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# Microstructure of gold as a record of mineral system evolution

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The microstructure of native gold grains commonly preserves evidence of original depositional conditions and later modifying events. Such information can be used to constrain mineral system evolution and provide important information about gold prospectivity within a region.

The microstructure of several hundred bedrock and placer gold grains from Mesozoic-Cenozoic terranes of the Far East of Russia, and from the Proterozoic Capricorn Orogen, Archean Kurnalpi Terrane [1] and Archean Pilbara Craton of Western Australia (WA), have been studied. The surfaces of polished by Ion Beam Miling gold grains have been analysed using conventional acid etching and BSE/EBSD methods. These microstructures typically record a complex evolution from original nucleation and growth of crystals to later hypogene and supergene transformations, including mechanical deformations, dissolution of Ag, phase recrystallization, and granoblastic granulation and disintegration.

Gold grains from Precambrian WA differ fundamentally from Russian samples. The former commonly have much lower Ag contents (<10%) in both bedrock and placer settings (except Pilbara nuggets), have long histories of burial and *in situ* diagenetic alteration while resident in the regolith, and no primary growth microstructures such as the oscillatory zoning (Fig. 1) seen in crystalline gold from epithermal deposits in Kamchatka (Russia). The microstructures in WA gold instead indicate primary growth from colloidal suspensions, then overprinting by multi-stage, low-temperature dissolution-re-precipitation processes during diagenesis, to produce abundant disintegration voids filled with authigenic minerals and micro/nano-particles of pure gold. Similar diagenetic microstructures have been observed in Russian gold, but only from colluvial conglomerates in Mesozoic sedimentary basins [2].

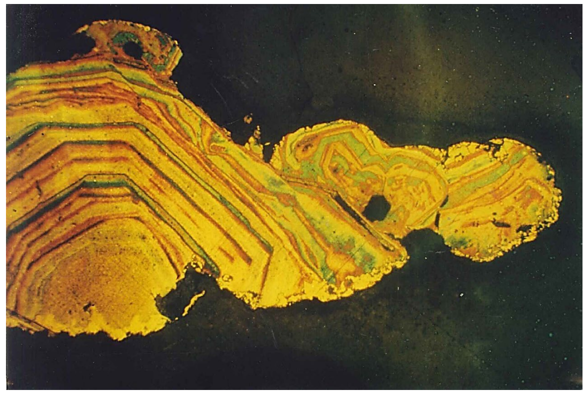

Figure 1. Gold oscillatory zoning microstructure – rapid cooling under supersaturated conditions with different solubility of components. Field of view is 1.5 mm.

[1] Hancock & Beardsmore (2020), GSWA Report 212, 21p.

[2] Nikolaeva *et al*. (2004) *Atlas TsNIGRI*, Moscow, Russia, 176p.