1 Introduction

In the south of Eastern Transbaikalia in the border area with China and Mongolia, there are at least 300 saline without outlet lakes. They are confined to the semi-arid zone Daurian steppes with pronounced continental salinization processes and are mostly located on the bottoms of the intermountain basins. Their origin is related to evaporative concentration of fresh waters lakes filling.

With rare exceptions, lakes are small, most several km², differ in chemical composition and salinity, which vary in space and time. Reason chronological hydrochemical changes are periodic filling and drying of lakes due to cyclic climatic changes. According to observations on the largest connected with each other lakes Barun-Torey and Zun-Torey having at maximum filling the water surface about 880 km², fluctuations in the level allocated cycles lasting from 8-10 to 35 years. In the 20th century, the highest levels of these lakes were observed in 1963-1965 and 1993-1995 [Obayazov, 2012], and in 1903-1904, 1921-1922 and 1944-1947 [Krendelev, 1986]. According to dendrochronological data, the first decade of this century in the northern part of the ecoregion Daursky characterized as arid [Vakhnina, 2011], and in the annual rings of pine Tsasuchey boron adjacent to these lakes differed most dry climatic conditions over the last 200 years (Fig. 1). As a result, most prominent in the territory lake Barun-Torey having at highest filling an area of water about 580 km² and a depth up to 4.8 m by 2009 turned into a small puddles (Fig. 2), and next year is completely dry. Filling the lakes in the region began in June 2013 in connection with a break in the territory of the Pacific monsoon [Davydova, 2014].

2 Hydrochemistry and formation of chemical composition lakes
According to the results of testing 2006-2009, salinity of the water in the lakes of Eastern Transbaikalia reached 329 g/L, in 45 of 65 lakes studied it did not exceed 25 g/L. The pH of all the lakes ranged 8.61-9.75.

The predominant anion salt lakes are carbonate (\(\text{HCO}_3^- + \text{CO}_3^{2-}\)) and chloride, with a predominance sulfate lakes are absent. Carbonates dominated mainly with salinity up to 10 g/L, more rare carbonate salt lakes (up to 50 g/L), in which chloride is the second largest anion determining chemical type of water. Water composition is hydrocarbon-sodium-magnesium if salt content of up to 1.5 g/L. A significant portion of the cations sum in these lakes may have calcium. Rarer lakes with magnesium-sodium compound, usually water salinity in these cases does not exceed 5 g/L. With increasing salinity, regardless of the prevalence of carbonate or chloride ion is replaced by a mixed cations composition solely on sodium.

Sulfates of more than 20% eq. (up to 33.9% eq.) are installed only in 10 lakes with total salinity range 1.1-174 g/L. When salinity to 5.2 g/L can be the predominant anion \(\text{HCO}_3^-\) or \(\text{Cl}^-\), more salty lakes are only \(\text{Cl}^-\). With increasing salinity, regardless of the prevalence of carbonate or chloride ion composition is replaced by a mixed cations composition solely on sodium.

Sulfates and chlorides are typical elements for such lakes (Li, Sr, F, P, Br, As, Se, W, U, and others) accumulated, the highest concentration had a F (up to 144 mg/L).

Leading factors in the formation of salinity and chemical composition of mineral water lakes assumed processes of evaporative concentration at which the direction of transformation of the chemical composition - carbonate type is replaced by sulfate and chloride further. Such a sequence is explained by precipitation of salts as the saturation of the lake waters, initially the least soluble calcium and magnesium carbonates, then sulfates of calcium, sodium, etc. Thermodynamic calculations concentrating freshwater supply some salt lakes springs showed that only these factors explain the chemical composition is often impossible [Zamana, 2009; Zamana, Borzenko, 2010]. Hydrobiological processes must be considered in the lakes themselves - the production of organic matter and sulfate reduction. With the first connected enrichment of lake water carbonate components, the second - the removal of sulfate from the water due to the transfer of sulfur in sulfide form and transfer it in the form of sulfides in sediments. Development of sulfate on one of the lakes is demonstrated in Fig. 4.

**Key words:** salt lakes, chemical composition, salinity of water, sulfate reduction.

**Acknowledgements**

This study was supported by integrated project no. 38 of the
Siberian Branch, Russian Academy of Sciences “Mineral lakes of Central Asia as archive of paleoclimatic records of high solution and renewal liquid ore”.

References


