

Week 3 Lecture 2 – Application

1) Introduction

- Nomenclature
- General Properties of Nuclei
- Chart of Nuclides
- Nuclear Processes, overview
- decay equations
- conservation laws
- Nuclear “Activity”

2) Mass and Energy

- Einstein’s cliché
- Q values
- Binding energy viz. Separation energy
- “Curve of the Binding Energy”
- Mass systematics (E-E, E-O, O-E, O-O)
- Isobaric masses (for beta decay)
- Mass model, Liquid Drop
- Mass surface

3) Nuclear Decay

- Decay Law
- Simplest form of kinetics
- Sequential Decay (three groups)
- Radioactive dating, Ages & Natural Activities

2nd Homework posted
& due on Monday

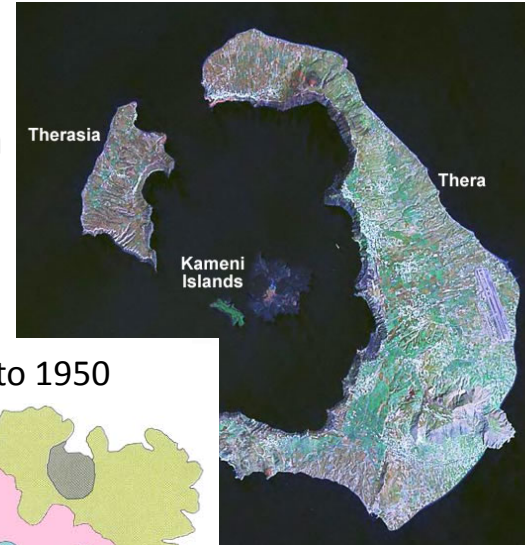


Santorini Explosion, but when?

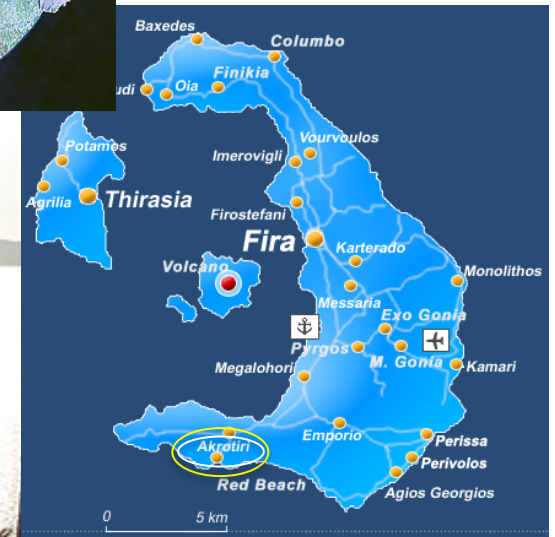
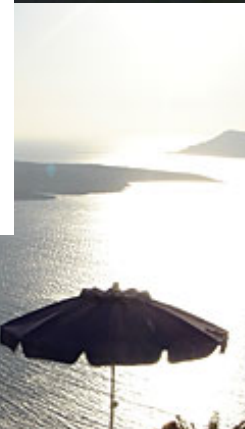
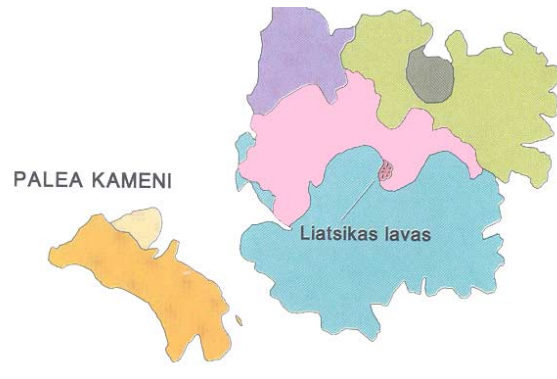
Date of the Explosion of volcano on Island of Santorini ?

Science 312 (28 April 2006) 548; doi:10.1126/science.1125087

The speculation is that the eruption of the volcano caused the destruction of the Minoan civilization on “nearby” island of Crete.



New lava from 50 AD to 1950

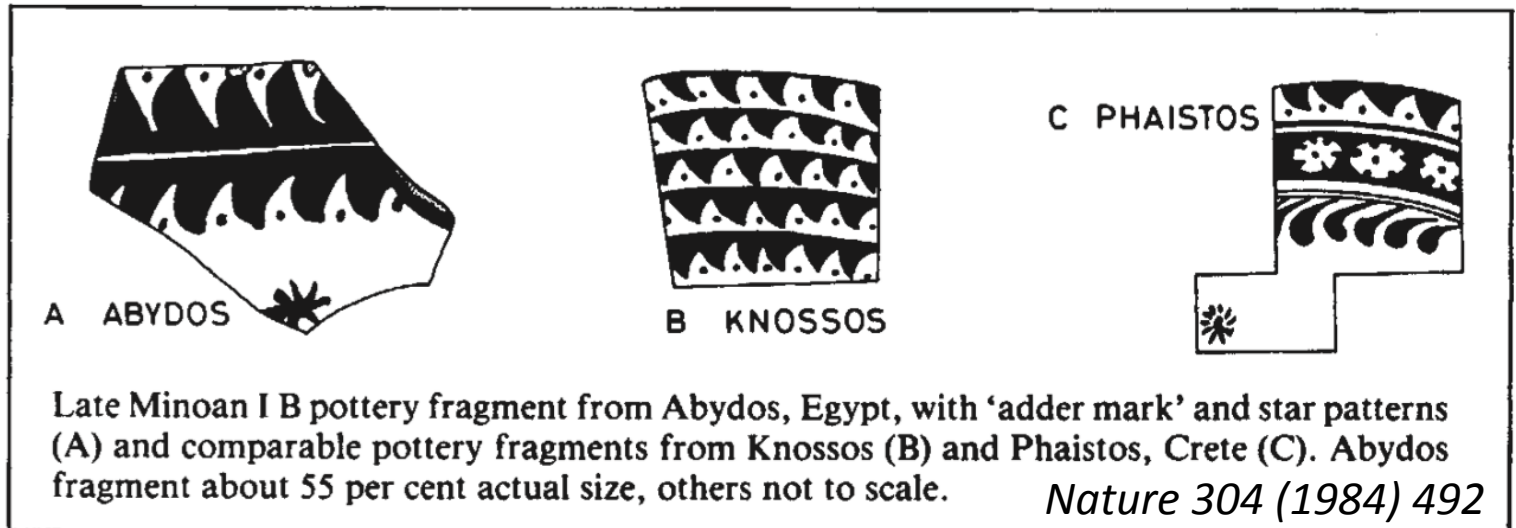


Santorini Explosion: Archeology

Suppositions: The excavations at Akrotiri have uncovered one of the most important prehistoric settlements of the Aegean. The first habitation at the site dates from the Late Neolithic times (at least the 4th millennium BC). During the Early Bronze Age (3rd millennium BC), a sizeable settlement was founded and in the Middle and early Late Bronze Age (ca. 20th-17th centuries BC) it was extended and gradually developed into one of the main urban centers and ports of the Aegean.

Facts: Evidence of habitation at Akrotiri first came to light in the second half of the 19th century. However, systematic excavations were begun much later, in 1967, by Professor Spyridon Marinatos. He decided to excavate at Akrotiri in the hope of verifying an old theory of his, published in the 1930's, that the eruption of the Thira volcano was responsible for the collapse of the Minoan civilization.

Example of Archeological argument: *Nature 304 (1984) 492*, by Peter Warren (Professor of Ancient History and Archeology, University of Bristol) He used an argument based on the pottery found in the excavation in comparison to examples of pottery from other known civilizations. "At present the balance of the archaeological evidence dates the ... no earlier than about 1500 BC. If the eruption is linked to the great Cretan destructions ... its archaeological date would be about 1450 BC ..."



Santorini Explosion, new ^{14}C sample



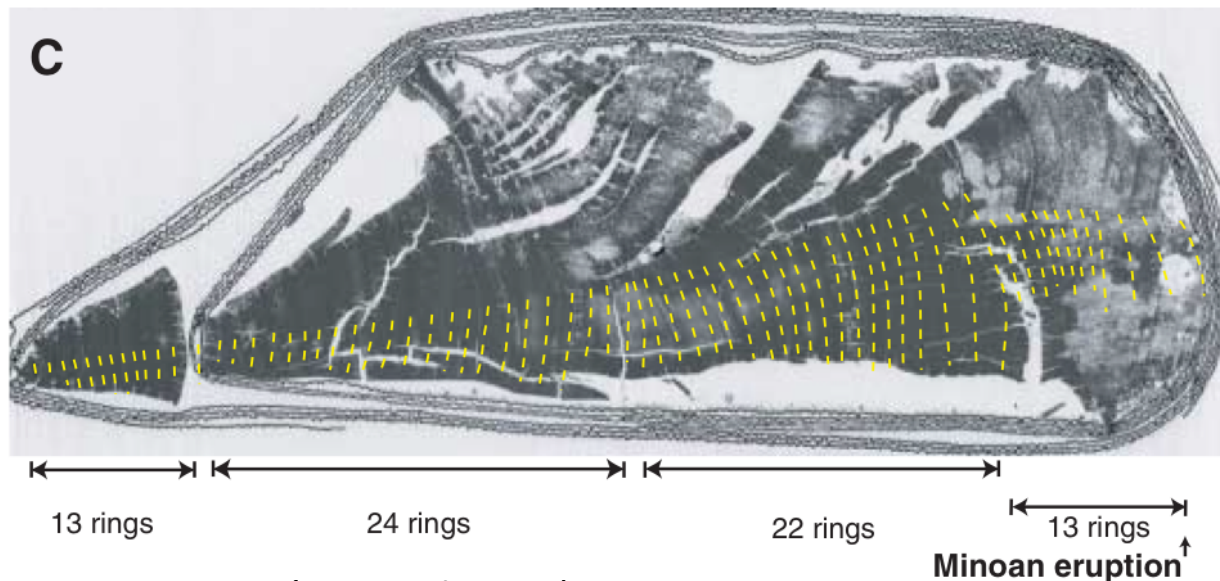
The remains of an olive tree were found buried below 60 m of ash from the eruption. (Red arrow in Fig. A)

The growth rings inside the branch indicated that it was alive for some time (>75 years).

The material was divided into four samples by ring number and the ^{14}C /total carbon was determined for each sample by AMS.

Approximate age: 3500 yr BP

Was AMS necessary?



Science 312 (28 April 2006) 548

^{14}C history, wiggle-matching?

The production of ^{14}C depends to some extent on particles in the solar wind, in general, the production of energy from the sun. This is not constant but it has been calibrated by measuring the ^{14}C in tree rings from a series of trees with known histories. The most recent overlapped histories and measurements is known as: *INTCAL04 TERRESTRIAL RADIOCARBON AGE CALIBRATION*, with a calibration curve that runs from 0 to 26,000 years B.P. !

The measured data was then matched to the wiggles in the curve in the region given by the ^{14}C /total-carbon ratio from AMS.

