

## Geochemistry of the Neoproterozoic Ikorongo Group of clastic sedimentary rocks, NE Tanzania: Implications for provenance, tectonic setting and upper crust composition

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Geochemical data are presented for the Neoproterozoic clastic sedimentary rocks from the Ikorongo Group in northern Tanzania in an attempt to constrain their provenance, tectonic setting and infer the composition of the Neoproterozoic exposed upper crust of the Tanzania craton. The Neoproterozoic Ikorongo Group is comprised of shales, siltstones and sandstones lying unconformably on the late Archaean Nyanzian Supergroup of the Tanzania Craton. The REE patterns of the Ikorongo mudrocks show fractionated REE patterns ((La/Yb)CN = 7.41-38.30), relatively flat HREE ((Gd/Yb)CN = 1.42-5.16) and negative Eu anomalies (Eu/Eu\* = 0.71 on average) which characteristics are similar to the average post-Archaean Australian Shale (PAAS). The La-Th-Sc systematic together with the PAAS-like REE patterns and trace element ratios of La/Sc (2.02-13.84), Co/Th (0.09-1.58), Cr/Th (1.39-18.24), and Th/Sc (1.39-18.24), indicate that the source area was dominated by a mixture of mafic and felsic rocks. The geochemical considerations and palaeocurrent studies suggest that the provenance of the Ikorongo group include high-Mg andesites, dacites, rhyolites and granitoids from the Neoarchaean Musoma-Mara greenstone belt of the Nyanzian Supergroup. Major and trace element tectonic setting discrimination diagrams suggest a continental setting for the Ikorongo Group.

The source area composition, which is taken to be representative of the Neoproterozoic upper crust of the Tanzania Craton, has a granodioritic composition with the following ratios of element pairs: K/U = 11311.3; K/Rb = 197.3; Zr/Nb = 10.9; Zr/Hf = 35.1; Nb/Th = 0.8; Nb/Ta = 9.8; Rb/Cs = 25.5; and Th/U = 6.3. Relative to other estimates, the upper crust is less evolved with elevated contents in TiO<sub>2</sub>, total Fe<sub>2</sub>O<sub>3</sub>, Sc, Cr, Co and Ni, and lower in CaO, Na<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>, Zr and Hf.

## *In situ* boron isotope analysis in foraminifera: Implications for palaeo-pH predictions

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The most significant consequences of the current increase in atmospheric CO<sub>2</sub> are future global warming and ocean acidification; oceanic pH is predicted to drop ~ 0.3 pH units over the next 250 years. To understand the link between ocean pH and ecosystem response an accurate determination of past pH is critical. Foraminiferal tests are a key component of marine carbonate and their boron isotope composition is a widely used proxy to reconstruct oceanic pH and hence past atmospheric CO<sub>2</sub> concentrations. To assess the robustness of the proxy and the precision of the pH and pCO<sub>2</sub> reconstructions we need to understand the factors that influence the incorporation of boron into foraminiferal calcite.

In this study we used *in-situ* and high-spatial resolution secondary ionization mass spectrometry (SIMS) to investigate the nature and extent of boron isotope variation within the tests of a number of planktonic foraminifera specimens from sediment traps and sea surface sediment samples (e.g. *G. sacculifer*, *G. ruber*, *G. truncatulinoides*, *G. tumida* and *G. menardii*). The sediment traps have a biweekly resolution and hence allow assessment of seasonal variability in boron isotopes. They cover bloom phases of this species, i.e. optimal environmental conditions, and also times when the species are rare and tiny, representing suboptimal environmental conditions. Furthermore, these traps were deployed for several years and hence allow assessment of inter-annual variability.

Distinct chamber and chamber-wall layer analyses within individual tests showed consistent average B-isotope values of *G. truncatulinoides* tests over a size range from 460 to 670 µm. In contrast, there was a significant change in the B-isotope ratio from chamber to chamber within a specimen with lower values in the last chambers of the specimen and higher values in the older part of the test. The highest B-isotope composition and concentration are found in the earlier chambers, whereas the gametogenetic crust has lower B-isotope values. The B-isotope changes within a specimen of *G. ruber* are in agreement with predicated values based on model calculations by Zeebe *et al* [2003]. Due to the spatial resolved analyses, it is possible to discriminate between the processes influencing the B-isotopic fractionation and to improve the palaeo-pH reconstruction.

### Reference

Zeebe R.E., Wolf-Gladrow D.A., Bijma J. and Hönisch, B. (2003). *Paleoceanography*, **18**(2).