An Ultra-High Resolution Sediment Record of Deglacial and Holocene Climate Change in East Antarctica: IODP Exp 318 Hole 1357 – The Adélie Basin

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We present the first ultrahigh resolution sedimentary section spanning the full Holocene from the East Antarctic Continental Margin. The section was collected via drilling from the 1000m deep Adélie Basin (66.5°S, 140.5°E) during IODP Expedition 318 in February, 2010. The site was triple-cored during to provide complete section recovery and abundant sample material. Sediments consist primarily of laminated diatomites with occasional diatomaceous muds. Terrigenous components increase in the lowermost 10 meters of the section. We recovered a 10-cm carbonate-cemented glacial diamict immediately underlying diatomaceous muds in Hole U1357A. Based on visual core description and physical properties analysis, Hole 1357B penetrated to within a meter or two of the diamict. Our chronostratigraphy is currently based on AMS radiocarbon dating: 34 dates from Hole 1357A, 101 dates from Hole 1357B, and 5 dates from Hole U1357C. Materials dated include macrofossils (clams and algae) as well as bulk decalcified organic matter and we experimented with both acid-base-acid (ABA) and acid-only (AO) pretreatments. Extending reservoir age corrections derived from a near-surface sediment comparison of ^{210}Pb and radiocarbon dates throughout the IODP cores we estimate the onset of marine sedimentation at the Adélie Basin as beginning at ~11,600 +/- 400 calibrated ^{14}C years B.P. Sedimentation rates range from 1.5 to 3.0 cm yr^{-1} in the uppermost 120 meters but drop to about 1 cm yr^{-1} in the sediments overlying the diamict. All paired AO versus ABA treated samples yield dates younger by 250 to 300 years for the acid-only treated samples. We interpret this as indicating that conventional ABA treatment removes more labile C in these sediment which contain abundant “fresh” organic phases – and we have therefore proceeded primarliy with AO sample pretreatment. Clam ages are generally younger than AO bulk decalcified ages by about 400 to 500 years, suggesting a relatively constant input of old refractory C through the Holocene, likely the result of shelf sediment resuspension and redeposition. These sediments are laminated throughout the entire section. We document several intervals wherein the numbers of laminae correspond to age differences determined by radiocarbon AMS dating. This suggests that many of the laminae are annual in nature. Yet we also document intervals where individual laminae cannot represent the rsults of annual sedimentation and we consider these sediments to be discontinuously varved.

Environmental datasets we present include laminae properties, organic geochemistry, diatom analyses, and stable isotope data, and xrf core scanner elemental composition. In general, following evidence for warmer conditions during the early Holocene, millennial variability appears attenuated during the mid and late Holocene, consistent with results from lower sedimentation rate Holocene cores collected over a broad portion of the East Antarctic Margin. These results contrast with evidence for significant millennial-scale mid-Holocene variability from sediment cores collected from both sides of the Antarctic Peninsula, consistent with modern observations of more rapid warming in West Antarctica associated with a postulated greater influence of oceanic heat transport via circumpolar flow. Surprisingly large higher frequency variability is evident at the Adelie Basin site, possibly related to variability in the Southern Annular Mode, drainage winds, and the polar easterlies.