Hydrochemistry and spatial variation of Arsenic, Boron and other trace elements in water bodies, Sud Lipez of the Bolivian Altiplano

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Abstract

The Sud Lipez is located southwestern part of the department of Potosí. Several sub-basins such as the Laguna Colorada, Pastos Grandes, Capina and Chalviri are located within the Altiplano Puna Volcanic Complex (APVC), between 4200 and 4500 m a.s.l (Rocha et al., 2021). Geologically, the rocks are predominantly dacitic to rhyolitic with a silicic composition (Murray et al., 2023). According to the available dates, the oldest volcanic centers are the Capina caldera 8.3 Ma, therefore Pastos Grandes came into activity for the second time 2.9 Ma ago and the La Laguna Colorada is an ignimbritic shield is the youngest 2.2 Ma (Ort et al., 2013). The region is characterized by its aridity, where precipitation is less than 150 mm/year, high evapotranspiration and occupied by salt flats and shallow saline lakes with accumulation of salts such as borax. The objective was to understand the processes and mechanisms that govern the hydrochemistry and spatial variation of arsenic, boron and other trace elements, as well as the influences exerted by different water bodies in this volcanic area. Thirty-seven water samples were taken from various sources; including springs, hot springs, streams, river, lake and groundwater. Field measurements include determinations of temperature (T), pH, Ox-Red potential (ORP), electrical conductivity (EC) and total dissolved solids (TDS). Water samples were collected for analysis of anions, cations, and trace elements.

The bodies of water that contribute to the Laguna Colorada, Pastos Garndes, Capina and Chalviri show variable temperatures (3.3 - 32.4°C) with a slightly alkaline pH (6.4 - 8.5). The salinity varies from 146 to 123600 uS/cm, with oxidizing conditions. The predominant water type in the Laguna Colorada is Na-HCO_3-Cl, Capina is Na-Ca-HCO_3, Pastos Grandes and Chalviri is Na-Cl. The concentrations of As exceed maximum permissible limits in Laguna Colorada (4 – 66730 µg/L) and (B) (0.05 – 522 mg/L). Pastos Grandes (5 – 2210 µg/L) and (B) (0.44 – 1.4 mg/L). Capina (9 – 51 µg/L) and (B) (0.05 – 0.3 mg/L). Chalviri (77 – 767 µg/L) and (B) (1 – 5 mg/L). The predominance of the type of water is associated with the dissolution of Na- and Ca-silicate minerals, as well as the dissolution of dolomite, calcite and the presence of ulexite. However, the significant variation observed in the hydrochemical characteristics of the four sub-basins is mainly due to the alteration of the volcanic rocks from decitic to rhyolitic and igmibritic composition due to the interaction with water, which dissolves these minerals, generating As-containing solutes and elevated B concentrations are due to accumulation in saline lakes. The bodies of water that contribute to the Capina Lagoon seem to be the most suitable for irrigation and animal consumption, since it has more favorable properties in terms of water quality.

References

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