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Basin morphology and seismic stratigraphy of Lake Kotokel, Baikal region, Russia

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ABSTRACT

The basin of Lake Kotokel, located along the eastern shore of Lake Baikal, Russia, has attracted several scientific projects to investigate the climate, vegetation and lake history throughout the Late Pleistocene and Holocene. However, little was known about its basin structure and sediment architecture. Echo sounding and 3.5 kHz single frequency sub-bottom profiling were used to decipher the basin morphology and seismic stratigraphy to a depth of approximately 50 m. The bathymetric map shows a very shallow lake of 4 m mean water depth and an almost flat lake bottom. A distinct elongated small-sized depression of up to 12 m water depth between the north-western coast and a small island developed along an NW-SE-oriented fault line. A total of 46 km of seismic profiles crossing the lake along 12 transects shows that the bottom sediments consist of three different facies, which accords to previously analyzed core sequences. Several distortions of sediment layers at various sites indicate tectonically induced impact, which resulted in up to 3 m vertical offsets of sediment packages at local sites. The offsets indicate a probably still active fault along the western shoreline of the lake. Soft gyttja of the upper 6 m does not show distortions and may have obscured potential younger tectonic activity. The sediments date to the Late Pleistocene. Small updoming features along the boundary between layers I and II may be assigned to degassing processes or to seismic activity. River channel fills along the north-eastern coast are indicative of a lower lake level prior to 15 ka BP. The sediment stratigraphy indicates that suitable coring sites for paleoclimate studies are only located in the southern part of the basin where almost undisturbed sediments can be expected.

1. Introduction

Lake basins are of particular importance for paleoclimate studies, as they are local sinks for a variety of sedimentary transport processes which contribute to the final deposition of material within a lake. The geological setting and morphology of a given lake basin and its catchment, local to regional climate conditions and human activity influence such dynamic processes significantly (e.g. Wünnemann et al., 2010). They even may amplify site-specific depositional patterns, if abrupt tectonic events, human-controlled landscape development or extreme climate events are involved. As a consequence, sediment architecture within a lake can vary through space and time, as demonstrated by seismic surveys in different lake basins in China and other parts of the world (e.g. Lister et al., 1991; Vanneste et al., 2001; Colman et al., 2002; Colman, 2006; Dietze et al., 2010; Daut et al., 2010).

Lake records are widely applied to infer the lake's history and related influencing factors by identifying various proxy data obtained from drilled sediment cores. They are preferably assigned to climate change throughout the Late Quaternary. Many of the reported results refer to a single sediment record, assuming that the obtained data reflect the general depositional conditions within the system caused by climate impact. However, little is known how strongly the basin morphology and the spatial variety in deposition may have overprinted the site-specific sediment composition, thus influencing the interpretation of records.

During recent decades, many lake records from the Lake Baikal region in southern Siberia were investigated for paleoenvironmental

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