

## **Plio-Pleistocene Interglacial Teleconnections between the Two Poles: Emerging Questions to address Earth's future**

Julie Brigham-Grette<sup>1</sup>, Raj Roychowdhury<sup>1</sup>, Rob DeConto<sup>1</sup>, Isla Castaneda<sup>1</sup>, Molly Patterson<sup>2</sup>, Greg DeWet<sup>1</sup>, Helen Habicht<sup>1</sup>, Martin Melles<sup>3</sup>, Pavel Minuk<sup>4</sup>, Anatoly Lozhkin<sup>4</sup>, Pat Anderson<sup>5</sup>, Andrej Andreev<sup>3</sup>, Pavel Tarasov<sup>6</sup>, Volker Wennich<sup>3</sup>.

<sup>1</sup>Dept of Geosciences, UMass-Amherst, juliebg@geo.umass.edu;

<sup>2</sup>Dept of Geology, SUNY-Binghamton;

<sup>3</sup>Inst. for Geology and Mineralogy, University of Cologne;

<sup>4</sup>North-Eastern Interdisciplinary Scientific Research Institute, Magadan;

<sup>5</sup>Quaternary Research Center, University of Washington;

<sup>6</sup>Dept of Earth Sciences, Free University of Berlin.

### **Abstract**

Paleoclimate records documenting widespread climate change from northeast Arctic Russia (Lake El'gygytgyn) and Antarctica over the past 3-4 Million years provide a new opportunity for understanding the sensitivity of the polar regions to forcings involving natural green house gas variability, changing orbital configurations and associated feedbacks. While geography and transient atmospheric CO<sub>2</sub> in excess of preindustrial levels can explain most of the bi polar Pliocene warming, the occurrence of Arctic super interglacials without clear pacing documented over the past 2.78 Myrs require additional explanation. We hypothesize that super interglacials in the Arctic correspond with extremes in insolation leading to the demise of the WAIS. During MIS 11c, 31, 49, 55, 77, 87, 91, and 93 Milankovitch forcing coinciding with extreme lows in eccentricity and high obliquity likely preconditioned the Earth system to synchronize summer melt intensity and duration to produce bipolar warming (Roychowdhury, et al. in prep). This warming likely led to the demise of the WAIS in the Southern Hemisphere and super interglacials in the Arctic Northern Hemisphere. Diatomite layers in the ANDRILL AND-1B record coincide reasonably well with many of the super interglacials (Melles et al, 2012) but unconformities in the AND-1B cores prevent direct correlation. Stage 31-33 (containing the Jaramillo paleomagnetic reversal) with some of the lowest  $\delta^{18}\text{O}$  values in the LR stack appears to have been a protracted interval of synchronous warming in both hemispheres (de Wet et al., 2016) with a return to mid Pliocene conditions in the western Arctic and little ice rafted debris around Antarctica (Teitler et al. 2015). The challenge has been to understand how these high latitude sites are linked with changes in ocean circulation and heat transport.

Why does this matter? The recognition that our bipolar cryosphere is extremely sensitive to small forcings confirms that future sea level rise is not reversible. This fact should shape coastal management policies as we educate the public and local/state/ and federal governments. It should be in our economic interests (country by country) to plan now for managed community relocations rather than continuing to protect infrastructures in place.

**Keywords:** interglacials, Pliocene, Pleistocene, paleoclimate

### **References**

Brigham-Grette, J., Melles M., Minyuk, P., Andreev, A., Tarasov, P., DeConto, R., Koenig, S., Nowaczyk, N., Wennrich, V., Rosén P., Haltia-Hovi, E., Cook, T., Gebhardt, T., Meyer-Jacob, C., Snyder, J., Herzschuh, U. 2013. Pliocene Warmth, Polar Amplification, and Stepped Pleistocene Cooling recorded in NE Arctic Russia. *Science* 340, 1421; plus supplemental.

- de Wet, G., Castañeda, I. S., DeConto, R.M. Brigham-Grette, J., 2016. A high-resolution mid-Pleistocene temperature record from Arctic Lake El'gygytgyn: a 50,000-year super interglacial from MIS 33 to MIS 31, *Earth and Planetary Science Letters* 436, 56-63.
- Melles, M., Brigham-Grette, J., Minyuk, P., and others. 2012. 2.8 Million Years of Arctic Climate Change from Lake El'gygytgyn, NE Russia. *Science* 337, 315-320; plus supplement.
- Roychowdhury, R. DeConto, R., Brigham-Grette, J. Eccentricity forcing and preconditioning of "Super-Interglacials". In prep.
- Teitler, L., Florindo, F., Warnke, D.A., Filippelli, G.M., Kupp, G., Taylor, B., 2015. Antarctic Ice Sheet response to a long warm interval across Marine Isotope Stage 31: A cross-latitudinal study of iceberg-rafted debris. *Earth Planet. Sci. Lett.* 409, 109–119.