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A geothermal resource in the Puna plateau (Jujuy Province, Argentina): New insights from the geochemistry of thermal fluid discharges

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Several hydrothermal mineralization and thermal fluid discharges are distributed in the high altitude Puna plateau at the eastern border of the Central Volcanic Zone of the Andes in the Jujuy Province, a region where volcanic explosive activity developed from Oligocene-Miocene to Neogene produced giant calderas and huge ignimbrite deposits. This study presents the geochemical and isotopic composition of thermal fluids discharged from Granada, Vilama, Pairique, Coranzulì and Olaroz zones, which are located between S 22°20'- 23°20' and W 66°- 67°. This aim is to provide insights into the physicochemical features of the deep fluid circulating system in order to have a preliminary indication about the geothermal potential in this area. The occurrence of partially mature Na+-Cl- waters suggests that a deep (>5,000 m b.g.l.) hydrothermal reservoir, hosted within the Paleozoic crystalline basement, represents the main fluid source. Regional tectonics, dominated by S-oriented faulting systems that produced a horst and graben tectonics, as well as NE-, NW- and WE-oriented transverse structures, favour the uprising of the deep-originated fluids, including a significant amount (up to 16%) of mantle He. The dry gas phase mainly consists of CO_2 mostly produced from subducted C-bearing organic-rich material. The interaction between meteoric water and Cretaceous, Palaeogene to Miocene sediments at shallow depth gives rise to relatively cold Na+-HCO_3–type aquifers. Dissolution of evaporitic surficial deposits (salares), produced by the arid climate of the region, strongly affects the chemistry of the thermal springs in the peripheral zones of the study area. Geothermometry in the Na-K-Ca-Mg system suggests equilibrium temperatures up to 200 °C for the deep aquifer, whereas the H2 geothermometer equilibrates at lower temperatures (from 105 to 155 °C), likely corresponding to those of the shallower aquifer. Although the great depth of the main fluid reservoir represents a strong limitation to the exploitation of this geothermal resource, the occurrence of Li- and Ba-rich deposits associated with the hydrothermal fluids may attract financial investments, giving a pulse for the development of this remote region.