

# RED OCTOBER GOLD DEPOSIT, NORTHEAST GOLDFIELDS, WESTERN AUSTRALIA

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## LOCATION

The Red October Deposit is about 80 km S of Laverton in the Mount Margaret Mineral Field of Western Australia (Figure 1) at 29°13'S, 122°19'E; Edjudina 1:250 000 map (SH51-06), Lake Carey 1:100 000 map (3339).

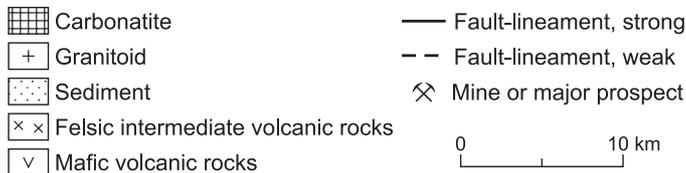
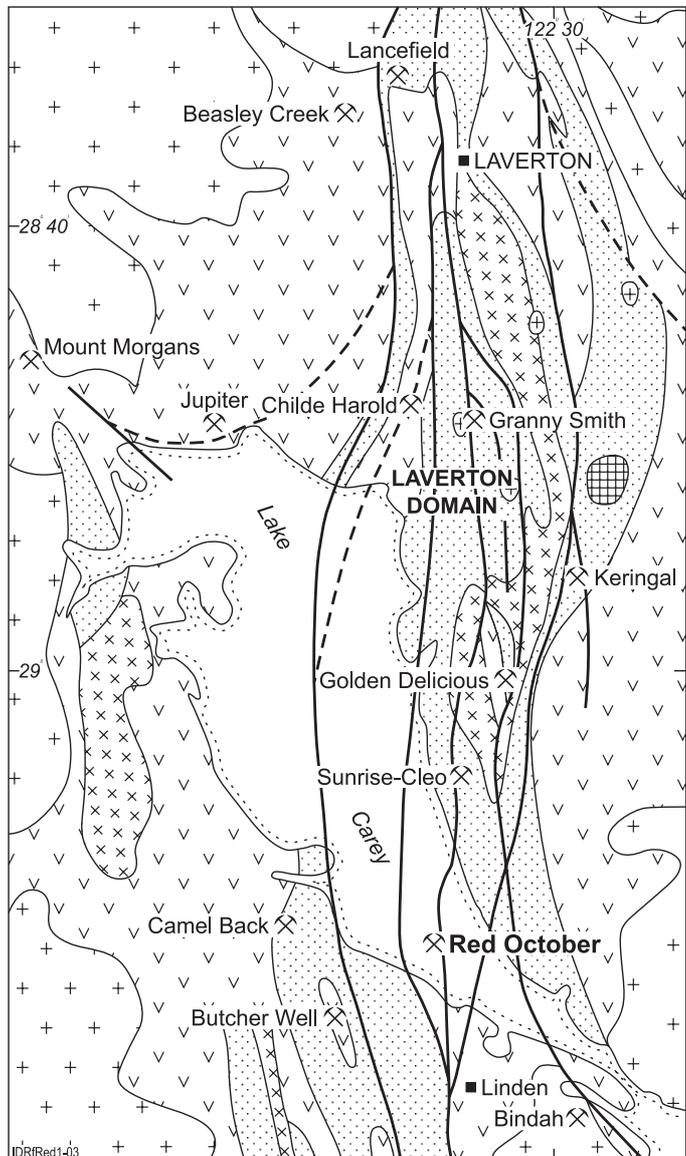


Figure 1. Location map of the Red October Au Deposit in relation to regional geology and Lake Carey.

## DISCOVERY HISTORY

In 1993, Mt Burgess Gold Mining NL geologists used helicopter magnetic survey data to define prospective second and third order structures as part of their regional exploration. They recognized a NE trending structure similar in orientation and in magnetic signature to that of the nearby Sunrise Dam Deposit and investigated it with a track-mounted aircore rig. The best intercepts of this drilling included 2 m at 1.78 g/t, 7 m at 0.42 g/t, 3 m at 0.37 g/t and 2 m at 0.3 g/t Au. After follow up drilling on 50 x 400 m centres, the first significant Au intercept at Red October was 21.5 m at 53.7 g/t Au from 28 m to the bottom of the hole.

## PHYSICAL ENVIRONMENT

Red October is located in a tributary channel of the Lake Carey palaeochannel and is overlain by hypersaline lake sediments (Figure 1), containing halite and gypsum. The climate is semi-arid, with hot summers and mild winters. Average minimum and maximum temperatures for July are 5-15°C and 21-37°C for January. Annual precipitation is 150-200 mm, compared to a potential evaporation rate of approximately 3500 mm per year (Bureau of Meteorology, 2003).

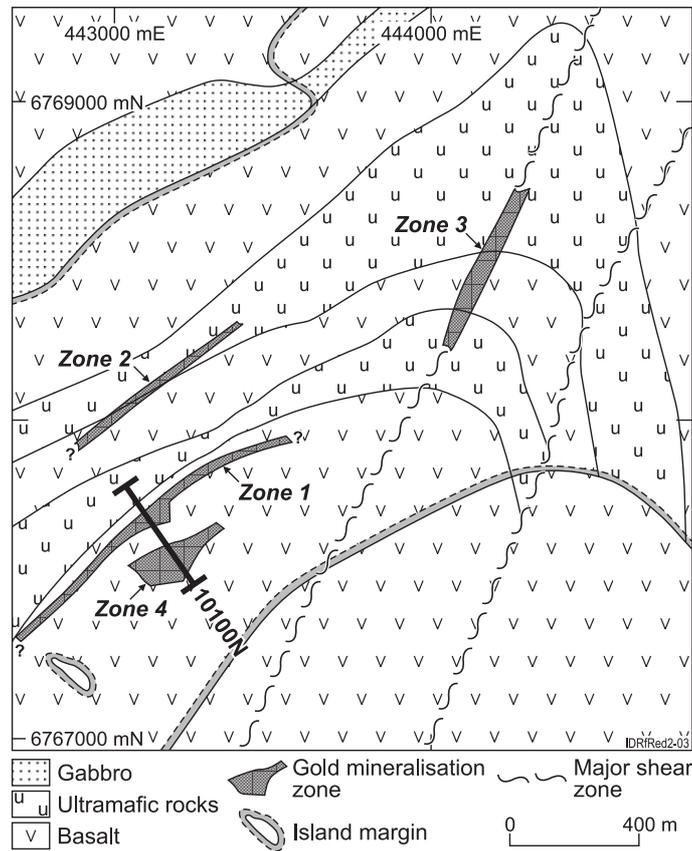


Figure 2. Local geological setting of the Red October Deposit.

## GEOLOGICAL SETTING

Red October (Figure 1) is situated within an Archaean greenstone belt in the Laverton Tectonic Zone (Hallberg, 1985). Gold mineralization is mainly in four zones controlled by a NE-trending brittle-ductile dextral shear (Figure 2), forming the contact between an ultramafic and a mafic unit (Jankowski, 1996). The ultramafic host rocks are altered to a silica-biotite-calcite-pyrite-arsenopyrite assemblage; the altered mafic host rocks are dominated by sericite instead of biotite. This alteration assemblage is also typical of the nearby Butcher Well Au deposit (Jankowski, 1996).

## REGOLITH

The regolith over the deposit consists of saprolite overlain by 10 to over 50 m of sediments. The weathering front on basalt is generally at 50-75 m depth and 20-75 m on ultramafic rocks, being deepest at the contact (Figure 3). X-ray diffraction and geochemical studies of the regolith along section 10100 mN assisted with the interpretation and differentiation of transported and residual materials. There are eight different regolith units.

1) The lower saprolite on ultramafic rocks contains smectitic clays whereas the basalt has been stripped or truncated to the lower saprolite. The blue-grey colouration of the kaolinitic upper saprolite is thought to be due to an overprint by late reduction, possibly by bacterial action or by decreased groundwater flow though this part of the regolith. Coarse structures, such as Mn oxide (pyrolusite) and quartz veining, are well

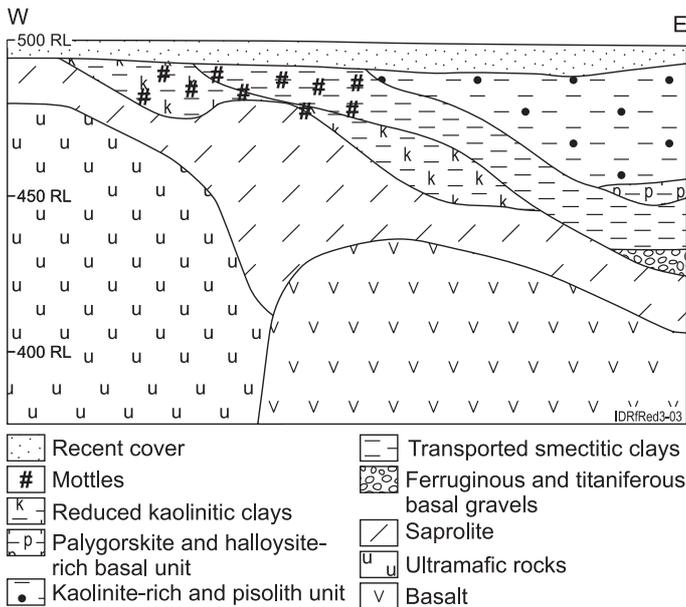


Figure 3. Schematic regolith cross section, Red October Deposit.

preserved, and fabrics in the basalt and ultramafic saprolite are fine-grained. Iron-rich mottling has overprinted the western part of the upper saprolite, similar to that of other palaeochannels, such as the Roe and Yindarlgooda palaeochannels (Dusci, 1994). However, such mottles are generally in lacustrine clay (see below).

2) Pale grey kaolinitic clays (5 m thick) form lenses from the base of the transported overburden. Iron oxides overprint the westernmost lens, forming kaolinite-quartz-goethite mottles (10-20 mm long and about 10 mm diameter). Ferruginous gravels associated with the eastern lens are rich in gibbsite, kaolinite, quartz and goethite.

3) Lime-green smectite-rich clays (10-20 m thick) overlie the grey kaolinitic clay. Both units extend for at least 800 m along the length of the tributary channel. They consist dominantly of smectite, chlorite-montmorillonite, kaolinite and goethite, with minor halloysite, sepiolite, palygorskite, gibbsite, talc and hematite. The hematite content increases towards the surface and overprints the transported clays to a depth of 30 m. At the E end of the section, Fe and Ti-rich gravels (2-2.35% Ti), up to 15 m thick occur at the base of the smectite-rich clay layer.

4) A unit of palygorskite-halloysite clays (10 m thick) contains clasts of ultramafic saprolite and minor kaolinite, goethite, hematite and quartz.

5) Blue-green kaolinitic and pisolitic plastic clays (up to 40 m thick) occur in the deeper, eastern part of the section, overlying the smectitic and palygorskite-halloysite clays. They comprise kaolinite, halite, halloysite, gibbsite, quartz, goethite and hematite ± smectite and sepiolite. Above about 20 m depth, the clay is red-purple to pink, due to hematite. Below 20 m, the clays contain grey pisoliths comprising goethite and kaolinite (5-10 mm diameter) with goethitic cutans and ferruginous gravel fragments (10-20 mm diameter). The mixed layer clays, pisoliths and gravels form lenses throughout the unit.

6) White plastic clay, about 1 m thick covers the central part of the deposit.

7) Unconsolidated ferruginous alluvium forms a continuous blanket 8-9 m thick over the whole deposit and is composed of halite, kaolinite, halloysite, goethite, gibbsite, smectite and hematite (± palygorskite).

8) Recent salt lake sediments (<1-2 m) consist of halite, gypsum and clay.

### MINERALIZATION

A NE trending shear zone on the NW limb of a tight isoclinal fold hosts high-grade zones of primary Au ore. The primary ore positions (Figure 2) are Zones 1-3 and Zone 4 is thought to be eluvial Au sourced from Zone 1. Supergene Au extends sub-horizontally S from the main shear, cutting through the saprolite into the transported clay and gravel filling the palaeochannel (Figure 4).

## REGOLITH EXPRESSION

### Dispersion

The dispersions of Au and other trace elements are shown in the cross-section through the deposit at 10100 mN (local grid) in Figures 4-6. In fresh rock and saprolite, Au is associated with quartz veins and sulphides or their weathered products. Goethite-overprinted smectitic and kaolinitic clays and ferruginous nodules and pisoliths host Au at depths of 30-40 m (Figure 4) within the transported overburden. Gold abundances are related to the ferruginous and titaniferous gravels in the eastern part of the section.

Antimony (Figure 4), Mo, Bi, Co, Pb, Hg and Cd are generally depleted in the transported clays, however, Sb, Mo, Bi, Pb and Co are enriched in the recent cover (ferruginous alluvium).

Copper, Zn, W and As concentrations are high in the ore zone and along

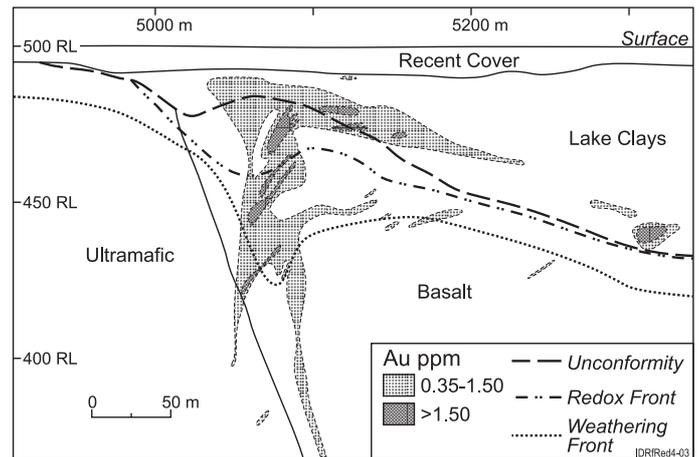


Figure 4. Gold distribution in cross section on 10100 mN (local grid).

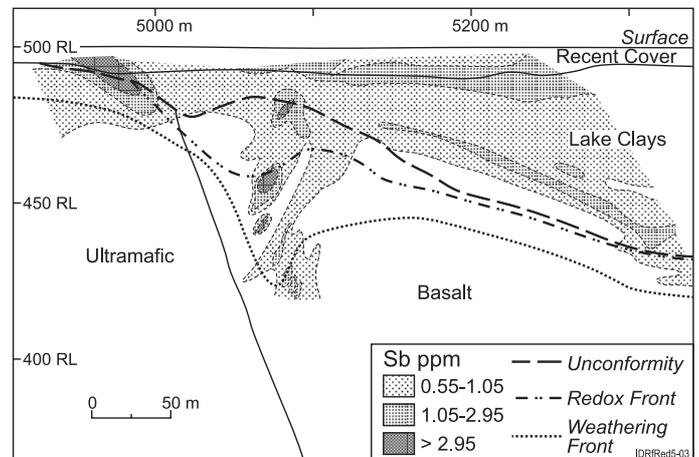


Figure 5. Antimony distribution in cross section on 10100 mN (local grid).

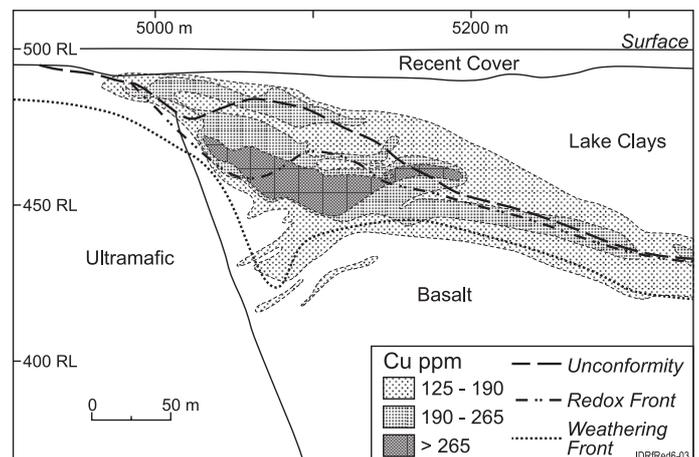


Figure 6. Copper distribution in cross section on 10100 mN (local grid).

the major unconformity between residual and transported materials. The concentrations are, however, relatively low in the transported clays (see Cu in Figure 6).

### Discussion

There is no well-defined spatial association between supergene Au and other pathfinder elements in the transported clays although there is an association between supergene Au, Cu Pb, Zn, Mo, As, W, Co and Bi in the saprolite of the ore zone. The relationship between Au and the abundance of ferruginous and titaniferous gravels in the eastern part of the section indicates mechanical dispersion of Au (also Mo, Sb and W) in Fe and Ti-rich basal gravels at the bottom of channels, rather than chemical dispersion.

Chemical dispersion of Cu, Zn, W and As may have taken place along the unconformity as these elements are more mobile in solution under acid oxidizing conditions (Boyle, 1979; Levinson, 1980) alternatively the elements may be dispersed physically as lag along the interface. In contrast, Sb, Mo, Bi, Co and Pb have been dispersed along the base of the recent cover, probably under alkaline condition (pH >7).

The element distribution suggests pH and drainage stratification in the profile. Copper, Zn, W and As are mobilized along the unconformity where the porosity is greater. This has allowed increased groundwater flow and oxygenation and the required decrease in pH, produced by sulphide weathering (ferrolysis) in the saprolite, for cation mobilization. Alternatively, acid and oxidizing conditions may be seasonally introduced by increased flow rates during flooding.

There is a low groundwater flow rate in the clays due to their impermeability and this, possibly coupled with bacterial activity, has de-oxygenated the groundwater to cause reducing conditions. The regional alkaline pH of the groundwater (7-9), coupled with the accumulation of basic ions in the stagnating waters has provided conditions suitable for oxyanion dispersion. In consequence, Sb, Mo, Bi, Co and Pb have been adsorbed and accumulated within the alluvial ferruginous mottled clays in the near surface. A similar association of Sb and Pb with Fe oxide granules has been documented at Kanowna Belle (Dell, 1992).

Salt lake environments are difficult to explore both logistically, due to access problems, and technically, due to the deep sedimentary cover, stripped weathering profile and the lack of near-surface enrichment of ore-related elements. Investigation of the regolith at Red October has revealed the role of mechanical dispersion and the importance of understanding the hydrochemistry in the enrichment and lateral dispersion of trace elements.

Near surface enrichment of Sb, Mo, Bi, Co and Pb at a depth of 8-10 m may show economic Au mineralization beneath Lake Carey. Delineation of the ore zone can be indicated by W, Cu and Zn concentrations, which show good correlation with the primary Au mineralization. The use of oxy-anions as an exploration tool needs to be further investigated as the extent of lateral dispersion surrounding the Au deposit is yet to be tested. Placer Au exploration strategies should also be considered during exploration for Au in the Lake Carey palaeochannel.

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**SAMPLE MEDIUM - SUMMARY TABLE**

Sample medium	Element	Analytical method	Detection limits (ppm)	Mean (ppm)	Median (ppm)	Percentiles		Dispersion (m)
						25th	75th	
Recent cover	Au	ICP-MS	0.01	131	<10	<10	13	<10
	As	ICP-MS	0.5	54	26	22	42	>200
	Bi	ICP-MS	0.1	0.4	0.3	0.3	0.4	>250
	Mo	ICP-MS	0.2	2.6	2.2	2	2.6	>350
	Sb	ICP-MS	0.2	1.3	1.2	1	1.2	<200
	W	ICP-MS	0.5	2.5	1.5	1.5	2	300?
	Zn	ICP-OES	1	85	75	53	90	>200
Lake clays	Au	ICP-MS	0.01	344	<10	<10	132	<250
	As	ICP-MS	0.5	93	39	19	104	>200
	Bi	ICP-MS	0.1	0.3	0.3	0.2	0.4	<150
	Cu	ICP-OES	1	107	90	63	130	>300
	Mo	ICP-MS	0.2	1.1	0.8	0.6	1	>300
	Sb	ICP-MS	0.2	0.9	0.8	0.6	1.2	>300
	W	ICP-MS	0.5	5	3	1.5	4	>250
Zn	ICP-OES	1	59	40	27	78	?	
Saprolitic clay	Au	ICP-MS	0.01	3820	25	8	691	<80
	As	ICP-MS	0.2	462	348	204	584	<100
	Cu	ICP-OES	1	173	162	137	193	>250
	Mo	ICP-MS	0.2	0.8	0.8	0.6	0.8	<80
	Sb	ICP-MS	0.2	2.1	1.6	0.6	1.9	<80
	W	ICP-MS	0.5	49	13	4	30	<60
	Zn	ICP-OES	1	243	136	67	336	<250
Mottled saprolite	Au	ICP-MS	0.01	263	60	28	330	<80
	As	ICP-MS	0.5	199	120	70	240	<60
	Bi	ICP-MS	0.1	0.05	<0.1	<0.1	0.2	?
	Cu	ICP-OES	1	213	190	145	270	>250
	Mo	ICP-MS	0.2	0.3	0.2	<0.2	0.6	<80
	Sb	ICP-MS	0.2	0.95	0.8	0.4	1	<80
	W	ICP-MS	0.5	5	2	1	5	<60
Zn	ICP-OES	1	79	46	29	110	<250	
Saprolite	Au	ICP-MS	0.01	1338	10	<10	170	<40
	As	ICP-MS	0.5	284	150	26	290	<60
	Bi	ICP-MS	0.1	0.02	<0.1	<0.1	<0.1	<20
	Cu	ICP-OES	1	247	200	130	290	>200
	Mo	ICP-MS	0.2	0.6	0.4	0.4	0.8	<80
	Sb	ICP-MS	0.2	1.2	0.6	0.2	1	<60
	W	ICP-MS	0.5	11.5	1.5	0.5	7	<40
Zn	ICP-OES	1	286	193	120	310	>300	
Saprock	Au	ICP-MS	0.01	139	80	<10	230	<10
	As	ICP-MS	0.5	265	135	120	190	<50
	Bi	ICP-MS	0.1	<0.03	<0.1	<0.1	<0.1	<6
	Cu	ICP-OES	1	143	140	130	150	<50
	Mo	ICP-MS	0.2	0.8	0.4	0.2	0.6	<80
	Sb	ICP-MS	0.2	0.76	0.4	0.4	0.6	<50
	W	ICP-MS	0.5	4.9	3.5	1	5.5	<30
Zn	ICP-OES	1	182	147	120	223	<40	

ICP-MS after extraction in aqua regia  
ICP-OES after extraction in aqua regia