A coupled biomarker-genetic approach to understanding the $U^{k'}_{37}$ SST proxy in estuaries

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Towards a mechanistic understanding of $U^{k'}_{37}$

The $U^{k'}_{37}$ SST proxy has been widely and successfully applied in the reconstruction of open ocean temperatures on centennial to orbital timescales and has proved an indispensable tool in our investigations of past climates. However, the utility of the $U^{k'}_{37}$ SST proxy is thought to break down in near shore settings experiencing more dynamic nutrient and salinity fluctuations. Given the importance of coastal systems, , knowledge of past local to regional SST variability is critical to habitat adaptation and restoration strategies. Furthermore, the rapid deposition of both marine and terrestrial organic and inorganic material in estuarine and coastal systems makes them valuable archives of high-resolution paleo-environmental information.

Here, we present the results of a 3-year-long monthly to sub-weekly resolved record of water column $U^{k'}_{37}$ and alkenone concentration (C_{37}total) and associated instrumental SST suggesting that while important and informative seasonal inconsistencies exist, especially during alkenone blooms, the integrated $U^{k'}_{37}$ signal preserved in Narragansett Bay sediments reflects mean annual instrumental SST. A subset of samples were analyzed for haptophyte-specific 18S ribosomal RNA (rRNA) to understand the composition of the alkenone-producing community during times of instrumental-$U^{k'}_{37}$ coherency and incoherency, alike. So far, the only alkenone-producing species detected in Narragansett Bay, *E.huxleyi* and *G.oceanica* - which dominate open-ocean production and form the foundation of the $U^{k'}_{37}$-SST calibration – were detected in the high salinity lower-Bay during the spring bloom of 2010. A second 'brackish' alkenone-producing population is suspected on the basis of high contributions of the $C_{37:4}$ alkenone in the low-salinity upper Bay.

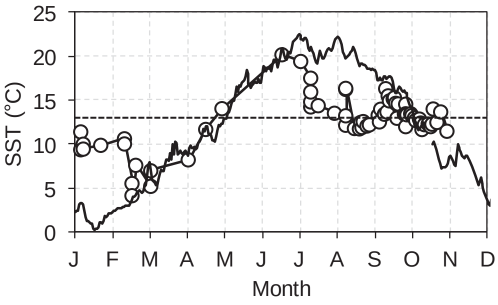

Figure 1. An example of the discrepancy between instrumental SST (solid line) and $U^{k'}_{37}$-inferred SST (open circles) from 2010. C_{37}total-inferred haptophyte blooms peaked in Feb and Aug during periods of maximum instrumental-$U^{k'}_{37}$ SST divergence. Black dashed line is the mean annual instrumental SST for Narragansett Bay for 2009-2011 (~13.4°C).

Fingerprinting uranium-bearing material: development and validation of methods

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The nuclear forensics project

Many parameters such as trace elemental impurity patterns [1], uranium or oxygen isotopic compositions [2, 3] and anionic impurities [4] are known to be tracers of geographical origin of uranium-bearing materials. These parameters can allow to go back to a part of the history (industrial treatment or origin) of a seized nuclear material when they are used individually (Figure 1).

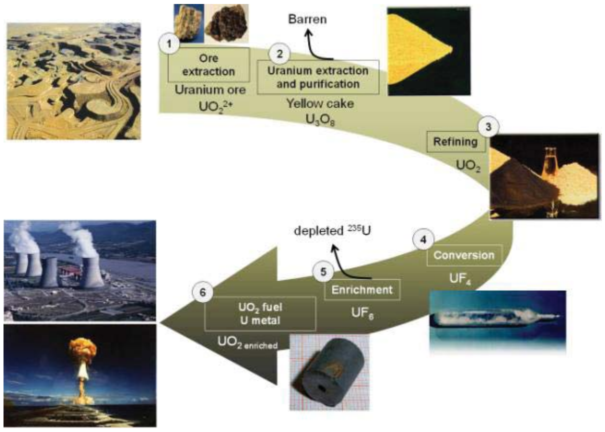

Figure 1: From ore to fuel: a variety of steps for uranium fingerprinting

But in some cases, they are not enough discriminating. We herein document a complete characterization of reference and unknown uranium ore concentrates for which REE, ($^{234}U/^{238}U$) and oxygen isotopic compositions were determined. This original approach which combined all three determinations covers a more global overview of such material.

Methods

A complete analytical procedure has been developed on a single sampling for trace-level determination of lanthanides and U isotopic composition in yellow cakes using ICP-MS, TIMS and PERALS (Photon Electron Rejecting Alpha Liquid Scintillation). The method was validated by the measurement of a reference material and will be applied for the analysis of unknown yellow cakes from various origins. Similarly, oxygen isotopic compositions of reference yellow cakes are currently under measurement by SIMS (Secondary Ion Mass Spectrometry) on particles and by fluorination on bulk samples.

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