



## **Mineralized and Barren Tourmaline Breccia at Río Blanco-Los Bronces Copper Deposit, Central Chile**

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The Río Blanco-Los Bronces porphyry copper-molybdenum cluster (14.8-4.3 Ma) in central Chile is one of the largest mining districts of the world with more than 200 Mt of contained Cu; almost 30% of these resources are hosted by hydrothermal breccias. These breccia complexes are tourmaline-, biotite-, chlorite-, or iron oxide-cemented and are widespread in the Paleo-Eocene and Mio-Pliocene porphyry Cu-Mo belt of the central Andes. The ongoing research project aims to understand the time-space relationships between the different breccia bodies and the multiple porphyry intrusions. For this, two cross sections in the southern part of the deposit (Sur-Sur and La Americana areas) are studied. Most interesting from the economic/genetic point of view is the intermineral breccia (tourmaline- and biotite-cemented), which have high copper grades. It is under debate whether there is a vertical mineralogical zonation of the cement of the breccia body from tourmaline-rich at the top to biotite-dominated at the bottom, or there are two superimposed breccia formation events. Textural and mineralogical observations of benches- and tunnels-outcrops, drill cores, and polished-thin sections support the first hypothesis.

Our work has been focused on tourmaline chemistry due to its high resistance to alteration and weathering, which allows this mineral to retain its original isotopic signature. Preliminary results of 127 microprobe measurements of tourmaline chemistry from the early mineralized breccia (BXT) and the late barren one (BXTTO) show that all the tourmalines belong to the alkali group and the composition ranges between the dravite-schorl end members.

There is a pronounced negative correlation between Fe (ferric?) and Al, probably due to exchange at the Z octahedral position. The backscatter images of tourmaline show oscillatory and sector zonings, i.e., alternating light bands/zones (high CaO, FeO, Na<sub>2</sub>O) and darker ones (enriched in Al<sub>2</sub>O<sub>3</sub> and MgO). There is no significant difference between the concentrations of the major constituent elements (SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, FeO, MgO), but a slight enrichment of TiO<sub>2</sub> is recognized in the BXTTO.

Previous works attempted to determine the age of the brecciation-mineralization event, dating sericite and biotite. The ages were interpreted to record thermal resetting of the K-Ar system by later intrusions. Therefore, we are attempting Ar-Ar dating of tourmaline (closure temperature ~600°C) albeit its low K<sub>2</sub>O contents (average 0.04 wt. %).

We will complement the tourmaline major element measurements (EMPA) with minor and trace elements data (LA-ICPMS) to find some discriminating factor between fertile and barren crystallization environment. We are also conducting B-isotopic analyses to identify the source/s of boron in these fluids (magmatic vs non-magmatic -evaporitic- origin).