METALLOGENIC BELTS IN THE CHILEAN PATAGONIA, BETWEEN 44° AND 48°S

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INTRODUCTION

The purpose of this paper is 1) to describe the different types of mineralization present in the Chilean Patagonia between 44° and 48°S (Aysén region), and 2) to interpret, on a regional scale, its occurrence in metallogenic belts.

GEOLOGY

The oldest rocks of the region have been grouped into the Metamorphic Basement extended along the western margin and the southern part of the region. They are low to medium grade metamorphic rocks, represented by schists, phyllites, quartzites and marbles of probably Upper Paleozoic age. This basement is unconformably overlayed by Upper Jurassic volcanoclastic rocks of rhyolitic to andesitic composition (Ibañez Formation). At the end of the Ibañez volcanic activity, started a back-arc marine transgressive-regressive cycle, corresponding to the Coyhaique Formation. This includes limestones, coquinas, black shales and sandstones of Lower Cretaceous age. The marine regression was accompained by the begining of the volcanism of the Divisadero Formation (Upper Cretaceous), represented by rhyolitic, dacitic, andesitic and minor basaltic rocks. These volcanic rocks underlie rhyolitic to basaltic rocks (Chile Chico Formation), that are products of a bimodal volcanism of Eocene age. In the Early Cenozoic, along the western side of the region, another volcanic arc was developped (Traiguén Formation), represented by silicic ash-flow tufs, sediments, and rhyolitic to basaltic lavas (Hervé et al., 1995). Along the eastern part of the region, the Chile Chico Formation underlie deposits of marine (Guadal Formation) and continental (Rio Frias Formation) Cenozoic basins. Most of the intrusive rocks are part of the North Patagonian Batholith, which is about 100 km wide Meso-Cenozoic composite plutonic belt that crosses the region from north to south. This huge batholith range in composition from granites to gab ›s, and it's ages vary from Late Jurassic to Pliocene (Pankhurst and Hervé, 1994). Tl : most important tectonic feature of the region is the dextral intra-arc strike-slip Liquiñe-Ofqui fault zone, at least

active since the Early Cenozoic (Cembrano et al., 1996). Holocene volcanism and Early Cenozoic volcano-sedimentary deposits (Traiguen Formation) have a close causal relationships with this fault zone.

MINERALIZATION

Mineralization in the last 170 Ma is generally restricted to three longitudinal metallogenic belts, in which hydrothermal activity was focused along the respective magmatic arcs: (Fig. 1).

1) **Upper Jurassic belt**, along which Au-Ag epithermal and Zn-Pb-Ag±Au mesothermal mineralization were formed.

2) **Lower Cretaceous belt**, which contains Au-Ag epithermal, Zn-Au skarn, and low grade porphyry copper mineralization, and

3) **Miocene belt**, which hosts Au epithermal and porphyry copper mineralization.

The Upper Jurassic Belt, Precious metal epithermal mineralization is hosted in felsic volcanic and subvolcanic rocks of the Ibañez formation. It is related to silicic and sericitic alteration and consists of stockworks and disemination of pyrite, arsenopyrite, native gold, electrum, and minor sphalerite, galena, and chalcopyrite. The ore bodies are stratiform horizons and funnel-shaped pipes. Grades vary from 0.2 to 4 ppm Au and 10 to 70 ppm Ag. Basic metals mesothermal mineralization consists of irregular bodies containing stockwork and dissemination of pyrite, arsenopyrite, sphalerite, Ag-bearing galena, and minor gold. Mineralization is hosted in felsic volcanic and subvolcanic rocks of the Ibañez formation, which present sericitic alteration. Ore grades vary from 2 to 8% Zn, 0.4 to 3% Pb, 10 to 100 ppm Ag, and 40 to 1,100 ppb Au. Field observations, structural interpretations and radiometric dating indicate that both type of mineralization occurred synchroneously with a magmatic and tectonic activity, in an Upper Jurassic (152-140 Ma) intra-arc pull-apart basin environment. Probably, both types of mineralization correspond to an hydrothermal system peripheral to porphyry copper (Palacios et al., 1996a; Parada et al., 1996).

The Lower Cretaceous belt. Precious metal epithermal mineralization is hosted in felsic volcanic rocks and domes of the Ibañez and Divisadero formations. Au-Ag mineralization occurs within sericitic and silicic alterations and consists of veins, hydrothermal breccias, stockwork and dissemination. Metallic assemblage is pyrite, silver sulphosalts, native gold, galena, and sphalerite. Ore grades vary from 0,3 to 15 ppm Au and 10 to 1,000 ppm Ag. Radiometric dating indicate that epithermal activity occurred between 99 and 113 Ma (Townley, 1996). Calc-silicate Au-Zn skarn mineralization is hosted in a fossiliferous limestone unit of the Coyhaique formation. Hydrothermal mineralization consists of sphalerite, native gold, electrum, hessite, scheelite, pyrrhotite, pyrite, arsenopyrite, galena, chalcopyrite, and maldonite. Geological information and radiometric data indicate that mineralization occurred between 100 and 108 Ma, related to felsic and dioritic intrusive magmatism (Palacios et al., 1996b). Low-grade porphyry copper mineralization consists of quartz dioritic stocks that intruded felsic tuffs of the Ibañez and Divisadero formations. Hydrothermal alteration corresponds to a potassic centre surrounded by phyllic and propilitic envelopes. Mineralization includes a weak stockwork with pyrite, chalcopirite,

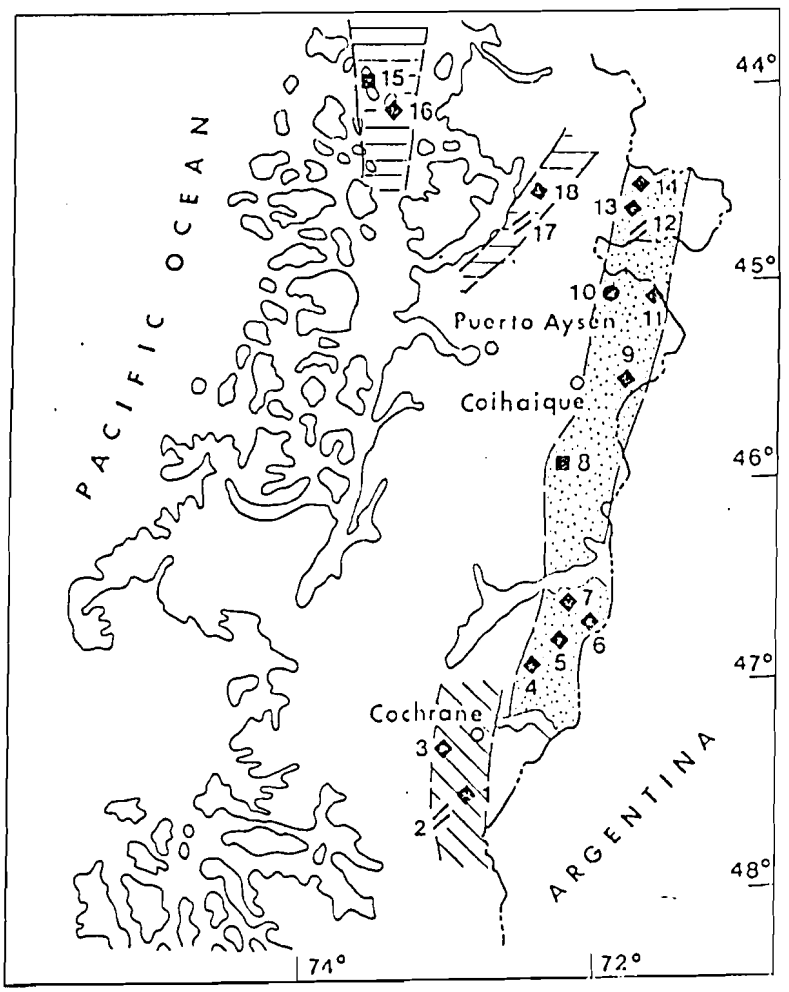

Fig. 1: Metallogenic belts in the Chilean Patagonia.

Inclined dash: Upper Jurassic belt; Dotted zone: Lower Cretaceous belt; Horizontal dash: Miocene belt; Diamand: epithermal mineralization; Parallel lines: veins (mainly epithermal); Circle: skarn mineralization; Square: porphyry copper mineralization.

1. El Faldeo prospect, 2. Lago Chacabuco prospect, 3. Lago Azul prospect, 4. Rio Furioso project, 5. Rio Amarillo prospect, 6. Rocoso prospect, 7. Fachinal mine, 8. Turbio prospect, 9. Castor-Pollux prospect, 10. El Toqui mine, 11. Katerfeld project, 12. Santa Teresa prospect, 13. Las Quemas prospect, 14. Cerro Agujas prospect, 15. Leucayec prospect, 16. Mulchey prospect, 17. El Queulat bajo prospect, 18. El Queulat alto prospect.

molybdenite and magnetite. Ore-grades vary from 0,1 to 0,2% Cu and 200 to 750 ppm Mo (Candia et al., 1994).

The Miocene belt. Consists in two metallogenic lineaments (oriented NS and NE) that follow the strike of the major fault-zones of the Liquiñe-Ofqui structure. Au-rich epithermal mineralization consists of veins, and irregular lens hosted in Paleozoic filites and Miocene microdioritic stocks, or forms stockwork in felsic volcanics of the Traiguén formation. Mineralization contains pyrite, arsenopyrite, and gold related to silicic and/or sericitic alteration. Ore grades vary from 0,2 to 60 ppm Au. Field observations suggest that the epithermal mineralization is strongly related to the epizonal intrusion of microdioritic stocks, dated in 5 Ma. Low-grade porphyry copper mineralization corresponds to quartz dioritic stocks that intrude the volcanic rocks of the Traiguén formation. Recognized hydrothermal alteration includes a phyllic centre with propylitic envelop, and mineralization (mainly as stockwork) is pyrite and chalcopyrite, with minor bornite and molybdenite. Ore-grades range from 0,2 to 0,5% Cu and 50 to 100 ppm Mo. Both types of mineralization developed in a intra-arc pull-apart basin tectonic environment.

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