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Deep drilling in Lake El´gygytgyn, NE Russia: coring perspectives for the first continuous 3.6 Mio year paleoclimate record in the terrestrial Arctic

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Lake El´gygytgyn is a 3.6 million year old impact crater lake with a diameter of 12 km and a water depth of 170 m, located in central Chukotka, NE Siberia. During the last 10 years the sedimentary record of the lake has become a major focus of multi-disciplinary multi-national paleoclimatic research. Futhermore, the meteorite impact event shall be reconstructed from the breccia and brecciated volcanic bedrock expected to occur beneath the lake sediments. To address these objectives, the International Continental Scientific Drilling Program (ICDP) and national funding agencies have provided funding for deep drilling operations on the lake and in its permafrost catchment in autumn 2008 and spring 2009.

A pre-site survey conducted at Lake El´gygytgyn has evidenced that a full-length sediment core would yield a complete record of Arctic climate evolution, back one million years prior to the first major glaciation of the Northern Hemisphere. This makes Lake El´gygytgyn unique in the terrestrial Arctic, especially since geomorphological evidence from the catchment suggests that the crater was never glaciated during the entire Late Cenozoic. Two sediment cores retrieved from the deepest part of the lake in 1998 and 2003 revealed basal ages of approx. 250 ka and 340 ka respectively, and thus, represent the longest continuous climate records as yet available from the Arctic

continent. Their continuous sedimentation confirmed the lack of glacial erosion, and the sediment composition underlined the sensitivity of this lacustrine environment to reflect high-resolution climatic change on Milankovitch and sub-Milankovitch time scales. Four sediment units were distinguished, reflecting relatively warm, peak warm, cold and dry, and cold but more moist climates. Additional cores from the western lake have shown that the formation of debris flows is associated with partial erosion of the underlying sediments at the slope, but also with the deposition of ´pelagic rain´ in the central part of the lake without erosion.

Seismic investigation carried out during expeditions in 2000 and 2003 revealed a depth-velocity model of brecciated bedrock overlain by a suevite layer, in turn overlain by two lacustrine sedimentary units up to 350 m in thickness. The upper well-stratified sediment unit appears undisturbed apart from intercalation with the debris flows near the slopes. Based on extrapolation of sedimentation rates the entire Quaternary and possibly parts of the late Tertiary record are reflected by the 170 m thick upper unit, whilst the earliest history of the lake is presumably represented with a higher sedimentation rate by the lower unit. There is no evidence for glacial erosion or complete lake drying in the entire sedimentary record.

Coring objectives include replicate cores of 630 m length to retrieve a continuous paleoclimate record from the deepest part of the lake and into the underlying impact breccias and bedrock. Studies of the impact rocks offers the planetary community with the opportunity to study a well preserved crater uniquely found in igneous rocks like those on Mars. One additional core to ca. 200 m into permafrost from the adjacent catchment will allow us to test ideas about arctic permafrost history and sediment supply to the lake since the time of impact.