GEOTHERMAL WATERS FROM THE TAUPO VOLCANIC ZONE, NEW ZEALAND: A VIEW THROUGH Li, B AND Sr ISOTOPES

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1. Introduction

In the present work, we report chemical and isotope data for 23 geothermal water samples from the Taupo Volcanic Zone (TVZ) in New Zealand. The Taupo Volcanic Zone has anomalously high heat flow and widespread hydrothermal activity.

Chemical and isotope data were analyzed for these deep geothermal waters in order to provide further constraints on the characterization of the associated deep geothermal reservoirs.

The present study aims therefore to characterize the fluids from the geothermal systems for the TVZ and more specifically, to constrain the nature and origin of these fluids : two essential parameters for the characterization of a geothermal resource.

The data reported here for TVZ geothermal samples are the major and trace elements and a broad range of isotope data: “traditional” isotope systematics e.g. Sr isotopes, and “non traditional” isotope systematics e.g. Li and B isotopes.

2. Multi isotopic characterization

Lithium concentrations are high (from 4.5 to 19.9 mg/L) and the most striking outcome of the present work is that lithium isotopic compositions (δ^7Li) are extremely homogeneous being comprised between -0.5 and +1.4‰. Li isotope tracing shows that the input of seawater is negligible in these geothermal waters and that Li and its isotopes are mainly controlled by water/rock interactions at high temperature (205 and 320°C) involving a deep andesitic reservoir with the contribution of sediments. This result is in accord with the geological context of the Taupo Volcanic zone corresponding to a back-arc rift, due to the subduction of the Pacific plate beneath the North Island of New Zealand.

Boron concentrations are also high and homogeneous, B concentrations are ranging from 17.5 and 82.1 mg/L. Boron isotopic compositions (δ^{11}B) are also very homogeneous and all negative, and display a small range of variation between -6.7 and -1.9‰. This B isotope signature is in a good agreement with a fluid signature derived mainly from water/rock interactions involving magmatic rocks and no seawater input.

Strontium concentrations are lower and more heterogeneous and are comprised between 0.02 to 0.16 mg/L. $^{87}Sr/^{86}Sr$ ratios are ranging between 0.70549 and 0.70961, showing very different Sr isotope signatures in the geothermal waters. These Sr isotope compositions are in agreement with local magmatic bedrocks and the highest Sr isotope ratios are the result of a significant contribution of waters having interacted with bedrocks having more radiogenic strontium like metasedimentary basement rocks.

3. Concluding remarks

This is the first time Li isotopes have been measured in geothermal waters from New Zealand. Each of these isotope systems on their own reveals important information about particular aspects of either water source or water/rock interaction processes, but considered together provide a more integrated understanding of the geothermal systems from the Taupo Volcanic Zone in New Zealand.

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