Dissertations

Compound-Specific Hydrogen Isotopes of Lipid Biomarkers in Lake El’gygytgyn, Ne Russia

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Date of Award
5-2012

Document Type
Open Access Dissertation

Degree Name
Doctor of Philosophy (PhD)

Degree Program
Geosciences

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Keywords
Arctic, Deuterium, Organic Geochemistry, Paleoclimate, Stable Isotopes

Subject Categories
Earth Sciences

Abstract
Recent successful drilling operations at Lake El'gygytgyn, NE Russia have recovered sediment cores back to 3.6Ma, representing the longest time-continuous sediment record of past climate change in the terrestrial Arctic. Analysis of the hydrogen isotopic ratio (δD) of specific organic biomarkers allows reconstruction of past hydrological conditions, thereby providing a powerful tool for reconstructing past Arctic climate changes. Compound specific isotopic analysis of sedimentary lipids from this remote basin provides new insights into the climate evolution of the Arctic, capturing the mechanisms and dynamics of the last two glacial-interglacial transitions, potentially enhancing the accuracy of modeled future climate change projections and presenting an opportunity to estimate past polar amplification of climate change. The results of this research document the first continuous, high fidelity continental record of reconstructed δD in precipitation from terrestrial plant leaf waxes in the High Arctic spanning the last 120 ka. The hydrogen isotopic composition of lipid biomarkers

were determined from previously obtained Lake El'gygytgyn sediment cores and compared with other multi-proxy evidence of past climate change within the lake basin. The modern isotope hydrology and controls on the δD lipid signal were first established within the El'gygytgyn Basin from modern precipitation, stream and lake waters, ice cover as well as modern vegetation, water column and lake bottom surface sediments in order to provide a modern context to properly constrain and interpret paleoclimatic proxy data. Reconstructed δD records of paleoprecipitation and temperature at Lake El'gygytgyn lead other northern hemisphere climate records (e.g. North Greenland Ice Core Project, NGRIP δ18O records) and are in phase with other continental and Antarctic climate records, suggesting early high northern latitude continental warming prior to established glacial-interglacial transitions. The data set generated here leads to multiple avenues of future work and provides critical insights into Arctic paleoclimate and paleohydrology, contributing to our understanding of high latitude environmental change over geological timescales. Collectively, the results of this dissertation research will provide a context for paleoclimate reconstructions and future organic geochemical and stable isotope analysis. Future application of compound-specific H isotope analyses to long drill cores (recovered in 2009; ~315m of sediment) will potentially provide a quantitative high-resolution record of paleoclimatic and paleoenvironmental changes spanning the last 3.6 Ma.