Millennial scale variability records in the western Subtropical Atlantic Ocean

VAUTRAVERS M[1]., SHACKLETON N.J[1]. GRUETZNER, J[2].

1 Cambridge University, Department of Earth Science, Godwin Laboratory, New Museum Site, CB3 2SA Cambridge, UK (mv217@cus.cam.ac.uk) (njs5@cam.ac.uk)

2 Geosciences Department, Bremen University, P.O. Box 33 0440, 28334 Bremen, Germany (jgruetzn@allgeo.uni-bremen.de)

We present detailed results obtained from ODP Leg 172 Sites 1060 and 1056, from the Black Bahamas Outer Ridge (74ºW, 31ºN, 3500 and 76ºW, 32ºN 2200 meters water depth respectively) covering the last Glacial/ Interglacial cycle. These sites are at present under the influence of the Gulf Stream current and Deep Western Boundary Current (within the Lower NADW and Upper NADW respectively). These locations are therefore of key importance for understanding both meridional heat transfer and thermohaline circulation variability. The history of these processes is of particular interest in the context of millennial scale climatic variations. The high sedimentation rate (30 cm /kyr on average) at Site 1060 enables us to compare this new marine data set to the Greenland ice core in great detail over the interval covering the last glacial, when the amplitude of the millennial scale climatic variability was maximal.

To investigate the deep-water conditions we use benthic oxygen and carbon isotopes at the highest possible time resolution. To study the surface hydrological variability, comprehensive planktonic foraminifera fauna analysis has been carried out on both cores and is used to reconstruct the sea surface temperatures (SIMMAX). We have determined the lithic content of the sediment in the >90 µm faction size and analysed the planktonic stable isotopes when possible.

Our results for site 1060 show that as far south as 30ºN, subpolar planktonic foraminifera species (*N. pachyderma dextral)* can still trace the northern hemisphere cooling, that sea surface temperatures changes match the temperature fluctuations recorded in Greenland and that iceberg signals can be detected even during stadial periods. Located right on the path of the present Gulf Stream Current, Site 1056 shows both a different pattern of surface SST's and overall warmer values, reaching 28˚C in summer during the interstadial 8. This new record may indicate a more continuous activity of the warm surface current during Glacial times than previously thought. However cold events can still be recognised, mainly in the winter temperature and are attributed to the cold Heinrich events.

Constraining the timing of magmatic evolution in the Youngest Toba Tuff rhyolite through dating of zoning in allanite

JORGE A. VAZQUEZ AND MARY R. REID

Dept of Earth and Space Sciences, UCLA, Los Angeles, CA USA (jvazquez@ess.ucla.edu, reid@ess.ucla.edu)

Dating of zoned crystals serves as an absolute means of quantifying the rates and timing of chemical change in the magma reservoir as well as correlating zoning between crystals. We present the first quantification of the age-compositional relations recorded by the compositional zoning of phenocrysts. By keying *in situ* ion microprobe ages to the chemical variations in allanite, a Th and LREE-rich epidote mineral, we resolve the timescales of magmatic evolution associated with the compositionally diverse (69-75 wt.% SiO_2) rhyolite of the 75 ka Youngest Toba Tuff (YTT). From the magnitude of ^{238}U-^{230}Th disequilibrium, most YTT allanite are ≤150 ka with most rim ages identical to that of eruption. Allanites from a fine-grained crystal-mush inclusion yield a similar age distribution but are distinct in size and composition from allanite in their host, suggesting that allanites within the host pumice are not simply derived from disaggregation of inclusions. Moreover, core-to-rim age distributions in single crystals suggest that the allanites are the product of crystal growth and magmatic evolution over 10's of ky. Compositional zoning of the YTT allanites occurs on a scale of 10's of microns and is defined by changes in both major, minor, and trace elements, with gross core-to-rim trends of decreasing LREE, MgO, and La/Nd, and increasing MREE, MnO/MgO, and ThO_2. The trends can be simply ascribed to growth from a melt evolving via crystal-melt fractionation rather than being due to re-equilibration or kinetic effects associated with allanite growth. However, some grains display opposite zoning trends and/or contain resorbed and evolved cores. Furthermore, zoning ranges from monotonic to oscillatory with distinctive resorption surfaces, and compositions of allanites from the most- and least-evolved YTT pumices overlap, suggesting complex crystal and magma histories. When considered together, the coupled time-composition relations of the zoning between different allanites are sufficiently disparate so that no absolute correlation exists between composition and age. This in turn suggests that individual YTT allanites record complex growth/magmatic histories and/or have "seen" compositionally diverse melts that persisted for 10's of ky prior to eruption of this voluminous rhyolite. Evidently, reconstructions of magmatic evolution from correlations of compositional zones between associated allanites, and possibly other phases, should be approached with caution.