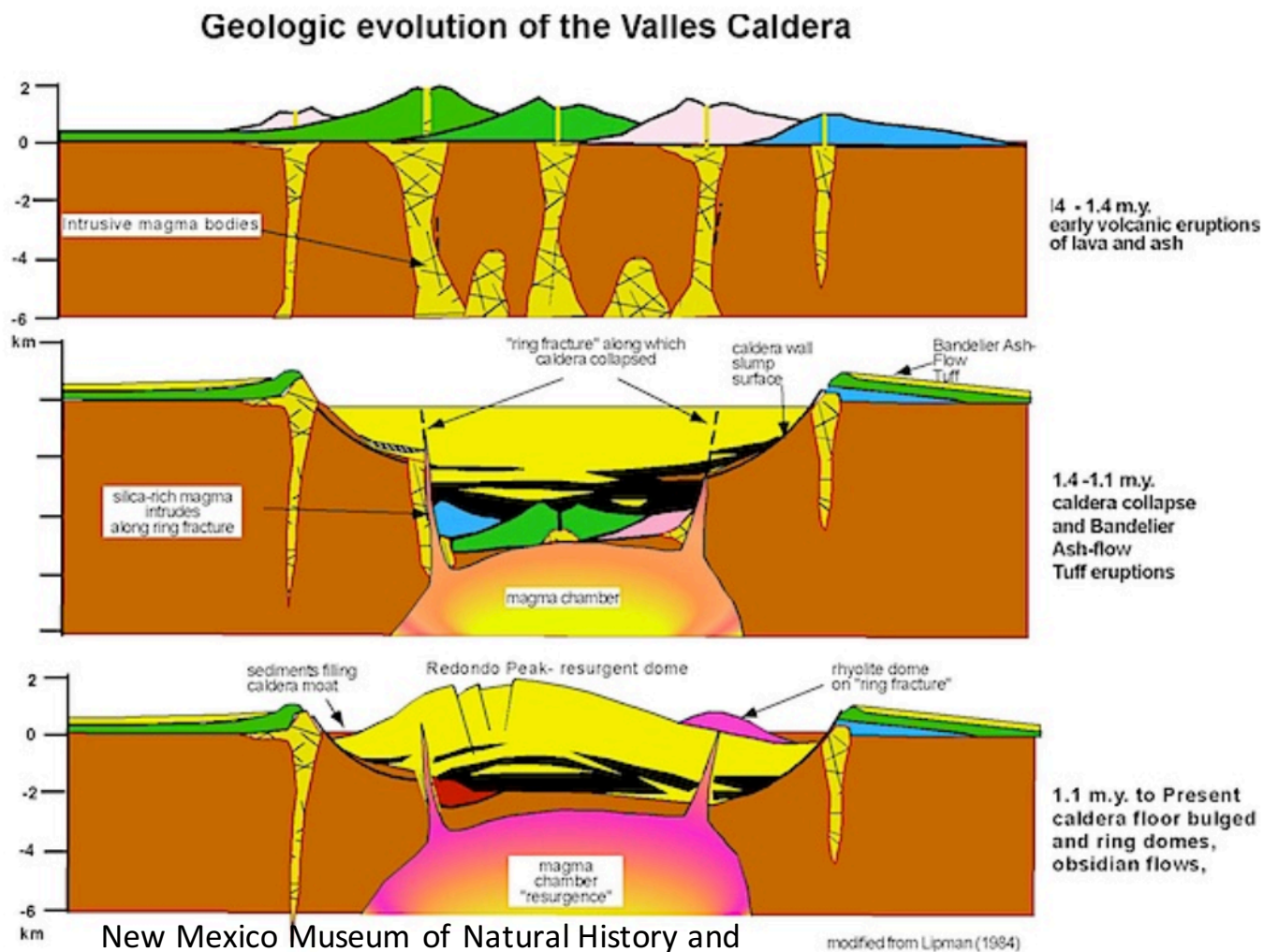


Geologic evolution of the Valles Caldera



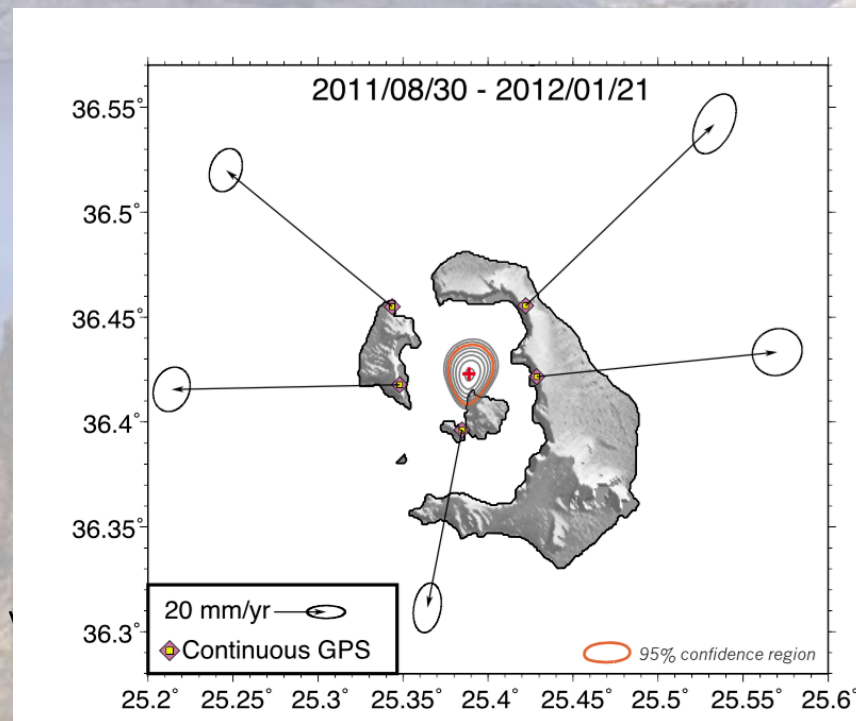
New Mexico Museum of Natural History and
Science

Implication: Vents on edge of ring faults, magma body beneath center of collapsed caldera

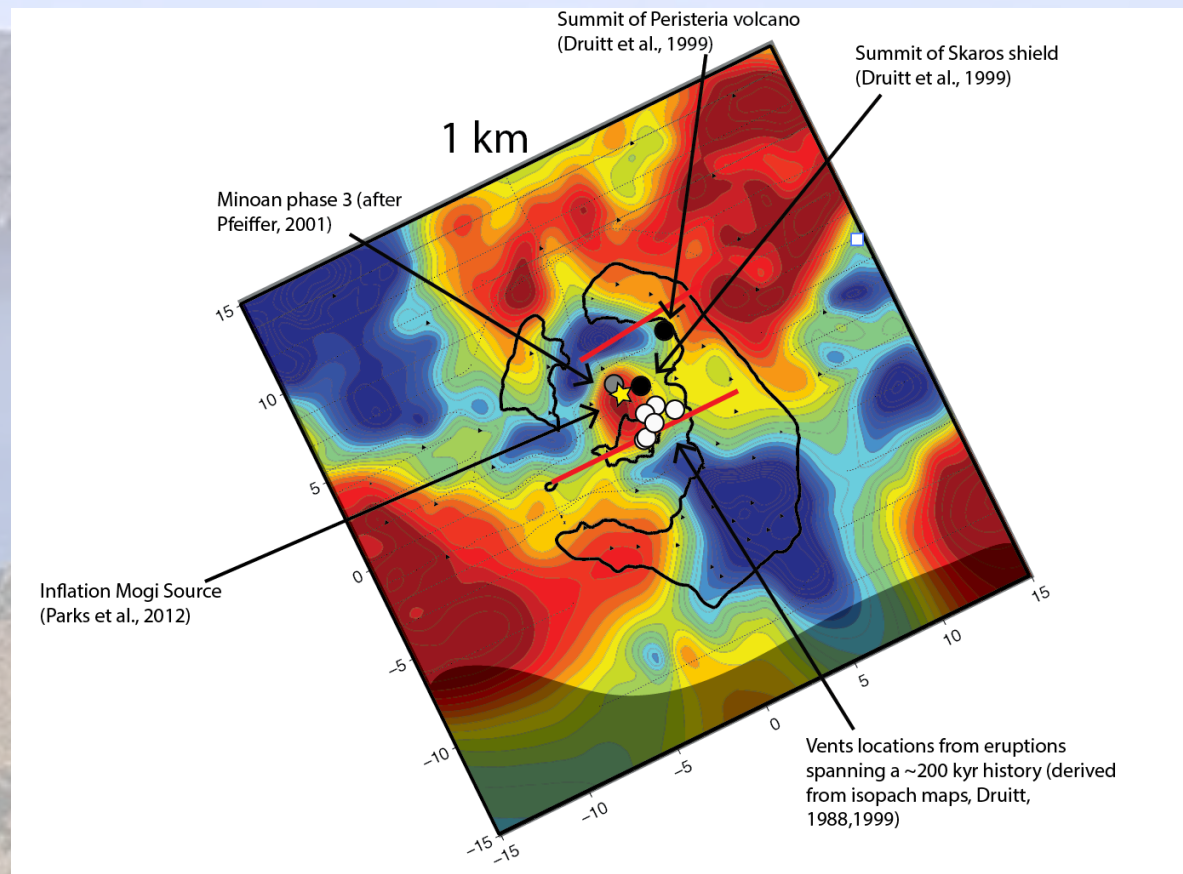


New Mexico Museum of Natural History and Science

Inflation point source for 2011-2012



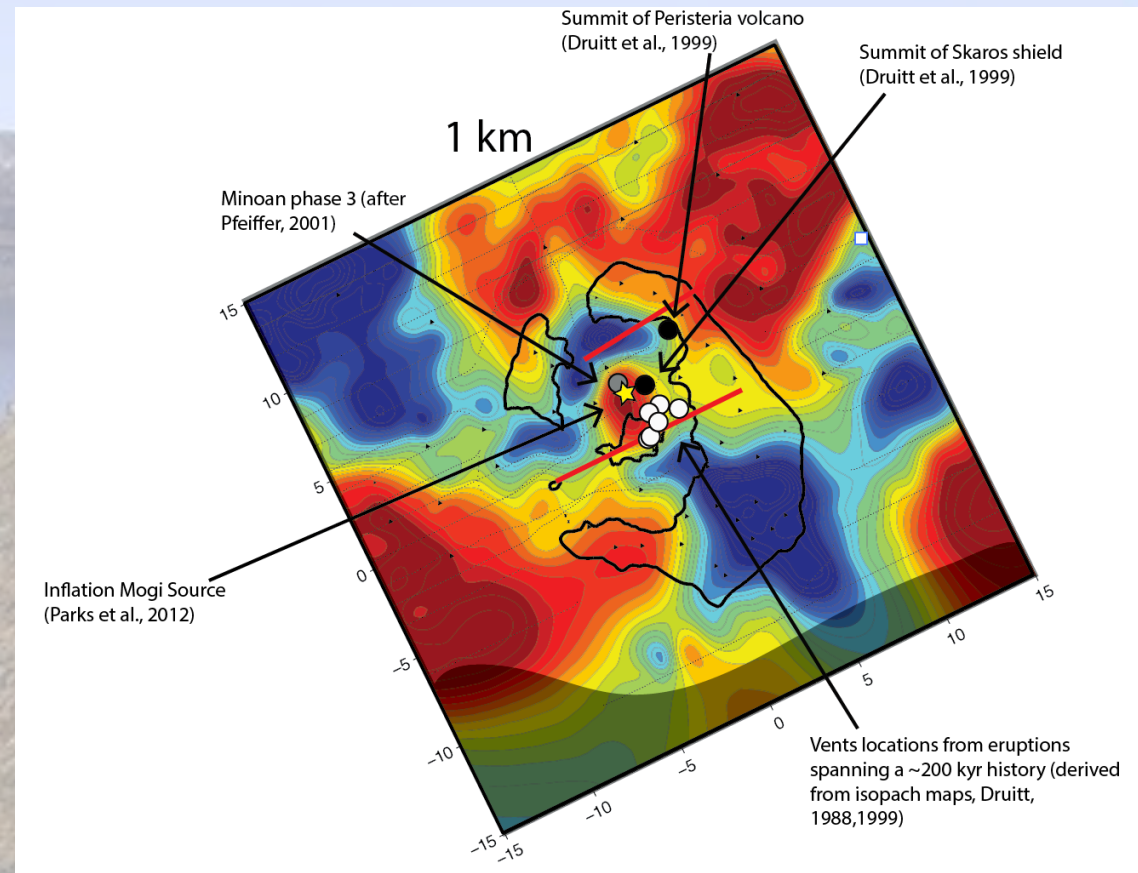
Newman et al., 2012



Caldera collapse at Santorini has been focused along ring faults located in the Northern portion of the caldera

Vents from large eruptions tend to localize along ring faults, Santorini has used the same ring faults through multiple caldera forming episodes

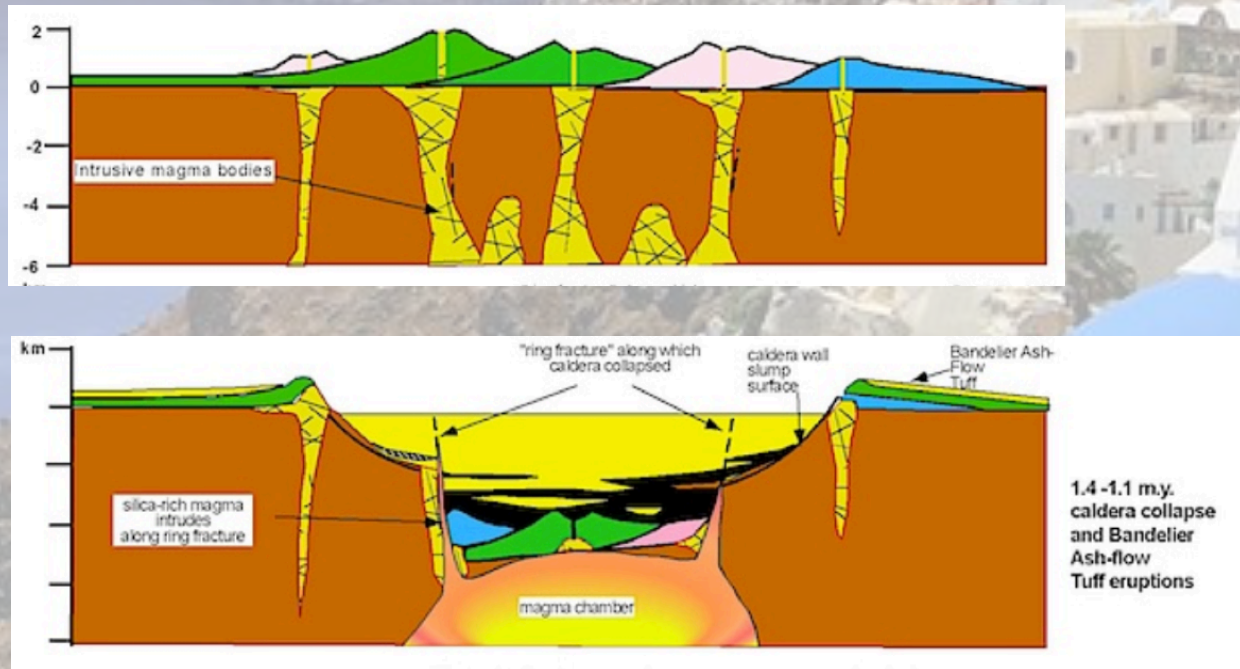
Magma body located in the northern portion of the caldera beneath region of caldera collapse



Concerns with the model

How is the topographic caldera formed?

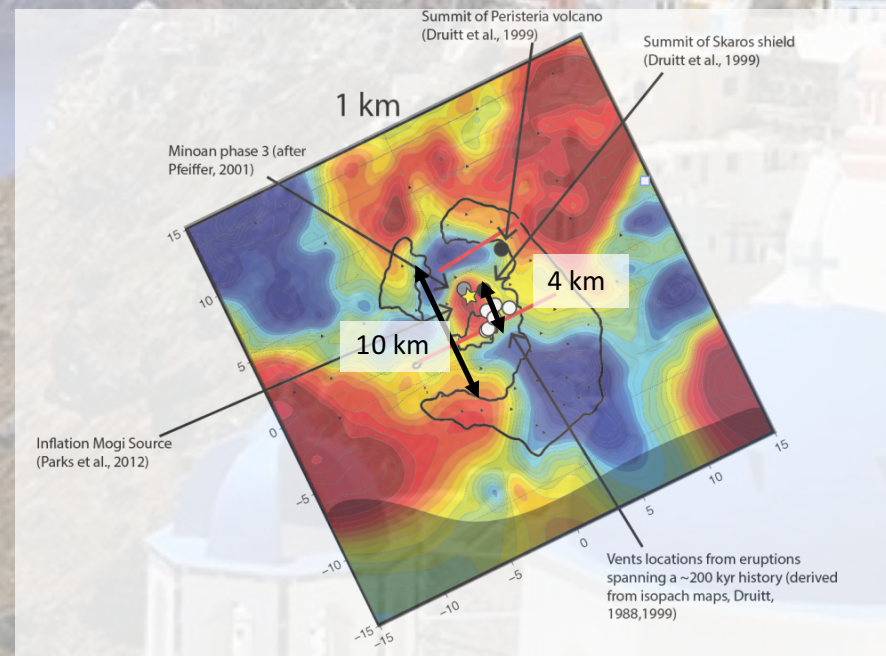
Usually thought to be related to land sliding...



New Mexico Museum of Natural History and Science

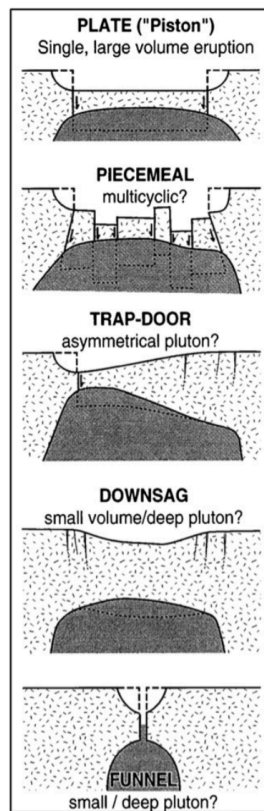
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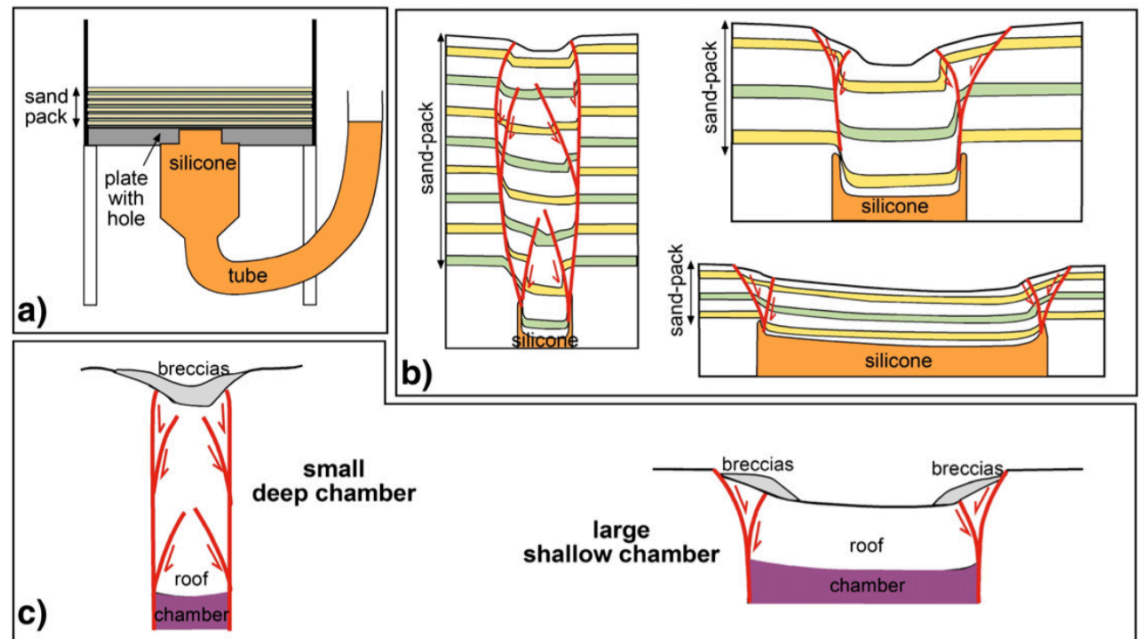
How are the faults oriented?

THE OLD VIEW



THE NEW VIEW

V. Acocella / *Earth-Science Reviews* 85 (2007) 125–160



Acocella, 2007

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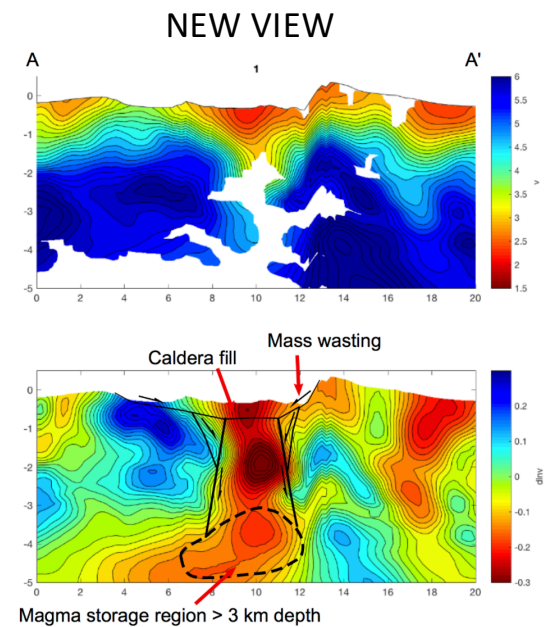
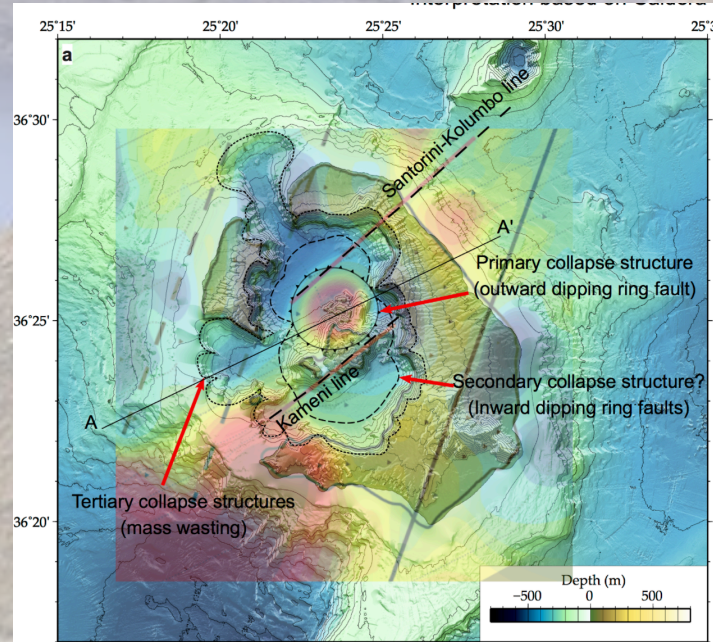
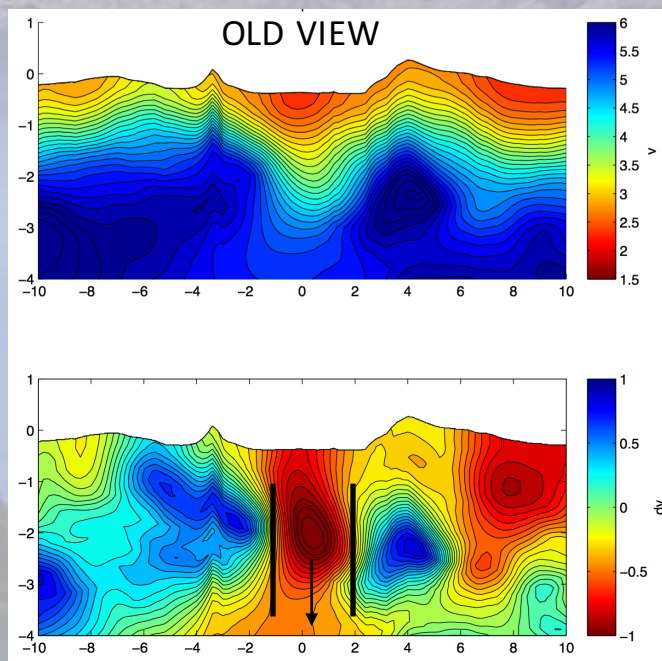
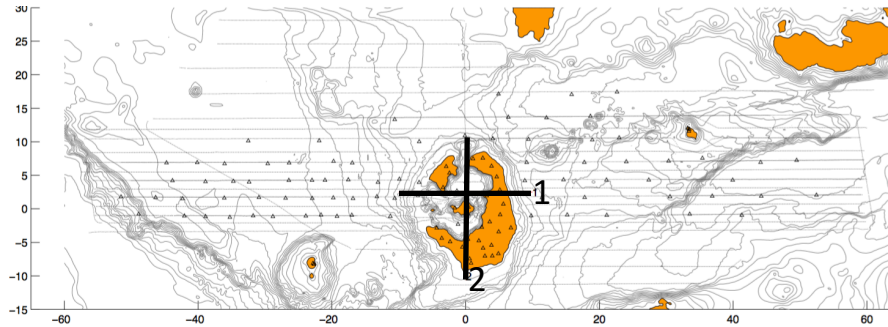
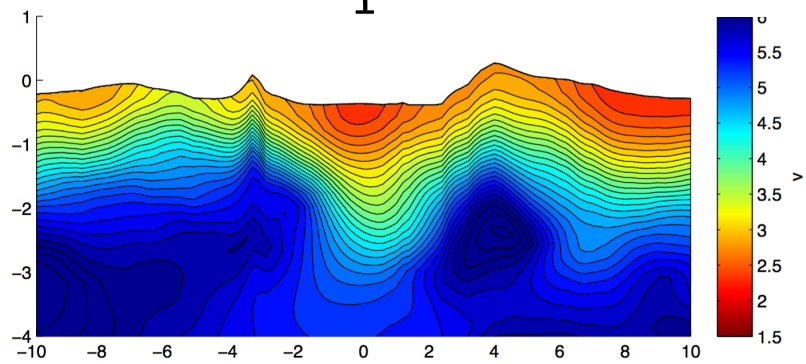


Figure made by Michele Paulatto

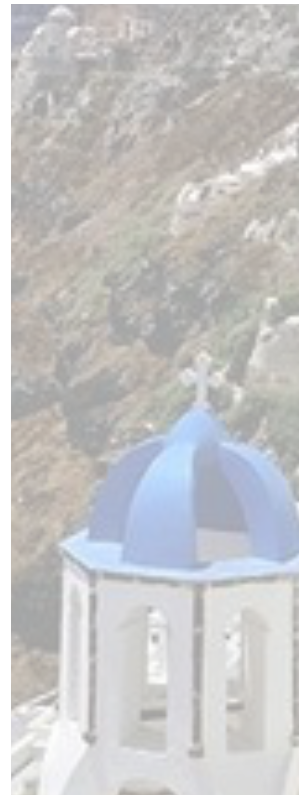
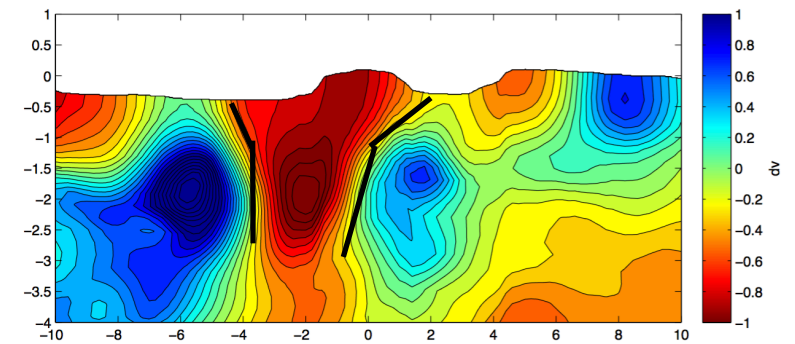
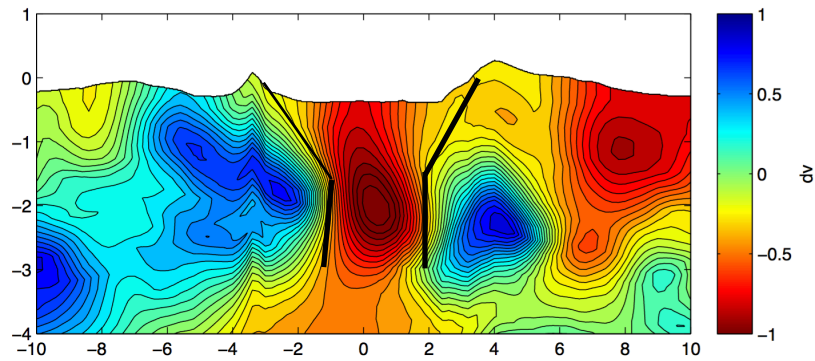
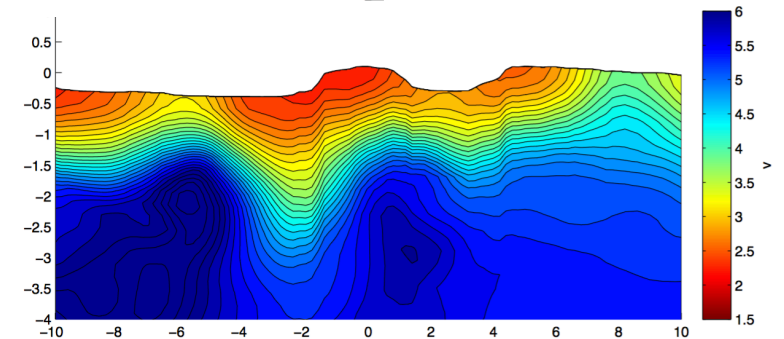
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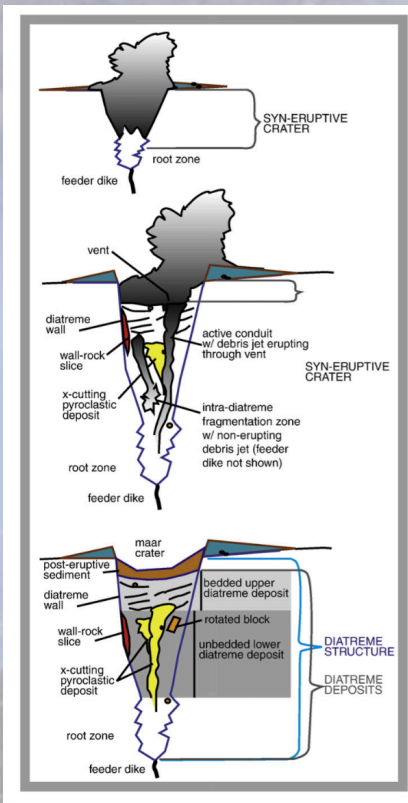
1



2



Diatremes (?)



White et al., 2011

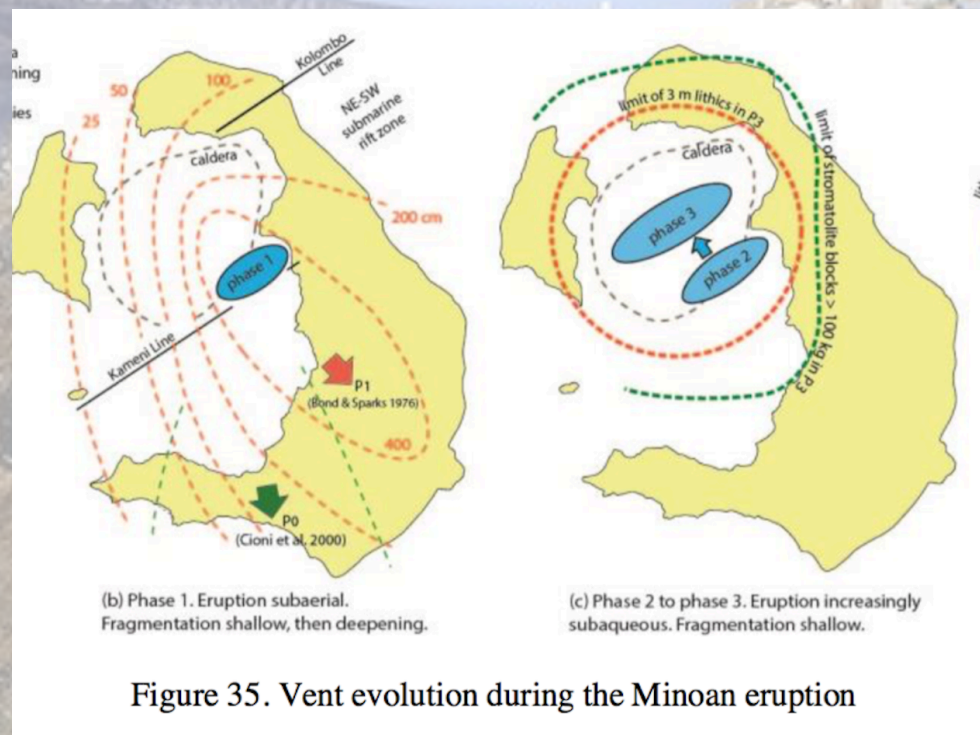
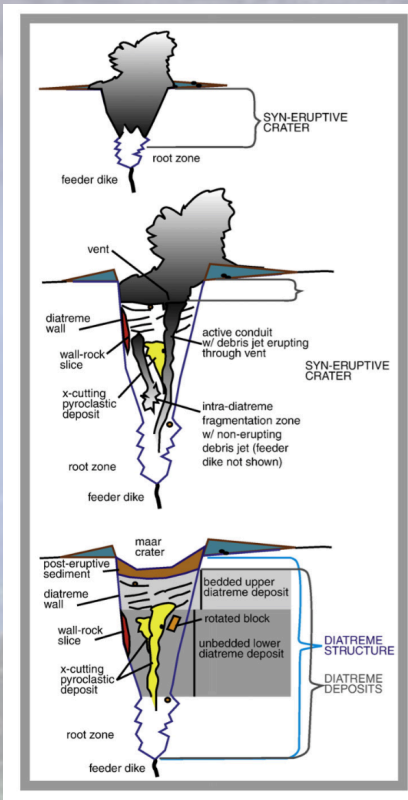


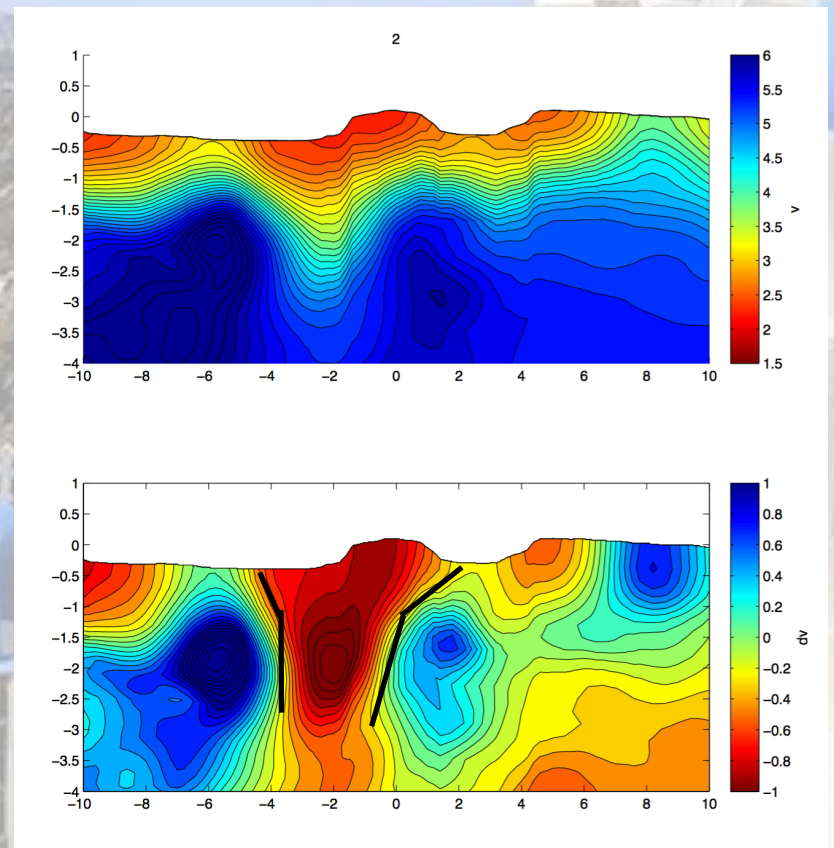
Figure 35. Vent evolution during the Minoan eruption

Druitt, Field Guide

Diatremes (?)



White et al., 2011

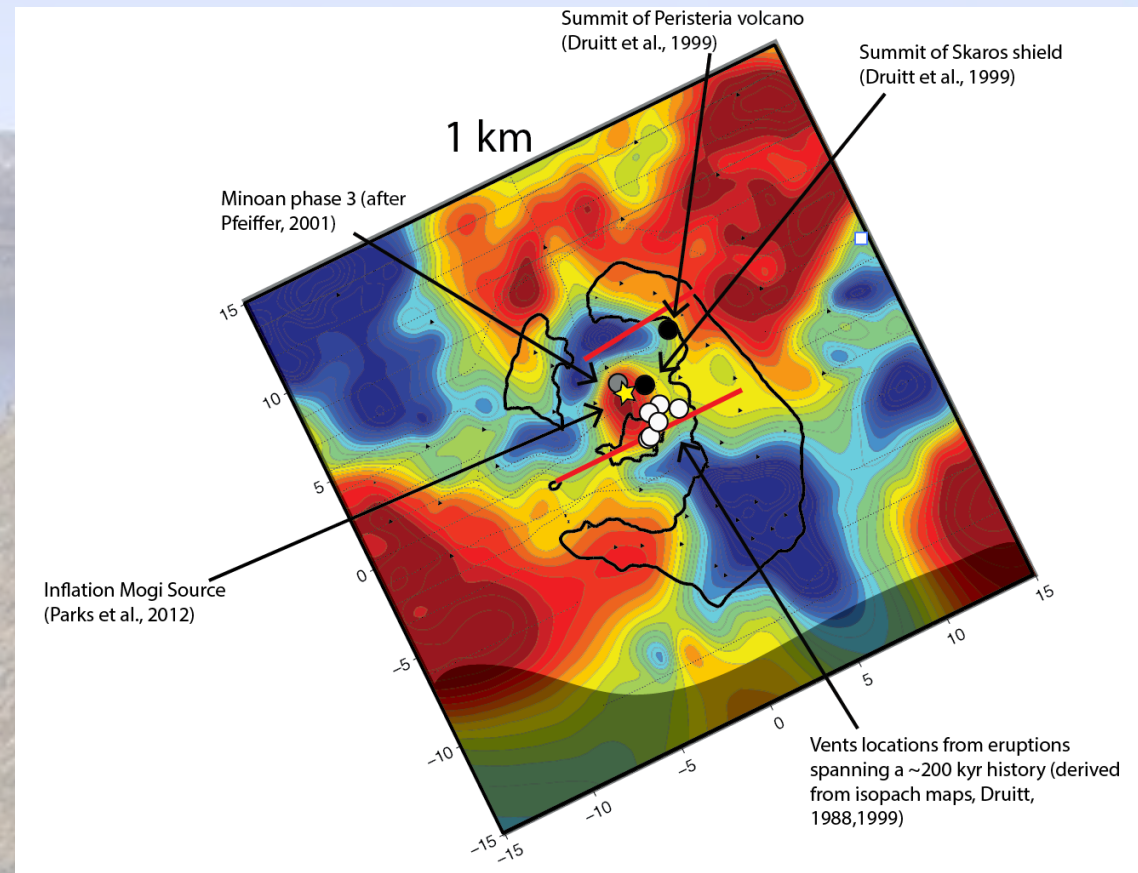


Recap

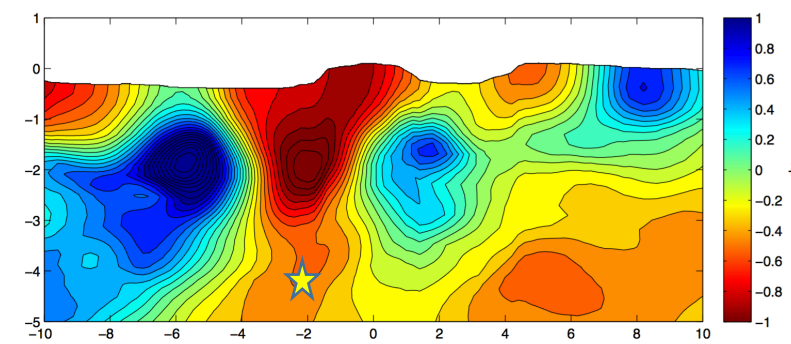
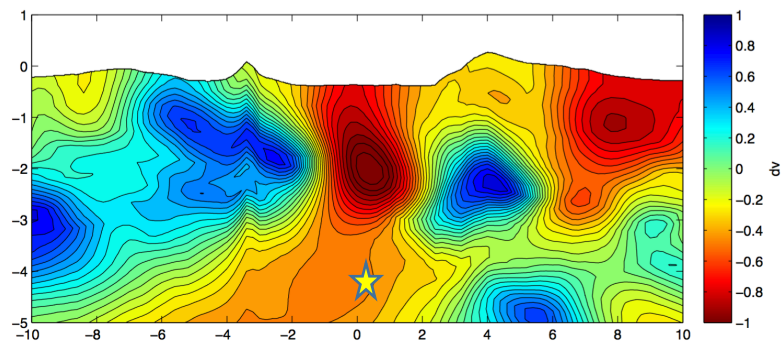
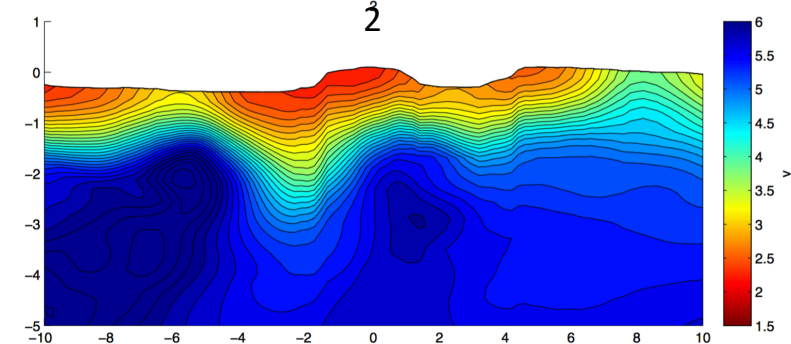
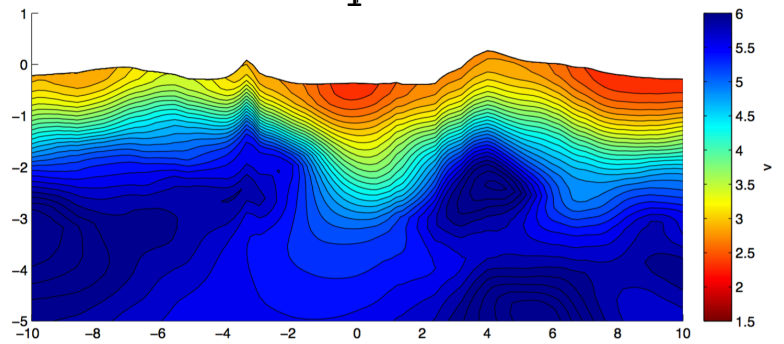
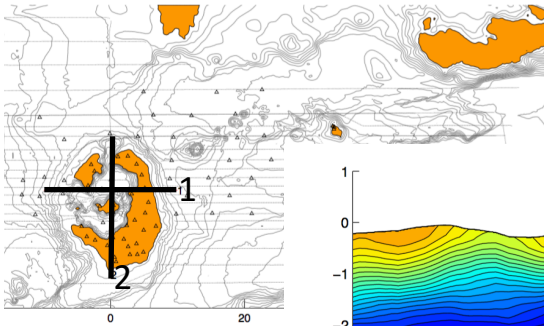
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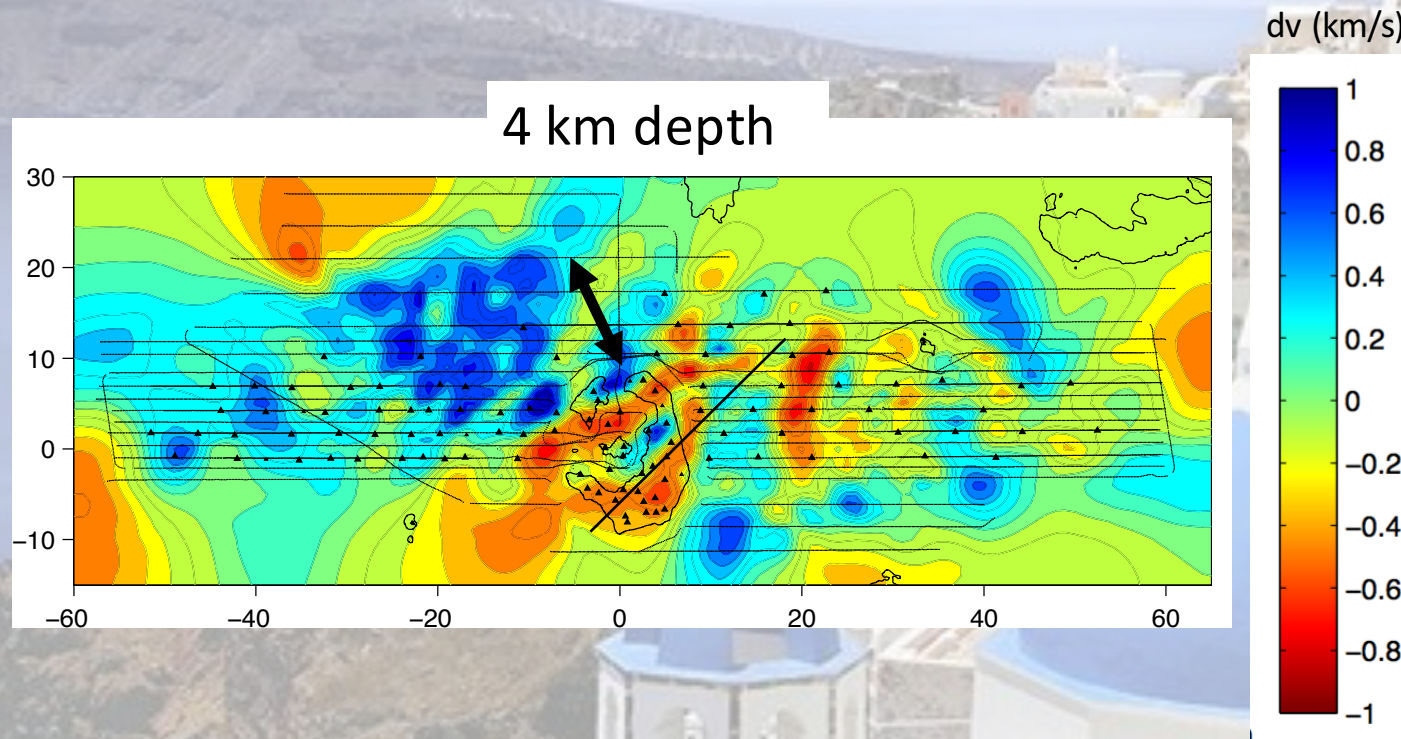
Magma body located in the northern portion of the caldera beneath region of caldera collapse

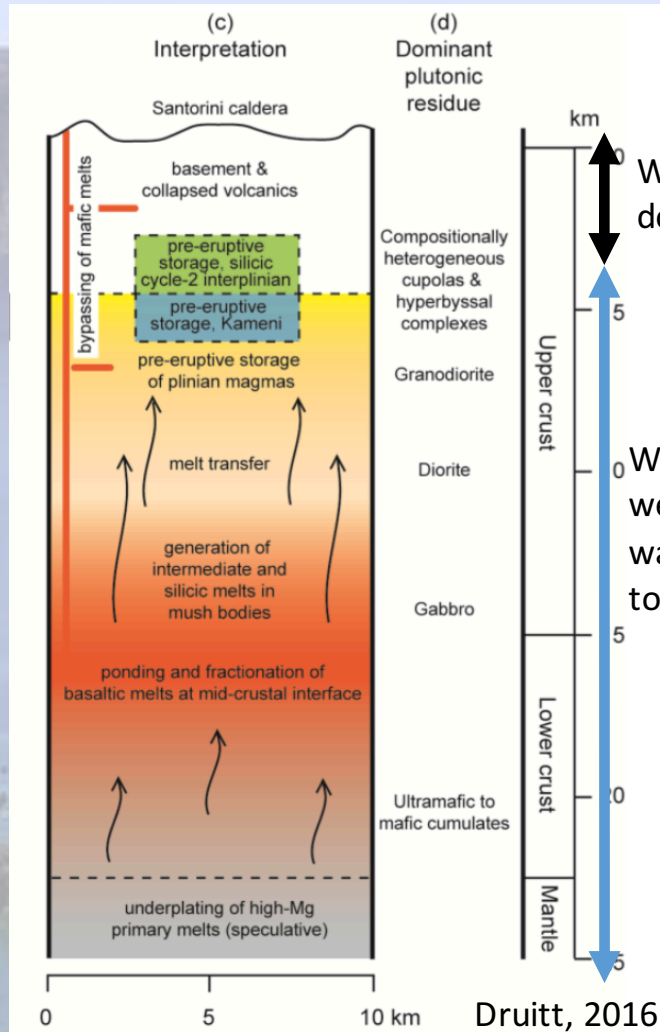


Views of the Magmatic(?) System



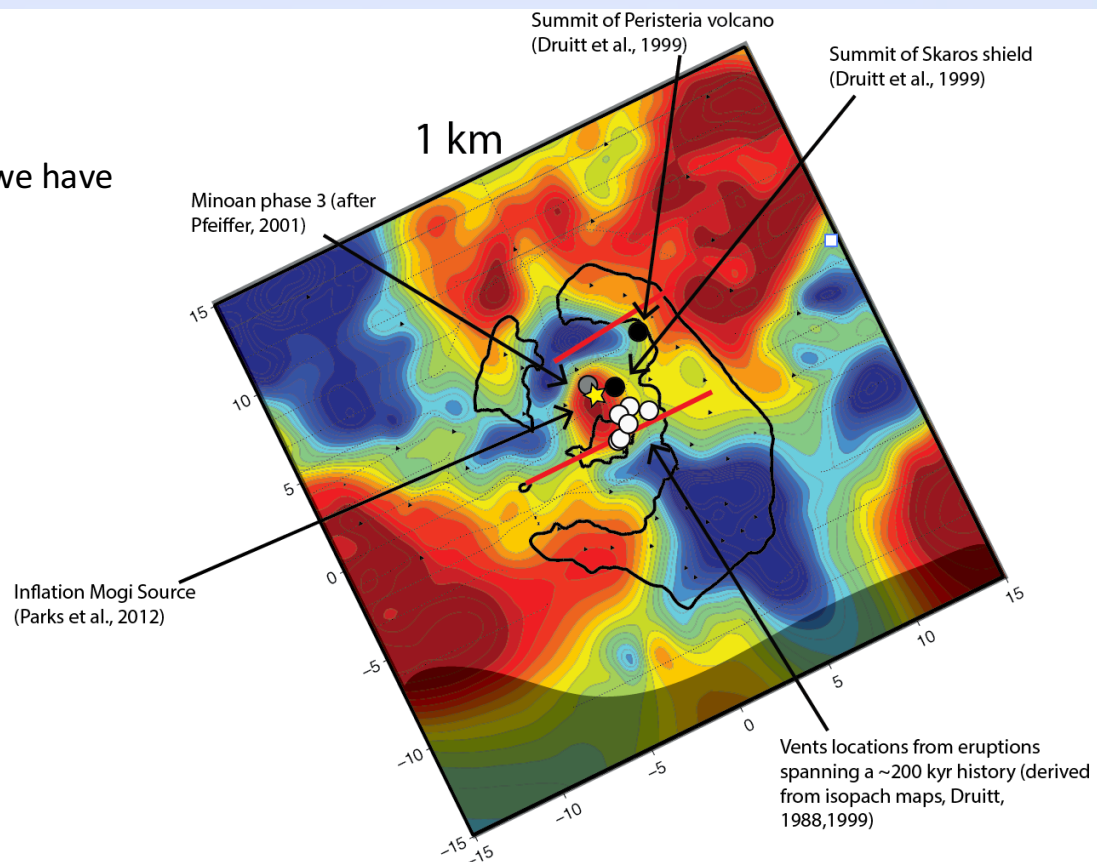
Views of the Magmatic(?) System





What we have done

What we want to do



Questions

