

## The Evolution of the Youngest Toba Tuff: a crystal disequilibrium study

L. THOMAS, S. BLAKE, S. KELLEY AND D. MORGAN

Department of Earth Sciences, The Open University, Milton

Keynes, U.K. (L.E.Thomas@open.ac.uk)

Address as above (S.Blake@open.ac.uk)

Address as above (S.P.Kelley@open.ac.uk)

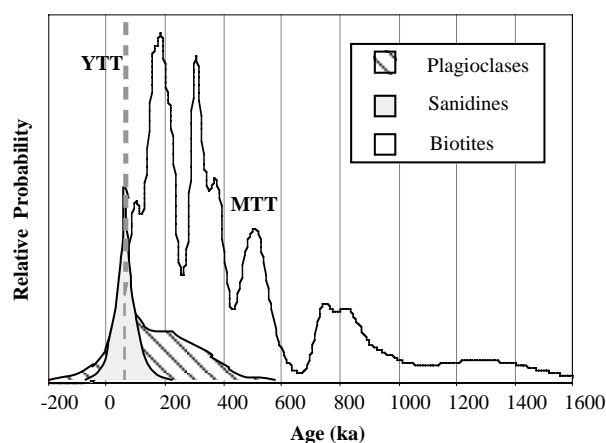
Address as above (D.J.Morgan@open.ac.uk)

The Youngest Toba Tuff (YTT) formed in Sumatra at 74 ka by the eruption of at least 2800 km<sup>3</sup> of dacite and rhyolite magmas. This paper identifies the pre-eruptive processes and time scales involved in the generation of these magmas. Our data suggest that the magma did not evolve continuously during the repose period after the previous major eruption (MTT – Middle Toba Tuff; 501 ka). Instead crystals formed at different rates and times.

The YTT pumices are compositionally and isotopically heterogeneous on intra-crystal to whole rock scales, testifying to an origin over time scales that were too short to homogenise compositional differences. <sup>87</sup>Sr/<sup>86</sup>Sr studies (both intra crystal and bulk analysis) show that the mineral phases are not in equilibrium with the glass of each other.

<sup>40</sup>Ar/<sup>39</sup>Ar in the YTT sanidines give the eruption age but biotites and plagioclases yield older ages (see figure 1).

**Figure 1 shows ages for biotites, sanidines & plagioclases from the YTT**



Models of trace element diffusion in plagioclase indicate that parts of the crystals experienced magmatic temperatures for 1000s of years and that a final stage of crystallisation took place within 10 years of eruption.

The data are best explained as remobilisation of a large igneous complex with a variety of ages in the crystal population.

### References

Chesner C.A. and Rose, W.I. *Bull. Volcanol* (1991) 53, 343-356

## Paleoceanographic proxies in Long Island Sound, CT, USA

E. THOMAS, F. LUGOLOBI, J.C. VAREKAMP

Department of Earth & Environmental Sciences, Wesleyan

University, Middletown, CT 06459-0139, USA

(ethomas@wesleyan.edu, flugolobi@wesleyan.edu,

jvarekamp@wesleyan.edu)

Western Long Island Sound (LIS) is an urban estuary heavily influenced by the close proximity of New York city. The estuary suffered seasonal hypoxia since the 1970s, and in 1999 lobsters (*Homarus americanus*) suffered >90% mortality. We used sediment cores representing the last several 100 years to reconstruct the temperature/salinity history of LIS, as well as its history of hypoxic episodes, and link these environmental factors to ecosystem changes as observed in benthic foraminifera.

Proxies for bottom water temperature and salinity are the oxygen isotopic composition ( $\delta^{18}\text{O}$ ) and the Mg/Ca and Sr/Ca ratios in the calcite tests of the benthic foraminifer *Elphidium excavatum*. The level of bottom water oxygenation is derived from the  $\delta^{13}\text{C}$  values in foraminiferal calcite, after a correction for paleosalinity. We collected isotope and element ratio data on living (Rose-Bengal stained) benthic foraminifera and water samples to determine the offsets in isotope composition between foraminiferal and 'equilibrium' calcite.

Oxygen isotope values of foraminiferal tests in LIS are influenced by the salinity, which is usually between 26 and 33 ‰. We used the  $\delta^{18}\text{O}$  values of river water and  $\delta^{13}\text{C}$  values of total dissolved inorganic carbon (both  $\sim -9.5$  ‰) to develop a mixing model of salinity,  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$ . We derive paleo-temperatures from the Mg/Ca and Sr/Ca data, and then derive the salinity from the  $\delta^{18}\text{O}$  values in the tests and the mixing model, after correction for 'vital effects'. From the calculated salinity we obtain the expected  $\delta^{13}\text{C}$  values, which we subtract from the observed values in carbonate. The difference (excess  $\delta^{13}\text{C}$ ) is a result of the oxidation of organic matter in the water column and at the sediment-water interface. We then recast the excess  $\delta^{13}\text{C}$  into paleo- $\text{O}_2$  concentration in the water from  $\text{O}_2$  solubility and salinity/temperature data.

Preliminary results show relatively stable temperature and salinity in the 17<sup>th</sup>-19<sup>th</sup> century, but strongly fluctuating values in the 20<sup>th</sup> century. Excess  $\delta^{13}\text{C}$  values increased in the mid 18<sup>th</sup> through 19<sup>th</sup> century, with strong variability in the 20<sup>th</sup> century. A west LIS core shows low salinity during three major wet periods (1950s, 1970s, 1990s) and a longer core shows the wet period around 1890 as a low salinity event. During these wet years, increased excess  $\delta^{13}\text{C}$  values indicate poorly ventilated bottom waters with substantial oxidation of organic matter, and probably strongly hypoxic conditions. Combination of element ratios and isotope data on foraminifera tests thus enables us to reconstruct a detailed, long-term record of environmental change in LIS.