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Timing and Significance of Mass Movement Events for the 3.6 Ma Sediment Record of Lake El'gygytgyn, Far East Russian Arctic

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The investigation of the 3.6 Ma old sediment core recovered from Lake El'gygytgyn, NE Russia (67° 30‘ N, 172° 5‘ E; 492 m asl; diameter 12 km; water depth 175 m) reveals that mass movement deposits (MMDs) have frequently reached the coring site during the lake's history (Sauerbrey et al., subm.). At least during the Quaternary, these short-lived events have not disturbed the pelagic lake sediment record, thus allowing for detailed paleoenvironmental and palaeoclimatic reconstructions (Melles et al. 2012). However, analysis of the MMDs provides new insights into the sedimentation processes in the lake basin and reveals differences between Quaternary and Pliocene environments.

In total, more than 420 mass movement events have reached the center of Lake El′gygytgyn since its formation 3.6 Ma ago. 91 % of these events are single turbidites, the rest is divided into debrites, slumps and slides which can be overlain by co-generic turbidites, as well as densites. The MMDs contribute significantly to the sediment infill at Lake El'gygytgyn comprising 35 % of the recovered sediment record. The influence of mass movement events on lake sedimentation has, however, decreased in the course of the lake's history. Although turbidites are found throughout the record and their portion of the total MMD amount remains constant, their portion of the sediment thickness has decreased from 18 % in the Pliocene to 11 % in the Quaternary. Similarly, the mean rate of MMD recurrence has been higher in Pliocene, 5 ka, compared to the Quaternary, 11 ka. However, the poorer recovery of Pliocene sediments might have led to an underestimation of Pliocene MMDs, as some core gaps coincide with coarser grained debrites. The higher portion of MMDs in the Pliocene can be explained by the higher erosion and deposition rates in the young, steep crater lake as well as by the generally warmer Pliocene climate.

Other mass movement events, especially debrites and slumps, are significantly thicker than single turbidites and contribute 20 % to the sediment thickness. They comprise a total of 39 events and have reached the lake center exclusively during warm climate conditions. We assume that the formation of debrites and slumps is associated with initial slope failure that has led to a debris flow and partial disintegration of the sediment. Underlying pelagic sediments are deformed during the debris flow's advance towards the lake center. A mass-flow generated turbidite is deposited in the deep basin. Possible triggering mechanisms for these MMDs may be sediment overloading, lake level changes as well as delta collapses.

References:
Melles, M. et al. (2012): 2.8 Million Years of Arctic Climate Change from Lake El'gygytgyn, NE Russia, Science, 337, 315-320.
Sauerbrey, M.A. et al. (subm.): Mass movement deposits in the 3.6 Ma sediment record of Lake El'gygytgyn, Far East Russian Arctic: classification, distribution and preliminary interpretation, Climate of the Past, 2013.