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Quantitative 'deep-time' palaeoclimate reconstruction using large benthic foraminifera

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Despite some promising work demonstrating that the geochemistry of large benthic foraminifera (LBF) faithfully records their environment [e.g. 1], the full potential of these organisms for palaeoclimate reconstruction has not been realised. Planktic foraminifera are routinely used to assess the temperature and pH (amongst other parameters) of the past oceans but are short lived and currently offer only limited information regarding seasonal change. In contrast, LBF may live for several years, particularly the large and widespread Paleogene genera such as *Nummulites* [2]. These foraminifera therefore offer the potential for quantitative reconstruction of seasonal changes of ambient seawater temperature and chemistry.

In order to investigate the use of LBF for seasonal palaeoclimate and palaeoceanographic reconstruction we analysed both recent and Eocene *Operculina ammonoides* (from five different reefs in SE Asia and the Great Barrier Reef) as well as Eocene *Nummulites djokdjokartae* and *N. laevigatus* (from Java and England respectively). Our results are obtained using the LA-ICPMS system at RHUL featuring a two-volume LA cell characterised by uniform signal response and rapid washout [3], enabling intratest compositional variability to be assessed on a μm scale. Our results show that recent *O. ammonoides* modifies its calcite test chemistry according to its environment. Moreover, our data demonstrate that, as in planktic foraminifera, a systematic relationship exists between Mg/Ca and temperature thus enabling the use of LBF for palaeotemperature reconstructions. Because the Nummulitids have a similar peak abundance range to planktic species usually considered to be surface dwelling (20-40 m), results derived from LBF can be considered to be representative of sea surface temperatures. Because the relationship between seawater Mg/Ca and test Mg/Ca has also been calibrated for a Nummulitid (*Heterostegina depressa*) [4], our data can also be used to better constrain the Mg/Ca ratio of Eocene seawater. Knowledge of this variable is vital for accurate palaeoclimate reconstruction using the Mg/Ca temperature proxy.

In addition to Mg/Ca, we have also investigated the use of these organisms as recorders of other important palaeoenvironmental and ocean-chemistry archives. Preliminary data appear to suggest that the use of B/Ca as a pH proxy appears to be viable in the Nummulitids. Furthermore, it appears that inter-ocean differences in chemistry can be evaluated. Finally, the variability of certain trace element systems in LBF calcite can be related to salinity, potentially offering a new and quantitative palaeosalinity proxy.

[1] Wefer & Berger, 1980, Science, 209:803. [2] Purton & Brasier, 1999, Geology, 27(8): 711. [3] Müller *et al.*, 2009, JAAS, 24: 209. [4] Segev & Erez, 2006, Geochem. Geophys. Geosyst., 7(2).