An assessment on a large geographic scale of Eurasian inland saline surface waters Version 3

Emil Boros,Marina Kolpakova

Abstract

The major ion concentration data of sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), chloride (Cl), sulphate (SO_4), bicarbonate (HCO_3), carbonate (CO_3) and pH (if it was coupled with ion data) were input into the database. The data were drawn from a large geographic scale across Eurasia (Austria, China, Hungary, Kazakhstan, Mongolia, Russia, Serbia, Turkey) and from a large number of saline lakes and pans (N=220) with minimum a 1.0 g L^{-1} salinity threshold. The 1.0 g L^{-1} salinity threshold was selected based on a former study (Boros et al., 2014), where this threshold was experimentally found to be the characteristic boundary of soda ecosystems. Salinity was estimated by the sum of measured concentrations of eight major ions (Na, K, Ca, Mg, Cl, SO_4, HCO_3, CO_3). As generally known, sodium is by far the most common cation in saline lakes and necessarily the dominant cation in soda type lakes. Therefore, sites were excluded from the dataset if Na was not the most abundant ion. If seasonal or annual water data were available, mean values were put into database. Most of the data came from papers (sources are indicated in the table).

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Protocol

Chemical assessment of Eurasian inland saline surface waters

Step 1.

Data collection and measurements

Major ion concentration data including sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), chloride (Cl^-), sulfate (SO_4^{2-}), bicarbonate (HCO_3^-), carbonate (CO_3^{2-}), and pH (if it was coupled with ion data) were compiled into a database. The data were drawn from a large geographic scale across Eurasia (Austria, China, Hungary, Kazakhstan, Mongolia, Russia, Serbia, and Turkey) and from a large number of saline lakes and pans (N = 220) with a minimum of 1.0 g L^{-1} salinity threshold. The 1.0 g L^{-1} salinity threshold was selected on the basis of a former study [27], where this threshold was experimentally found to be the characteristic boundary of soda ecosystems. Salinity (TDS) was estimated by the sum of major ion concentrations (Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}, HCO_3^-, and CO_3^{2-}) and 1 mg L^{-1} accuracy was used for all input concentration data independently of the theoretical accuracy of original measurements, therefore decimals were rounded to integer value. As generally known, sodium is by far the most common cation in saline lakes and necessarily the dominant cation in soda type of lakes [1]. Therefore, sites with the most abundant ion other than Na^+ were excluded from the dataset. If seasonal or annual water data were available, we used mean values for the database. Most of the data came from papers [1,15,26-39] published in the period from 1956 to 2017. However, we cannot estimate a reliable universal accuracy and reproducibility for all data in this study, because none of the published papers reviewed provide data on uncertainty, furthermore, several of them were carried out by different kinds of national standard methods of ion concentration measurements, but all of them are based on the same international methods of ICP-

MS for cations (ASTM 3500-Na-C, -K-C, -Ca-C, -Mg-C), alkalinity titration (ASTM 2320 B), chloride argentometric titrimetry (ASTM 4500-Cl^-B) as well as sulfate ions turbidimetry (ASTM 4500-SO_4^{2-}E).
The collected published data were supplemented with some unpublished sample series in the case of Mongolia and Kazakhstan. They are indicated in the attached table as "Author's unpublished data". The pH was measured on site using a WTW multiline field instrument with a SenTix 41 electrode. The samples were filtered through GF5 glass fiber filters (0.4 µm nominal pore size) in the laboratory. For the determination of cations (Na^+, K^+, Ca^{2+}, and Mg^{2+}), samples were analyzed with the EPA 6020 standard method of inductively coupled plasma mass spectrometry [40] with 2% accuracy. Anion concentrations were measured according to Hungarian standard analytical methods (MSZ). Chloride ion concentration was determined by the argentometric method (MSZ 448-15:1982). Sulfate ion was precipitated in a strong acidic medium with barium chloride, and the resulting turbidity was measured photometrically at 405 nm and compared with standard solutions (MSZ 12750-16:1998). Alkalinity was determined by titration, and the concentration of HCO_3^-, CO_3^{2-}, and OH^- ions was calculated using the Hungarian standard MSZ 448-11:1986. All of anions and alkalinity were measured with 5% accuracy.

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