RENE-1: Geotermia en los Andes: un desafío para una sociedad sustentable

Geochemical evolution of Nevados de Chillán Geothermal System: evidences from hydrothermal alteration in well Nieblas 1

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The interplay between a heat source, permeable reservoir rocks and thermal fluids grants geothermal systems with a highly dynamic environment in which diverse factors shape their physico-chemical evolution. It is known that processes such as boiling and mixing of fluids as well as intense water-rock interactions, among others, are common in these settings. However, given the singularities of each geothermal system, it is not evident to elucidate their geochemical progress without a proper and detailed analysis of its hydrothermal alteration.

In order to define the geochemical evolution of Nevados de Chillán Geothermal System (NCGS), a hydrothermal system associated to an active volcanic complex in the Southern Andes, we studied the hydrothermal alteration assemblages in the 1000 m-length well Nieblas 1, by combining petrographic analysis, X-ray diffraction (XRD) and scanning electron microscopy (SEM) in thirty-eight samples.

Our data show a vertical zoning of the alteration mineralogy beginning with a shallow argillic zone up to 280 m depth, mainly channeled through fractures within the interval 170 and 220 m, where we report the presence of quartz, iron oxides, chlorite, corrensite, chlorite-esmectite and illite-esmectite. Overlapping the argillic alteration, between 100 and 300 m depth, we observed a sub-propylitic zone documented by the existence of calcite, quartz, traces of epidote, chlorite, chlorite-esmectite, illite-esmectite and zeolites. Finally, up to 1000 m, we notice a propylitic alteration characterized by the presence of epidote, calcite, albite, chlorite and illite. By means of cross-cutting relationships of the alteration mineralogy, together with the vertical zonation we established the existence of at least two hydrothermal events along the NCGS's evolution, during which the mixing with shallow fluids and boiling of deep fluids took place. This last process is evidenced by the presence of textures such us jigsaw quartz and bladed calcite. In order to further constrain the chemical nature and progress of the hydrothermal fluids associated to such events, fluid inclusions analysis will be carried out to determine parameters such as homogenization temperatures and salinity, among others. All these mineralogical characteristics will allow us to define a hydrothermal alteration model for this active geothermal system.