Evolution of the East Antarctic ice sheet across the mid-Miocene climate transition based on ice-rafted detritus provenance studies

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The Mid-Miocene Climate Transition (MMCT, ~14 Ma) is an interval of major climate reorganization, accompanied by significant decreases in global temperatures and sea-level. During this interval the East Antarctic Ice Sheet (EAIS) expanded to at least 85% of its present volume, and may have transitioned from a wet- to frozen-bed regime. The geology of East Antarctica exhibits a distinct variation from the Ross Sea to Prydz Bay that allows for the application of geochemical tracers to determine the provenance of ice rafted detritus (IRD) and identify EAIS sectors that supply IRD [1,2]. Prior work from ODP Site 1165 (Prydz Bay) indicates major ice-rafting events sourced from the Adélie and Wilkes margins from late Miocene through early Pliocene, but not during the early Miocene (19-14 Ma) [3], indicating a change in EAIS dynamics and IRD production from these margins through the MMCT.

IODP Site U1356A, located off the coast of Adélie Land, is well positioned to capture the signal of iceberg discharges from this sector. Six peaks in the number of clasts >2mm between ~14.1-13.2 Ma were identified from U1356A; samples were selected across each of these to represent peak, intermediate and low clast counts. Samples were sieved at 150μm, the weight% >150μm was determined, and every hornblende grain >150μm was dated by ^{40}Ar/^{39}Ar. ^{40}Ar/^{39}Ar hornblende ages from each sample show a dominant population of 1400-1600 Ma, consistent with the Mertz shear zone, but slightly younger than the coastal geology of Adélie Land (>1700 Ma), and indicating no significant sourcing of IRD from George V Land or the Ross Sea sector. Ongoing provenance work with 6 additional IRD peaks surrounding the original peaks is underway to further evaluate EAIS evolution over the MMCT.

[1] Roy et al., (2007) *Chemical Geology* **244**, 507-519
[2] Pierce et al., (2011) *Paleoceanography* **26** PA4217
[3] Williams (2010) *EPSL* **290**, 351-361.

Solid-Solution Interfacial Reactions: Effect of Solution Saturation State

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Solid-solution interfacial reactions—specifically silica-rich inorganic surface coatings—play a critical role in the evolution of natural and engineered systems and the transport of radionuclides in the environment. For example, Nugent et al.[1] has shown that development of silica-rich inorganic surface coatings form quickly on albite samples in the field and suggests the formation of these coatings are the reason for the discrepancy between laboratory and field measured weathering rates. Similar surface-layers have been observed in weathering studies conducted with mineral-based glasses, French and Roman glass samples, and surrogate nuclear waste glasses[2,3,4]. Knowledge gaps in the fundamental understanding of alteration layer formation impede the ability to link macroscopic reaction kinetics to nanometer scale interfacial processes that occur at the surface of mineral and glasses, especially under near-saturated conditions.

Therefore to address the scientific challenge of deciphering the complex reactions controlling the formation and evolution of silica-rich surface layers; a series of flow-through experiments were conducted as a function of $a[\mathrm{SiO_2(aq)}]$, from dilute to near-saturated conditions with respect SiO_2(am), at pH(23°C) = 9.0 and T = 90°C. Results illustrate that as the saturation state of the solution increases the dissolution rate decreases by approximately two to three orders of magnitude. Furthermore, analysis of reacted grains illustrate significant changes in the elemental composition and structure of the hydrated-surface.

In addition to the afore-mentioned experimental measurements, Monte Carlo simulations are being used to gain additional insight into the evolution of the elemental profiles. Recent advances to the code developed by Kerisit and Pierce [5] enable visualization of the history of the Si sites in a reacted glass sample to determine the origin of elements that comprise the hydrated-surface layer.

Although the data collected to-date provide key information on the processes occuring at the glass-water interface, additional experimentation and modeling will be required to develop a more robust understanding of these reactions.

[1] Nugent et al. (1998), *Nature*, **395**, 588-591.
[2] Hamilton et al. (2001), *GCA*, **65**, 3683-3702.
[3] Pierce et al. (2007), *Appl. Geo.*, **22**, 1841-1859.
[4] Verney-Carron et al. (2008), *GCA*, **72**, 5372-5385.
[5] Kerisit and Pierce (2011), *GCA*, **75**, 5296-5309.