

High temporal resolution $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ heterogeneity in a *Porites lobata* coral skeleton

N. ALLISON¹, A.A. FINCH^{1*} AND EIMF²

¹Department of Earth Sciences, University of St. Andrews, Fife KY16 9AL, UK

(*correspondence: aaf1@st-and.ac.uk)

²NERC Ion Microprobe Facility, University of Edinburgh, Edinburgh EH9 3JW, UK

$\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ were determined at high spatial resolution (beam diameter $\sim 30\mu\text{m}$) by secondary ion mass spectrometry (SIMS) across ~ 1 year of a modern *Porites lobata* coral skeleton from Hawaii. All analyses were made on coral fasciculi (which make up the bulk of the skeleton) and not centres of calcification. Our data indicate that skeletal $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ are dominated by weekly-monthly oscillations (of $>2\text{‰}$ and $>5\text{‰}$ respectively) which far exceed the annual seasonal signal. These variations do not reflect seawater temperature or composition.

The dissolved inorganic carbon (DIC) pool available for calcification is derived from seawater or from molecular CO_2 , which can diffuse from the coral tissue into the calcification site. Variations in the $\delta^{18}\text{O}$ of the DIC pool may reflect the source of DIC (seawater or molecular CO_2), calcification site pH (affecting the proportions of DIC formed via hydration and hydroxylation of molecular CO_2 and the proportion of HCO_3^- derived from seawater DIC that is converted to CO_3^{2-}) and DIC residence time at the calcification site (influencing the extent to which oxygen isotopic equilibrium with the surrounding water is obtained). DIC pool $\delta^{13}\text{C}$ is also affected by DIC source and calcification site pH (affecting DIC speciation). However carbon isotopic equilibrium at the calcification site is reached in $<20\text{s}$, before any significant uncatalysed oxygen isotopic equilibration has occurred. The $\delta^{13}\text{C}$ of the molecular CO_2 component of the DIC pool is affected by the balance of photosynthesis and respiration and the amounts, types and $\delta^{13}\text{C}$ of material respired in the coral tissues.

We do not observe significant correlations between skeletal $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ in either the original or detrended datasets. Furthermore, neither $\delta^{18}\text{O}$ or $\delta^{13}\text{C}$ correlates with calcification site pH, estimated from previous SIMS measurements of skeletal $\delta^{11}\text{B}$. Our data suggest that the $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ composition of the DIC pool is affected by multiple independent influences at this time scale.

Highly depleted melt inclusions in olivine from Shatsky Rise

R. ALMEEV^{1*}, M. PORTNYAGIN², T. WENGORSCH¹, T. SANO³, J.H. NATLAND⁴ AND D. GARBE-SCHÖNBERG⁵

¹Institut of Mineralogy, Leibniz University of Hannover, Germany, (r.almeev@mineralogie.uni-hannover.de)

²IFM-GEOMAR, Kiel, Germany

³National Museum of Nature and Science, Tokyo, Japan

⁴Rosenstiel School of Marine and Atmospheric Science University of Miami, USA

⁵Institute of Earth Sciences, Kiel University, Germany

Shatsky Rise east of Japan is a unique oceanic plateau with characteristics of both “plume head” and non-plume origin [1-3] which was cored during IODP Expedition 324 in 2009. Igneous rocks sampled at four sites are variably altered pillows and massive lava flows of olivine phyric and plagioclase-clinopyroxene microphyric basalts. On-board geochemical data [4] show that the basalts are broadly MORB-like, similar to those from the Ontong Java Plateau (OJP) and likely originating from a slightly enriched MORB-like source.

We report here the first results of geochemical study of olivine-hosted melt inclusions from moderately altered olivine-phyric basalts cored at the Site U1349 (Ori massif, Sample 324U1349-12R4/37-39). Melt inclusions and olivines were analyzed for major elements by electron microprobe and for trace elements by LA-ICPMS. Olivine phenocrysts range in composition from Fo81 to Fo87 (NiO up to 0.4 wt%) and contain small glassy ($<20\mu\text{m}$ in size) and relatively large partly crystallized (30-60 μm) inclusions. Before analyses, partly crystallized inclusions were homogenized in internally heated pressure vessel at 200 MPa and 1210 °C and 1280 °C and subsequently quenched after 5 and 20 minutes, respectively. Melt inclusions obtained after both heating treatments and corrected for post-entrapment re-equilibration with host olivine have primitive, broadly MORB-like compositions and highly depleted trace element patterns compared to NMORB and the Kroenke-type basalts (OJP) with respect to Ba, Th, Nb, Ta, LREE, Sr, Zr and Hf (e.g., $\text{La}_N/\text{Yb}_N = 0.2-0.4$ in inclusions vs. ~ 0.7 in NMORB). The presence of highly depleted melts trapped in olivine suggests strong geochemical heterogeneity of the Shatsky Rise mantle sources ranged from less to significantly more depleted than average DMM.

[1] Duncan & Richards (1991) *Rev. Geophys* **29**, 31–50.

[2] Sager *et al.* (1999) *J. Geoph. Res.* **104** (B4), 7557–7576.

[3] Fougler (2007) *Spec. Pap. Geol. Soc. Am.*, **430**, 1-28.

[4] Sager *et al.* (2010) Proc. IODP, **324**: Tokyo.