Centennial-scale sea surface temperature and salinity change in the Florida Straits during the early Holocene

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Previous studies showed that sea surface salinity (SSS) in the Florida Straits [1] as well as Florida Current transport [2] covaried with changes in North Atlantic climate over the past two millennia. However, little is known about earlier Holocene variability in the Florida Straits. Here, we combine Mg/Ca-paleothermometry and stable oxygen isotope measurements on the planktonic foraminifera *G. ruber* (white variety) from Florida Straits sediment core KNR166-2 JPC51 (24° 24.70′N, 83° 13.14′W, 198m deep) to reconstruct a high-resolution (~35 yr/sample) early to mid Holocene record of sea surface temperature and $\delta^{18}O_{SEAWATER}$ ($\delta^{18}O_{SW}$, a proxy for SSS) variability. In addition, we also measured Ba/Ca ratios in the same shell material as a proxy for riverine input into the Gulf of Mexico over the same time interval. After removing the influence of global $\delta^{18}O_{SW}$ change due to continental ice volume variability, our $\delta^{18}O_{SW}$ record suggests early Holocene surface salinity enrichments caused by increased evaporation/precipitation ratios in the Florida Straits associated with periods of reduced solar output [3], increased ice rafted debris in the North Atlantic [4] and the development of more permanent El Niño conditions in the eastern equatorial Pacific [5]. When considered with previous high-resolution reconstructions of early Holocene tropical atmospheric circulation changes, our results provide evidence that solar output variability over the Holocene can have a significant impact on the global tropical hydrologic cycle.

[1] Lund & Curry (2006) *Paleoceanography* **21**, PA2009. [2] Lund *et al*. (2006) *Nature* **444**, 601–604. [3] Reimer *et al*. (2004) *Radiocarbon* **46**, 1029. [4] Bond *et al*. (2001) *Science* **294**, 2130–2136. [5] Marchitto *et al*. (2010) *Science* **330**, 1378–1381.

Rare earth element variation in hydrothermal Fe-oxide Cu-Au systems

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Mineral deposits of Cu-sulphides and gold paragenetically associated with hematite and magnetite may also contain variable, in some cases economic levels of uranium and rare earth elements. The size of these deposits, e.g. Olympic Dam with an ore body in excess of 3x5x2km implies large, crustal scale fluid processes. Alteration of the host rock of these deposits is variable but distinct alteration mineral facies can be distinguished. The commonly identifed regional geochemical footprint of these REE anomalous deposits is a pronounced sodic alteration (albitisation) with accompanying formation of calc-silicate / magnetite / Fe-amphibole breccias and metasomatism. On the depositional side of the mineralising system we can distinguish two types of alteration asociated with Cu and Au mineralisation: i) a pyrite/magnetite dominated assemblage with pronounced potassic (biotite, K-spar) alteration and a predominance of chalcopyrite ± bornite, locally and variably overprinted by hematite + bornite + covellite + chalcocite. ii) a hematite dominated assemblage with bornite + covellite + chalcocite and much less chalcopyrite. Gold content appears related to sulphide abundance but Au rich zones with low sulphide grades are present. The different alteration/mineralisation zones have distinct REE patterns. The regional albitisation zone, which is seen as the source region of the metal components displays a path of initial depletion of LREE followed by an overall REE depletion as the involved rock is progressively converted to an albitite. Intermediate sections dominated by magnetite / biotite / K-spar alteration can have intense enrichment of REE including the formation of discrete RE minerals (allanite) but this appears to be most related to a late stage of the mineralising process. A pronounced enrichment of the REE occurs in the hematite / sericite dominated section, with REE rich barite and fluorite as well as RE minerals such as bastnaesite, florencite, monazite and xenotime. On the mineral grain scale enrichment of REE and U is pronounced in the hematite / sericite dominated part of the system.