

201983: gold nugget, 47K Patch prospect (Sholl Terrane, northwest Pilbara Craton)

Sample type	Gold nugget
Total weight	2.3 g
Sample location	47K Patch, about 32 km south of Karratha
Coordinates	MGA Zone 50, 492217E 7676570N
Datum	GDA94
1:250 000 map sheet	YARRALLOOLA (SF 50-6)
1:100 000 map sheet	PINDERI HILLS (2255)
Tenement	E 47/3443; P 47/2039-S
Collector	Artemis Resources Limited



Location and sampling

The sample was provided by Artemis Resources Limited in January 2019. The gold nugget came from a colluvial/eluvial patch (compiled out of the GSWA 1: 100 000 scale geological series maps; GSWA, 2020) at the 47K Patch prospect in the northwest Pilbara region (Artemis Resources Limited 2019, written comm., 11 January).

Geological context

The 47K Patch prospect is located about 6 km east of the Maitland Shear Zone, interpreted as a low angle thrust in the Sholl greenstone belt of the Sholl Terrane, in the northwest Pilbara Craton (Hickman, 2016; GSWA, 2020). The local bedrock includes metamorphosed pillow and massive basalt, dolerite sills, and minor felsic tuff, sandstone, shale, and chert of the 3117 – 3115 Ma Bradley Basalt. Metamorphosed massive hornblende monzogranite and syenogranite of the c. 2930 Ma Yannery Granite are exposed about 0.7 km east-southeast of the sample locality. Northeasterly striking Proterozoic dolerite dykes transect the area (Hickman, 2021, 2022; GSWA, 2020).

Artemis Resources Limited recovered around 6 kg (193 oz) of nuggety and fine-grained gold from colluvial-eluvial scree at the 47K Patch prospect in 2018, during shallow surface rehabilitation work. The gold is believed to have been shed from bedrock conglomerate-hosted mineralization (Artemis Resources Limited, 2018).

The nearest regolith landform — mapped by GSWA at the 1: 100 000 scale — is an alluvial-fluvial unit comprising unconsolidated gravel, sand, silt, and clay in active, but poorly defined drainage channels on floodplains (GSWA, 2020).

Methodology

The gold sample was photographed and weighed, and its overall morphology and external features, such as colour, roundness, surface relief, coatings, mineral inclusions, and mineral assemblages were recorded using visual morphometry. The raw surface of the sample was analysed using scanning electron microscopy with energy dispersive X-ray system (SEM-EDS). The sample was then mounted in epoxy resin, cut and polished, and the gold grain microstructure, inclusions, and silver content were examined using reflected-light microscopy and SEM-EDS. Gold microchemistry was determined by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), calibrated against certified gold reference materials (CRM; Murray, 2009). The sample was ablated in triplicate along 0.5 mm-long traverses and average values calculated for elements present in the CRM. The gold surface was repolished after laser ablation, etched with aqua regia, and internal structure examined using reflected-light microscopy. Details of this method are described in Hancock and Beardsmore (2020).

Morphology

The ferruginous gold nugget has dimensions 13 x 8 x 3 mm, with a well-rounded shape, smooth, shiny, dark brown surface extensively covered with a magnetic Fe-oxide minerals, probably maghemite (Fig. 1).

SEM-EDS analysis of raw surfaces

The surface of the gold nugget is compacted, with slightly elevated ridges showing numerous scratches separating shallow depressions with a smooth and blocky texture, with locally preserved organic material and spheres and micro- and nanoparticles of gold within Fe-rich, illite (K) and chlorite (Fe, Mg) clays (Fig. 2a,b). There is no detectable Ag on the gold surface.

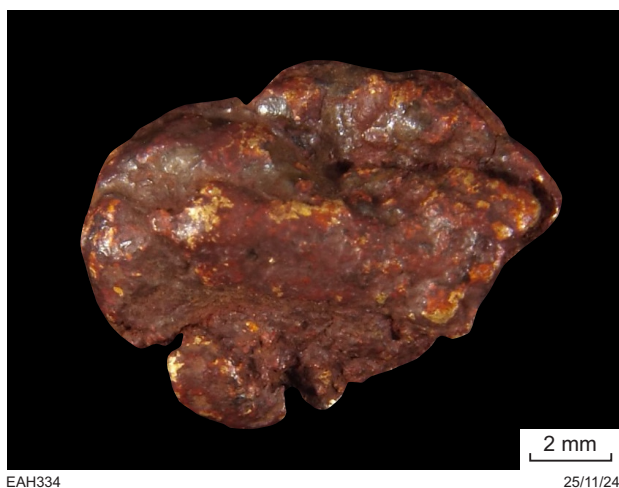


Figure 1. Sample 201983: gold nugget, 47K Patch prospect

Optical microscopy of polished surfaces

In the polished section, the gold nugget is revealed to be extensively disaggregated, with interstices between gold domains largely filled with ferruginous silica-rich clays, maghemite and quartz grains, and gold micro- and nanoparticles (Fig. 3a). In turn, coarse gold, maghemite and granulated quartz also have voids or fractures variably filled with clays and fine gold (Fig. 3b).

SEM-EDS analysis of polished surfaces

The bulk gold nugget contains 9% Ag, but there are some narrow, curvilinear, high-purity (low-Ag) intergranular veinlets along granulated gold grain boundaries (Fig. 4). The Fe–Al clay film of 5–10 µm wide is covered gold surface.

LA-ICP-MS analysis

Ag, Cu and Hg were consistently detected within the gold grain, in concentrations higher than the instrument detection limit, and probably occur as limited solid solutions in the gold. The gold contains 8% Ag, and moderate amount of Cu (209–236 ppm) and Hg (197–222 ppm) (Table 1). Mg, Al, Ti, Zn, Se, Rb, Pd, and Sb were also consistently detected at low (in sub-ppm) concentrations (Table 2), possibly occurring in micro- and nano-inclusions.

Acid etching

The gold microstructure is polycrystalline with irregular, partly recrystallized grains having sharp and curved crystal boundaries, and incoherent polysynthetic twinning, all indicating intense deformation and gold dissolution (Fig. 5a). The nugget has an outer 10–70 µm wide rim and local intergranular veinlets of fine-grained, polycrystalline gold (Fig. 5b).

Interpretation

The coherent gold domains in the nugget are polycrystalline and contain up to 9% of Ag and moderate amounts of Cu and Hg, suggesting primary crystallization of gold from hydrothermal fluids. The current disaggregated internal texture of the nugget probably resulted from intensive, diagenetic disintegration and dissolution of the gold along intergranular veinlets, with removal of Ag and filling of the voids with ferruginous clays, maghemite, quartz and gold nanoparticles. Subsequent erosion and transport of the nugget in the surficial environment recrystallized its outer rim and generated fine Ag-poor intergranular veinlets, and later on Fe–Al film.

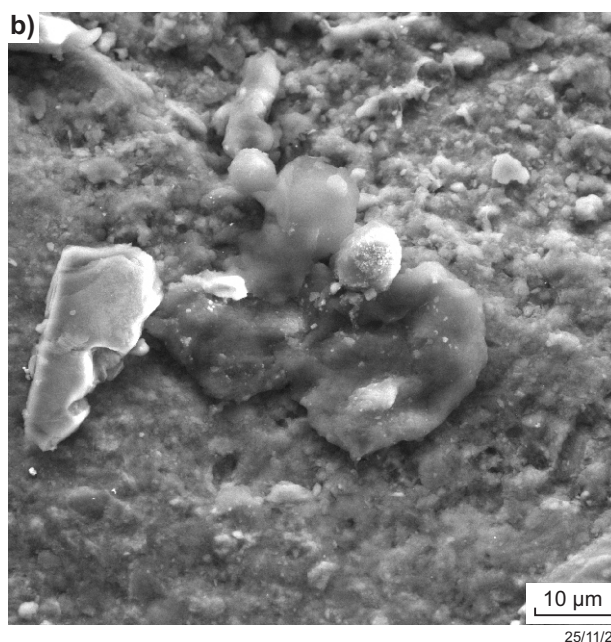
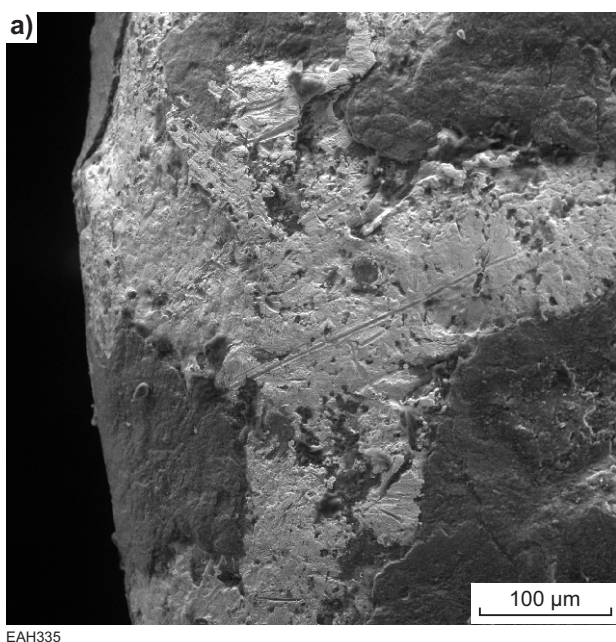


Figure 2. Secondary electron images of surface of parts of sample 201983: gold nugget, 47K Patch prospect

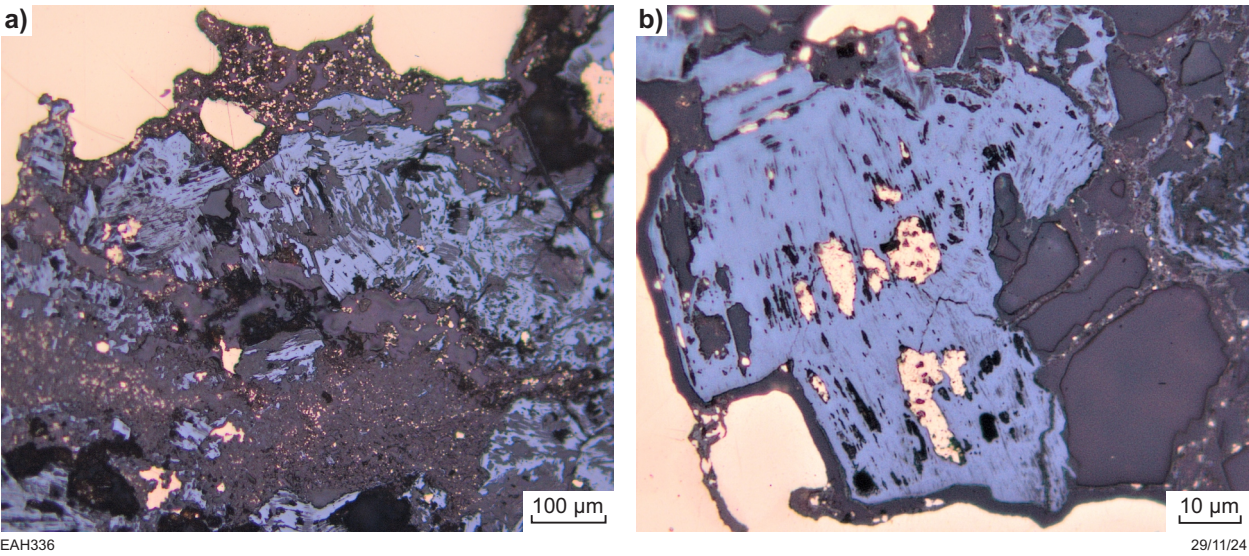


Figure 3. Reflected-light photomicrographs of polished surface of sample 201983: gold nugget, 47K Patch prospect.

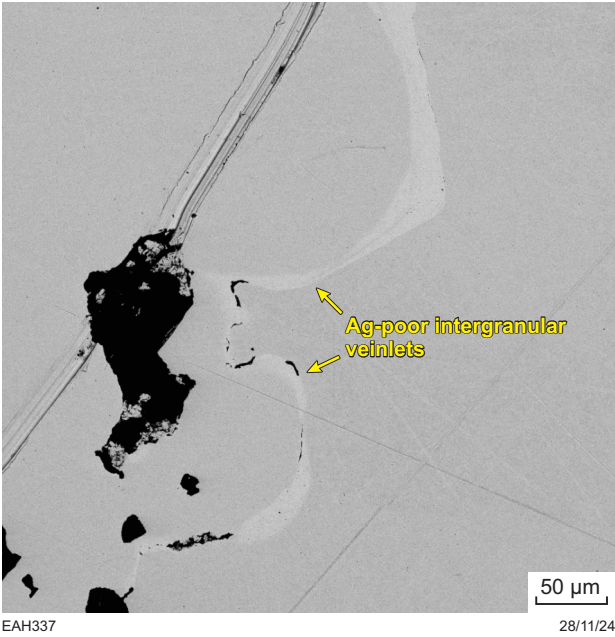


Figure 4. Backscattered electron image of polished surfaces of selected area of sample 201983: gold nugget, 47K Patch prospect

Table 1. LA-ICP-MS data for main elements (above detection limit) in three traverses for sample GSWA 201983: gold nugget, 47K Patch prospect

Ag (%)	Cu (ppm)	Hg (ppm)	Other elements (ppm ¹) ²
8.4	236	222	
7.7	209	197	
7.9	231	204	

NOTES: 1 See Table 2 for concentrations and detection limit
2 Results are only shown where standards are available for the element

Table 2. LA-ICP-MS compositional data for sample GSWA 201983: gold nugget, 47K Patch prospect

Laser ablation track	Unit	⁷ Li	⁹ Be	¹¹ B	²³ Na	²⁵ Mg	²⁷ Al	²⁹ Si	⁴⁴ Ca	⁴⁵ Sc	⁴⁹ Ti	⁵¹ V	⁵³ Cr	⁵⁵ Mn	⁵⁷ Fe	⁵⁹ Co	⁶⁰ Ni	⁶⁵ Cu
1	cps			73		58	29	190		2	3	2			23	4	3	16480
2	cps			5		56	32			2	5	1				2		14587
3	cps					138	153				5	2			16		6	16111
1	ppm					0.57	0.04				0.07				0.96		0.06	236
2	ppm					0.55	0.04				0.10							209
3	ppm					1.35	0.21				0.09				0.68		0.10	231
DL*	ppm					3.3	1.3		2.6		1.5		1.7	1.1	3.4		2.9	1.5
Laser ablation track	Unit	⁶⁶ Zn	⁶⁹ Ga	⁷² Ge	⁷⁵ As	⁸² Se	⁸⁵ Rb	⁸⁸ Sr	⁸⁹ Y	⁹⁰ Zr	⁹³ Nb	⁹⁸ Mo	¹⁰¹ Ru	¹⁰³ Rh	¹⁰⁸ Pd	¹⁰⁹ Ag	¹¹¹ Cd	¹¹⁵ In
1	cps	8				3	1								6	10012802		
2	cps	7				3	4								3	9239623		
3	cps	10				3	9	3							4	9445802		
1	ppm	0.22				0.76									0.09	83800		
2	ppm	0.19				0.76									0.06	77400		
3	ppm	0.28				0.76									0.06	79100		
DL*	ppm	5.3			2	3.1								1.5	1.8	2.4		
Laser ablation track	Unit	¹²⁰ Sn	¹²¹ Sb	¹²⁶ Te	¹³³ Cs	¹³⁸ Ba	¹³⁹ La	¹⁴⁰ Ce	¹⁴¹ Pr	¹⁴⁵ Nd	¹⁵¹ Eu	¹⁵⁷ Gd	¹⁵⁹ Tb	¹⁶² Dy	¹⁶⁵ Ho	¹⁶⁷ Er	¹⁶⁹ Tm	¹⁷² Yb
1	cps	31	2															
2	cps		6		3			3										
3	cps	7	2		2			1										
1	ppm	0.23	0.02															
2	ppm		0.05															
3	ppm	0.06	0.02															
DL*	ppm	1.6	2.8	5.6														
Laser ablation track	Unit	¹⁷⁵ Lu	¹⁷⁸ Hf	¹⁸¹ Ta	¹⁸² W	¹⁸⁵ Re	¹⁸⁹ Os	¹⁹³ Ir	¹⁹⁵ Pt	²⁰² Hg	²⁰⁵ Tl	²⁰⁸ Pb	²⁰⁹ Bi	²³² Th	²³⁸ U			
1	cps			1						60004	1							
2	cps									53208				1	2			
3	cps		1			1				55037								
1	ppm									222								
2	ppm									197								
3	ppm									204								
DL*	ppm								2.5	2.5		1.5	2.2					

NOTES: cps, count per second; ppm, parts per million; DL, detection limit

*Detection limits have been determined using AuRM Reference Gold Standards (London Bullion Market Association). Standards were analysed nine times each and an average 2σ (95% Confidence Interval) Limit of Detection determined. Some results given in the text are quoted as values that are below the detection limit for these analytes. These values must be considered as "for information" only.

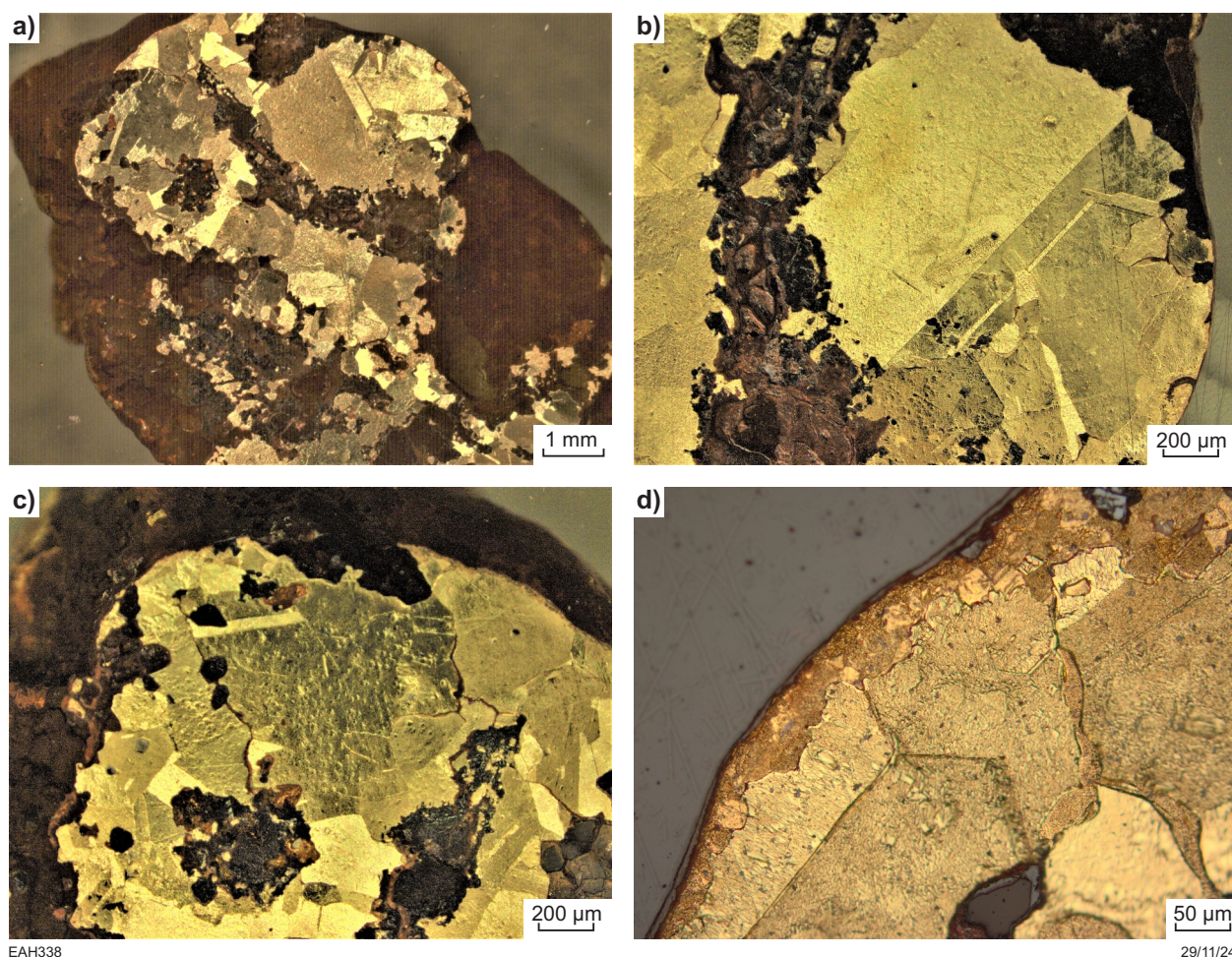


Figure 5. Reflected-light photomicrographs, after repolishing and acid etching, of parts of sample 201983: gold nugget, 47K Patch prospect

Acknowledgements

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Recommended reference for this publication

Hancock, EA, Blay, OA and Beardsmore, TJ 2025, 201983: gold nugget, 47K Patch prospect; GSWA Mineralogy Record 17: Geological Survey of Western Australia, 5p.