

Exploration



The search for new deposits in Chile and overseas is a permanent strategic activity that will enable us to ensure the future of our business.

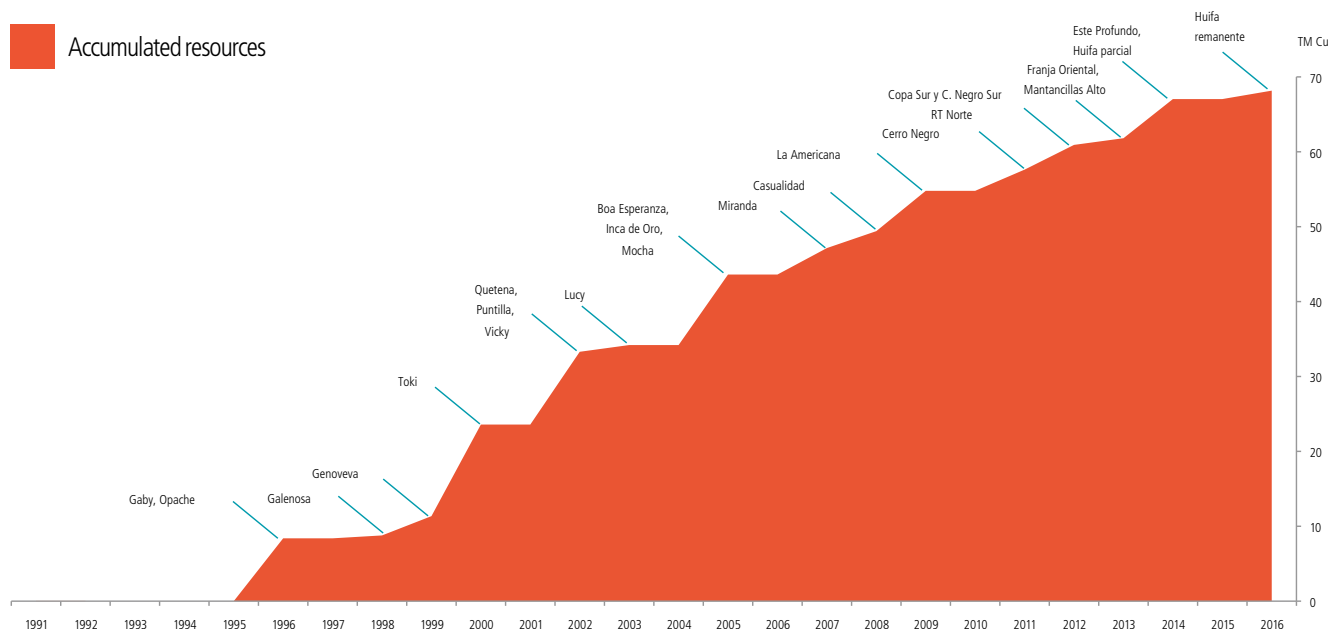
In mining, exploration activities comprise a series of stages that range from basic studies through to advanced projects. At each stage of this process, data, information and knowledge is added, regarding mineral resources discovered which, depending on their size and quality, will add to the company's mineral base and could in the future become new main operation for Codelco.

Our strategic plan has included exploration activities since 1991 when the company's Explorations Area was created.

Between 1991 and 2016, these activities contributed 68.2 million tonnes of fine copper to Codelco's resource and reserve inventory.

Geological resources discovered and incorporated into Codelco's inventory, 1991-2016

(in millions of tonnes of fine copper)



Note: These resources correspond to the stage of advanced exploration studies.

In 2016, reconnaissance work was completed on the La Huifa project. This geological resource, which contains 2.43 million tonnes of fine copper with a 0.2% total copper (CuT) cut-off grade, now forms part of Codelco's inventory.

After exploration work undertaken through to 2016, the company has a project portfolio with potential geological resources in the order of 7-10 million tonnes of fine copper. As these resources are still at different stages of exploration, they do not yet form part of the corporate inventory and their inclusion will depend on the results of subsequent phases.

Geological resources incorporated in 2016

0.2% CuT cut-off grade	Resource millions of tonnes	Copper grade %	Fine copper millions of tonnes
La Huifa	606	0,4	2,43

CuT: cobre total.

Codelco is among the companies with the world's lowest exploration costs (according to Strategies for Copper Reserves Replacement 2015, a study prepared annually by SNL Metals & Mining).

Investment

Global exploration investment marked a new record in 2012 when it reached US\$21,000 million. Non-ferrous metal exploration budgets subsequently tightened gradually to US\$7,000 million in 2016, which represented a 21% drop respect of the previous year and almost two-thirds regarding the 2012 record.

In 2016, investment in exploration in Chile reached US\$443 million, positioning it fourth in the world and first in Latin America where it was followed by Peru and Mexico.

At Codelco, we invested US\$38.4 million in mineral exploration activities during 2016, a 47% drop respect of previous year. This is mainly explained by budget adjustments due to lower commodity prices.

In response to these market conditions, we drew up a contingency plan that mainly implied postponing exploration follow-up activities which, although they correspond to the discovery stage, are the most intensive in investment. Instead, we were able to boost the process of generating exploration areas, thereby increasing the base of early-stage exploration projects, which will put us on a stronger footing once the investment cycle returns to normal.

Exploration in Chile

In 2016, the company focused mainly on brownfield exploration activities in an effort to improve the different Divisions development plans by identifying new opportunities to increase their mineral resource base.

In the case of greenfield exploration, which focuses on areas with the greatest potential to contain porphyry copper deposits, the different phases of the exploration process include geological mapping, geochemical sampling, the use of geophysical techniques and scouting drilling.

Areas of brownfield and greenfield exploration in Chile, 2016

In 2016, we successfully identified seven new exploration targets of which six were greenfield and one was brownfield.

	Anomalies	Prospects	Targets	Advanced exploration	Total
N° areas under study	44	18	5	1	68
N° areas perforated	Studies without drilling	4	2	1	7
Meters drilled		5,820	4,358	6,269	16,447

The La Huifa advanced exploration project, located in the vicinity of the El Teniente mine, concluded with a geological model and estimation of its copper and molybdenum resources. Its databases were audited by a specialized external company. Using a cut-off grade of 0.2%, its resources were estimated at 606 million tonnes, with an average CuT grade of 0.4% and 151 ppm Mo (parts per million of molybdenum) which, at a CuT cut-off grade of 0.5% corresponds to 128 million tonnes with an average CuT grade of 0.79% and 306 ppm Mo.

Mineralization occurs in a system of hydrothermal tourmaline breccias and copper sulfides wich is associated with the earliest stages of the mineralization of the El Teniente deposit.

Through the studies conducted in the La Huifa area, preliminary knowledge was acquired about mineralization on the eastern flank of the El Teniente Division, opening up new opportunities for exploration in this area.

Exploration overseas

Codelco’s overseas exploration seeks to broaden potential contributions to mineral resources considering that exploration in Chile has historically been intense, and to progress in the the company’s internationalization efforts.

This work has focused on Andean countries such as Ecuador, which have geological similarities to Chile, as well as those such as Brazil with a high potential for new copper discoveries.




Ecuador

- Exploration Agreement with Ecuador’s ENAMI EP in 2011
- Operated through the EMSA Ecuador subsidiary since 2012
- More than 20 prospects assessed
- Prospect at stage of obtaining environmental permit for follow-up exploration
- Project at follow-up exploration stage: Llurimagua, 25,000 meters of drilling
- In 2016, EMSA Ecuador applied for mining rights in 49 areas, totaling some 200,000 hectares.

Brazil

Activity since 2000

- Operated through the Codelco do Brasil Mineração subsidiary since 2001
- Deposit discovered in 2005
- Two follow-up exploration projects: Tancredo (with Xstrata) and Liberdade (with Pan Brazilian)
- Five prospects for basic exploration
- Exploration activity is concentrated in the Carajás mining district and positioning in the Tocantins and Goiás states.

 Exploration offices

Brazil

Our Codelco do Brasil subsidiary continued to evaluate its own portfolio of prospects and those which we are exploring under partnerships. Activities were concentrated in the Carajás mining district, located in the State of Pará, where most of the world’s largest mining companies are also engaged in exploration or have mining interests.

At present, Codelco has mining resources at the exploratory stage and with potential in the Liberdade project, which is part of the portfolio with its partnership, the local company Pan Brasil. Preliminary estimates of in situ resources at Liberdade are in the order of 242 million tonnes, with a copper grade of 0.77%.

We also carried out scouting drilling at five prospects in four of which we have found geological evidence of hydrothermal systems, similar to those associated with the district’s deposits. These will, therefore, be further explored in greater detail.

We also expanded our sphere of action positioning new mining properties in other states, particularly Tocantins and Goiás, which will increase our exploration base in Brazil.

Ecuador

In this Andean country, Codelco is undertaking exploration activities through an agreement, signed in November 2011, with state-owned Enami EP (Empresa Nacional Minera del Ecuador). In addition, it is conducting its own exploration through its 100%-owned subsidiary, Emsaec S.A. (Exploraciones Mineras Andinas Ecuador).

Under the agreement with Enami EP, we have evaluated more than 20 prospects of which the Llurimagua and Mina Real (or Nanguipa) projects are active.

The Llurimagua project is located in the Imbabura Province, 80 kilometers north of Quito, and is the most important prospect in the Enami EP-Codelco portfolio. In 2016, 10,000 meters of boreholes were drilled which, together with those drilled in 2015, takes the total to 25,000 meters. The geological evidence gathered so far confirms the existence of a porphyry copper-type deposit which is of interest to Codelco and means that exploration work will continue in 2017.

The Mina Real or Nanguipa project is located in the Zamora-Chinchipe Province, some 460 kilometers south of Quito. It is still at the initial exploration phase, with work on the surface to define possible drilling targets.

One of the most important events for mining exploration in Ecuador was the government's announcement in March 2016 that it will resume the award of mining concessions. In this context, our subsidiary there has applied for mining rights in 49 areas that total almost 200,000 hectares located in very promising and scarcely explored regions of the country. Once these rights have been obtained, these areas will become part of Codelco's own portfolio in Ecuador and will be subject to evaluation and preliminary geological exploration.

Innovation in exploration models

Exploration is a knowledge-based activity which handles a large volume of data, which is necessary to classify, keep up and update. To this end, we have created a system of geographic information that facilitates ready access to it.

Together with the conceptual models created using knowledge of the different deposits, this information enables us to identify the factors and critical variables that determine the geological processes involved in the formation and location of mineral deposits.

In developing exploration models, we have focused on applying technologies that allow indirect detection of mineral bodies located at great depth. This is, indeed, the key challenge for mining exploration today since all those bodies that are exposed or easy to detect have already been found.

In 2016, we also participated in research and technology development programs that included:

- A program of collaboration sponsored by the Australia's AMIRA International that focuses on identifying diagnostic minerals which form halos of mineralized systems. Based on the results of the first phases of this study, it was concluded that this methodology is promising for its use in areas with outcrops that are distant from mineralized centers which would permit vectorization towards the mineralized system. In 2016, a blind test was carried out in a pilot area proposed by Codelco and its results will be used to validate the methodology.
- Tests of new technologies for the acquisition of geophysical data, including the use of a drone for an internal magnetometry pilot project was carried out. In the second stage of this project, the data gathered will be validated and a second survey will be carried out, using a new drone with magnetometry equipment, designed specifically for high-resolution work.

Exploration partnerships

In the case of exploration, our aim is also to identify and manage the acquisition of assets and/or partnerships with third parties as a complementary mechanism for increasing our base of mineral resources.

These partnerships enable us to develop business opportunities in projects on mining properties belonging to Codelco or third parties.

As of end-2016, we had partnerships with third parties on properties belonging to Codelco in Chile in the Puntilla Galenosa project (with Pucobre), the Anillo project (Fortune Valley Resources Inc.) and the Roberto project (Anglo American Norte). In other countries, partnerships include both Codelco properties and those of third parties.



Dron measurements at the Chuquicamata exploration district.

Exploration partnerships

Projects in Chile	Partner	Type
Anillo	Fortune Valley	Oro
Puntilla – Galenosa	Pucobre	Cobre
Roberto	Anglo American Norte	Cobre

Projects overseas		
Liberdade	Pan Brasil	Cobre
Tancredo y otros	Xstrata Brasil	Cobre
Grupo Propiedades	(ENAMI EP) de Ecuador	Cobre

