



Geochemical and isotope evidence for shallow heating of hot springs in a metamorphic terrain in Sri Lanka

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Geothermal systems are commonly associated with volcanic activities or recent uplifts. Here we investigated seven hot springs with temperatures of up to 122 °C in the metamorphic Proterozoic crust of Sri Lanka .(.).....(Chandrajith et al., 2013). These formation waters were compared with nearby low-temperature groundwaters and local precipitation. Samples were analyzed for their major and minor element compositions and stable oxygen and hydrogen isotope ratios.

All three water types showed similar characteristics. For instance, the geothermal waters showed low trace element concentrations as exemplified by Fe, Mn, Cu, Cr, As and Zn. Concentrations of these elements were comparable to those of non-geothermal waters. Both, geothermal and non-geothermal waters could be classified as Ca–Na–HCO₃ type waters. The stable isotope compositions of geothermal waters ranged from 6.5 to 5.0 for $\delta^{18}\text{O}_{\text{H}_2\text{O}}$ and from 39 to 28 for $\delta^2\text{H}_{\text{H}_2\text{O}}$. In non-geothermal waters, the water isotope values had similar ranges from 6.3 to 5.0 and from 37 to 28 for $\delta^{18}\text{O}_{\text{H}_2\text{O}}$ and $\delta^2\text{H}_{\text{H}_2\text{O}}$.

Water stable isotope measurements revealed that hot geothermal waters also scattered around the local meteoric water line. They furthermore showed negligible $\delta^2\text{H}_{\text{H}_2\text{O}}$ shifts, thus confirming origin from precipitation with negligible modification by water-rock interactions. The geochemical and isotope data from geothermal and corresponding non-geothermal waters matched closely and confirmed the hypothesis of a common source. Geochemical and isotope results suggest a meteoric origin for the geothermal waters in Sri Lanka. They are recharged from higher altitude precipitation and undergo subsequent circulation to shallow depths under high hydraulic pressure gradients. Heating is likely caused by a much steeper than expected heterogeneous geothermal gradients for such metamorphic terrains. The hot springs are likely associated with a thrust zone that holds potential to become a source for future energy development.

Reference:

.Chandrajith, R., Barth, J.A.C., Subasinghe, N.D., Merten, D., Dissanayake, C.B., 2013. Geochemical and isotope characterization of geothermal spring waters in Sri Lanka: Evidence for steeper than expected geothermal gradients. *Journal of Hydrology*, 476: 360-369.