Towards better Greenland source attribution for IRD via Pb-Pb in feldspar and Ar-Ar in amphibole

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A major uncertantity in future climate predictions involves changes in the mass and areal extent of the Greenland ice sheet (GrIS) and its variability in a warmer climate. Understanding the growth of the GrIS during Pliocene intensification of northern hemisphere glaciation may enable the critical evaluation of existing models and aid in future validation of these models. The provenance of Ice rafted debris (IRD) deposited in marine sediments has great potential to fingerprint regions of present and past iceberg calving in the coastal zones of continental margins. As such, this could potentially be a poweful technique when confining the extent of the GrIS during past climatic intervals. However, the IRD record is only as strong as the onshore land-based record of potential sources.

Two minerals common within IRD that have been used previously and that show great promise in this regard are feldspar and amphibole. Pb isotopes in feldspar record a diagnostic signature of the continental crust within distinct geologic terranes. In particular, Greenland is composed of a number of distinct terranes with proven distinct Pb isotope signatures. Ar-Ar dating of amphiboles records the thermal history of a terrain when it was metamorphosed above or cooled below c. 550ºC. Due to distinctive metamorphic histories within different terranes this signature is also potentially diagnostic of a particular source area. The two minerals together could be particularly powerful but only if the potential areas of calving are well-characterised.

Here we present data from fluvio-glacial sediments from sites around the margins of Greenland and discuss their diagnostic characteristics. We then compare these diagnostic geochemical signatures to some circum-Greenland core top IRD samples from numerous offshore sites, acting as a proof of concept. Finally, we present data sets from Mid Pliocene IRD from ODP Site 907, from numerous depths and time intervals, to further develop the proposed method and apply it to a key period in the development of northern hemisphere glaciation.

Indium's aqueous behavior in a stream influenced by acid mine drainage

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Indium is an increasingly important metal in semiconductors and electronics, and its use is growing rapidly as a semiconductive coating (in indium tin oxide) for LCD displays, flat panel displays, and photovoltaic cells. It also has uses in important energy technologies such as LEDs. Despite its rapid increase in use, very little is known about indium's environmental behavior, and concerns are emerging over its health impacts.

One significant flux of indium to the environment is from nonferrous mining and smelting. Mineral Creek is a headwater stream in southwestern Colorado that is severely affected by heavy metal contamination as a result of acid mine drainage. This includes indium concentrations that are 10,000 times those found in natural rivers. There have been a variety of remediation efforts in this watershed, including the installation of bulkheads to reduce water flow from mining tunnels, and removal of tailings piles. These remediation efforts appear to have reduced metal loadings in the system, though they remain above chronic aquatic standards. Indium, however, has not been previously measured, and no standards exist for indium in natural waters. In this work, a pH modification experiment was conducted in August 2005 to investigate the effects of an active remediation proposal to increase the pH of the creek. At the existing pH of ~3, indium concentrations are 6-29 μg/L (10,000x those found in natural rivers), and exist completely in the dissolved phase. Upon raising the pH of the system to > 8, all of the indium became associated with the suspended solid phase, primarily due to sorption to iron-oxides. This work informs how much indium may be mobilized from nonferrous mine wastes globally, and provides much-needed data about the aqueous behavior of indium.

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