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Distribution and frequency of mass transport deposits in Lake El'gygytgyn, Chukotka, NE Siberia, and their inferred triggering mechanisms

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Lake El'gygytgyn is an impact crater that formed 3.6 million years ago in Chukotka, northeastern Siberia. The lake is bowl-shaped with a mean diameter of 12 km and a maximum water depth of approximately 170 m. At present, the lake is ice-free only during the short summer period of approximately 3 months. Pilot cores retrieved in 1998 and 2003 showed that the lake sediments reflect climate change in great detail. A seismic pre-site survey revealed approximately 330 m of lacustrine sediments on top of the suevite that was initially formed by the meteorite impact 3.6 million years ago. Seismic profiles revealed an upper sediment package of approximately 150 m thickness with well-layered sediments. These are intercalated with mass transport deposits mainly in the more proximal parts. Below 150 m blf, the sediment characteristics are acoustically more massive with slightly higher sonic velocities (1650 m/s vs. 1550 m/s). The sediment succession at the lake center is mostly undisturbed by mass transport deposits at least for the upper 150 m and thus formed an ideal spot for deep drilling.

The lake was drilled down into the impact bedrock in winter/spring 2009 within the framework of the ICDP. Three holes were drilled at a site in the lake center, reaching as far down as 517.3 m below lake floor with a total recovery of 75%. The cores penetrated 315 m of lacustrine sediments before they hit the suevite bedrock.

This study focuses on the uppermost approximately 50 to 60 m that were imaged by a 3.5 kHz echosounder survey in 2000 and 2003. All profiles nicely display the mass transport deposits that intercalate the well-layered pelagic sediments. The mass transport deposits could be classified by their morphology and internal acoustic structures as (i) slumps or (ii) debris flows, the latter associated with (iii) overlying small turbidites. Lithological descriptions and chronology from the drill cores were projected into the echosounder data and used to trace the mass transport deposits along all profiles. Some of the mass transport deposits cover large areas of the lake and form several distinct lobes. At certain depth intervals, different mass transport deposits could be detected at different places in the lake. This points at synchronous triggering events such as paleo-earthquakes or changes in lake level leading to slope instabilities.