Unravelling Plio-Pleistocene sea surface temperature signals: a multi-proxy latitudinal approach from the South China Sea

CHARLOTTE L. O'BRIEN[1]*, RICHARD D. PANCOST[1] AND GAVIN L. FOSTER[2]

[1]Organic Geochemistry Unit, School of Chemistry, University of Bristol, UK, c.l.obrien@bristol.ac.uk (* presenting author)

[2]School of Ocean and Earth Science, National Oceanography Centre, University of Southampton, UK

The tropical oceans are thought to have played a major role in the evolution of the Earth's climate since the Pliocene, such that accurately reconstructing tropical sea surface temperatures (SSTs) is an essential part of investigating how the global climate system has evolved over the past 5 Ma. Marine sediments from the tropical South China Sea (SCS) have yielded numerous paleotemperature records, however disagreement among different proxies and the potential causes of these differences may be hindering our understanding of the climate system. Using sediments from ODP Sites 1148 and 1143 located in the northern and southern SCS, respectively, we have applied three independent paleo-proxies to examine variations in SST for the past 5 Ma. Specifically, we have generated comparable SST records using the alkenone $U^{K'}_{37}$ index, TEX_{86} and Mg/Ca ratios in planktic foraminifer, *G. sacculifer.*

Our Pliocene TEX_{86}-derived temperatures for both sites indicate SSTs continuously higher than 27°C, exceeding modern mean annual SSTs. The southern SCS is generally warmer (28.0-32.5°C) than the northern SCS (27.0-31.0°C), with ODP Site 1143 displaying both greater variability (4.5°C) and a long-term decrease from 4 to 2 Ma. In contrast, the northern ODP Site 1148 exhibits lower variability (3.5°C) and no apparent trend such that the two records converge to similar values in the Pleistocene. Our Mg/Ca-SSTs show a similar trend to Mg/Ca SSTs at ODP Site 806 in the western equatorial Pacific [1], remaining generally stable (25.5-31.5°C) throughout the last 5 Ma with no indication of any global cooling. Alkenones are abundant in our samples. However, during the Pliocene, concentrations of tri-unsaturated alkenones are below detection limits indicating that SSTs in the SCS were above the limits of the $U^{K'}_{37}$ proxy (27.0-29.0°C) during this time.

The high $U^{K'}_{37}$ indices are consistent with the high SSTs in our TEX_{86} records, implying that SCS SSTs in the Pliocene and early Pleistocene exceeded modern mean annual SSTs. In contrast, our Mg/Ca SSTs (25.5-30.5°C) during this same period are offset from our TEX_{86}-SSTs (27.0-32.5°C) by, on average, >2°C at both SCS sites. Furthermore, our alkenone SSTs for ODP Site 1148 show that the northern SCS has cooled over the last 2 Ma, but this cooling is not seen in our Mg/Ca records. Higher TEX_{86}-derived temperatures may be in part due to TEX_{86}-SST estimates corresponding to warm season SSTs, as reported for a SCS core top sample [2], but it is unclear if such a bias can explain the high $U^{K'}_{37}$-derived SSTs. With these data we shall discuss reconstructing past tropical warmth and the application of various SST proxies in the Pliocene.

[1] Wara *et al.*, (2005) *Science* **309**, 758-761. [2] Shintani *et al.*, (2008) *J. Asian Earth Sci.* **40**, 1221-1229.

Trace element composition of gahnite in Broken Hill-type mineralization in and near the Broken Hill Pb-Zn-Ag deposit, Australia: implications for exploration

Joshua J. O'Brien[1*], Paul G. Spry[1], Graham S. Teale[2], Simon Jackson[3], and Dean Rogers[4]

[1] Iowa State University, Ames, Iowa, jjobrien@iastate.edu (* presenting author), pgspry@iastate.edu

[2] Teale and Associates, Adelaide, Australia, geologists@tealeassociates.com.au

[3]Geological Survey of Canada, Ottawa, Canada, Simon.Jackson@NRCan-RNCan.gc.ca

[4] Perilya Limited, Broken Hill, Australia, dean.rogers@perilya.com.au

Gahnite-bearing rocks ($ZnAl_2O_4$) are volumetrically abundant throughout the Proterozoic Broken Hill Domain, New South Wales, Australia, where they are associated with Broken Hill-type (BHT) Pb-Zn-Ag mineralization (including the supergiant, 200 Mt, Broken Hill deposit). Historically, the presence of gahnite has been utilized as an exploration guide for ores of this type, but has led to relatively limited sulfide discoveries. Major element chemistry has been used successfully to define a compositional range of gahnite associated with metamorphosed massive sulphides deposits, but it fails to distinguish sulfide-rich from sulfide-poor occurrences.

Major and trace element data from LA-ICP-MS and electron microprobe analyses provide valuable insight both into the origin of gahnite at Broken Hill, and its use as an exploration guide. Samples from 12 BHT deposits were analysed to determine whether or not prospective BHT deposits can be compositionally distinguished from non-prospective occurrences based on trace element content. Data were discriminated using a Principal Component Analysis to distinguish gahnite associated with the main ore lode from that associated with unmineralized lode pegmatites and sillimanite gneiss. Gahnite from the main ore bodies at Broken Hill have a relatively restricted compositional range that, based on a series of bivariate plot with density ellipses, overlap with the compositions of gahnite from several minor BHT occurrences. Based on contour maps of ore grade (wt. % Pb + Zn) associated with each gahnite locality, gahnite associated with the highest grades from the minor BHT deposits, have compositions that plot within the field for gahnite from the main ore bodies suggesting that trace element chemistry (e.g., Co: 60-80 ppm, and Cr+V+Mn+Ga: 1,100-2,200 ppm) may be used as an exploration guide for high-grade ore.