

Twenty-two outsize tsunami deposits at Lake Harutori-ko along the southern Kuril Trench in the past 9500 years

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Along the southern Kuril Trench, which faces the Japanese island of Hokkaido, this fast subduction generated recurrent earthquakes up to magnitude 8 in two centuries of written history. Eastern Hokkaido's largest well-documented interplate earthquake, the Tokachi-oki earthquake of moment magnitude (M_w) 8.1 in 1952, shook much of northeast Japan and generated tsunami waves 1-4 m high along the Hokkaido coast. Here we use deposits of prehistoric tsunamis in the lake bottom to infer the infrequent occurrence of larger earthquakes.

The long stratigraphic record of lacustrine cores at Harutori-ko provides evidence for unusually large tsunamis in the past 9500 years. This lake or lagoon, which contains anoxic bottom water, is separated from the sea by a 5-m-high beach berm that the 1952 tsunami did not cross since 2500-3000 yrBP. Deposits beneath the lake bottom of Harutori-ko consist of diatomaceous laminated mud that alternates with sandy beds 0.1-1.0 m thick. A core 1 km from the modern beach contains 22 such beds. All of these beds grade upward from shell-bearing sand with gravel, through mud-clast breccia and laminated silt and sand, into organic mud.

Stratigraphic series of these sand sheets, intercalated with volcanic-ash layers from Komagatake and Tarumai volcano, south western Hokkaido, and radiocarbon dating show that unusually large tsunamis occurred every ca. 430 years on average in the past 9500 years, most recently about 350 years ago in Edo era.