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THE DON SIXTO MINING PROJECT: A LOW SULPHIDATION AU-AG DEPOSIT OF PERMIAN-TRIASSIC AGE, MENDOZA, ARGENTINA. MINERALOGY, FLUID INCLUSIONS, STABLE ISOTOPES AND 40AR/39AR AGE RESULTS

5-08

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The Don Sixto deposit, formerly known as El Pantanito and La Cabeza, is located in the southeastern Mendoza Province, in the San Rafael massif, and is one of the few epithermal gold mineralizations related to the Permian-Triassic magmatism in central western Argentina. Don Sixto is a low sulfidation Au-Ag deposit with a gold resource of 1,258,000 ounces, considering a cut-off grade of 0.5 g/t Au (Van der Heyden *et al.,* 2007).
The local geology (Fig. 1) includes the Late Carboniferous Agua Escondida Formation consisting of alternating beds of sandstone and shale. These rocks are uncomformably overlain by the volcanic-pyroclastic units of the Choique Mahuida Formation (Early Permian-Late Triassic) with rhyolite, rhyolitic ignimbrite, and pyroclastic lenticular deposits. The rhyolitic subvertical dikes of the El Portillo Group (Late Permian-

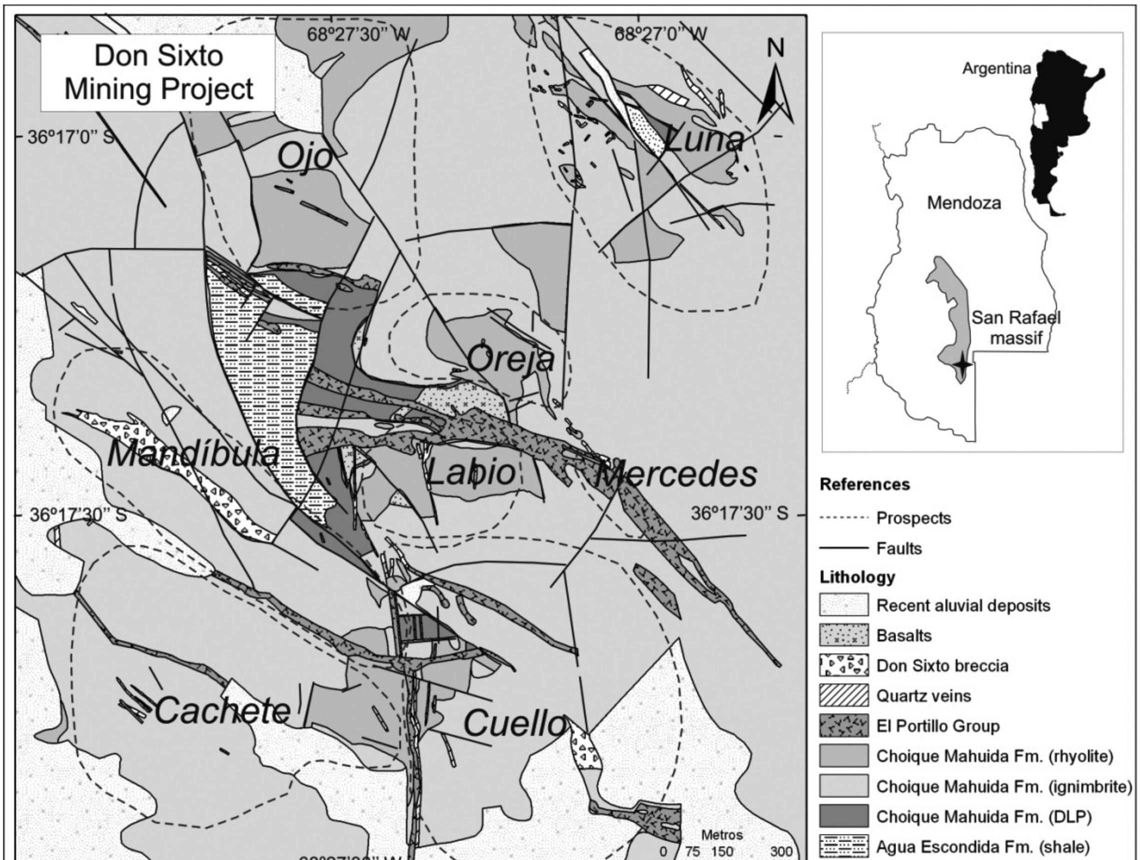

Fig. 1 - Geologic map of the Don Sixto mining area. Modified from Mugas Lobos *et al*. (2010).

Early Triassic) crosscut the previous sequences, mainly with a NW-SE and N-S strike (Mugas Lobos *et al.,* 2010). Minor irregular bodies corresponding to Don Sixto and Silicea breccias are locally significant. The hydrothermal alteration is widespread and affects the ignimbrites and rhyolites that are strongly to moderately silicified and moderately to strongly sericitized; argillic and propillitic alterations are weakly to moderately developed.

The mineralization occurs as Au-quartz veins and Au-dissemination in the volcanic-pyroclastic units. Detailed studies allowed the identification of seven stages of mineralization (Mugas Lobos 2012). The first sixth stages are quartz veins and the last stage is represented by fluorite; most of these stages have banded, colloform, and comb infilling textures. The presence of quartz veins with bladed calcite replacement texture (bladed quartz, Fig. 2a) and quartz veins with adularia crystals (Fig. 2b) are indicative of boiling processes in the hydrothermal system.

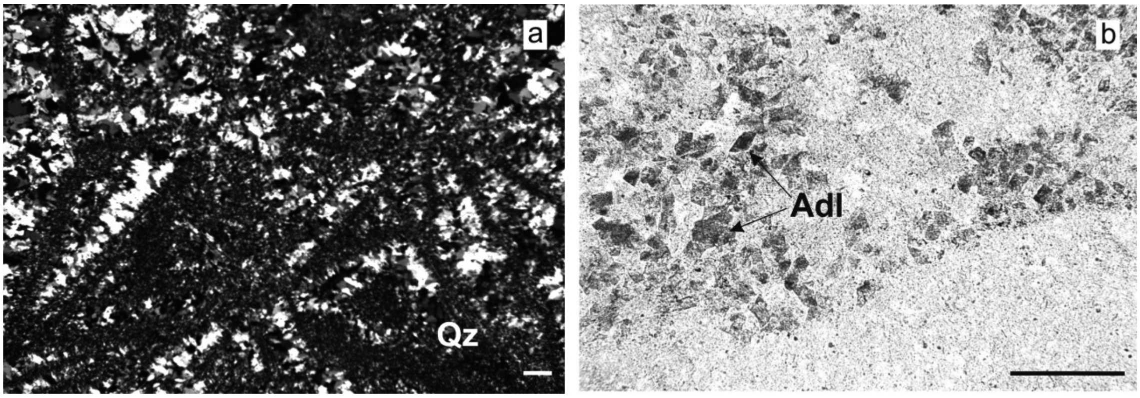

Fig. 2 - a. Lattice bladed quartz texture. b. Rhombic adularia crystals (<60 μm) in a bladed quartz vein. Abbreviations according to Whitney and Evans (2010); bar scale = 200μm.

The microthermometric studies were performed in quartz and fluorite samples, in petrographically defined fluid inclusion assemblages (FIAs, Goldstein and Reynolds 1994). Small (<10 μm), primary, mainly irregular, biphasic (liquid-vapor) fluid inclusions were analyzed to obtain melting (T_m) and homogeneization (T_h) temperatures. For the quartz veins, the salinity and homogenization temperatures have their maximum value in the stage 4, related to a boiling process, with values up to 4.96% NaCl eq. and <286.9ºC respectively. In fluorite, the salinity and homogenization temperatures have lower average values with 1.05% NaCl eq. and 173.1ºC respectively.

As a complement, stable isotope studies for oxygen and sulfur were performed in quartz and pyrite samples from the vein system. For the oxygen, the $\delta^{18}O$ values for the different quartz stages are in the range of 1.11 to 4.41‰, relative to VSMOW and the calculated δ value for the fluid is in the range of $\delta^{18}O_{H2O}$=-6.92 to -3.08‰; these final results indicate a meteoric source for the oxygen in the hydrothermal fluid. For the sulfur, the obtained δ34S values were 2.37 and 1.77‰, relative to VCDT. As an approximation, the calculated δ value in the fluid is $\delta^{34}S_{H2S}$ = 1.09‰, which indicates a possible magmatic or even a mixed source.

The ore mineral association in Don Sixto (Fig. 3) includes major amounts of pyrite, arsenopyrite, chalcopyrite and sphalerite, with lesser pyrrhotite, galena, marcasite, magnetite, bornite, boulangerite and polybasite. The precious metal bearing minerals are represented by gold of variable fineness, silver, acanthite, uytenbogaardtite, stromeyerite and a selenium-enriched mineral association with acanthite, polybasite and naumannite, together with the tellurium-enriched stutzite and cervelleite. The main precious metal mineralization occurred in the stage 4, associated to the boiling process. Chalcocite, digenite and covellite, together with supergenic hematite, goethite and anglesite were recognized.

The age of the alteration-mineralization process was obtained from adularia crystals by the $^{40}Ar/^{39}Ar$ multiple step heat method, giving a result of 252.7±1.3 Ma (Mugas Lobos 2012); this age directly links the mineralization at Don Sixto to their hosting Permian-Triassic magmatic rocks.

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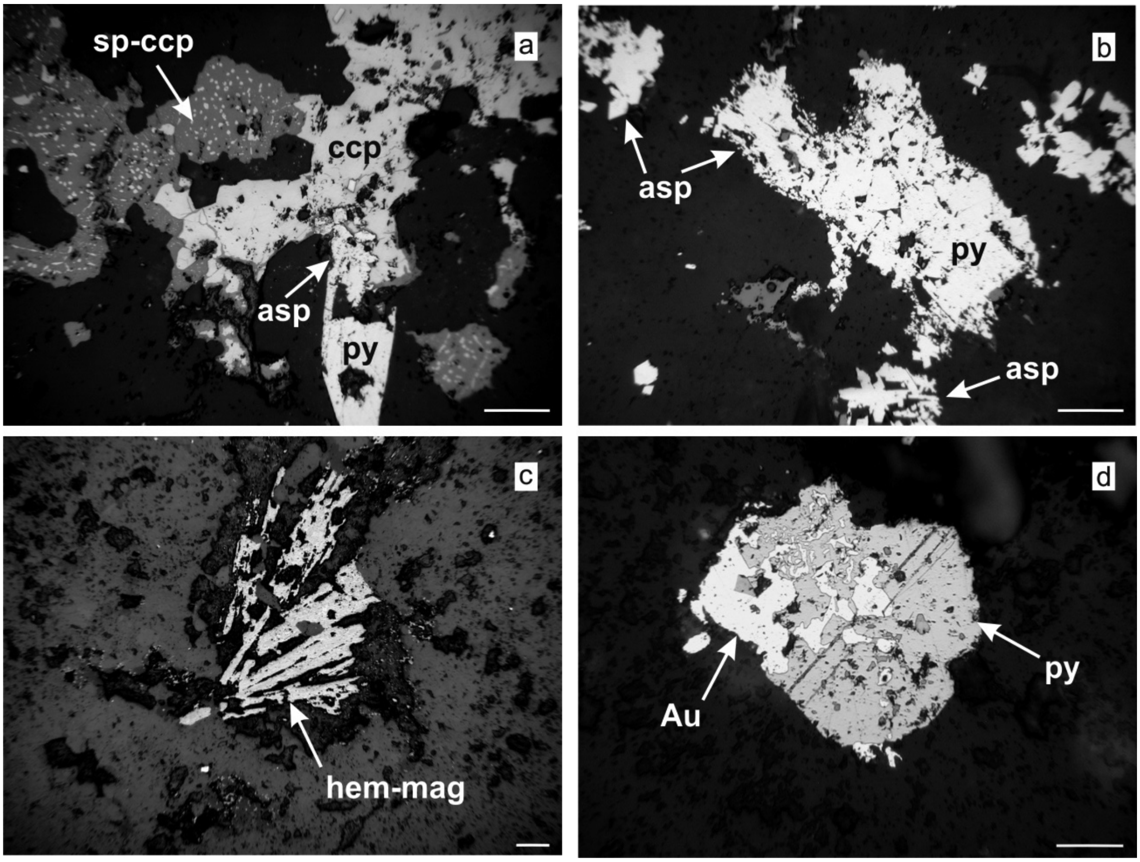

Fig. 3 - Photomicrographies: a. Chalcopyrite in sphalerite developping chalcopyrite disease textures, associated with grains of chalcopyrite, pyrite and arsenopyrite. b. Pyrite-arsenopyrite aggregate; at the bottom, small arsenopyrite grains with star twining. c. hypogenous hematite grains partially replaced by magnetite. d. Gold-pyrite intergrowth. Abbreviations by Chace (1956); bar scale = 100 μm.

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