CHARACTERIZATION OF THE MINERALIZING FLUIDS OF THE QUEBRADA DEL DIABLO LOWER WEST EPITHERMAL GOLD DEPOSIT, ARGENTINA

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BACKGROUND

The Gualcamayo Mining District (GMD) is located in the eastern Precordillera of Argentina. Gold mineralization in the district is hosted by three deposits (Fig. a): Amelia Inés- Magdalena (AIM), Quebrada del Diablo (QDD) Main, and Quebrada del Diablo (QDD) Lower West.

The oldest rocks of the GMD area are Late Cambrian to Early Ordovician marine platform limestones. These rocks are overlain by Middle Ordovician shales and Upper Ordovician siliciclastic conglomerates and sandstones deltaic deposits. These deposits are discordantly overlain by post-glacial transgressive facies and a long-lived sequence of paralic sedimentary facies of Carboniferous to Permian age. The Paleozoic sequence is intruded by the Gualcamayo Igneous Complex, which consists of subvolcanic dacitic intrusives of Late Miocene age (~9 Ma) (Fig. a).

AIM consists of veinlets and breccias with a paragenesis of pyrite, chalcopyrite, sphalerite, arsenopyrite, gold, calcite, and quartz which overprints a skarn mineralization.

QDD Main is a gold deposit hosted in dissolution and collapse carbonatic breccias affected by dolomitization, silicification, and decarbonatization. The gold mineralization consists of free gold in microscopic grains spatially associated to oxidized sulfides (pyrite, marcasite, As-pyrite, chalcopyrite, sphalerite, and pyrrhotite), galena, orpiment, realgar, cinnabar, calcite, quartz, gypsum, and barite.

QDD Lower West is a gold deposit with an ore grade of 2.85 g/t located at ~ 600 m depth and to the west of QDD Main. The mineralization of QDD Lower West is hosted by the cement of tectonic breccias conforming an irregular body elongated in West-East direction of 500 m long, 100 to 150 m wide and ~150 m thick. Three alteration-mineralization stages were recognized in this deposit. The first stage consists of a fine-grained intergrowth of pyrite, arsenopyrite, chalcopyrite, and sphalerite forming the cement of tectonic breccias. This ore paragenesis is spatially associated with sparitic calcite (I) and microcrystalline aggregates of quartz (I). Pyrite and chalcopyrite of the first stage are replaced by hypogene marcasite and covellite, respectively, suggesting an increase in ϕS during this mineralization stage. The second stage is formed by barren calcite veinlets (calcite II). The third stage consists of fine-grained intergrowths of calcite (III), adularia and quartz (II) in veinlets and minor hydrothermal breccias. Spatially associated with these minerals there are realgar, orpiment, calaverite, and coloradoite.

The aim of our research is to establish the physicochemical conditions and the origin of the mineralizing fluids of the QDD Lower West gold deposit based on ore paragenesis, isotopic, LA-ICP-MS and fluid inclusion studies in order to build a genetic model for this deposit.

METHODS

The LA-ICP-MS mapping was performed in one sample at the Chemical Fingerprinting Laboratory of Laurentian University with a Resonetics Resolution M-50 excimer Ar–F laser system with He–Ar carrier gas.

Fluid Inclusion studies included petrographic and micro-thermometric analysis and were performed in calcite II of seven samples. The micro-thermometric analysis were conducted using a Linkam stage calibrated at -56.6 °C, +0.0 °C, and 25 °C. A heating rate of 5 °C/s was used for ice-melting temperatures and 10 °C/s for homogenization temperature measurements. Salinity and density were calculated using the Microsoft Excel spreadsheet for interpreting micro-thermometric data from fluid inclusions HOKIEFLINCS_H_2O-NaCl.

One sample of limestone host-rock and one sample of hydrothermal calcite were analyzed for C and O isotopes and two samples of sulfides were analyzed for S isotopes at Activation Laboratories (Actlabs, Canada).

RESULTS

LA-ICP-MS mapping shows that gold is hosted in pyrite and as submicroscopic inclusions in sphalerite and calcite (Fig. b). Our fluid inclusions results indicate that the barren fluids of the second stage had temperatures between 306.5 and 248.5 °C and low salinity (~1.5 wt.% NaCl eq.). The δ^{18}O value of the hydrothermal calcite (17.3‰ δ^{18}O SMOW) is lighter than 2 fluid that obtained for the limestone (20.2‰ δ^{18}O SMOW), while the δ^{13}C value of hydrothermal calcite is slightly heavier than that obtained for the limestone (-1.54 ‰ δ^{13}C VPDB). This could indicate that C and O in hydrothermal calcites come from the limestones by carbonate dissolution process. The δ^{34}S

H S values calculated from the isotopic composition of the first stage pyrite are ~2 ‰ (At 305.5 to 294.8 °C: -1.79 and -1.65 ‰ $\delta^{34}S$. At 248.5 °C -2.09 and -1.95 ‰ $\delta^{34}S$), which is within the magmatic field (generally between -5 and 7‰).

CONCLUSIONS

The ore paragenesis studies performed in QDD Lower West deposit reveals that early mineralizing fluids (that led to gold mineralization hosted in pyrite and as submicroscopic inclusions in sphalerite and in calcite), had intermediate sulfidation conditions with the fS increasing towards the end of the stage. According to fluid inclusion results, the barren fluids of the second stage had low temperature and salinity. The late mineralizing fluids were neutral and had intermediate to high sulfidation conditions. The isotopic results reveal that the limestone host rock was the source of the C and O and that sulfur was of magmatic origin.

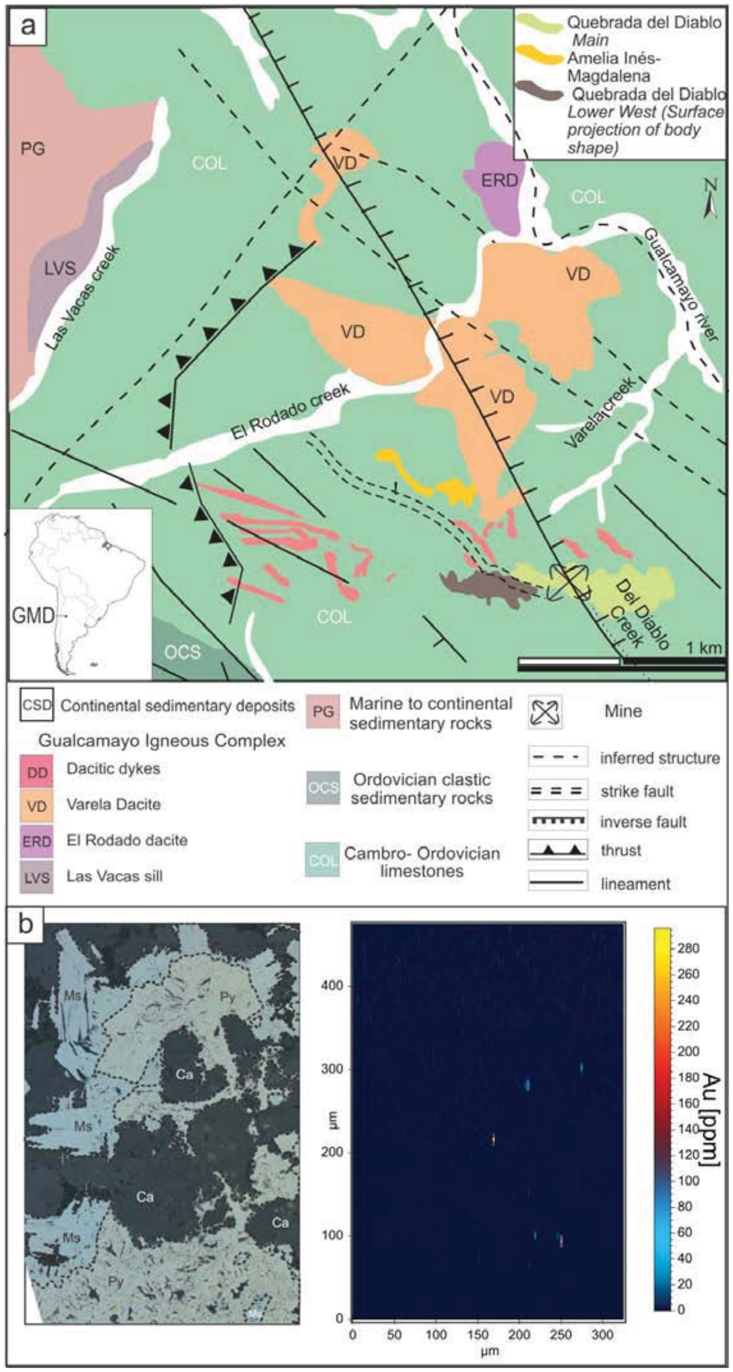

Figure. a) Geology of the GMD showing the location of the mineralized bodies. b) LA-ICP mapping. Left: Mapped sample