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Catastrophic events in the Quaternary outflow history of Lake Baikal

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Abstract

Lake Baikal is Earth's deepest lake and an iconic site of scientific study. This vast basin holds sedimentary archives of environmental change dating back to the Miocene and its array of palaeoshorelines and surrounding relief record the past ~ 1-3 Ma of lake-levels and outflows. Here we present an extensive review of previous work alongside a new set of observations concerning the Quaternary development of Lake Baikal, with special focus on lake-level fluctuations and the formation and evolution of the lake's three known outlets. The sequence of shoreline terraces indicates that lake-levels were both higher and lower in the past. Lake Baikal stood ~ 200 m higher during the Last Interglacial, i.e. Marine Isotope Stage (MIS) 5e and dropped to 40 m below (present-day) during the Last Glacial Maximum (MIS 2). The relative lake-level variations reflect climate factors and gradual or sudden (coseismic) tectonic impacts on the elevation of the lake's outlet thresholds. Three successive outlets are known: i) the palaeo-Goloustnaya-Manzurka, associated with the Manzurka Alluvium; ii) the palaeo-Irkut, and iii) the currently-active Angara River outlet. We propose that the Manzurka Alluvium is the product of catastrophic events in Lake Baikal. The sudden (possibly coseismic) collapse of the ~ 15 x 3 km Goloustnaya fault-block into Lake Baikal triggered a mega-tsunami that thrust overwash deposits across neighbouring drainage divides above Lake Baikal and the valleys of the Goloustnaya-Manzurka River system. The age of the Manzurka Alluvium remains poorly constrained, but the mega-tsunami is potentially traceable to an unconformity in drill-core sediments at ~ 0.8-1.0 Ma, although older (late Pliocene) and younger (~125 ka) ages have also been proposed. The Irkut outlet existed between MIS 6 and MIS 5 when lake-level was ~ 200 m higher than present (~ 640-650 masl) and a large bay