

Sedimentation in Proval Bay (Lake Baikal) after earthquake-induced subsidence of part of the Selenga River delta

E.G. Vologina^{a,*}, I.A. Kalugin^b, Yu.N. Osukhovskaya^c, M. Sturm^d, N.V. Ignatova^a,
Ya.B. Radziminovich^a, A.V. Dar'in^b, M.I. Kuz'min^c

^a Institute of the Earth's Crust, Siberian Branch of the Russian Academy of Sciences, ul. Lermontova 128, Irkutsk, 664033, Russia

^b V.S. Sobolev Institute of Geology and Mineralogy, Siberian Branch of the Russian Academy of Sciences, pr. Akad. Kopt'yuga 3, Novosibirsk, 630090, Russia

^c A.P. Vinogradov Institute of Geochemistry, Siberian Branch of the Russian Academy of Sciences, ul. Favorskogo 1a, Irkutsk, 664033, Russia

^d Swiss Federal Institute for Environmental Science and Technology (EAWAG), P.O. Box 611, CH-8600 Dübendorf, Switzerland

Received 14 May 2009; accepted 5 February 2010

Available online xx November 2010

Abstract

The paper presents the results of a comprehensive investigation into the recent sediments of Proval Bay. This bay formed during catastrophic flooding of a big block of land as a result of an earthquake in 1862. Comparison of the sketch map of the bay for 1862 with its modern map shows that the boundary of the Selenga River delta has shifted considerably eastward. The sediments of Proval Bay are sands, silty pelite, and pelitic silt. Terrigenous material is predominant and consists of mineral grains and land plant remains, admixed with diatom frustules and sponge spicules. In the southwestern part of the bay, turbidites and a soil layer have been found. The latter was buried when the water level in Lake Baikal rose after the construction of the Irkutsk dam in 1959–1964. In the northeastern part of the bay, a peatlike layer has been found in the bottom sediment core. It formed in Lake Beloe, which existed in the Tsagan steppe before the 1862 earthquake. According to diatom analysis, this lake was shallow and eutrophic. The sedimentation rates in different parts of Proval Bay differ greatly and directly depend on proximity to the Selenga River. Variations in the geochemical indicators which reflect the ratio of organic to clastic components in the bottom sediments of the bay are controlled by temperature and water level variations in Lake Baikal.

© 2010, V.S. Sobolev IGM, Siberian Branch of the RAS. Published by Elsevier B.V. All rights reserved.

Keywords: earthquake; bottom sediments; magnetic susceptibility; diatoms; rate of recent sedimentation; elemental composition; Proval Bay

Introduction

Relatively recent natural features are of particular interest to researchers. One of them is Proval Bay, located in the southwest of Lake Baikal. It formed as a result of a catastrophic earthquake in the Selenga River delta in 1862.

The Tsagan earthquake, which occurred on 12 January 1862 (N.S.), was one of the strongest in East Siberia. Its consequences were studied in detail and documented by the expedition staff of the Imperial Russian Geographical Society (Siberian Branch) (Mushketov and Orlov, 1893; Orlov, 1872; Sgibnev, 1864; Solonenko, 1977).

From the analysis of primary data, the magnitude of the main shock is estimated at ~7.5 (Kondorskaya and Shebalin, 1977). The epicentral coordinates determined at different time are somewhat different. For example, according to (Kondor-

skeya and Shebalin, 1977), the epicenter was located southwest of the present shoreline of Proval Bay, whereas S.I. Golenetskii (1996), placed it northeast of the bay.

The earthquake was accompanied by considerable subsidence and flooding of the Tsagan steppe, where small lakes existed. Colonel A. Fitingof (1865) estimated the subsidence between the villages of Dubinina and Oimur at 2 sazhen (~4 m). The greatest vertical displacement was observed at the northeastern extremity of the Tsagan steppe. Scientists from the Russian Geographical Society estimated it at ~28 ft. (~9 m) (Orlov, 1872). The total subsided area is estimated at 200 km². A sketch map of the Tsagan steppe with the flooded area (according to the Russian Geographical Society, expedition of summer 1862) is shown in Fig. 1, a.

Bottom sediments up to 3.6 m thick accumulated in the bay after the earthquake (Ladokhin, 1960). The soils of the Tsagan steppe are the marker horizon of the lower boundary of these sediments. The bottom sediments from the bay were studied by some researchers (Kazenkina and Ladokhin, 1961;

* Corresponding author.

E-mail address: vologina@crust.irk.ru (E.G. Vologina).