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Geochemical anomalies in carbonate lacustrine sediments as seasonal and centennial environmental proxy for continental climate conditions in South Siberia during the last 2450 yrs.

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Sedimentation history of saline lakes efficiently reflects environmental change in catchment area especially for wet-arid conditions. Different sediment carbonates allows quantitative assessment of physicochemical conditions and bioproduction. Shira lake in South Siberia is a good representative object for detail weather-climate modeling due to it‘s local hydroclimatic information and annually laminated bottom sediments. Thermodynamic estimation of rock-water multisystem in conformity with local conditions and source matter gives grounds for interpretation of measured geochemical parameters in sediments as environmental indicators like temperature, salinity, pH etc. At the same time using a modern scanning X-ray fluorescence technique for sub-millimeter microstratigraphic study of varves results quantitative environmental reconstruction year by year.

Meromictic Shira Lake is closed shallow (25 m) basin 9,4x5,3 km2 of brackish water (total salinity up to 19 g/l) inflowed by small Son river. Continental climate provides mean July temperature 18o and January -20oC. A long-term waterbody stratification with intra-annual chemocline depth 11-16,2 m is observed as well as level oscillations up to 7 m

Sediment has thin laminated structure, where black clay-carbonate organic bearing layers are coupled with white organic free ones. Thickness of rhythms varied from 2 mm in the uppermost 20 cm of core to 0.4 mm close to the bottom. Clastic components quartz, feldspar, micas, chlorite are distributed under dust and flood events but not regularly.

Visible 6 light intervals depleted of organics are revealed along the core. They have 45-120 mm in thickness and are repeated every 200-250 mm. Dark and light sediments are different in water content as well as rock-forming element composition. LOI<500oC is rather lower in light components, that confirms lack organic matter. Correspondingly, calcite (18-30%) and monohydrocalcite (13-14%) predominate in black muds coloured by organics and hydrotroilite, but dolomite (54%), less calcite (11%) with a touch of strontianite are concentrated in light layers.

To construct depth-age model 137s is measured in upper part subsampled by 5 mm. Coincidence between isotope dating and counting of individual layers corroborates annual origin of them. Then varves with average thickness 0.6 mm were counted for the complete core, and age of bottom is estimated as 2450 yrs BP. Three radiocarbon dates showed the same result on the assumption of 1200 years reservoir effect for each measurement due to input of soluble ancient carbonate from bedrocks.

Computer physicochemical simulation in natural rock-water-gas multisystem of Shira lake is executed by “Selector” software used method of thermodynamic potentials minimization under local equilibrium state. Thermodynamic estimations proves that carbonate matter within annual couple is corresponded to cold (winter) conditions, and organic component - to warm season. Inverse temperature dependence for solubility product of strontianite and positive correlation between transpiration and strontianite content in solid phase both contribute to concentrate Sr in sediments during cold season due to decreasing temperature and increasing water salinity through ice cover as well. Also inverse correlation is revealed between Sr content and lake level documented from 1920 year.

So light carbonate Sr-enriched layers formed during each cold season as well as at the time of extremely low lake level periods with higher saline water every 450-550 yrs. Sr signal was also measured in similar carbonate sediments of Telmen lake situated in Northern Mongolia ∼800 km south-east from Shira.