

201984: gold nugget, 47K Patch prospect (Sholl Terrane, northwest Pilbara Craton)

Sample type	Gold nugget
Total weight	4.9 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 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 has recovered around 6 kg (193 oz) of nuggety and fine-grained gold from colluvial-eluvial scree at the 47K Patch prospect in 2018, during the 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 gold nugget has dimensions of 18 x 10 x 3 mm, and a perfectly rounded and flattened ('melon seed') shape, with a smooth, shiny, brown surface punctuated by darker patches of Fe-oxide minerals (Fig. 1).

SEM-EDS analysis of raw surfaces

The brown colour of the gold nugget surface arises from a fine film of Fe-Al clays and darker patches of Fe-oxide minerals. There is no detectable Ag on the gold surface.

Optical microscopy of polished surfaces

In polished section, the gold nugget is seen to have large embayments (once dissolution cavities) now filled with Fe-oxide minerals (partly goethite), and Al–Si clays containing abundant disseminated gold particles. Goethite primarily forms reniform incrustations along gold boundaries, and contains abundant small gold particles (Fig. 2a,b). A rounded chalcopyrite inclusion of 30 μm as observed in the coherent gold matrix (Fig. 2b).

SEM-EDS analysis of polished surfaces

Coherent gold domains in the nugget contain 7.5% Ag. Abundant gold micro- and nanoparticles are disseminated in Fe-oxide minerals and Si–Al clays (Fig. 3).



Figure 1. Sample 201984: gold nugget, 47K Patch prospect

LA-ICP-MS analysis

Ag, Cu and Hg were consistently detected within the gold, in concentrations higher than the instrument detection limit, and probably occur as limited solid solutions in the gold. The gold contains 6–8% of Ag, and moderate amounts of Cu and Hg (399–506 ppm and 183–295 ppm, respectively; Table 1). Mg, Al, V, Zn, Sr, Pd, and Sb were also consistently detected at low (sub-ppm) concentrations (Table 2), possibly occurring in micro- and nano-inclusions. High abundances of lithophile elements, such as Na, Mg, Al, Si, and Ca, detected in Traverse 1, suggest the presence of silicate mineral inclusions.

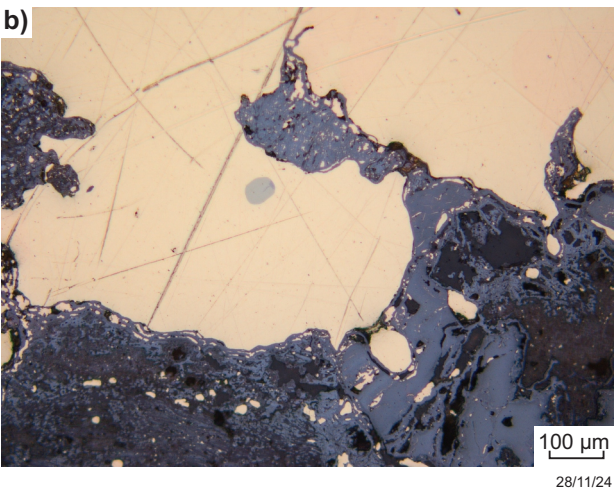
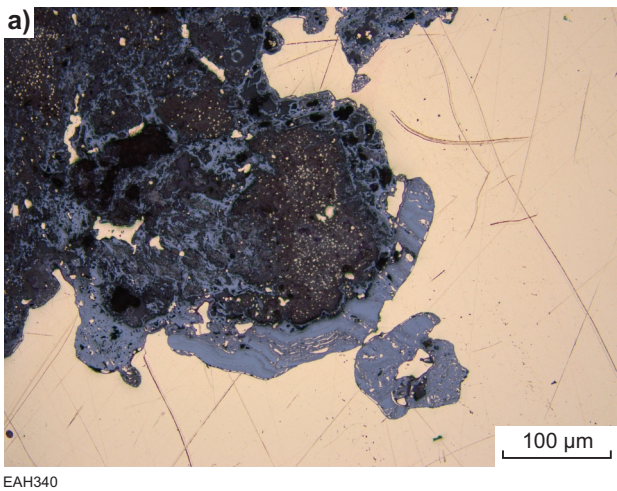
Acid etching

The gold microstructure is granular polycrystalline, with crystals having irregular size and shape, curved and angular boundaries, and polysynthetic incoherent twinning, all indicative of intensive deformation and recrystallization (Fig. 4a–c). The compacted outer rim, the internal voids and the intergranular veinlets are filled with Fe–Si–Al clays (Fig. 4b,c).

Table 1. LA-ICP-MS data for main elements (above detection limit) in three traverses for sample GSWA 201984: gold nugget, 47K Patch prospect

Ag (%)	Cu (ppm)	Hg (ppm)	Other elements (ppm ¹) ²
6.9	399	295	Al, Ca, As
8.4	405	275	
6.4	506	183	

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



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Figure 2. Reflected-light photomicrographs of polished surface of selected area of sample 201984: gold nugget, 47K Patch prospect

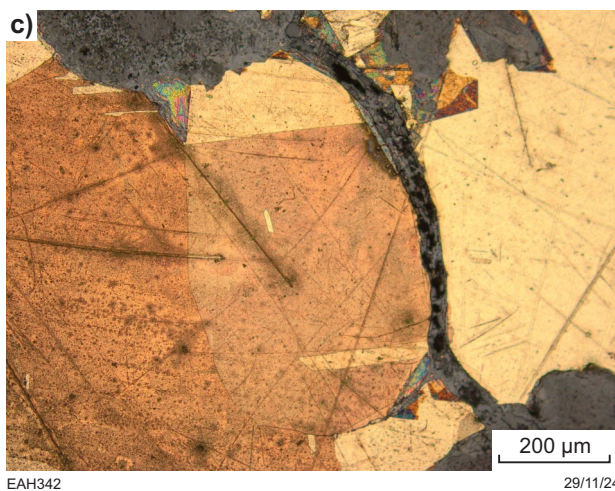
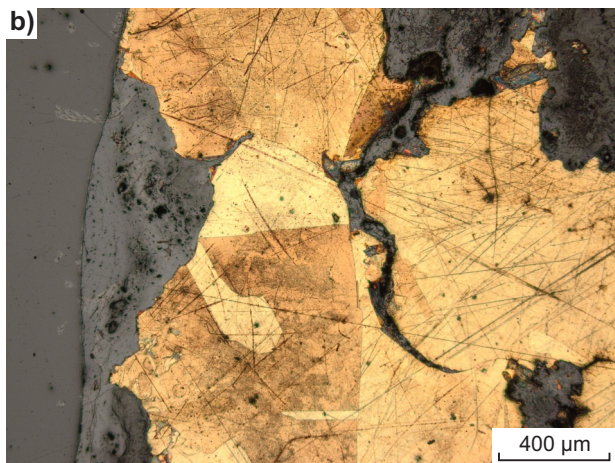
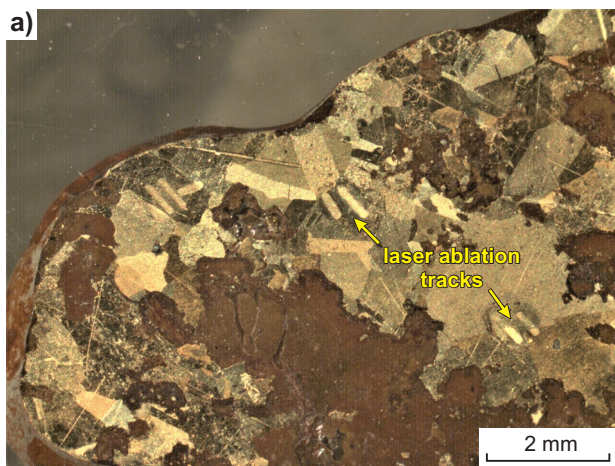


Figure 4. Reflected-light photomicrographs, after repolishing and acid etching, of parts of sample 201984: gold nugget, 47K Patch prospect

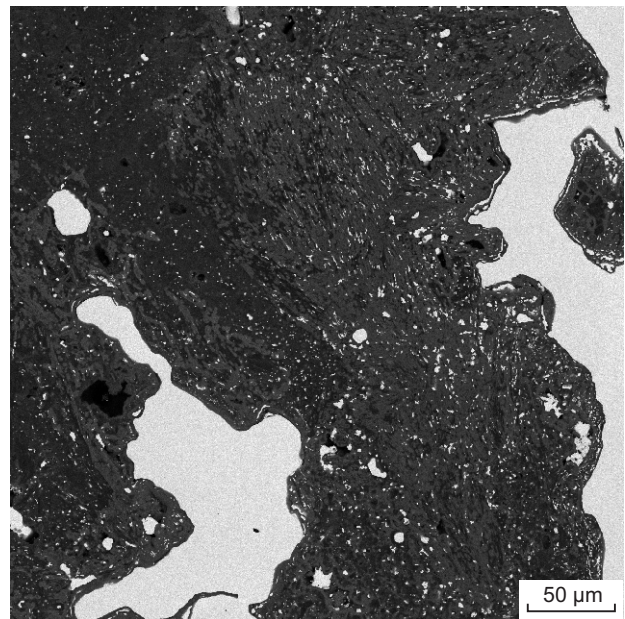


Figure 3. Backscattered electron (BSE) image of polished surface of selected area of sample 201984: gold nugget, 47K Patch prospect

Interpretation

Gold in the sample is polycrystalline, and contains up to 8% of Ag, moderate amounts of Cu and Hg, and a chalcopyrite inclusion, suggesting primary crystallization from hydrothermal fluids. Its disaggregated internal fabric probably resulted from intensive, diagenetic and subsurface alterations — deformation, disintegration and dissolution — of the gold along intergranular veinlets, with removal of Ag and filling of the voids with goethite, ferruginous clays and pure gold nanoparticles.

Table 2. LA-ICP-MS compositional data for sample GSWA 201984: 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			210	104	143	4745	974	168	10	12	1	5	62	42		22	27838
2	cps			121		61	943				2	7	2		6			28258
3	cps					71	531				3	4					5	35285
1	ppm					1.40	6.39		21.8		0.21		0.10	0.17	1.74		0.33	399
2	ppm					0.61	1.27				0.05		0.04		0.30			405
3	ppm					0.70	0.72				0.07						0.08	506
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	85	2		185			18			7				33	8254339		1
2	cps	4			4	2		3						1	51	10057735		
3	cps	11						3						2	41	7595710	4	
1	ppm	2.14			6.11										0.46	69100		
2	ppm	0.11			0.15	0.54									0.70	84200		
3	ppm	0.30													0.57	63600		
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	90	8	1		6												
2	cps	28	4	3														
3	cps		5		1								2		1			
1	ppm	0.65	0.06															
2	ppm	0.21	0.04															
3	ppm		0.04															
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									79630			1					
2	cps									74334			2					
3	cps									49524								
1	ppm									295			0.02					
2	ppm									275			0.02					
3	ppm									183								
DL*	ppm									2.5			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.

Acknowledgements

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Recommended reference for this publication

Hancock, EA, Blay, OA and Beardsmore, TJ 2025, 201984: gold nugget, 47K Patch prospect; GSWA Mineralogy Record 18: Geological Survey of Western Australia, 5p.

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