Geochemical evolution processes of geothermal water in Tethys Himalaya belt

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A significant modern active geothermal zone named the Tethys Himalaya geothermal belt has been developed in the southern part of the Tibetan Plateau. Many hot springs with high temperature and pressure are discharged along this geothermal belt. Some rare and dispersed elements (e.g. B, Li, Rb, Cs, As) are unusually enriched in geothermal waters[1]. Through field investigation and sampling for 10 typical hot springs in some large-scale geothermal fields, the dominant geochemical evolution processes are tracked and introduced.

The hot springs can be classified as two main types according to hytrochemical compositions, thermal reservior temperature and water circulation depth. The first type of hot springs contains Na-Cl-HCO_3 and Na-Cl type and the thermal reservoir temperature is higher than 120℃. After considering the significantly enriched some typical elements of Li, B and As and representative indicators of Li/Cl, B/Cl and B/Li, the high concentration of chemical compositions in the geothermal water is closely related to the strong water-rock processes and more likely to be related to the evolution of the late residual magma fluid mixing. The second type of geothermal springs are mainly Ca-Na-HCO_3 and Na-HCO_3 type. In addition, the thermal reservior temperature and the concentration of Li, B and As are much lower than the first type of springs. In contrast, the second type mainly represents geothermal springs with shallow depth of circulation, frequent replacement of groundwater and large proportion of cold water. The trace elements of geothermal springs are mainly controlled by the strength of water-rock interaction.

Summarily, the unusual enrichment of rare and dispersed elements in Tibet are likely to be the result of the strong water-rock interactions and late residual magma fludis mixing. This study provides useful insight into the geochemical characteristics as well as further understanding of the evolution processes of geothermal water in Tibet.

[1] Zhang Wenjie, et al. (2015) Applied Geochemistry, 63:436-445.