Geophysical Research Abstracts
Vol. 12, EGU2010-9671-1, 2010
EGU General Assembly 2010

Reconstruction of paleoenvironmental changes from Pingualuit Crater Lake sediments during glacial-interglacial cycles MIS 1 to MIS 8: a long-term terrestrial record from the Canadian Arctic

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The sediments of the 1.4 Ma old Pingualuit Crater Lake offer the rare opportunity to study terrestrial climate dynamics in the Canadian Arctic not only during the postglacial period, but over several hundreds of thousands of years as its deep sediment infill yields an uninterrupted arctic paleoclimate record covering several interglacial-glacial cycles corresponding to Marine Isotope Stage (MIS) 8, 7, 6, 5e, 5d-2, and 1. The Pingualuit meteoritic crater (Nunavik, Canada; 61 17' N, 73 41' W) is located in the northernmost part of the Ungava Peninsula in northern Quebec - close to the area where the Laurentide Ice Sheet reached maximum thickness during the last (Wisconsinan) glaciation. The crater is a circular depression approximately 400 m deep and 3.4 km in diameter. The closed-basin, cold-monomictic lake is presently 267 meters deep and ice-free for only approximately one month a year. The location and depth of the lake protected the sediments from scour during glacial cycles.

There are three diatom and pollen-rich intervals in the 8.5 m core recovered from Pingualuit Crater Lake during the 2007 field season that indicate ice-free, warm conditions; the Holocene and two previous interglacials. IRSL age estimates place the first interglacial during MIS 5e and the second interglacial during MIS 7. Sampling resolution is approximated between 200-500 years during the interglacial periods. Analysis of the diatom assemblages of the three warm periods indicates the lake experienced significantly different environmental conditions during each of the three interglacials. The paleoenvironmental changes recorded by the diatoms are also reflected in the pollen and sediment record (MS, wet density, grain size, ICP-MS trace metal geochemistry). The diatom succession indicates there were significant changes in the length of ice cover and/or lake levels and nutrient availability during each interglacial, affecting the primary productivity of the lake. Of particular note, the oldest interglacial MIS 7 has the lowest productivity and is dominated by a previously undiscovered species of centric, planktonic diatom (tentatively named Cyclotella pingualuitii) that went extinct prior to the MIS 5 interglacial. Changes in seasonality and aeolian activity are likely strong influences on the paleonvironmental record from Pingualuit Crater Lake.