# Fluid evolution in an Andean geothermal system: coupling fluid inclusions thermometry, LA-ICP-MS and geochemical modeling

P. SÁNCHEZ-ALFARO[1,2]*, T. DRIESNER[3], C. HEINRICH[3], M. REICH[1,2], P. PÉREZ[2,4], G. ARANCIBIA[2,4], J. CEMBRANO[2,4], E. CAMPOS[2,5] AND S. LOHMAR[6]

[1]Universidad de Chile, Santiago, Chile (*correspondence: vsanchez@ing.uchile.cl, mreich@ing.uchile.cl)
[2]Centro de Excelencia en Geotermia de los Andes, Chile
[3]ETH Zürich, Isotope Geochemistry and Mineral Resources, Zürich, Switzerland (thomas.driesner@erdw.ethz.ch; christoph.heinrich@erdw.ethz.ch)
[4]Pontificia Universidad Católica de Chile, Santiago, Chile (pvperez1@uc.cl; garancibia@ing.puc.cl; jcembrano@ing.puc.cl)
[5]Universidad Católica de Antofagasta, Chile (edcampos@ucn.cl)
[6]MRP Geotermia Chile (silke.lohmar@geotermia.cl)

The nature of the interplay between active tectonics and fluid flow is a key feature to better understand the chemical evolution of fluids in geothermal and hydrothermal systems.

The objective of our current research is to assess the nature of the interplay between brittle deformation, chemical evolution of fluids and mineral paragenesis in the geothermal field of Tolhuaca in the Southern Andes volcanic zone. Tol-1 is a vertical 1.080 m deep core hole that yields relevant information regarding the evolution of the Tolhuaca geothermal system. The methodology includes fluid inclusion analysis using microthermometry and LA-ICP-MS in structurally-oriented fault-veins and veins hosted in the host rocks, and chemical analysis of the present-day vapor and liquid fluid phases from the geothermal reservoir. These analyses allow constraining the chemical evolution of the fluid and identifying thermal-regime changes.

Our results indicate that the metalloid (B, As) concentrations in paleo-fluids and present-day fluids are significantly different, strongly suggesting changes in the deep magmatic vapor contribution. Moreover, the structural and mineralogical vertical segmentation and the evidence of brecciation and wide-spread boiling episodes reveal a periodical feedback between fault-fractures networks activation and mineralization sealing the conduits for fluid flow. This hypothesis is being tested by numerical experiments of heat-fluid-rock interaction constrained by simulated and geologically meaningful P-T conditions.