

# Training and Research at the Andean Geothermal Centre of Excellence (CEGA)

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The Andean Geothermal Centre of Excellence (CEGA) is two years old, funded for five years (2011 to 2015), and renewable for five years more. A Conicyt-Fondap<sup>1</sup> project, CEGA offers scientific help for modeling geothermal reservoirs and improving geothermal knowledge in Chile and other Andean countries. CEGA works to develop geothermal as a sustainable, environmentally-friendly, and economically competitive alternative-energy source in Chile and Latin America.



Pools of water collect every spring at El Tatio Geysers Field.  
PHOTOS COURTESY OF CEGA.

How? By creating, improving, and communicating scientific knowledge about geothermal resources in Chile and the Andes; by training and encouraging top undergraduate and graduate students to advance basic and applied research in geothermal energy in academia and industry; by creating a new “in-house laboratory culture” (not yet available) for generating results in state-of-the-art facilities in Chile; by promoting collaborative-geothermal research among CEGA,

<sup>1</sup>Conicyt is the Chilean National Science Foundation program. Fondap is a Conicyt program supporting projects in priority areas.



Dr. Valiya M. Hamza (photo right) on a field trip with CEGA geologist Mauricio Muñoz. They are measuring water temperatures at wells throughout the Metropolitan Region of Chile. Earlier in his career, Dr. Hamza discovered an underground river flowing beneath the Amazon.

academic institutions, and industry; by identifying, evaluating, and developing new and emerging technologies for geothermal assessment and exploration; by increasing public awareness of geothermal energy; and by promoting geothermal as a renewable and clean alternative energy.

All this reinforces one foremost goal: building a framework for focused and collaborative geothermal projects in six research areas: Magmatic Systems, Heat-Water-Rock Interactions, Fluid Geochemistry, Reservoir Architecture & Geofluid Dynamics, Structure, Tectonics & Geophysics, and Surficial Processes & Environment.

Academic training is key. This means educating undergraduate, graduate, and post-doctoral students in all geothermal areas; encouraging graduate students to work in different national and international laboratories for interdisciplinary experience; participating in CEGA short courses, conference meetings, and workshops; and becoming a leading international student training center for geothermal-resource development in Latin America.

On an organizational chart, CEGA sits in the Department of Geology at the University of Chile, but it remains involved in geo-science and engineering programs at other Chilean universities. CEGA investigators work on research projects with about 40 students at the undergraduate, master, and doctorate levels.

What is studied? Examples include low-enthalpy processes (heat-flow mapping in the Santiago and Talca basins of central Chile) and



Graduate students Oscar Benavente and Constanza Nicolau sample geothermal waters with Dr. Dobson (photo right).

## Focus on Chile

high-enthalpy situations (alteration patterns in active and fossil geothermal fields; the mineralogy and geochemistry of silica sinters; structural controls on geothermal systems; gas geochemistry in selected geothermal areas; the dynamics of



Graduate student Constanza Nicolau (foreground) collects sinter samples at El Tatio Geothermal Field.

magmatic chambers; new isotopic systems in geothermal research; and geophysical surveys in active and fossil geothermal fields).

Several analytical instruments are available in CEGA laboratories. Students undertake water and rock analyses, mineral characterization, radiogenic dating, gas geochemistry (lab in progress), and geophysical surveys. All these help promote collaborative research with industry and with national and international centers—and they help improve geothermal training and research in Chile.

Current collaborative projects are underway at Lawrence Berkeley National Laboratory (U.S.), the Institute of Earth Science and Engineering and University of Auckland (New Zealand), Karlsruhe Institute of Technology and the International Geothermal Center (Germany), and Italian universities in Florence and Bologna. Study topics include helium isotopes in geothermal systems, gas geochemistry, silica sinter, structural control, and geophysical surveys of geothermal fields. The collaborations help students, researchers, and the people of Chile understand and facilitate geothermal development in the Andes of Latin America.

## CEGA/LBNL Collaboration

Dr. Patrick Dobson, of the Lawrence Berkeley National Laboratory (LBNL), traveled to Chile at the end of 2012 as a Fulbright Specialist in association with CEGA, the Andean Geothermal Centre of Excellence, at the University of Chile in Santiago. A collaborative effort between LBNL's geothermal program and CEGA was undertaken—a study of the variations in helium isotope ratios at geothermal hot springs and fumaroles throughout the Andes.

Dr. Dobson helped Chilean graduate students studying geothermal geochemistry and numerical modeling to increase their practical and theoretical skills. The students in the photograph at right are from the University of Chile on a visit to the Olla de Mote thermal area at the Nevados de Chillán—a group of stratovolcanoes in southern Chile.

The class was led by Professor Alfredo Lahsen and Dr. Juan Rojas; Dr. Dobson gave a guest lecture on geothermal exploration methods.



PHOTO BY P. DOBSON.