Building Eoarchean crust: the arc tholeiite – TTG connection

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A pertinent issue in Archean research is the genetic relation between the TTG suite and the associated mafic supercrustals. Here we present a coherent model for the geodynamic evolution of the oldest (3.65 to 3.85 Ga) continental crust in southern West Greenland. Within the Isua Supracrustals, tholeiitic and boninite-like metabasalts dominate the sequence, both displaying trace element characteristics found in mafic rocks from the Isua region [1]. Boninite-like rocks in Isua are derived from ultradepleted sources with La/Yb, Gd/Yb, Zr/Nb in Isua tholeiites [1]. Boninite-like rocks in patterns consistent with a subduction-related origin. This is well metabasalts dominate the sequence, both displaying trace element within the Isua Supracrustals, tholeiitic and boninite-like present a coherent model for the geodynamic evolution of the oldest (3.65 to 3.85 Ga) continental crust in southern West Greenland. The cause for the decoupling of the Hf and Nd isotope systems is melting of arc tholeiites at 10-20% of partial melting. Petrological phase equilibria and trace element modeling suggest a close relationship between Isua arc tholeiites and the TTGs [3,4]. Notably, Hf-Nd isotope signatures between the two lithologies overlap in both showing the characteristic decoupling of initial Hf-Nd isotope compositions. Systematically elevated 142Nd anomalies of tholeiites and TTGs [5] are also in agreement with a related origin. The decoupled Hf-Nd signature is likely an inherited feature from melting of the tholeiites. This is also underlined by new Hf and O in zircon data from Eoarchean TTGs [6] that indicate melting of a mafic rock record for the preservation of depleted Hadean mantle domains.

Holocene intermediate water circulation at the Carolina Slope from sedimentary 231Pa/230-Th

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Meridional overturning circulation (MOC) may play a crucial role in global climate change both at Milankovitch and abrupt timescales, making it an important target for paleoceanographic study. Measured ratios of 231Pa/230-Th in sediment cores are sensitive to deep and intermediate water residence times, and may provide a dynamical tracer of past MOC strength in the waters overlying core sites. We will present a new 231Pa/230-Th record from core KN140-2-51GGC on the Carolina continental slope at 1790 m. This core has an expanded Holocene section [1], allowing for detailed examination of circulation during the 8.2 ka event, resumption of Labrador Sea Water Production, mid-Holocene climate optimum, and cooler late Holocene.

Previous records of Holocene 231Pa/230-Th at intermediate depths show no net 231Pa transport [2] (sedimentary ratios at the seawater production ratio of 0.093) or a transition from low ratios in the early Holocene to production-ratio levels in the mid-to-late Holocene [3]. Sedimentary ratios similar to the production ratio may suggest sluggish MOC in intermediate water in the eastern and central Atlantic. Our results indicate that sedimentary ratios at the Carolina slope remained below the 231Pa/230-Th production ratio in seawater throughout the Holocene. These ratios, falling between 0.08 and 0.07 in the earliest Holocene and between 0.07 and 0.06 through the remainder of the Holocene, indicate export of 231Pa, possibly through vigorous ventilation at intermediate depths. This discrepancy between our record and published sites may point to influence of Labrador Sea Water, or the influence of the deep western boundary current along the North American continental slope, at our site. Sediment composition analyses, particularly biogenic opal content, will allow for better constraints on the influence of particle type on 231Pa scavenging at this site. 231Pa/230-Th results will be compared to predictions from advection/scavenging models to assess the role of MOC vs. water column ingrowth/scavenging in determining sedimentary ratios. This new record will enable improved comparison between intermediate and deep sites, enhanced understanding of existing water mass boundary records through the addition of a dynamical tracer of ventilation strength, and cross-basinal comparison of ventilation at intermediate depths.