Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11822

Nanoparticle suspensions elucidate high-grade gold mineralisation processes

LAURA PETRELLA[1], NICOLAS THEBAUD[1], **DENIS FOUGEROUSE**[2], BRIAN TATTITCH[3], LAURE A.J. MARTIN[4], STEPHEN TURNER[5], ALEXANDRA SUVOROVA[1] AND SARAH GAIN[6]

[1]the University of Western Australia

[2]Geoscience Atom Probe, John de Laeter Centre and School of Earth and Planetary Sciences, Curtin University

[3]University of Western Australia

[4]The University of Western Australia

[5]Newmont

[6]Geological Survey of Western Australia

Presenting Author: Denis.Fougerouse@curtin.edu.au

Orogenic-type gold deposits often preserve high-grade gold mineralisation in quartz veins. Gold concentration is thought to be achieved through the accumulation of metals transported as dissolved species in hydrothermal fluids from their source to the site of deposition. However, the generally low metal solubility observed in aqueous solutions from orogenic systems requires additional processes to explain the formation of high-grade gold mineralisation. Recent reports of Au nanoparticles in high-grade gold veins suggest that their formation is linked to the mineralisation process. In the case of gold, increasing evidence suggests that nanoparticle suspensions nucleating proximal to the ore deposit are required for the formation of bonanza gold grades. However, processes leading to nanoparticle nucleation and deposition remain elusive. In this study, we collected gold-rich quartz veins from five locally high-grade orogenic gold deposits that emplaced in different host lithologies at crustal depths ranging from 1.5 km to > 5 km below the surface. The gold mineralisation studied also formed at different ages, which range in age from the Archean to the Cretaceous. We conducted a detailed petrographic investigation of the coarse gold samples by Transmission Electron Microscopy (TEM) that revealed the systematic occurrence of metal nanoparticle (Au, AuAg, Cu, Ag_2O) preserved within amorphous silica and/or amorphous or micro-crystalline carbon as inclusions in gold or directly adjacent to gold grains. We show that Au is not the only metal occurring as nanoparticle in high-grade orogenic gold systems, metals nanoparticles (Au, AuAg, Cu, Ag_2O) are ubiquitous in such systems and their association with silica and carbon can help elucidate key processes leading to efficient and focused gold deposition. We propose that a flash-vaporisation mechanism at the site of deposition is responsible for the concomitant nucleation of various metal nanoparticles, deposition of amorphous carbon and silica gel. Our observations provide a step change in our understanding of metalliferous deposit formation.