

GEOLOGICAL RECONNAISSANCE OF THE WARBURTON RANGE AREA, WESTERN AUSTRALIA.

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INTRODUCTION.

A geological reconnaissance of the Warburton Range area was prompted by the recent marketing of copper ores extracted from the immediate vicinity of the Warburton Range Aboriginal Mission. Earlier geological reconnaissances of the same area were conducted by Talbot and Clarke (1917) and Forman (1932, 1933).

The present report discusses the physiography, stratigraphy, structure and economic potential of the area, and also suggests correlations with adjacent areas. The report is accompanied by a geological compilation based on photo index map Talbot, sheet 3/468, scale 1 mile = 1 inch.

The geological reconnaissance was carried out during the period October 2nd to 12th, 1961.

LOCATION AND ACCESS.

The Warburton Range Area is contained within the "Talbot" international series sheet S.G. 52-9 delineated by latitudes 26° and 27° south and longitudes 126° and 127° 30' east. The locality falls within a native reservation, and permission to enter the area must be obtained from the Department of Native Welfare.

A native mission Station, operated by the United Aborigines Mission, is located near the junction of Hughes and Elder Creeks on the north-west foothills of the Warburton Ranges, and caters for the welfare of the nomadic natives of the region. The Station includes a store, hospital, and school, and is connected to the Flying Doctor radio network based at Kalgoorlie. A landing strip for light aircraft, and water facilities, are available at the Mission.

From the West Australian side, the Warburton area may be reached by travelling eastwards along a graded dirt road from Laverton to Cosmo Newberry Mission (50 miles), and thence north-eastwards for a further 300 miles via the southern margin of Lake Throssell.

A graded dirt road running north-eastwards for some 170 miles connects the Warburton Mission with the Giles Weather Station. Forty miles along this road, a newly-constructed track branches westwards to link with Carnegie Pastoral Station and thence to Wiluna.

Supplies and mail are carted by the Mission truck which makes a trip monthly to Laverton. The Giles Weather Station forms the nearest permanent settlement and has a weekly mail service from Alice Springs. Giles is operated jointly by the Bureau of Meteorology and Weapons Research, and is connected by a graded dirt road running some 400 miles eastwards via Mulga Park and Mount Davies pastoral Stations to meet the Adelaide to Alice Springs Highway 10 miles south of Kulgera. From this South Australian side, a branch track also connects to the Warburton area via the Blackstone Ranges.

PHYSIOGRAPHY.

From a regional aspect, the area has an average elevation between 1,500 and 2,000 feet above sea level but shows a gradual fall from north-east to south-west. Consequently major drainages are controlled by this fall and drain westerly or southerly to terminate in outwash aprons or become lost in adjacent sand plains areas.

Dissection of the hilly belts is influenced mainly by structural and lithological features and, with the exception of the higher Warburton Range ridges, local differences in elevation seldom exceed 200 feet. Physiographic units distinguished within the area are:—

Dissected Hills and Ranges.

Resistant ridges and dissected hills of metamorphic rocks comprising the Warburton Ranges form the major positive elements of relief. These are south-east trending in the north-west sector, but alter to an east trend in the south-east sector.

Higher ridges range up to 600 feet above the Elder Creek level at the mission site, and are flanked by, or interbedded with, lower, less-resistant belts of similar trend. Dissection of the hilly belts has been general with drainages mainly controlled by rock fracture systems, strike and dip features, and lithological diversity.

In the south-west sector, lower lying breakaway and butte features are formed by dissection of the flat-lying Palaeozoic sediments.

Outwash Plains.

Flat alluviated plains skirt or occupy the lower lying areas of the hilly belts. These are associated with the sheet drainage of the area, and appear as red loamy outwash plains (or aprons) showing little, if any outcrop, but frequently mantled by veneers of stoney or fragmentary material derived from the upland areas.

These plains support strong stands of mulga vegetation and (dependent on gradient) usually present regular dense grove patterns, arcuately arranged (convex downslope), and up to a half mile in length. Intergrove areas may be bare or show scantier vegetation. In some sectors, the increased frequency of mulga banding presents a dense thicket appearance.

Other alluviated and calcreted drainages also included with this unit are separately discussed in the water supply report for this area.

Sand Plains.

Extensive developments of red aeolian sand plains, commonly formed into parallel seif dunes, appear in the north-east and south-west sectors. Dunes average 30 feet in height, and can vary up to 1 mile in length. General dune orientation is along south-west lines, but directions appear confused, anastomosing, or chain-like, where adjacent to upland belts.

Some recent sand movements has occurred (directed towards the south-west), but in general, the sand plain and dune areas are now fixed by spinifex and low scrub cover.

In the south-west sector, sand plain areas locally contain small developments of mulga-covered lateritic rises and occasional low breakaways, forming the Tertiary surface as developed over Palaeozoic sediments.

STRATIGRAPHY.

Within the area, metamorphic rocks of sedimentary and volcanic origins, rise abruptly out of the sand plains to form upland areas and prominent ridge belts. On lithological and structural grounds, these rocks bear a strong resemblance to the Nullagine System overlying the undoubted Archean rocks in the Pilbara and Murchison areas of West Australia.

In the Warburton region, it is apparent that the metamorphic rocks have been mobilised to form porphyry and granite bodies, and are thus tentatively relegated to the Lower Proterozoic era.

These rocks form the basement and probably the source areas for the Palaeozoic beds developed marginal to and transgressing the Warburton rocks in the west and south-west.

Younger superficial formations of Cainozoic age mask a large proportion of the metamorphic and Palaeozoic terrains.

All of the rocks appear unfossiliferous and formation names which are proposed below are purely tentative, subject to more intensive field and petrological study, and approval by the West Australian Stratigraphical Nomenclature Committee.

Lower Proterozoic Metamorphics.

Distribution and attitudes of the metamorphic rocks indicate a major anticlinal flexure with the eroded core now represented by the various metamorphic belts of the Warburton Range. Higher grades of metamorphism are confined to the axial

zone of the anticline, whilst on the east flank, upper horizons of the sequence have been further mobilised to yield granite and porphyry bodies.

From bottom to top, the formations which can be distinguished are:

Miller Volcanics (after Miller Hill).—This name is tentatively proposed for a sequence of some 5,000 to 6,000 feet of fine to medium grained doleritic and basaltic lavas and extrusives appearing along the axial portion of the flexure. The sequence also contains minor intraformational volcanic breccias, tuffs, and agglomerates, and thin metasedimentary bands (mainly calcareous).

Metamorphism has produced massive and schistose rocks of amphibolitic grade, but relic volcanic and sedimentary textures are frequently recognised in the relatively unaltered zones.

The Miller Volcanics are conformably overlain on both flanks by the Elder Dolomites, and in the axial sector are also intruded by two concordant porphyry sills (Warburton Porphyry). Basal beds of the Miller Volcanics are not exposed.

Elder Dolomites (after Elder Creek).—Thinly bedded dolomitic limestones, associated with ribbed, argillaceous and cherty beds, are exposed on either side of the structure to form the immediate lower slopes and foothills of the Warburton Ranges.

This dolomitic sequence is approximately 1,500 feet thick and is conformably overlain on both flanks by the Hughes Volcanics.

Hughes Volcanics (after Hughes Creek).—A sequence of predominantly fine grained doleritic and basaltic lavas and flows which overlie the Elder Dolomites are tentatively grouped as the Hughes Volcanics. This sequence is approximately 3,000 feet thick and locally contains thin pyroclastic and calcareous members.

A discontinuous thin chert breccia horizon appears towards the upper part of the sequence along the western foothills, and forms two topographic ridges.

The Hughes Volcanics are conformably overlain by the Ainslie Volcanics.

Ainslie Volcanics (after Ainslie Hill).—This name is tentatively proposed for the sequence of fine to medium grained doleritic and basaltic lavas and flows which overlie the Hughes Volcanics.

The sequence is approximately 4,000 to 5,000 feet thick and locally contains thin pyroclastic and sedimentary members. Amygdaloidal lava varieties predominate throughout the sequence and appear as fine grained greenish rocks containing calcite and quartz amygdales, locally rimmed or replaced by secondary epidote, and more rarely by copper carbonates or sulphides.

Copper mineralisation occurs within the Ainslie Volcanics on the western limb of the structure and forms the potentially cupriferous belt of the area. Epidote mineralisation in the form of stainings, coatings, joint and shear fillings, is also common in the Ainslie rocks, particularly about the areas of known copper mineralisation.

The Ainslie Volcanics are overlain on both flanks by the Townsend Quartzites and in the south-west sector are also transgressed by the Palaeozoic beds. On the west flank, outliers of overthrust Townsend Quartzites are frequently repeated over the Ainslie Volcanics, whilst on the east flank the upper Ainslie Volcanics and Townsend Quartzites are mobilised to yield porphyry.

Townsend Quartzites (after Townsend Range).—A sequence consisting of some 500 feet or more of quartzites, form a prominent escarpment facing north-east near the junction of Hughes and Elder Creeks. These extend in an almost unbroken line for some 30 miles south-east to Lilian Creek, where they form the topographic prominence known as the Townsend Range.

The dominant lithology is a uniform white to buff coloured, thinly laminated, current-bedded, medium grained, blocky quartzite which also contains thin pebble horizons towards the base.

Talbot and Clarke (1917) refer to these beds as comprising part of their "Townsend Range Series" of Ordovician age.

From the present investigation, the Townsend Quartzites appear more or less conformable with the underlying Ainslie Volcanics, but are separated from them by a low angle thrust. Isolated quartzite outliers frequently appear as conformable strike remnants fused to the underlying Ainslie Volcanics east of the main escarpment.

On the eastern limb, the Townsend Quartzites are metamorphosed and grade into phyllitic schists, quartz schists, sericite schists, etc., whilst further east, they have been completely mobilised to yield porphyry and granite masses. In view of this mobilisation, the Townsend Quartzites are preferably grouped with the Lower Proterozoic sequence.

Lower Proterozoic Mobilisations and Igneous Intrusives.

Mobilisations and igneous intrusives distinguished within the area are:—

Warburton Porphyry.—This name is tentatively proposed for the massive or foliated fine-grained, dark grey, brown, or black, quartz-albite porphyries which intrude the Miller Volcanics in the axial zone of the flexure and is also extensively developed along the eastern limb.

Twin concordant porphyry intrusions appearing on either side of the axis, form prominent ridges, and are suggestive of two bedded horizons injected along axial crests in sill form.

The porphyry dykes contain prominent phenocrysts of quartz, albite, and microcline (rare), and are locally pyritic. Felspars are pink or white, whilst quartz of similar dimension is pale blue (often opalescent) or clear.

Along the eastern flank, the porphyry developments are identical with the sill forms but often show relic bedding and contain remnant horizons of "porphyritised" but undigested country rocks. Further east, the porphyry passes transitionally into granitic rocks and is presumably a form of rock mobilisation (analogous to granitisation) which may represent a "front" or pre-granitisation stage.

Granitic Rocks.—Pink and grey, medium to coarse grained granitic rocks developed in the north-east sector are considered to represent a further mobilisation from the "porphyritised" stage. Such rocks appear as composite, fine to coarse grained, foliated, or gneissic varieties, often porphyritic in albite, microcline, and blue quartz. The granite terrains also contain remnant metamorphics and younger dyke intrusives.

Absence of ferromagnesian minerals in some of the granitic terrains suggests a widespread mobilisation of psammitic rocks. Prominent jointing sets are developed in the granitic rocks but the general rock grain which can be observed, conforms to the trend of the adjacent metamorphic belts.

Minor Intrusives.—These include younger quartz bars and doleritic dykes. The quartz bars are extensively developed in the metamorphic rocks, being generally concordant but on the west flank locally appear as transverse joint or fracture fillings.

A more or less conformable doleritic dyke intrudes the Hughes Volcanics along the central northern margin. Other minor forms are also present in the granitic terrains.

Prefolding sill intrusives appear as dark green, mottled and black, coarse grained, basic, gabbroic, amphibolitic rocks. These are difficult to distinguish from the hypabyssal phases associated with most of the volcanic belts. Some of the basic and ultrabasic gabbroic rocks could be related to the broader developments of similar rocks known in the Blackstone Range area and forming part of the Giles Complex of South Australia.

Palaeozoic Glacial Beds.

The Proterozoic rocks are overlapped to the west and south-west by a flat-lying glacial sequence considered to be of Palaeozoic age. The sequence is unfossiliferous but similar extensive developments known in adjacent regions are generally regarded as Permian.

For the most part, the sequence is overlain by extensive sand plains or secondary cappings of ferruginous (lateritic) or siliceous (billy) cements. Geology in these areas is therefore restricted to cliff edges, breakaways, or flat-topped mesas.

In the south-west sector ("Sisters" locality), approximately 60 feet of section is exposed. Here the beds consist of tillitic siltstones showing gradations into sandy varieties and are often micaceous, ripple-marked or current-bedded. Erratics generally occur within the siltstone flour matrix but can appear in any horizon. The erratics are commonly faceted, and unsorted, and show a great variation from pebble to boulder size.

A basal bed which transgresses the volcanic rocks on the western flank is made up of a fine grained, brown, sandstone which is extensively ripple-marked. This sandstone also contains a heavy concentration of rounded pebbles and boulders to present a conglomeratic appearance.

Upper beds of the sequence contain scattered erratics only, and these consist mainly of quartzite similar to the Townsend Quartzites which form the uppermost member of the Proterozoic sequence.

Cainozoic Formations.

Ferruginous and siliceous cements are common in the interdune areas of the sand plain country and represent portion of the lateritic profile as developed during the Tertiary period. Thicker cappings (up to 16 feet) were recorded in dissected Palaeozoic areas.

Calcrete limestone formations, also of Tertiary age, are recorded along the trunk drainages of the area. These form the principal sources of shallow water, and are further discussed in a separate report.

Quaternary aeolian sand plains and other outwash plain formations which mask a large proportion of the area have already been discussed under Physiography.

STRUCTURE.

From the repetition of strata and recorded dips it is apparent that the Lower Proterozoic rocks of the Warburton Area form part of a major anticlinal flexure. The anticline is itself refolded along south-west lines to present a distribution which arcuates from a north-west trend in the north-west sector to an east trend in the south-east. Local dip reversals noted across the structure indicate the existence of minor crenulations.

No closure is evident in the mapped area but from the structural widening in the south-east, a closure to the north is suspected. As evidenced by the relationship between the Townsend Quartzites and Ainslie Volcanics, the folding gives way to low angle thrusting on the west flank.

On the eastern limb, upper members of the Lower Proterozoic sequence have been mobilised to yield porphyry bodies which are locally intrusive into the metamorphic rocks and also pass transitionally into granitic rocks further east.

As mentioned earlier, the "porphyritisation" is regarded as a form of rock mobilisation (analogous to granitisation) and probably represents a "front" or pregranitisation stage. (Similar transitions from identical porphyries to granite have also been recorded by Noldart and Wyatt (unpublished) on what could represent a strike extension of the same group of rocks, east of the Gregory Range in the East Pilbara).

The mobilisation is probably contemporaneous with the period of major folding and has been responsible for the introduction of minor forms of mineralisation into the associated metamorphic rocks.

Both granite and porphyry are strongly factured with master jointing developed along north-east and north-west lines. Quartz bars, copper bearing shears, younger doleritic dykes, and minor faults follow similar directions but also appear as conformable strike features.

Foliations and lineations noted in the granite and porphyry terrains generally parallel the bedding trends of the adjacent metamorphic belts. Other lineations including those related to thrusting movements, are mainly parallel to the axis of refolding and trend at 215°.

Small displacements noted in the metamorphic terrains and the presence of numerous quartz bars indicated the widespread existence of minor transcordant and strike faults. Except for the thrusting recorded on the western flank, the existence of major faulting within the area was not established.

Flat-lying Palaeozoic glacial beds occur marginal to, or transgress the Proterozoic rocks in the west and south-west. From the extensive developments known west of the area it is apparent that arched structures are extremely unlikely and if present would only exist in the broadest form. Absence of major escarpments is sufficient evidence that the glacial beds have remained comparatively undisturbed since deposition.

Tertiary and Quaternary formations of this area are merely superficial and contain no structural elements.

CORRELATION WITH ADJACENT AREAS.

Suggested correlations already referred to in the text and those given below, are purely tentative proposals which could assist in providing a better understanding of the Precambrian Stratigraphy both in this State and those adjoining.

Lower Proterozoic Rocks.

The Lower Proterozoic rocks are unfossiliferous but are classified as Proterozoic purely on structural and lithological similarities to rocks of the "Nullagine System" which overlie the undoubted Archean in other sectors of this State (Pilbara, Murchison). A similar correlation has been suggested by Forman (1932, 1933).

In the Warburton area (and also in the East Pilbara), these Proterozoic rocks are considered to have undergone geosynclinal deformation and mobilisation to yield granite and porphyry masses. For this reason they are tentatively grouped as Lower Proterozoic.

Comparing descriptions given by Commonwealth geologists (Wells, Forman and Ranford) in Bureau of Mineral Resources Records 1959-61 entitled "Geological Reconnaissance of the Rawlinson-Macdonald Area, Western Australia," the metamorphic rocks of the Warburton area are tentatively suggested as being equivalent to the "Dean Metamorphics" (also classified by Commonwealth geologists as Lower Proterozoic).

Further, the "Rawlinson Porphyry" which intrudes the "Dean Metamorphics" in the northern areas is similar in composition, character, and rock relationships to the Warburton Porphyry. Similar porphyries are also known in the East Pilbarian and South Australian extensions.

Upper Proterozoic Rocks.

Upper Proterozoic tillites and associated beds recorded by the Commonwealth geologists in the Rawlinson-Macdonald area suggest affinities with the tillites of the Upper Proterozoic "Adelaide System" of South Australia. They are not represented in the Warburton area.

Palaeozoic Rocks.

Ordovician rocks as recorded in the Rawlinson-Macdonald area have no equivalents in the Warburton region.

The glacial beds form part of Talbot and Clarke's "Wilkinson Range Beds", and in the Warburton locality, form the northern margins of the "Officer Basin".

They are tentatively regarded as Permian and are probably correlative with the "Buck Formation" as recorded in the adjacent Rawlinson-Macdonald area.

Discussion on Precambrian Correlations.

On regional trends, lithology, and folding, the metamorphic belts of the Warburton area are suggested as forming an extension of the "Nullagine System" of the Pilbara area, and developed within a major north-west to south-east trending geosynclinal belt, marginal to the more primitive Archean (Pilbarian-Yilgarnian) nucleus. The same belt is also suggested as extending through the Blackstone-Musgrave areas and thence to Spencer's Gulf in South Australia.

Mobilisations recognised within these terrains have apparently been confined to the main geosynclinal trough, and are not evident where filling shallow basins on the more stable Archean block. Within the geosyncline, a comparable pattern of folding, and generation of similar suites of microcline, blue quartz (often opalescent), and albite bearing granite and porphyry (often transitional) has resulted.

Epidotisation, minor copper mineralisation and the generation of charnockitic and younger adamellite granites are also characteristic and have been recognised throughout the belt.

Age determinations on the more primitive "Pilbarian-Yilgarnian" block show the oldest metamorphism to be 2400 to 2800 m.y. (Wilson *et al.* 1960). This is considerably older than the oldest metamorphisms recorded on other Pre-Cambrian areas of this and adjoining States (1100, 1500-1800 m.y.).

From the above it is further suggested that the rocks forming the undoubted Archean in the "Pilbarian-Yilgarnian" block are not represented in these eastern areas. Also, the Archean of South Australia would be equivalent to the Lower Proterozoic as recognised by the present author in the Warburton area and to the Lower Proterozoic mapped by Commonwealth geologists in the adjacent West Australian and Central Australian regions.

ECONOMIC GEOLOGY.

Underground water and copper form the principal minerals of economic interest known within the area. The former is discussed in a separate report entitled "Water Supplies, Warburton Range and Adjoining Areas" (Sofoulis, this publication). Copper, other minerals, and the oil potentialities of the sedimentary rocks are discussed below.

Copper Mining.

The presence of copper mineralisation from this remote region was first reported by explorer F. Hann in 1903, but it was not until recently that any development had been undertaken. There are no registered tenements as the area forms part of a large native reserve and the mining itself is carried out exclusively by native working parties.

To date, a total production of 68.68 tons of approximate 11 per cent. ore and valued at £1,526 has been reported to the Mines Statistical Branch as having been sold for use in the trace mineral fertilising industry.

Workings.—Examination of the known copper occurrences were made in conjunction with Mr. E. Timoney of the Mines Inspectors' Branch, and the relative plans, sampling, and assay data for each deposit are given in Mr. Timoney's report entitled "Copper Deposits, Warburton Range Area", (W.A. Mines Department, unpublished).

Development of the eight known occurrences are still in the prospecting stages and the workings are mainly in the form of scattered costeans and shallow trenches, confined to the "Ainslie Volcanics" at the localities shown on the accompanying plate. These deposits are numbered one to eight in keeping with Mr. Timoney's classifications.

Deepest workings (13 ft. V.D.) are at the "Windlass Shaft" on No. 3 deposit, located approximately one mile north-west of the Mission Station.

Copper Lodes.—Some of the lodes are discontinuously traceable over the surface for long distances but show considerable variation in copper content and can grade into barren quartz-calcite or quartz bars. Where copper bearing, the lodes

consist of a ferruginised silica-calcite matrix containing varying amounts of copper carbonates, silicates, oxides (local) and sulphides (rare).

The copper lodes are usually vertically disposed and can appear as thin copper bearing veinlets, or tabular, lenticular bodies from several inches up to 3 to 4 feet thick. Local developments up to 8 feet thick are also known. The principal lodes generally have well defined walls and are recognised as occupying minor shears or fractures in the volcanic rocks. These are transcordant to the enclosing country rocks (similar to the mapped quartz bars) and would correspond to the fracture pattern recognised in the adjacent porphyry, granite and metamorphic belts.

Epidote veins are commonly associated with the copper lodes and epidotisation of country rocks adjacent to copper lodes is also a prominent feature.

Future of the Industry.—There are no deposits of major economic importance known within the area.

Deposits 1, 3, and 5 are considered to be suitable for small scale mining by native working parties.

Mr. Timoney estimates that deposit No. 1 could supply some 400 to 500 tons of 10 per cent. to 12 per cent. copper ore which at current prices and cartage costs is estimated to give a net return of £10 to £12 per ton. Deposits Nos. 3 and 5 show possibilities of smaller tonnages of higher grade ores if selectively mined. Other deposits of the area are considered insignificant.

Under normal circumstances, the exploitation of these deposits would be out of the question as the full value of most of the ores capable of being produced would be taken up in transportation to the nearest rail head (Leonora, 440 miles).

The present development by native working parties is probably the only method of exploitation and the success of this venture is wholly dependent on the cheap cartage rates offered by the Mission Station. Scope of these operations is fixed at 20 tons per month which is the back-loading capacity of the mission truck.

Mr. Timoney considers that if worked as a co-operative, a balanced production of 20 tons per month from Nos. 1 and 3 deposits should yield a wage of £10 per week for eleven men.

Despite the primitive methods of working, the continuation of this industry would make a substantial contribution to the local native economy, as well as provide a useful form of employment in what would otherwise be an idle native community.

Other Minerals.

Minor forms of gold and silver mineralisation have been recorded about the area but as yet no economic deposits have been located.

Restricted occurrences of coarse grained basic and ultrabasic sills which may be related to the "Giles Complex" of South Australia, could contain minor amounts of nickel, chromite, and allied segregations.

The area has not been fully prospected for minerals but from similar occurrences recorded from the easterly extensions of this province, their concentrations into major economic deposits seem unlikely.

Remoteness of the locality would preclude any but higher grade ores being exploited.

Oil Potentialities.

The Paleozoic glacial beds which flank and transgress the Proterozoic rocks to the west and south-west form the northerly margin of the Officer Basin at present being investigated for oil along its south-easterly extension in South Australia.

Westerly these glacial are known to extend as far as the western edge of Lake Throssell where they unconformably overlie Proterozoic rocks and Archean granites. Little is known of the stratigraphic sequence across this 200 miles width and the possibility of older Palaeozoic or Proterozoic source beds occurring in deeper portions of the basin should not be overlooked.

On present indications, these beds appear as flat, structureless, thin aqueoglacial or fluvioglacial deposits which have negligible oil prospects.

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REPORT ON SOME PEGMATITES NORTH OF YALGOO.

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INTRODUCTION

On the 19th and 20th October, 1961, the writer inspected the pegmatites on Mineral Claims 26, 27 and P.A. 2571 on Dalgaranga Station also M.C.'s 34 and 35 at Warda Warra (near the Kylie Group).

These claims were pegged earlier this year, after the discovery by the Todd brothers of the presence of beryl, tantalite and tapiolite in and around some pegmatites on Dalgaranga Station.

The homestead on Dalgaranga Station is about 60 miles north-east of Yalgoo in the Yalgoo Goldfield and Warda Warra is 15 miles north-north-east of the homestead on the other (north-west) side of the No. 2 Rabbit Proof Fence.

GENERAL GEOLOGY.

All of the ore-bodies visited are in country of low relief with a large amount of soil cover.

All of the rocks seen in the area are Archean in age and these include greenstones, gneiss and granite, and the pegmatite bodies. The pegmatites have intruded both gneiss and greenstone.

The pegmatites themselves have prominent quartz cores with pegmatitic envelopes which are often obscured by soil and they have preferred strikes of north-north-east or east.

The main economic minerals are beryl, tantalite and tapiolite.

THE DEPOSITS.

M.C. 26.

This claim for 300 acres which was pegged by Don Todd is now being worked by Todd and Palmer. It is 3 miles east of Dalgaranga outcamp which is about 16 miles north-east of Dalgaranga Homestead (22 miles by track) and has about the same latitude as Mt. Palmer.

There is one main pegmatite reef and several smaller ones on the claim. The main reef was being mined at the time of inspection while several potholes have been dug in a smaller beryl-bearing pegmatite which runs north-east for about 200 yards from a point about 150 yards north of the centre of the main body.

The main reef which is about 380 feet long, striking N. 85° E. and dipping to the north at 45° (hanging wall), forms the southern edge of a plateau 50 feet above the lower creek flats. A cutting made along the hanging wall from the eastern end of the reef is 75 feet long, 3 feet to 10 feet wide and up to 10 feet deep.

The pegmatite has a lensing quartz core with a maximum width of 27 feet. The coarse-grained felspar outcrops in a band about 10 feet wide on the hanging wall of the quartz but on the southern side the felspar occurs in veins intruding the granitic country rock. The band of felspar on the hanging wall is zoned and the mineral associations with each zone are quite distinct.

The adjacent country rock is a black, highly micaceous gneiss while the outer shell of the pegmatite consists of felspar with onion-shaped muscovite and some quartz. The shell is three feet thick and the "onions" of muscovite which are two to three inches in diameter form in clusters. This same onion-shape was noticed in the mica occurrence in pegmatite to the north.

The second zone on the hanging wall, about 18 inches to two feet thick, contains felspar and beryl with some topaz. The beryl is white with occasional light colouring. Between this zone and the quartz core is a layer of quartz and felspar about five feet thick.

The pegmatite bands on the footwall side of the quartz show a beryl content, and some fluorite was identified at the western end of the body.

Some eluvial tantalite and tin was reported from the lower ground down the slope from the footwall but neither mineral has been found in the pegmatite so far.

There appears to be a considerable amount of beryl in this pegmatite but the dip of the ore zone may cause some difficulty in mining.

M.C. 27.

Dan Todd pegged this 300 acre claim about 3.7 miles south-east of Dalgaranga outcamp and about 3½ miles south-west of M.C. 26 (4.3 miles by track). Besides the main quartz-cored pegmatite there are several small pegmatite veins on the claim and these have yielded beryl in many places. A feature of the quartz and felspar occurrences on this claim is their grey colour. The grey felspar also shows creamy patches in crystallographic continuity with the grey material. The country rock is greenstone.

In the north-east part of the claim there is a prominent reef of grey quartz about 120 yards long. It strikes east-west, is about 30 feet wide and has a pegmatite envelope. About 25 yards south of the western end of the quartz is a pit (6 ft. x 6 ft. x 20 ft.) in pegmatite. The reported beryl production from this pit is six tons.

A shallow trench two feet deep and 40 feet long has been dug east along the northern edge of the quartz reef (in pegmatite) from a point 25 yards east of the western end. Some tantalite has been exposed in the partly decomposed pegmatite.

A deep trench 50 feet long has been dug east along the north wall of the main pegmatite from 60 feet east of the quartz outcrop. This trench, which varies in depth up to 15 feet, has an average width of about three feet. The trench exposes a vertical contact between decomposed greenstone to the north and the decomposed pegmatite. The outer zone of the pegmatite is of felspar and onion-shaped muscovite.

This trench has yielded a parcel of tapiolite (about 14 cwt. at 71 per cent. Ta₂O₅) from a narrow zone at the outer edge of the pegmatite. The West Australian Government Chemical Laboratories identified tapiolite, with some microlite and simsonite, (using X-ray methods) from samples submitted by the claim holder. The microlite (calcium pyrotantalate) and simsonite (calcium aluminium tantalate) are not highly desirable.

Tapiolite is dimorphous with tantalite. It has the same chemical composition (Fe Ta₂O₆) but belongs to the tetragonal crystalline system while tantalite is orthorhombic. The isomorphous tapiolite-mossite series range from iron tantalate to iron niobate in the same way as the tantalite-columbite series is isomorphous from iron tantalate to iron niobate.