Geophysical Research Abstracts
Vol. 18, EGU2016-16646, 2016
EGU General Assembly 2016
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Climate-Ocean-Ice sheet interactions across the Pliocene and Pleistocene: Preliminary Results from IODP 341 Exp (Gulf of Alaska).

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Since the Pliocene, global climate history is distinguished by the transition into a colder world, dominated by the onset and intensification of major Northern Hemisphere glaciations which have changed in their duration and intensity. It has been argued that cooling in the surface ocean has been driven by or been conducive to continental ice-sheet growth, or that progressive sub-glacial erosion and feedbacks might explain changing ice-sheet extent and dynamics independently of climate change and/or the potential regional climate impacts of tectonic uplift. At present, isolating climate as the driver of evolving continental ice volume since the Pliocene is hindered by the limited long term data sets which directly link climate changes to evidence for ice-sheet advance/retreat, erosion, and tectonic evolution over million year timescales.

IODP Expedition 341 (May-July 2013) drilled a cross-margin transect from ice-proximal sites on the continental shelf to distal sites in the deep Pacific. This study focuses on the two most distal sites (Site U1417, c. 4190 m water depth and Site U1418, c. 3667 m water depth) which extend from modern until the Miocene and Pleistocene, respectively. The sites contain a rich recorded history of climate change, glaciation and tectonics, to allow for a detailed understanding of the interaction between north-east Pacific paleoceanography and the history of the north-west Cordilleran ice sheet, neither of which are fully understood given limited data which pre-dates the Last Glacial Maximum. The focus of this research is to reconstruct sea surface temperatures (SSTs), ice rafted debris (IRD), and primary productivity inputs through the Pliocene and Pleistocene (since ca. 6 Ma).

We have reconstructed SSTs using the UK37' index, and compare to the relative abundance of C37:4 alkenone (for subpolar waters), C37 alkenone concentrations (for coccolithophore production), TAR index (to identify the terrestrial or marine source of the organic matter), bulk δ13C and δ15N analyses, IRD and diatom counts, and we compare our results with evidence for evolving ice-sheet history as determined through the shipboard-generated lithostratigraphy. Our SSTs during the Pliocene and Early Pleistocene are on average 2.5 and 3.5 C warmer than the modern, respectively, with the first IRD peak appearance at 2.8 Ma. The overall trend towards cooler SSTs and a larger Cordilleran ice-sheet is similar to other northern hemisphere ice-sheets, but we show that there may be important local control from north-east Pacific SSTs.