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Buried Fe/Mn sedimentary Layers as Markers of past Conditions in Lake Baikal

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High spatial variability of sedimentation rates and sedimentary organic matter content makes Lake Baikal an excellent natural model to study diagenetic processes related to redox reactions. In contrast to most lakes, the oxic stage of diagenesis is widely presented in Baikal. The whole water column is constantly oxygen-enriched and, oxygen penetrates into sediments over most of the lake floor. As a result, different forms of oxidized Fe and Mn accumulations are spread in the sediments, shaping various patterns of secondary diagenetic formations (e.g., Fe- and Mn-enriched layers, Fe/Mn crusts and nodules). Low and constant sedimentation rates, small amounts of settling organic carbon and, sufficient oxygen supply to deep water are conditions for their formation and preservation. The Fe/Mn accumulations are a product of early diagenetic processes, moving dynamically with the redox interface.

In the regions of relatively high sedimentation rates, Fe/Mn layers are formed/dissolved during tens to hundreds years whereas it takes thousands of years to accumulate substantial amounts of Fe and Mn within thick oxidized layers typical of slow sedimentation areas [1]. This time scale allows Fe/Mn sedimentary layers to serve as markers of past conditions in the lake. If the equilibrium between sedimentation rates and rates of reduction/oxidation of Fe and Mn accumulated at the redox interfaces is disturbed, Fe/Mn enrichments may be buried within the sediments. Lack of organic matter or sharp one-time increase in sedimentation rate may be responsible for their burial. Both cases occurred in Baikal sediments resulting in widespread buried Fe/Mn layers. Different types of buried Fe/Mn enrichments, which are relics of former top-core accumulations, are observed in the lake:

i) compact Mn-depleted Fe crusts, occurring in the uppermost sediments (within

approximately 10 cm below water-sediment interface) predominantly in Northern Baikal. They were possibly formed during period of low sedimentation 300-700 years ago when supply of both biogenic and terrigenous material was reduced due to Little Ice Age cooling [2];

ii) compact interbeds of greenish colour, which we used to call “green” layers [2], located in Holocene sediments as well as below the Holocene-Pleistocene boundary in all lake basins and on the underwater Academician Ridge. Recent studies [3] show they are made of Mn-enriched vivianite micro-concretions. The concretions are apparently formed from Fe and Mn hydroxides previously accumulated within the recent and/or buried oxidized layers, then gradually transformed into vivianites. Such layers bearing tiny vivianite concretions may serve as markers of low sedimentation rates.

iii) hard 1 to 2 cm-thick Fe/Mn crusts found deeply below the water-sediment interface (up to 4 m depth) on Academician Ridge and adjacent areas. Some evidences show they were formed 70-80 kyr B.P. [4-6]. We previously related the crusts formation to transition periods of low sedimentation between glacial and interglacial climates [4]. New data on the structure of Academician Ridge [7, 8] as well as specific features of the crusts composition and location allow proposing that they are of sub-aeral origin, further submerged due to tectonic lowering. Hypothetical time of these tectonic events (70-80 kyr B.P.) does not conflict with the *Tyiskaya* tectonic phase (150-120 kyr B.P), whose youngest impulses became apparent up to Holocene. Due to inertness of organic matter in these sediments and its low content ($C_{org.} < 1\%$) [6], Fe/Mn crusts are not dissolved. Since the dissolution/formation of Fe/Mn layers within the uppermost sediments of Academician Ridge takes thousands of years [1], it should take much longer for dissolution of dense Fe/Mn crusts buried deeply (meters) below the water-sediment interface.

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