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Origin of Boron in the Damxung Co Salt Lake (Central Tibet): Evidence from Boron Geochemistry and Isotopes

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The origin of boron in boron-rich salt lakes in the Tibetan Plateau has long been the subject of debate. The Damzung Co Salt Lake in central Tibet has high boron concentrations (B = 276–313 mg/L) and is an ideal site for investigation. The aim of this study is to analyze the boron geochemistry and isotope composition of surface brine, source water, country rock, and Quaternary deposits (carbonate clay, stromatolite, and travertine) in the lake, to understand the unusual boron enrichment of the salt lakes in Tibet (Figure 1). Concentrations of boron in stream water samples from the basin are low (B = 0.172-2.08 mg/L), with the exception of one sample that has an input of

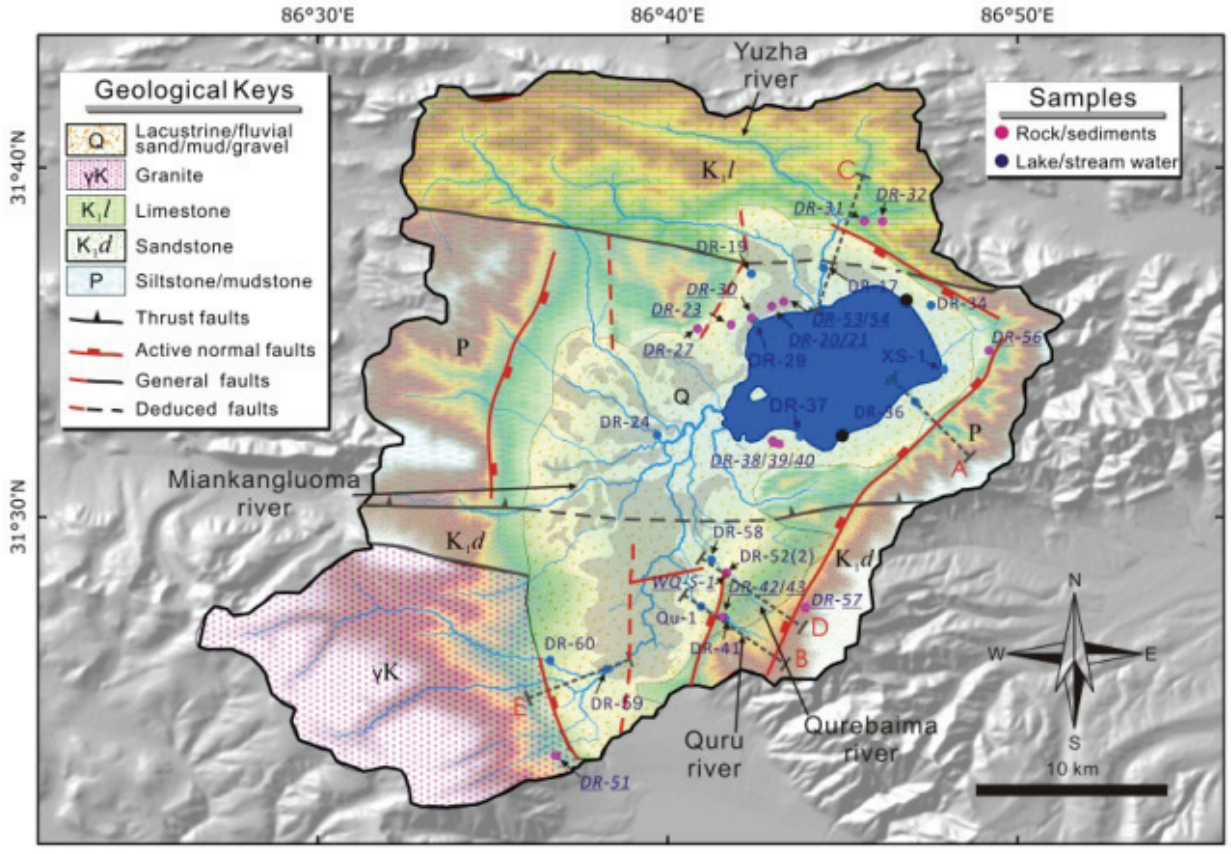

Fig. 1. Simplified geological map and sample locations within the Damxung Co Salt Lake. Dashed black lines represents the locations of profiles in Fig.2.

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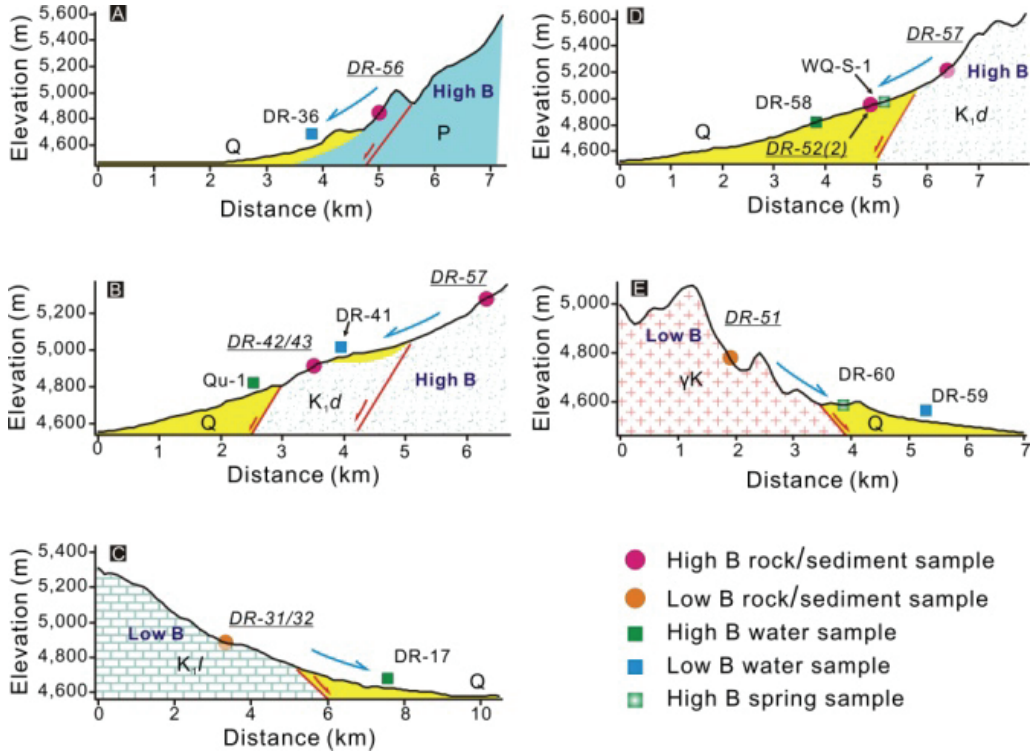

Fig. 2. Cross-sectional pattern of the boron distribution.

geothermal water (B = up to 13.6 mg/L). Their variable boron isotope compositions represent the characteristics of country rock weathering input (δ11B = –8.6 to –0.5‰). Hot springs have much higher boron concentrations (B = 3.31–49.4 mg/L) than streams and cold springs (B = 0.434–4.82 mg/L). Boron isotope data show that the δ11B values of streams, hot springs (–9.8 to –8.5‰), and cold springs (-14.5 to -1.2‰) are much higher than those of the salt lake (–18.5 to –17.4‰), except in samples containing Quaternary deposits. This finding, therefore, rules out the possibility that the present boron deposits originate from country rock weathering or hot springs, as historically proposed by Chinese scientists. The slight variability in boron isotopic composition in the present lake indicates only one major boron source. Three samples containing Quaternary deposits have different boron isotopic compositions with –37.2 to –35.3‰ (carbonate clay), –29.5 to –24.9‰ (travertine), and –28.2 to –26.7‰ (stromatolite). The fractionation factor between carbonate clay and the lake are very similar to that between seawater, sediment and carbonate in a similar pH range, compared with stromatolite and travertine. Hence, we conclude that early carbonate clay deposits within the lake basin are the present main source of boron in the Damxung Co Salt Lake (Figure 2).

Key words: Boron geochemistry, Origin, Quaternary deposits, Damxung Co Salt Lake, Tibet

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