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KOHINOOR COPPER DEPOSIT, CLONCURRY MINERAL FIELD, QUEENSLAND

BY

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Contents

Plate: Kohinoor copper deposit, Dobbyn district, Cloncurry Mineral Field. Scale 1 inch : 100 feet.

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SUMMARY

The Kohinoor copper deposit, from which over 1,000 tons of ore have been extracted was in 1935 found by the Aerial, Geological and Geophysical Survey of North Australia to have associated with it, and along the line of lode to the north, a marked electro-magnetic anomaly.

Geochemical testing in 1958 has indicated anomalous copper distribution which corresponds closely to the geophysical anomaly and, in the southern part, to the exposed line of copper mineralization. In the northern part, where there are no workings and only sparse outcrop (with weak copper mineralization), the coincidence of the geophysical and geochemical anomalies indicates a prospecting target. Outcrop is inadequate to determine whether there are any geologically favourable features where the anomalies occur, but a flexure in the geophysical anomaly could be interpreted as a deflection in the lode, which might be a favourable locus for ore emplacement.

The grade of primary ore in and below the existing workings is unknown and the greatest known width of ore is seven feet. It is therefore unlikely that a major orebody exists within 200 or 300 feet of the surface but the northern anomalies should be worth testing.

LOCATION AND ACCESS

The Kohinoor group of copper workings are about 3¼ miles slightly east of north from the branch railway line terminus of Dobbyn, and about 2 miles north-north-west of the Orphan copper mine. Dobbyn, 75 miles north-north-west of Cloncurry, is a very small settlement lacking a store or hotel. It is linked to Cloncurry by track and road, via Kajabbi, in addition to the rail link. From Dobbyn the workings are reached by following the Burketown road to the Kingsfield Homestead track, which is then followed about ¾ mile to a sandy creek crossing. The workings lie roughly ¾ mile north-west of the creek crossing. The old access track is very ill-defined.

TOPOGRAPHY

The workings lie in an area of slight relief and only fair outcrop, on the eastern flank of a low belt of hills between St. Pauls Creek and Coppermine Creek. It is drained, by very small water courses, to the east where alluvial plains extend to Coppermine Creek.

The line of lode crops out discontinuously and has very little topographic expression, particularly in the north where outcrop is scanty.

Soil cover, where present, ranges from a few inches to probably several feet. Generally it is shallow. Soils are both residual and transported in origin. Transported soil is found mainly along the watercourse in the north.

WORKINGS AND PRODUCTION

The following summary of workings and table of production are compiled from the Queensland Department of Mines Annual Reports for the years 1918 (p.66), 1919 (pp.11 & 60),

1920 (p.58), 1921 (p.50), 1922 (p.47), 1923 (p.52), 1928 (p.9), 1929 (p.50) and 1941 (p.31).

Lease No. 1748 (Kohinoor) was extant in 1915 as it is shown on the map of leases in the Annual Report for that year, but the first record of workings is for the year 1918.

1918 - The shaft (then the most northerly) was sunk to a depth of 105 feet from the 70-ft. level. It was planned to go to 200 ft. but a heavy flow of water was encountered. Another shaft 80 ft. to the south was connected (before 1918?) to the northern shaft by a drive (level not stated). The drives in the mine totalled 130 ft; most of the ore was extracted from above the drive.

1919 - Some 500 ft. of prospecting development had been carried out in the mine up to the end of 1919. Fifty feet of driving at the 110 ft. level had exposed a lode with 5 to 7 feet width of payable ore.

1920 - A compact limestone (crystalline calcite) was sunk in - whether from surface of underground is not clear - and a cross-cut opened up for 20 feet, to the west wall (of the limestone?). No payable ore was located. Another shaft was sunk 70 feet to the north and the lode was tested at several points.

1921 - A winze was sunk from the bottom level 25 feet to the lode. The south shaft, designed to intersect the lode, reached a depth of 80 feet, and a prospecting shaft reached 12 feet. The ore shoot in the winze is stated to dip south.

1922 - A parcel of ore was taken from "the two shafts and the winze".

1928 - The mine was reopened and repaired. The lode has been proved to 150-ft. depth; it has a greater length (not stated) than the average small mine. Ore assays 15% copper.

1929 - Ore was stoped from above the 100-ft. level.

Production

Year	Ore Long Tons	Copper Long Tons	Per-cent Copper	Value	Remarks
1918	570			£2,600	Included 16 tons of 24% Cu ore.
1919	300		18		
1922	36	7.04			From 2 shafts and winze.
1929	116	18			Also 87 oz. Ag from above 100ft. level.
1941	11.01	1.04			From dumps?
	1,033				

The tonnage figures are almost certainly incomplete as the Warden's report, from which most of the data are taken, commonly lists a figure for "other small mines" in the Cloncurry Field. Nye and Rayner (1940) record production of 260.19 tons of copper-gold ore which yielded 36.63 tons of copper and 6 oz. of gold, giving an average grade of 14.08% copper and 0.46 dwt. per ton gold. It is not known to what extent these figures are additional to those recorded in the Annual Reports of the Department of Mines.

All workings are now inaccessible. There are four shafts in the southern part of the line of lode, and a fifth farther north. In addition many pits, costeans and small pot-holes have been sunk along the main lode and on other points where weak mineralization was found at the surface.

The surface workings are shown on the accompanying plan, with depths. The shafts were measured by lowering a tape from the collar; the depths shown represent present effective depth, which in most cases is not the same as the original depth. Horizontal openings could be seen from two of the shafts, as shown. All the deeper shafts contain water.

INVESTIGATIONS

No previous geological investigations are known to have been made. From September to December 1935 a geophysical survey, using magnetic, electro-magnetic, self-potential and resistivity methods, was made of the Orphan and Kohinoor deposits, and intervening ground. The survey was carried out by the Electrical Prospecting Company of Sweden for the Aerial, Geological and Geophysical Survey of North Australia (A.G.G.S.N.A.) Rayner and Nye (1936) reported for the latter organization, and included some notes on the geology.

The geophysical survey indicated a very strong magnetic anomaly over the Kohinoor lode, particularly at the northern end. In order to test surface indications of mineralization beyond recorded mineralization a geochemical survey was carried out around the Kohinoor workings by A. McClure, under the supervision of A. D. Haldane, from 1st June to 12th July, 1958. Soil samples were taken at a depth of 15-18 inches from auger holes 50 feet apart, on lines 100 feet apart and at right angles to the line of lode. After crushing and rejection of any coarse gravel the prepared sample was fused with potassium bisulphate. The melt was then taken up in dilute hydrochloric acid. Sodium potassium tartrate/sodium acetate buffer was added to a suitable aliquot of the acid extract and then extracted with 2, 2' biquinolyl (cuproine in amyl alcohol) and the copper estimated by visual comparison of the violet complex so formed against prepared standards.

The geological mapping was done by E. K. Carter, using the geochemical grid, compass, tape and pacing, on 2nd to 4th October, 1958.

The geophysical contours shown on the accompanying map are the electro-magnetic contour lines taken from Rayner and Nye (1936, Plate 5) and are the -400 and -500 gauss contours. The geochemical contours show the results of the geochemical survey in relation to a background established from the copper values obtained on soil samples taken away from the line of lode and which showed a consistent minimum value within the limits of normal variation.

GEOLOGY

REGIONAL

The deposit occurs in strongly folded, faulted, and metamorphosed Precambrian rocks which are host to all the metallic mineral deposits of north-western Queensland.

The Dobbyn 4-mile geological sheet (see Carter, 1959) shows the deposit to be in the Leichhardt Metamorphics, which consist largely of metadacite, with some metarhyolite, metabasalt and metasediments. As the acid lava in the mine area appears to be metarhyolite and no metadacite has been recorded possibly the deposit is in the lower part of the conformably overlying Argylla Formation, which is also an acid lava succession, but with metarhyolite the main lava type. Granite crops out about 2 miles to the west and also occurs to the south-east. The strata have been moderately metamorphosed, with recrystallization of the lavas and the formation of chlorite and amphibolite schist. The regional trend of the strata is roughly north; dips are high - generally steeper than 60^{0}.

Most of the mineral deposits in the Dobbyn district occur in host rocks similar to those adjacent to the Kohinoor deposit. All lodes are controlled by faults.

LOCAL

Lithology

The succession, as exposed, from about 400 feet east of the lode to 300 feet west of it is:

Acid lava, probably metarhyolite.

Slate (poorly exposed).

Porphyritic acid lava, as above, possibly 125 feet thick but with some associated ?metadolerite.

Metadolerite, probably about 100 feet thick, but varies along the strike.

Thin, discontinuous line of quartz.

Gabbro, at least 90 feet wide (poorly exposed).

Belt, 50 feet or more wide, with no outcrop, but quartzite and quartz rubble.

Quartz vein, marking the line of lode, with some associated grey coarsely crystalline calcite, and with travertine along the western margin. Quartz reef is up to 22 ft. wide in outcrop.

Belt of porphyritic acid lava, with some sheared metadolerite and biotite schist, in the south, but it appears to strike into the lode and is absent at the surface farther north.

Dark schist and slate, poorly exposed in belt up to 125 feet wide. The schist appears to be in part sheared metadolerite and in part schisted metasediments, possibly including greywacke.

Quartzite, up to 170 feet wide. The quartzite is grey and is fine-grained. It does not crop out in the north of the area.

A short distance west of the quartzite vesicular basalt (not mapped) was observed.

The acid lava is pink, fine to medium-grained, and has phenocrysts of feldspar in a finer groundmass. Some banding was seen. It conforms to the strike of the other strata and is very similar in appearance to the metarhyolites of the region. For these reasons it is considered to be extrusive.

There may be two or more ages of dolerite. Some appear to be massive, fairly fresh, dark and fine-grained. Several outcrops east of the lode are of a brown, massive, medium-fine grained rock which in handspecimen displays a typical ophitic, doleritic, texture. In addition to these, dark chlorite and biotite schist, some of it clearly of doleritic (or basaltic) origin, occurs widely, but does not crop out well. The schist has formed partly as a result of shearing, but some appears to be due to regional metamorphism. Amphibolite has also been mapped.

The gabbro, which is exposed in sparse small, rounded, outcrops, along the whole length of outcrop of the lode, is typically gabbroic in texture and appearance. It is fresh, massive and apparently undeformed and is clearly later than the metadolerite, but some of the fresh-looking, massive dolerite could be genetically related to it.

Along the southern tributary of the water-course in the north of the area (near co-ordinates 2225N, 250W) some banded and veined rocks are probably silicified and hydrothermally altered basic igneous rocks.

Structure

Both east and west bedding dips have been measured, and it is not clear whether the oldest strata are on the east or the west. Regional considerations suggest that the oldest strata are the east-dipping quartzite beds on the west. No repetitions by folding or faulting were recognised. All strata dip at 60° or steeper. The trace of bedding on cleavage in slate at 490N, 260E has a pitch of 27°S. No other evidence for pitch of the folding was obtained.

Considerable faulting has disturbed the area. The north-north-westerly striking lode probably occupies a fault plane, parallel to the eastern block of strata but cutting at a small angle across the strike of the western block. The other quartz veins sub-parallel to the lode probably also represent fault-traces. Small displacements of the quartzite, and lines of quartz and quartz rubble, indicate cross-faults which strike east to east-south-east. There may be some north-east striking faults also. None of the cross-faults were observed to displace the lode, but outcrop is inadequate to be certain that the lode is not displaced.

THE LODE

The main lode strikes about 345° magnetic and so far as can be judged from the surface and the available accounts of the underground workings, dips about vertically. Partings and banding in the central quartz outcrop dip 80°-85° east. "Limestone" (grey crystalline calcite) which at the surface forms part of the lode, extends 20 feet to the west at an unspecified depth (see Workings and Production).

At the surface the quartz of the lode ranges from massive to vughy and brecciated. It is commonly iron-stained and in places, as shown on the accompanying maps, has small

patches of pyritic boxwork. Surface evidence of mineralization is meagre but doubtless the best indications have been destroyed by mining operations. The lode may be traced north of 2250N by small, scattered, outcrops of quartz and calcite, a few of which contain specks of copper minerals.

Poorly exposed weak copper mineralization forms a line in soil up to 100 feet west of the main lode, but appears not to be of economic interest as a series of pits sunk along it were abandoned at shallow depths.

The cross-fault at 260N, 250E, marked by quartz and grey calcite, also has sparse malachite associated with it.

The walls of the shafts, as seen from the surface, show the secondary copper mineralization to be confined in places to near-vertical shears and elsewhere to be dispersed through calcite. In places the eastern wall rock is quartz, and elsewhere it is biotite schist. Dump material consists of blocky siliceous slate and grey crystalline calcite, some with malachite.

GEOCHEMICAL RESULTS

The results of the geochemical survey are shown on the accompanying plan in the form of contours. The contour interval is not uniform but increases in geometric progression. The dispersion pattern of copper, as shown by the contours, is controlled by mineralization along the line of the central quartz outcrop and by topography. Six maxima occur in the dispersion pattern, four of these are centred over or immediately adjacent to the central quartz outcrops. Of the remaining two, one covers the area of the old workings in the south and the other in the north occurs in an area of soil cover with poor outcrop. The dispersion maxima all fall on a north-north-west line which is co-linear with the line of the geophysical anomaly to a marked degree.

The contour intervals on the west flank as far north as 2000N are reduced by rising ground. On the east side and north of 200N the ground falls away and is reflected in the spreading of the 2 x contour level.

There is little doubt that the geochemical anomaly is a direct result of the dispersion of copper mineralization occurring along the line of the central quartz outcrops. At the southern end mining activities may be expected to have disturbed the normal dispersion pattern, but it is not possible to identify such effects with certainty from the geochemical contours. The remainder of the area is considered to be fairly free from spurious anomalies caused by mining.

INTERPRETATION OF RESULTS

The electro-magnetic anomaly closely follows the line of the outcropping lode, except near the northern end, where it swings to the north-west. It is strongest near the bend, about 2500N, where outcrop is poor. The interpretation given by the consultants who carried out the survey (see Rayner and Nye, 1936, p.11) is that the anomaly represents mineralization.

A self-potential survey over the same area gave less conclusive results, but was also strongest at the northern end; the interpretation for the electro-magnetic anomaly therefore appears to be borne out by the self-potential work.

A surprising feature of the geophysical survey is that the gabbro, which presumably forms a continuous body of appreciable size along the east of the lode, does not appear to be indicated by the horizontal component of the electro-magnetic anomaly (see Rayner and Nye, 1936, pl.5). It does, however, appear to be indicated in the vertical component and in some of the self-potential profiles (Rayner and Nye, pl.6). The differences in the several profiles could possibly be interpreted to indicate that the gabbro is discontinuous.

The geochemical anomaly may be accounted for by the generally weak surface mineralization. At the northern end, where there are no workings, sufficient sparse, weak, copper mineralization is present to account for anomalous amounts of copper along the extension of the lode, but the pronounced "high" coincidental with that of the geophysical anomaly appears to be significant. Taken together the two types of anomaly appear to indicate a prospecting target worth further work.

The mapping of the surface geology gives no evidence either for the deflection of the lode to the north-west at the northern end, or for significant mineralization. The area covered by the geochemical and geophysical anomalies is, however, one of poor outcrop.

The lode appears to have been controlled by a fault or shear and to be generally narrow - greatest recorded width of ore is seven feet - but if the lode changes strike, as the electro-magnetic anomaly indicates is possible, the point of flexure could provide a favourable locus for a larger orebody.

CONCLUSIONS

The known mineralization appears to be controlled by a fault of unknown magnitude, but no evidence was found for deformation of a magnitude sufficient to suggest that a major orebody may be present. The lode at the surface and in underground workings is narrow. No evidence is given in existing records of grade of copper content in the primary zone; probably all the ore mined - over 1,000 tons, but almost certainly less than 1,500 tons - consisted of secondary ore. The geophysical and geochemical anomalies, jointly, indicate that possibly a zone of mineralization, of greater width than that mined, lies below an area of poor outcrop towards the northern end of the area mapped. As the anomalies are narrow any concealed orebody is probably small, within 200 or 300 feet of the surface, but the anomalies are worth testing.

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KOHINOOR COPPER DEPOSIT

DOBBYN DISTRICT

CLONCURRY MINERAL FIELD

QUEENSLAND

Scale in Feet

0 20 40 60 80 100 200 400 600

Geology by E. K. Carter

October 1958

Grid as For Geochemical Survey

Magnetic North

GEOCHEMICAL DATA.

	Background	70 p.p.m. Cu
2 X	"	140 " "
4 X	"	280 " "
8 X	"	560 " "
16 X	"	1100 " "

2X Geochemical contour.

"Migmatite" and allied rocks.

Grey, fine-grained, quartzite.

Metamorphosed acid lava, generally porphyritic.

Dark schist and slate, in part of doleritic origin.

Dolerite and derivatives.

Gabbro and microgabbro.

Grey, coarsely crystalline, calcite.

q - Quartz

Quartz rubble

Cu Copper mineralization, generally malachite

75 Bedding, ?Flow banding or dip of lode, showing dip.

" " " " " " " , vertical.

Vertical cleavage or schistosity.

32' Shaft, with depth. Deep shafts inaccessible.

3' Pit, showing depth.

Dump.

Outcrop boundary.

" , position approximate.

Outline of geophysical anomaly.