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## Alteration and Mineralization Types of the Laurani Porphyry Deposit in Central-Andean Metallogenic Belt, Bolivia

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### 1 Introduction

The Laurani porphyry deposit is located in the Altiplano, an extensive North-South trending structural basin that formed in Central-Andean metallogenic belt, Bolivia. The Altiplano poly-metallic province contains sub-volcanic ore deposits, principally with Pb, Zn, Ag, Cu, Cd mineralization which are associated with acid differentiated end products of Upper Tertiary volcanic activity (F.Ahlfeld, 1967).

The rock units expose in the Laurani ore-field consist of Silurian shales, siltstones, and sandstones that crop out among the small hills surrounding the volcanic complex, and are unconformably overlain by poorly consolidated Tertiary red-bed conglomerates, sandstones, and siltstones (Kurt T. Katsura, 2004). The Laurani volcanic complex includes the extrusive volcanic rocks and sub-volcanic intrusions, the former consists of extrusive andesite and dacite flows, breccias, intercalated tuffs, agglomerate and tuffaceous sediment rocks, and the later consists of porphyritic andesite and porphyritic dacite intrusion.

Structures at the Laurani deposit are relatively single while well developed, which mainly consist of different generations faults and joints. And structures may have an important controlling effect on mineralization (Kurt T. Katsura, 2004).

Though the deposit was discovered and mined during the Spanish Colonial Times, its research degree is very lower than the other deposits in this region. Based on geological mapping of ore district, the alteration and mineralization types of the deposit have been summarized firstly.

### 2 Alteration and mineralization types

#### 2.1 Alteration types

Widespread hydrothermal alteration in the ore district, and the main alteration types include silicification, sericitization, argillization and propylitization. In them, silicification develops mainly near the ore-bodies, which appears as cryptocrystalline siliceous bands, and quartz has a paragenesis relation with pyrite, tetrahedrite and other ore minerals. Sericitization occurs in white and off-white, schistic and scaly, which is mainly altered from feldspar. Argillization is one of widespread alterations in the deposit, and mainly includes the mineral paragenesis of kaolinite and alunite. The extrusive volcanic rocks and sub-volcanic intrusions have occurred in the argillization of different intensity. Propylitization occurs in the edge of the weak-intermediate grade argillization (Mateo, 2004), which principally includes the mineral paragenesis of epidote and chlorite.

#### 2.2 Mineralization types

Mineralization in the Laurani deposit has a paragenetic relationship with the tectonic activity and magmatism, and four mineralization types can be identified. Porphyry-type Au-(Cu) mineralization in porphyritic andesite shows the ores of lower grade, but a potentially large tonnage (10-90 Mt, based on similar deposits). This mineralization type is similar with the Kori Kollo gold deposit which is far approximately 55km to southern Laurani district, and the gold occurs with disseminated sulfides and as fracture filling veins and veinlets in argillic altered rocks beneath a silica cap (Kurt T. Katsura, 2004). Epithermal veins-type Au-Pb-Zn-Ag-(Cu) mineralization is located in the San Geronimo and Tatal Pata areas, and is identified as an underground reserve of 2 million tons of oxide ore in the veins that grade 1% copper, 220gpt silver, and 2.5gpt gold (Enns and Findlay, 1996). Contact-type Cu-Au-Ag mineralization mainly occurs within the contact zone of porphyritic andesite and intercalated tuffs.

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The ore-bodies of the contact-type mineralization are generally large and thick, and in veins, lenticular and other irregular shaped. Explosive breccia-type Au-Cu mineralization hosts within breccias, and distributes mainly in veins and veinlets. Four mineralization types constitute a porphyry-type ore-forming system. Therefore, the Laurani deposit occurs in a great ore-finding potential.

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