EGU21-13358
https://doi.org/10.5194/egusphere-egu21-13358
EGU General Assembly 2021

Tracing gold nuggets back to the source: a microchemical analysis of tertiary gold placers in Central Spain.

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Gold placers are abundant and intensively surveyed in western Iberia since antiquity. Three Cenozoic gold placers covering Neoproterozoic-Lower Paleozoic basement rocks have recently been revealed, which stand out for the number and size of the samples recovered: Salvatierra de Tormes (ST), Santibáñez el Alto (SA) and Casas de Don Pedro-Talarrubias (CSDP). To date, primary sources remain undiscovered. We have combined microchemical, inclusion analysis and morphology of gold nuggets to define the placer gold signature and its relationship with bedrock primary sources and infer mineralization styles. Coarse gold particles prevent secondary resetting of source signature and increase the chances to investigate mineral assemblages. Nuggets morphology analysis have reveled that ST and SA deposit are fluvial "trunk" placers, while CSDP represents an autochthon or colluvial placer type. Four different types of gold have been defined in nuggets: core gold (T1), rim gold (T2) fine grained gold in Fe-oxyhydroxides aggregates (T3) and "mustard" gold (Au+Sb-Pb-Fe-oxides) (T4).

Based on those categories we have explored primary and secondary signatures in the deposits. Lode signature is observed in the core of nuggets (T1) with a fineness between 800 and 1000. Alloy composition ranges from binary (Au:Ag) in SA to ternary (Au:Ag:Cu) in ST and CSDP. Sulphides and sulfarsenides dominates inclusions association in ST, while Sb- and Sb-Pb-Fe phases appear in ST and CSDP respectively. CSDP primary gold shows a distinct Hg content. The identification of mineral phases non-compatible with supergene conditions in gold and textural remnants of annealing microstructures, point to an hypogenic origin of T1 in all deposits and coul be compatible with a mesothermal system (<400ºC) in which, CSDP represents the higher T and SA the lower T end. A hybrid hydrothermal-magmatic system is proposed.

Secondary signature is complex and reveals several stages. Older evidence of in-situ modification of primary gold was found in CSDP gold-bearing quart fragments, with pervasive alteration under oxidizing and alkaline conditions. This process liberated gold from T1 and primary phases (e.g., aurostibite), leading to the formation of auroatimonades and "mustard" gold (T4), showing a

complex textural pattern. Gold particles were subsequently modified during fluvial transport and deposition through the interaction with fluids, which activated Ag-leaching processes, resulting in the development of gold-rich rims (T2). Partial dissolution and re-precipitation of gold in reduction conditions formed very fineness gold particles embedded in Fe oxy-hydroxides (T3).