On the basis of the reconstruction, a synchronous / asynchronous scheme of the processes of lake sedimentation and development of the environment in the northwestern part of the East European Plain at the boundary of the Pleistocene and Holocene will be compiled using the geoinformation method.

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MINERALOGY AND CRYSTAL CHEMISTRY OF AUTHIGENIC CARBONATES FROM CALCITE-DOLOMITE SERIES OF SHALLOW LAKES SEDIMENTS (BAIKAL REGION)

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The high degree of influence of regional natural and climatic factors on sedimentation in intracontinental reservoirs requires a comprehensive study of their bottom sediments. The important information is contained in the mineralogical and crystallochemical characteristics of authigenic mineral phases, since the composition and structure of the precipitating minerals are directly dependent on the chemistry of lacustrine water, salinity, temperature and biological productivity of the paleobasin, which in turn are controlled by the regional climate. This dependence is most clearly manifested for low-temperature authigenic carbonates possessing a wide spectrum of isomorphism in their crystal lattice and significant variations in the degree of order / disorder in the structure [Reeder, 1983].

We present the results of mineralogical and crystallochemical studies of the authigenic carbonates from bottom sediments of shallow saline lakes at Baikal region. The objects of studying are Holocene evaporite sections of three closed lakes with carbonate type of sedimentation –Verchnee Beloe, Bol'shoe Alginskoe and Kiran. They are located in western Transbaikalia - the region with prevailing of arid and semi-arid climate conditions. The main methods of investigations are: X-ray diffraction analysis (ARL X'TRA, Cu K_α radiation) and IR-spectroscopy; additional methods are scanning electron microscopy, SR XFA, analysis of stable isotopes ($\delta^{18}O$ and $\delta^{13}C$) and others.

The assemblage of authigenic carbonate minerals of the lacustrine sediments consists of Mg-calcites with different Mg contents and excess-Ca dolomites. By the chemical composition and the position of main analytical peaks on X-ray patterns as well as position of absorption bands on IR spectra Mg-calcites and excess-Ca dolomites are situated between $CaCO_3$ and stoichiometric dolomite ($CaMg[CO_3]_2$). Natural low-temperature Mg-calcites are poorly crystallized; the crystallites are smaller than 10 µm. Their detailed study encounters difficulties because of the lack of single crystals of required quality and size.

Carbonate mineralogy was considered on the basis of the position of the most intense reflection (*hk* =104) in the trigonal varieties in the range of angles of 28.5–32.5º (2Θº Cu$K\alpha$) (Fig. 1). The interplanar spacing d_{104} varies from 3.036Å (calcite) to 2.887Å (stoichiometric dolomite) and serves as a measure of the Mg content of these carbonates. For a detailed description of the Mg-calcites, we divided them into three groups: (1) low-Mg calcites (LMC) with $MgCO_3$ < 4–5 mol.% (3.036 Å > d_{104} > 3.02 Å); (2) intermediate-Mg calcites (IMC) with 5–18 mol.% $MgCO_3$ (3.02 Å > d_{104} >2.98 Å); and (3) high-Mg calcites (HMC) with 18–43 mol.% $MgCO_3$ (2.98 Å > d_{104} > 2.90 Å). The excess-Ca dolomites, in which excess of $CaCO_3$ can amount to 7 mol.% as compared with the stoichiometric dolomite, are characterized by d_{104} of 2.90 to 2.887Å. On the high-resolution X-ray patterns of the studied samples, the peaks corresponding to d_{104} of carbonate minerals look like two maxima of varying intensity: (1) LMC and IMC and (2) HMC and excess-Ca dolomites (Fig. 1).

The conventional boundary between them is located at 30º 2Θ Cu$K\alpha$ (d_{104}=2.98 Å). These broadened diffraction peaks are of intricate shape, and each of them is a superposition of several peaks of carbonate phases with different contents of Mg in the structure. Decomposition of complex XRD-profiles of carbonates into individual peaks by the Pearson function VII provided the whole set of existing carbonate minerals in each sample [Solotchina et al., 2012]. The model approach allowed us to determine the position of the maximum, integral intensity of the analytical peak of each phase and to obtain their quantitative ratios with a high accuracy. The concentration of $MgCO_3$ in Mg-calcite structure was determined by the calibration plots of dependence between the d_{104} and $MgCO_3$ content (mol.%) [Goldsmith, Graf, 1958].

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At present, Mg-calcites are regarded as mixed crystals varying from true solid solutions (low-Mg calcites) to mixed-layered structures (high-Mg calcites) in the series calcite-dolomite and characterized by different stabilities [Deelman, C., 2011]. These structures are sequences of calcite and magnesite layers alternating with different degrees of ordering and forming nanosized domains. Mixed-layer structure of excess-Ca dolomite [Drits et al., 2005] is more similar to the structure of high-Mg calcite than to that of dolomite *sensu stricto*, this mixed crystal is the end-member of the series of anhydrous Ca–Mg carbonates including low-Mg calcite, intermediate-Mg calcite, high-Mg calcite, and excess-Ca dolomite. Moreover, stoichiometric and nonstoichiometric dolomites are, most likely, of different genesis. Stoichiometric dolomite is extremely rare in Holocene and modern sediments of continental water basins, even when the waters are oversaturated with $CaMg(CO_3)_2$ [Last, 1990]. Our investigations have shown that the excess-Ca dolomites are a permanent component of saline lakes sediments just as Mg-calcites. We have established that the lacustrine Mg-calcites do not form a continuous series from low-Mg to high-Mg varieties: there is a break between Mg-calcites containing <18 mol.% $MgCO_3$ and >30 mol.% $MgCO_3$ (a blank space on the XRD spectra near 2Θ Cu*K*α = 30º). We suppose that the break in the series of Mg-calcites is probably due to the transition from true solid solutions ($MgCO_3$ < 18 mol.%) to layered “domain” crystals, which are regular in their utmost form.

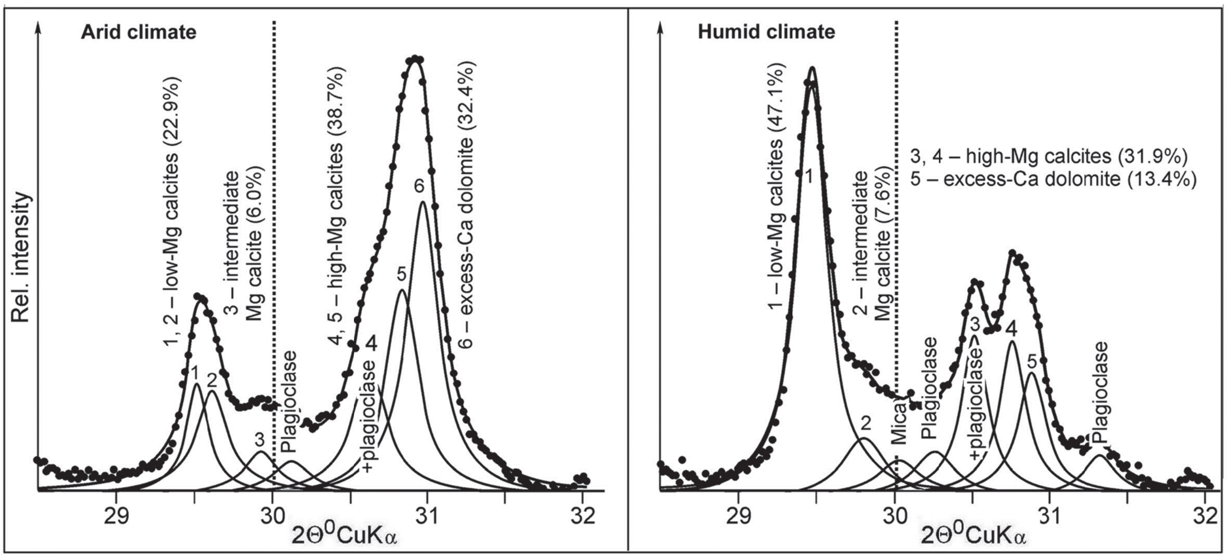

Fig. 1. Results of modeling of experimental XRD profiles of carbonates in the range of d_{104} peaks. The total modeled profiles (solid line) are in agreement with the experimental ones (dotted line). The diffraction peaks of individual phases are described by Pearson VII function. The total content of carbonates in the sample is taken equal to 100%

It is known, that sedimentation of carbonates of the calcite–dolomite series is determined by a number of factors: Mg/Ca ratio, total carbonate alkalinity, salinity, pH value, temperature, and organic productivity of the water [Nechiporenko, Bondarenko, 1988]. These factors are controlled by the lake water balance depending mainly on the regional climate. Based on the studies performed, we obtained a carbonate record carrying the information about the stratigraphic distribution of Mg-calcites and Ca-dolomites in sedimentary sections. Juxtaposing the carbonate record with the data of lithological analysis, determined stable isotopes ($\delta^{18}O$ and $\delta^{13}C$), and distribution of some geochemical indicators of climatic changes, we reconstructed the intricate evolution of lakes, which was controlled by the regional climate [Solotchina et al., 2012].

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PALEOCLIMATE RECORDS OF THE HOLOCENE INFERRED FROM PROGLACIAL LAKE BOTTOM SEDIMENTS OF EAST SIBERIA

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Currently, glacier area in the south part of East Siberia is not extensive. In most causes, these glaciers are less than 1 km^2 [Margold and Jansson, 2011; Stokes et al., 2013; Osipov and Osipova, 2014; Kitov et al., 2015]. However, alpine relief and other geomorphological evidences such as terminal moraines, fossil shorelines and deltas of glacial lakes indicate extensive glaciation of the area in the past [Back and Strecker, 1998; Osipov et al., 2003].

The goal of this study is to reconstruct a glacier response to climate changes during the Holocene based on high-resolution geochemical proxies inferred from the East Siberian proglacial lakes of the East Sayan Ridge, the Baikalsky Ridge and the Kodar Ridge.

Dating of the sediments cores and fluvio-glacial deposits was based on ^{210}Pb and ^{137}Cs chronology for the upper sediment layers, and radiocarbon (14C) calibration performed by AMS built by Budker Institute of Nuclear Physics, Novosibirsk, Russia.

According obtained 14C data, forming of Tompuda moraine (Northern Baikal) was two studies. The first study begun from Belling-Allered and ended to 11.8-12.4 ka BP. The second study of deglaciation was 9-11 ka BP. In general, Pleistocene glaciers of the East Sayan Ridge, the Baikalsky Ridge and the Kodar Ridge were melted to the early Holocene. The modern glaciers most likely formed during the Little Ice Age.

The intensity of the supply of surface water into proglacial lakes has primarily depended upon a rate melting of glaciers and summer air temperature. The distribution of Rb, Zr, Nb, Y and Th will be closely associated with the clastic material and can be related with a rate melting of glaciers. The elemental composition of bottom sediments were investigated by two methods: X-ray fluorescence spectrometry and inductively coupled plasma mass spectrometry. X-ray fluorescence spectrometry was undertaken to provide quantitative information on 20 trace elements (from K to U) and a time resolution in “year-season”[Stepanova et al., 2015; Trunova et al., 2015].