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The 4.2ka event, early Holocene, and possible late Pleistocene North Pacific climate recorded in the Mt. Hunter (Denali) ice cores

Content

In the North Pacific, large swings in climate, such as the so-called Little Ice Age, Medieval Climate Anomaly, and the 4.2 ka event, have all occurred during the Middle-Late Holocene, providing an opportunity to investigate the regional climate and environmental response to hemisphere-scale changes. Two surface-to-bedrock ice cores (210 meters) recovered from the Mt. Hunter plateau (Alaska) have been used to document late Holocene climate variability in the North Pacific, underpinned by an annual layer counted timescale that extends to ~800 AD (190 meters depth). Here we describe new data and approaches being used to investigate Holocene and late Pleistocene conditions on Mt. Hunter through analyses being performed in the bottom 20 meters of the cores. To establish a chronology in the lowest portion of the cores, we have completed 14C analyses on 16 samples using established (water insoluble organic carbon [WIOC]) and new (dissolved organic carbon [DOC]) techniques. Calibrated 14C ages from the two deepest samples indicate that basal ice on Mt. Hunter has an early Holocene (≥8 kyr) origin. Samples from depths of 199.8 to 205.6 meters have nearly uniform 14C ages (3,100 to 3,600 years cal BP), which may reflect a significant increase in snow accumulation at Mt. Hunter in the mid-Holocene coeval with regional Neoglaciation. To further investigate this interval and chronology, we are using laser-ablation ICP-MS to identify potential volcanic signals, and following up with tephra analysis to fingerprint the Lena, White River, and Aniakchak eruptions. Fieldwork in summer 2022 will use a variety of geophysical approaches (ice-penetrating and phase sensitive radar) as input to a full-Stokes 3D ice flow model under development, which will provide additional depth-age constraints. Finally, we have completed a full d18O-H2O isotope profile for the cores, showing relatively uniform values through the core section thought to contain the 4.2ka event. In contrast, a pronounced but continuous 5‰ increase in d18O-H2O occurs approximately 2 meters above the bed, coincident with a 40-fold reduction in sodium, calcium and magnesium measured by laser-ablation ICP-MS over the same interval. Based on the location and structure of these changes, we tentatively infer that the isotope and chemistry excursions near the bed represent the late Pleistocene-Holocene transition, and the isotope profile in that area possibly shows evidence of a climate reversal akin to the Younger Dryas. Based on the combination of all of these results, we will consider and discuss the stratigraphic continuity of the ice column base, and compare data to other regional ice core and paleoclimate records to provide context for our results.

Primary authors: WINSKI, Dominic; BROOKS, Hanna (University of Maine); KREUTZ, Karl (University of Maine); OSTERBERG, Erich (Dartmouth College); WAKE, Cameron (University of New Hampshire); SCHWIKOWSKI-GIGAR, Margit (PSI - Paul Scherrer Institut); JENK, Theo Manuel (PSI - Paul Scherrer Institut); FANG, Ling (Paul Scherrer Institute); KURBATOV, Andrei (University of Maine); CAMPBELL, Seth (University of Maine); ER-WIN, Emma; KINDSTEDT, Ingalise; BRADDOCK, Scott (University of Maine); MAURER, Jonathan (University of Maine); INTRONE, Douglas (University of Maine); HANDLEY, Michael (University of Maine); KOROTKIKH, Elena (University of Maine)

Presenter: WINSKI, Dominic

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