ZULEIKA SANDS GOLD DEPOSIT, ORA BANDA, WESTERN AUSTRALIA

M.J. Lintern

CRC LEME, CSIRO Exploration and Mining, PO Box 1130, Bentley WA 6102

LOCATION

The Zuleika Sands gold deposit is approximately 40 km NW of Kalgoorlie at 30º32'10"S, 121º03'54"E; Kalgoorlie 1:250 000 map sheet (SH51-09).

DISCOVERY HISTORY

The Zuleika Sands Au deposit is hosted by sediments in a palaeochannel and was discovered in 1989 by drilling out from the outcropping Zuleika South deposit (Figure 1). Critical to discovering such deposits in the Eastern Goldfields region were recognition of i) sands at the base of the palaeochannels and ii) anomalous Au within them (S. Devlin, pers. comm., 1992).

PHYSICAL FEATURES AND ENVIRONMENT

The local area (Figure 1) consists of: (i) a floodplain in the W and central portion that continues to the W as a broad valley that receives run-off and flows only after heavy rain; a palaeochannel is located beneath it; (ii) a residual pediplain in the E part that rises gently to the E, and, between them, (iii) a narrow, subdued erosional spur.

The region has short, warm winters and long, hot, dry summers, with minimum and maximum temperatures of 4-16ºC (July) and 19-31ºC (January). The annual rainfall is 250-300 mm (range 100-500 mm), with more than half falling during winter; mean annual evaporation is about 3000 mm. Vegetation is mainly open woodland. The floodplain has patchily distributed salmon gums (*Eucalyptus salmonophloia*), some over 15 m high, and other eucalypts less than 15 m high, and groundcover mainly of chenopod (saltbush) shrubs <0.5 m high, such as bluebush (*Maireana* spp.). A thickly vegetated area of closed woodland, several hundred metres across, occurs to the S, on 4200mN.

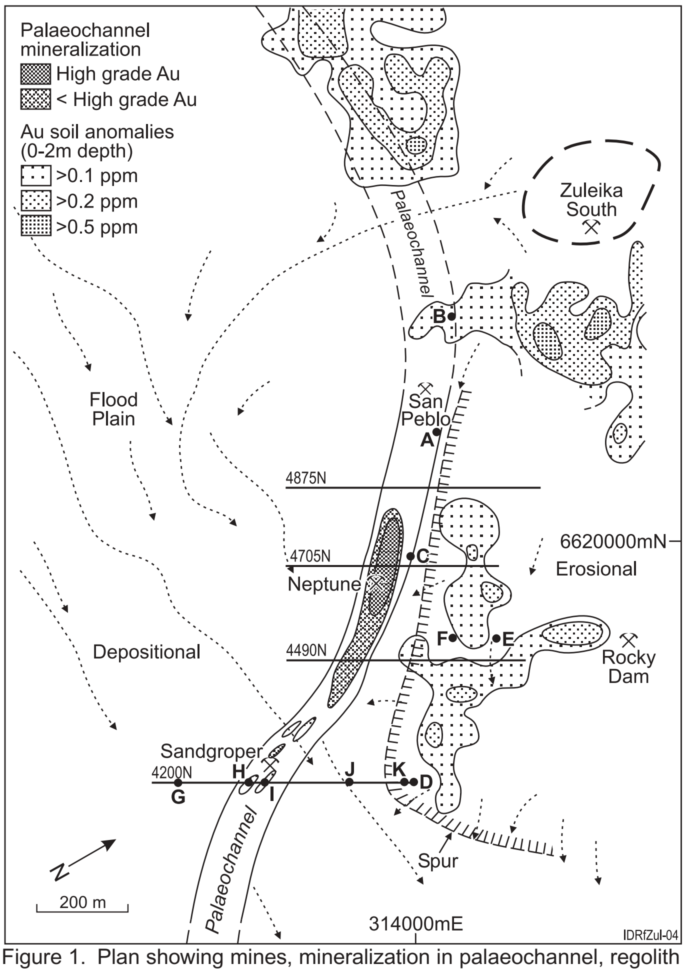

Figure 1. Plan showing mines, mineralization in palaeochannel, regolith units, geochemical traverses, soil profiles and the present drainage. A-K are soil profiles.

GEOLOGICAL SETTING

The Zuleika is situated in the Archaean Kalgoorlie Greenstone Belt, with primary mineralization (e.g., at Zuleika South) hosted by high-Mg basalts, and associated with shears. The regional geology of the area has been described by Harrison *et al.,* 1990. Erosion along a major regional NNW-trending structure, the Zuleika Shear, formed a drainage channel, the deepest part of which is 15-20 m below the present surface. This is now filled with Tertiary sands and clays blanketed by recent colluvium-alluvium. The depth of the sediments covering the basal sand varies but increases towards the S. The base of the channel is at a mean RL of 370 m along section 4875mN, reducing to below 363 m along 4450mN. An early high energy stream flow is implied by the angular quartz gravel and boulders at the base of the channel and a gradient much steeper than that of the present land surface. The E margin of the channel is very steep (Figure 2). The basement rocks beneath the channel include weathered shales, felsic, mafic and ultramafic rocks.

REGOLITH

The regolith is developed mainly in the palaeochannel sediments, which consist of : (i) calcareous soils, colluvial gravels and homogeneous heavy red clays (0-2 m); (ii) light grey clay with patchy, indurated, red, ferruginous mottles that are larger and less numerous towards the base (2-9 m); (iii) grey clays and sandy silt, mottled red to brownish and abundant goethitic pisoliths (9-13 m) and (iv) ferruginous clays and silty sand cementated with clay; gravel- and boulder-sized angular quartz rubble, generally with Mn-staining; there are some local, nodular and brecciated dolomitic bodies several tens of metres in length (13-17 m depth). The underlying basement consists of over 17 m of saprolite-grading to saprock, above fresh bedrock.

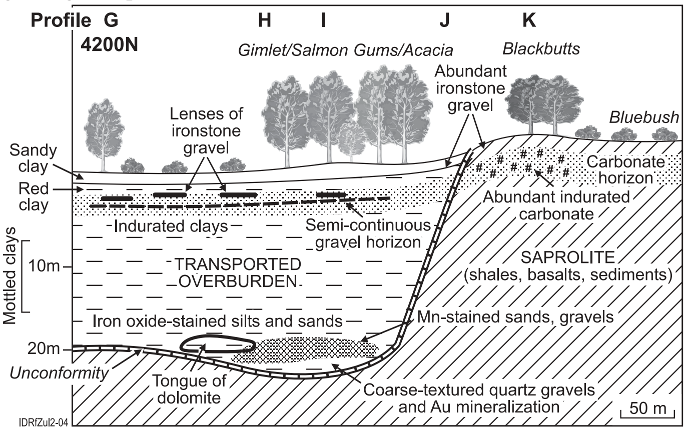

Figure 2. Regolith sectional model through the palaeochannel.

MINERALIZATION

The Zuleika Sands deposits occur over 1 km within and beneath the palaeochannel (Figure 1). Mineralization in the palaeochannel is divided into three zones, which are named, from N to S, San Peblo, Neptune and Sandgroper. The zones are situated to the S and W of known basement mineralization, the closest of which, Zuleika South, is about 500 m to the NE of San Peblo.

The origin of the mineralization in the palaeochannel has not been determined. There is some sub-economic mineralization within the sediments, but the highest grades occur at the unconformity between the basal sands and the underlying weathered basement. Some high grades also occur well below the unconformity (e.g. 5 m at 7.81 g/t, 8 m beneath the unconformity) which suggests a basement source for the Au. Preliminary examination of Au in heavy mineral concentrates from the palaeochannel shows that the Au particles have low Ag contents and are barely corroded, suggesting recent secondary precipitation.

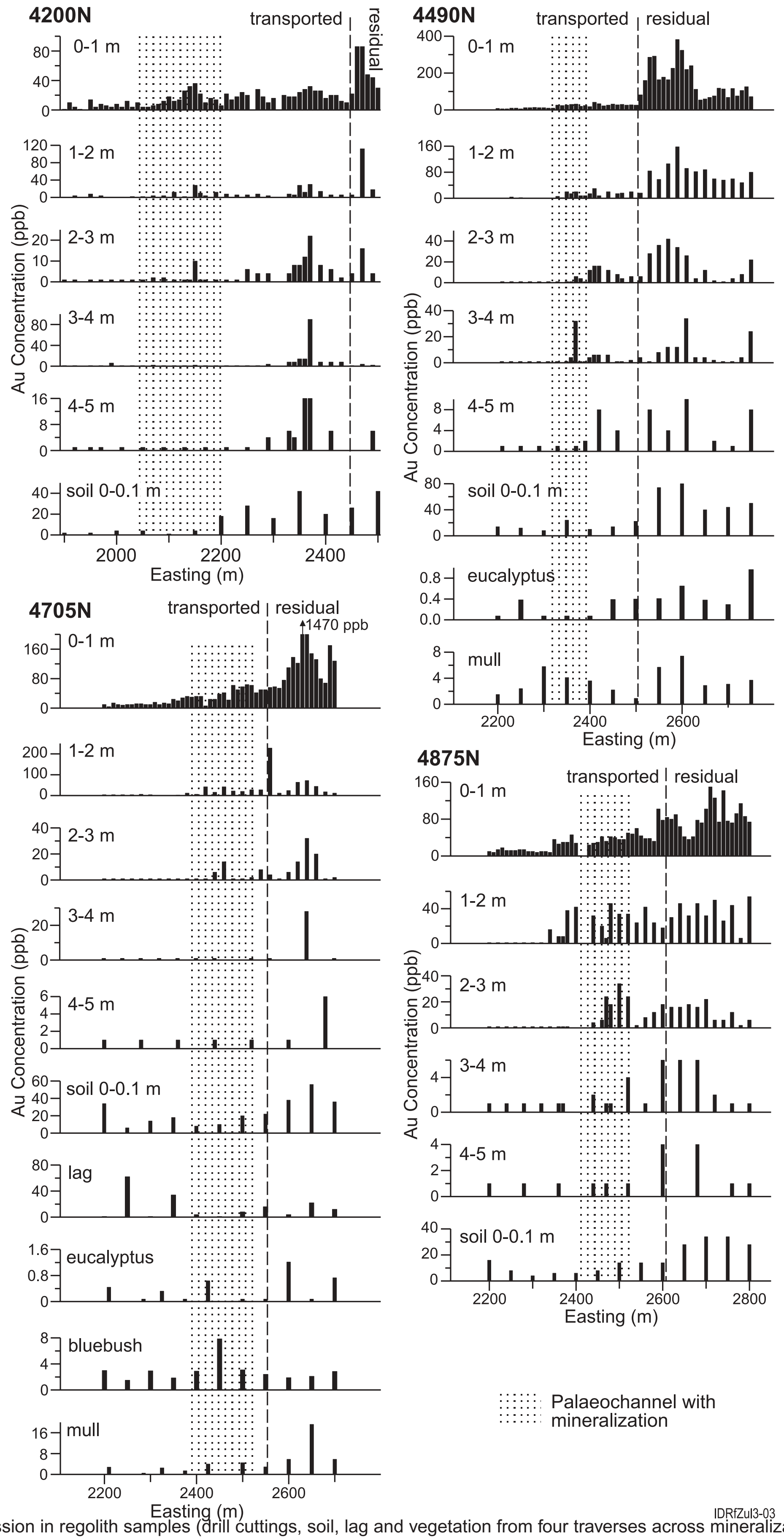

Figure 3. Gold expression in regolith samples (drill cuttings, soil, lag and vegetation from four traverses across mineralization at Zuleika.

REGOLITH EXPRESSION

The geochemical expression of mineralization was investigated along 4 traverses each over 400 m across the palaeochannel mineralization (Figure 1). Data from: (i) RC drill cuttings at 1 m intervals to 5 m depth, (ii) soil (0-0.1 m), eucalyptus leaves, bluebush (leaves and branches), decaying organic matter (mull) and coarse lag (2-6 mm) are shown in Figure 3 and (iii) soil profiles from shallow pits up to 2 m depth (Figure 4). The RC drilling for the regolith investigation was deliberately shallow to avoid cross-hole contamination from mineralization. The distribution of elements other than Au is discussed by Lintern and Butt, 1992.

There is no consistent indication of buried mineralization in the drill cuttings (0-5 m). The highest Au concentration (1470 ppb) was found in residuum over saprolite on 4705mN. Gold concentrations in 0-5 m

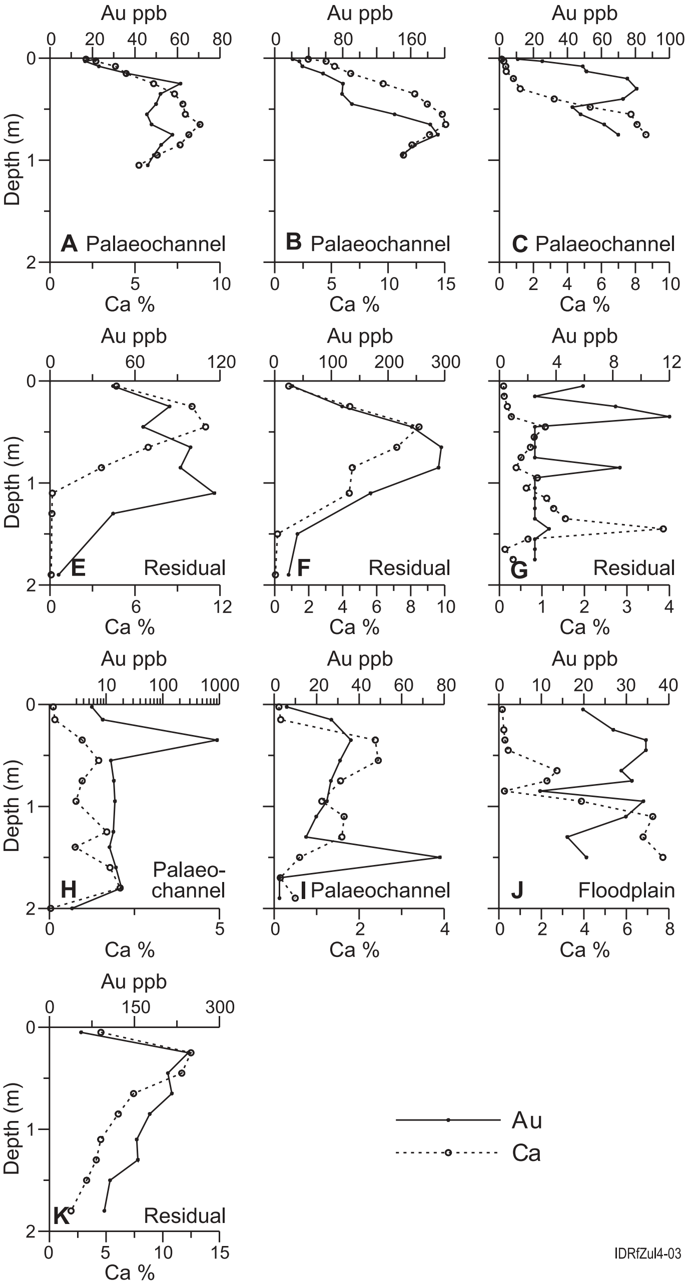

Figure 4. Calcium and Au concentrations in soil profiles.

samples increased from W (transported) to E (residual), and decreased with depth (Figure 3). Gold concentrations (median 26 ppb) in the upper transported regolith were similar above mineralization to those over barren sediments to the E, but higher than those to the W (10 ppb). Some unusually high concentrations of Au were found in the upper transported regolith, but these do not all occur above the palaeochannel mineralization. Similarly, soil (0-0.1 m), lag (2-6 mm) and vegetation (bluebush, eucalyptus and mull) do not indicate buried mineralization, although one bluebush sample above mineralization on section 4705N was anomalous (8 ppb, dry weight).

Gold in the soil profiles appears to be concentrated in the top metre, consistent with the drill data (Figure 4), and appears to be associated with pedogenic carbonate in profiles A, B, F and K. Higher Au contents (100-300 ppb) and a closer correlation with Ca occur in the residual soil profiles (E, F, K and D), and have skewed populations where carbonate appears. In the floodplain profiles (Figures 4G and J), where there is generally less pedogenic carbonate, some of the Au appears associated with ferruginous granules or is randomly distributed. In profile C, a carbonate-poor hardpan has developed close to the surface within which the Au concentration of Au is apparently associated with halite. In profile H, a highly anomalous sample (910 ppb Au) is probably due to particulate Au; a similar single point anomaly occurs in profile I (Figure 4).

The data neither support nor contradict the hypothesis that Au anomalies in the near-surface are related to Au mineralization beneath the transported overburden. The Au in the upper regolith of the floodplain above the palaeochannel exceeds background areas to the W, but it is not distinct from Au in the floodplain immediately to the E, where input from outcropping residual regolith is very possible. The poor association between mineralization in the palaeochannel and the Au contents of overlying sediments suggests that there is no relationship. The soil, soil profile and lag data similarly suggest natural input to the floodplain soils of particulate Au from the residual soils up-slope and this has masked any suggestion of possible upward movement of Au from buried mineralization.

REFERENCES

Harrison, N., Bailey, A., Shaw, J.D., Petersen, G.N. and Allen, C.A., 1990. Ora Banda Gold Deposits. In: F.E. Hughes (Editor), Geology of the Mineral Deposits of Australia and Papua New Guinea. Monograph 14, The Australasian Institute of Mining and Metallurgy, Melbourne, pp 389-394.

Lintern, M.J. and Butt, C.R.M., 1992. The distribution of gold and other elements in soils and vegetation at Zuleika, Western Australia. Report No. 328R. CSIRO Australia, Division of Exploration Geoscience, Perth, 90 pp.

SAMPLE MEDIA - SUMMARY TABLE OF RANGES[1]

Sample medium	Au (ppm)	Ag (ppm)	As (ppm	Se (ppm)	Sb (ppm)	Bi (ppm)	Cu (ppm)	Pb (ppm)	Ni (ppm)	Zn (ppm)	W (ppm)
Eucalyptus leaves	<0.0001-0.0012	<1	<1	<0.1	<0.1	Na[2]	3-12	na	1-11	7-39	<0.1
Mull	<0.0005-0.0192	na	0.49-2.32	na	<0.1-0.16	na	4-10	na	4-22	5-28	na
Maireana sedifolia	0.0015-0.00785	na	na	na	na	na	7-10	na	3-9	5-16	na
Lag (>1 mm)	<0.002-0.062	<1-5	41-69	<1-5	2-20	<1-3	67-144	13-23	110-326	26-38	3-12
Soil (0-2 m)	<0.002-1.672	<1-6	6-58	<1-9	<1-8	<1-4	49-131	<1-19	84-984	5-93	<1-20
Ground water	na	na	na	na	na	na	na	na	na	na	na
Transported overburden	<0.002-72.3	<1-8	1-97	<1-9	<1-15	<1-5	36-137	<1-19	75-540	9-64	<1-14
Saprolite	<0.01-40	na	na	na	na	na	na	na	na	na	na
Bedrock	na	na	na	na	na	na	na	na	na	na	na

[1] The data (apart from mineralized material in transported overburden and saprolite) reflects typical weakly anomalous material from the depositional regime *downslope* of mineralization and are unrelated to *underlying* mineralization.
[2] na = not analysed.