

Thermal springs and active fault network of the central Colca River basin, Western Cordillera, Peru

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Thermal springs are prevalent water discharges along the Andes of Southern Peru. They are connected with neotectonic movements and high heat flow of the Nazca-South America subduction zone. The aim of the work is to present hydrogeochemical and isotopic characteristics of thermal springs, as well as associated efflorescences precipitating in their vicinity and relationship of geothermal areas to active fault network.

The study area is located in the central Colca River basin, between Sibayo and Canco in the Western Cordillera of the Andes in southern Peru. The sampled thermal springs discharge from different sedimentary and magmatic rock formations (Jurassic-Cretaceous to Quaternary) and are situated on altitude range: 1380-2140 m a.s.l. (Colca Canyon floor), 3300-3800 m a.s.l. (Colca Valley floor) and 4330-4750 m a.s.l. (N slopes of the extinct Hualca Hualca volcano).

The hydrogeochemical and isotopic (δD and $\delta^{18}O$) characteristics of thermal waters in the study area indicates that the reservoir waters originate from a mixture of meteoric and magmatic fluids, with reservoir temperatures, estimated by Na-K geothermometry, varying between 180-220°C and exceeding 240°C in case of Paclla springs at the Colca Canyon floor. The temperature of the thermal water discharges varied from 30°C to 93°C. Different mixing ratio of deep-originated fluids with meteoric waters at shallow depth results in dilution of chloride (Na-Cl) waters controlled by magma degassing and by water-rock interactions and enriching with SO_4^{2-} and HCO_3^- ions. TDS of these waters varied from 1370 mg/L to 4398 mg/L. Another group of thermal springs constitute outflows of shallow steam-heated meteoric water which are dominantly sulphate and bicarbonate waters, with significantly lower TDS (275-1270 mg/L). Efflorescences accompanying the studied springs form mainly white, yellow and colourless coatings, encrustations and single crystals. Dominating mineral phases are K, Al, Mg, Fe, Na, Ca, NH_4 sulphates, Ca, Na carbonates and Na, Ca-Al chlorides. Elemental sulphur was also identified. In many cases, especially in the area of Paclla/Llahuar and Pinchollo, studied thermal springs show clear correlation with crustal normal and strike-slip faults. In other sectors their relation to active faults is less pronounced.