

## Geochemical dispersion of gold and silver in silcrete as a vector towards VHMS exploration

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This study reports the first occurrence of an economic supergene Au deposit in near-surface silcrete within a deep weathering profile. The profile over the Scuddles Cu-Zn-Pb VHMS deposit in the Golden Grove district, Western Australia, is developed on a volcano-sedimentary sequence and consists, from the base, of supergene sulphide- and oxide- enrichment zones, ferruginous saprolite, a leached zone of kaolinitic saprolite, silcrete and a ferruginous zone of mottled clays and pisolitic duricrust.

Silcrete is massive at depth, grading upward into a silicified collapsed breccia. It consists mainly of quartz (> 90%) and <10% kaolinite, zircon, xenotime, rutile, cassiterite and monazite. Sulphides occur as inclusions in rutile, cassiterite and quartz. Although a few Au grains are primary, with Ag-rich cores and Ag-poor rims, most of the gold in the silcrete is pure, with no detectable Ag, and considered supergene. It is intimately associated with Ag halides that cement the silicified collapse breccia and postdate silicification. The gold is nanocrystalline (<10 nm) and clustered to form microcrystalline aggregates (up to 200 µm). The silcrete is characterized by: (1) a multi-element association of Au, Ag, I, Br, Cl, Sb, Sn, Bi, Hg, Mo, W, Te and Ge; (2) low abundances of Al, Fe, K, Na, Ca, Mg, Ba, Sr, Rb, Cs, Tl, P, F, Ni, Cu, Zn, Co, S, Se and V; and (3) residual concentration of Ti, Zr, Hf, Nb, Ta, Y, Th and U.

The formation of the supergene Au in silcrete has involved mobility of Au and Ag as halide complexes in saline groundwaters, under acidic conditions resulting from the oxidation of primary sulphides at depth. These acidic waters probably reached the surface via faults, by-passing the near-neutral to alkaline conditions in the oxide and supergene sulphide zones. Gold precipitation in the silcrete may have been response to a rise in pH and/or dilution of the halide concentration. Discovery of a Au-bearing silcrete over VHMS deposits has potential significance for exploration in regolith-dominated terrains with similar weathering histories elsewhere in the world.