Copihues and Banded Iron Formations (BIF): The Nahuelbuta Mountains - Southern Chile

R. Oyarzun & P. Cubas

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The copihue (Lapageria rosea, Philesiaceae) growing near Mahuilque (Nahuelbuta). Image: P. Cubas.

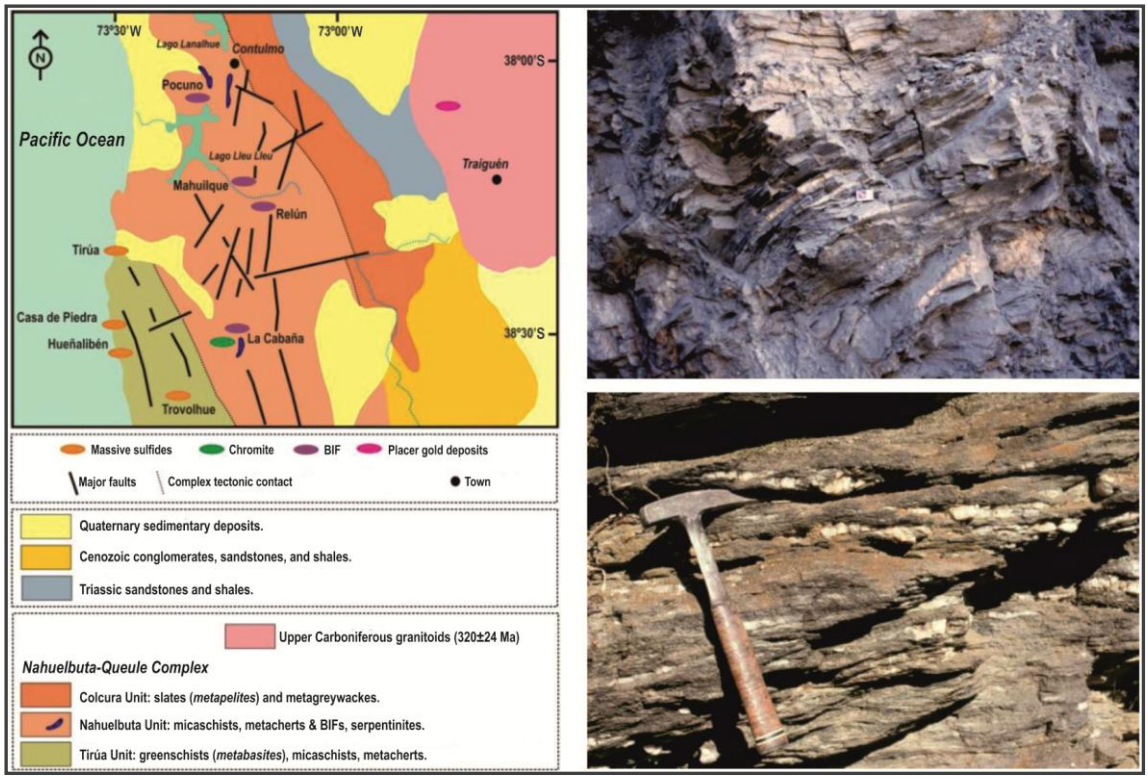
The Nahuelbuta Mountais get the name from the indigenous Mapuche language *(= Araucanian*) in which it means “big puma” (= *big cougar*). These mountains are part of the Chilean Costal Ranges and continue south into the so-called Queule Mountains. The Nahuelbuta Mountains extend for about 100 km long (*N-S*) and about 70 km wide (*E-W*), with a peak altitude of 1400 meters above sea level, although in general the altitudes do not exceed 1000 m. The annual rainfall is in the order of 3000 mm (= *3000 L* m^{-2}) (*Garreaud 2017*), which allows the existence of an imposing forest whose maximum expression is the araucaria (*Araucaria araucana: the “monkey puzzle tree”*), all of this in the context of a temperate rainy climate.

Location of the area (adapted from Garreaud 2017) and an araucaria forest (Araucaria araucana) in Nahuelbuta (Scott Zona 2010). The lichens that hang from the branches of the araucaria mainly correspond to the genus Protousnea (arrow).

R. Oyarzun and P. Cubas are Retired Associate Professors of Geology and Botany respectively

On the geology of the Nahuelbuta Mountains and the iron ore deposits

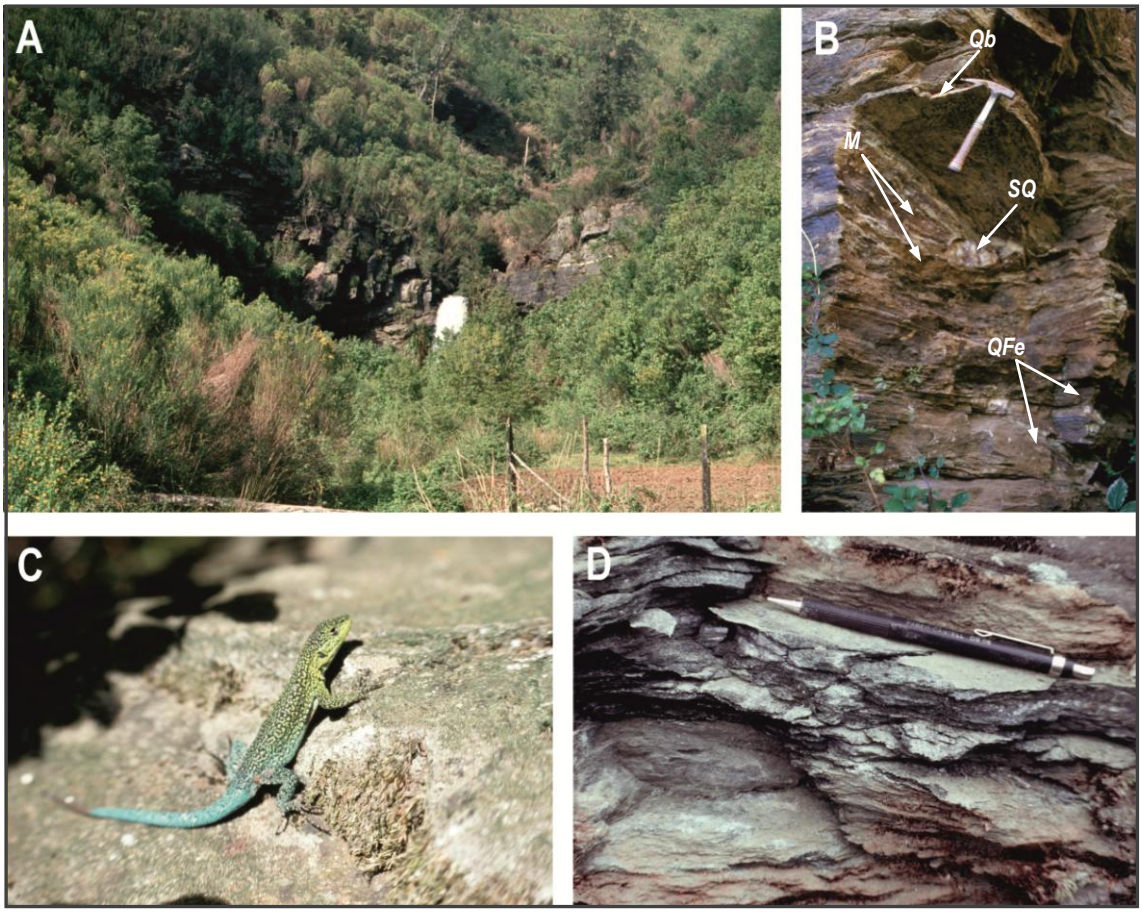
The Nahuelbuta Mountains are part of a tectonic block whose exhumation (*uplift*) began rapidly about 4 Ma (Melnick et al. 2009), that is, during Pliocene time. However, the rocks are much older and can be ascribed to the so-called Nahuelbuta-Queule Complex, which consists of Paleozoic rocks deformed to different degrees and originally belonging to an oceanic accretionary prism (*Oyarzun 1986; Oyarzun et al. 1986*). The complex can be divided from East to West into the following units (*e.g. Lillo & Oyarzun 2013*):



On the left, geology and mineral deposits of the Nahuelbuta Mountains (Oyarzun, 1986; Oyarzun et al., 1986); on the right, above, slates of the Colcura Unit in the town of Capitán Pastene; below micaschists from the Nahuelbuta Unit (Mahuilque). Lillo & Oyarzun (2013).

- Colcura Unit, with strongly folded slates and metagreywackes. High T − low P metamorphism.
- Nahuelbuta Unit, with micaschists, metacherts, BIFs, and serpentinites. Low T − medium P metamorphism.
- Tirúa Unit, with greenschists (*metabasites*), micaschists, and metacherts. Low T − medium P metamorphism.

The Nahuelbuta Unit hosts the only Banded Iron Formations (BIF) in the Pacific coast of South America and, unlike other BIFs in the world (*typically Precambrian*), this one is of Paleozoic age, a remarkably unique feature. Unlike those of Brazil (*Lake Superior type*), the Nahuelbuta BIFs are of the Algoma type (*Oyarzun et al. 1986*), that is, they formed in relation to volcanic activity, and together with the iron oxide facies (*magnetite*) these ores also carry sulfides (*pyrite, bornite, chalcopyrite*). These facies can be found in Mahuilque, Relún and La Cabaña (*see previous figure*), and in the first two localities the ore deposits have possible reserves of 170 Mt (Fe), with grades of 31% Fe in Mahuilque and 39% Fe in Relún (*Oyarzun et al. 1986*). Other deposits (*of lesser economic interest*) are massive sulphides in greenschists along the coast and chromite in serpentinites, plus some gold-bearing placer deposits (*see previous figure*).



The Mahuilque area (except D). A: The upper iron beds in quartzites with a gentle dip to the SE; B: Iron bearing quartzites (QFe) from the upper iron beds with intercalations of micaschists (M), barren quartzites (Qb) and segregation quartz (SQ); C: A "small inhabitant" of the sector, the locally known as "slender lizard" (Liolaemus tenuis); D) Greenschists (metabasites) south of Mahuilque, with chlorite-epidote-albite-actinolite. Images: P. Cubas.

On the copihue, national flower of Chile and a typical plant of the zone

Copihues (Hunt 2005)

Why write here about the copihue and not about the araucaria? Because size is not always the most important thing, and because also, "small is beautiful". In addition, the copihue habitat has decreased rapidly, among other things because the forest to which the copihue belongs has almost disappeared in Chile (*Terram 2016*).

The copihue (*Lapageria rosea*, Philesiaceae) is a climbing perennial plant that can reach up to 6 m in height, with alternate, lanceolate-ovate leaves, up to 12 cm long. The flowers are large (up to 10 cm long), and have the typical organization of many monocots: 6 free tepals (pink, red and sometimes white), 6 stamens and an elongated pistil with a trilobed stigma.

The fruit is an ovate-oblong to spherical berry, with a white and sweet pulp, edible, with numerous seeds inside. The

copihue is relatively frequent in the native forests of the Maule, Biobío, Araucanía and Los Ríos regions, but at low altitudes and in sectors with moderate winter cold.

The genus name *Lapageria* was a tribute by the Spanish botanists Hipólito Ruiz and José Pavón (*who described the plant in 1802*) to the first wife of Napoleon Bonaparte, whose maiden name was Marie Josèphe Rose Tascher de la Pagerie. The common name, copihue, comes from the name given by the Mapuches to the fruit of the plant.

Copihues from Nahuelbuta near Mahuilque. Image: P.Cubas.

The illegal collection of copihue from the forests is resulting in a poor prognosis for the conservation of the species. In this regard, it would be important to legally impede the cutting of wild plants without proper authorization (*for their part, people should stop buying them*); up to now the restrictions only affect a small part of the country, leaving the most important areas (*in southern Chile*) unprotected (*Terram 2016*).

A final comment

As we explained at the beginning of this work, Nahuelbuta means the mountain range of the "big puma". In this regard, this is no longer just a linguistic curiosity (as in the past), because in fact the cougars have returned to their old environment. The above are images captured from a home video in the surroundings of the Cordillera de Nahuelbuta (Radio Bio Bio 2018).

References

R. Garreaud (2017) Meteorología de la Cordillera de Nahuelbuta. http://dgf.uchile.cl/rene/Nahuelbuta/#:~:text=En%20el%20Balance%20Hidrico%20Nacional,con%20unos%201000%20mm%2Fa%C3%B1o.

E. Hunt (2005) Copihues. En: https://es.wiktionary.org/wiki/copihue

J. Lillo & R. Oyarzun (2013) Geología Estructural Aplicada a la Minería y Exploración Minera: Principios Básicos. Ediciones GEMM - Aula2puntonet, 206 pp. http://www.aulados.net/GEMM/Libros_Manuales/index_libros.html

D. Melnick, B. Bookhagen, M.R. Strecker & H.P. Echtler (2009). Segmentation of megathrust rupture zones from fore-arc deformation patterns over hundreds to millions of years, Arauco peninsula, Chile. Journal of Geophysical Research, 114: B01407 (doi:10.1029/2008JB005788).

R. Oyarzun (1986) El Complejo de Nahuelbuta-Queule: un posible caso de acreción paleozoica en Chile central-sur. Estudios Geológicos 42: 11-22.

R. Oyarzun, H. Clemmey & S. Collao (1986) Geologic and metallogenic aspects concerning the Nahuelbuta Mountains banded iron formation, Chile. Mineralium Deposita 21: 244-250.

Radio Bio Bio (2018) Pumas en Nahuelbuta. https://www.facebook.com/RadioBioBio/videos/pumas-en-nahuelbuta/1976974442592676/

Scott Zona (2010) Parque Nacional Nahuelbuta. Bosque de Araucaria araucana. https://es.wikipedia.org/wiki/Cordillera_de_Nahuelbuta#/media/Archivo:P.N.Nahuelbuta2.jpg

Terram (2016) En Chile no se conoce el estado de conservación del copihue, a pesar de ser la flor nacional. https://www.terram.cl/2016/09/en-chile-no-se-conoce-el-estado-de-conservacion-del-copihue-a-pesar-de-ser-la-flor-nacional/

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