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THE YEURALBA MINERAL FIELD, NORTHERN TERRITORY.

by

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SUMMARY.

Sandstones and tuffaceous sandstones of Lower Proterozic age have been folded and intruded by porphyry, epidiorite, and granite, in the Yeuralba area. The granite intrusion was followed by a strong tensional movement and a regional system of block faults and strong joints was developed. Lower Cretaceous sandstone and percellanite unconformably overlie the igneous rocks and Lower Proterozoic metamorphics.

The granite has been hydrothermally altered to a marked degree along these fractures. Tin, tungsten, gold and bismuth mineralization is associated with greisen, tourmalite, topazite, and other alteration products of the granite. Cassiterite-bearing tourmalites and cassiterite-wolframite-gold-bearing topazites and tourmalites occur within the granite mass and wolframite-shheelite-bismuth-bearing greisens at the contant between the granite and the sediments.

Bulk sampling and preliminary grab sampling of a number of these bodies indicates that several of the bodies should be tested in a more detailed manner, to determine whether they will bulk at a grade which would permit economic mining of the deposits.

INTRODUCTION.

General.

A geological investigation of the Yeuralba mineral field was undertaken by the Bureau of Mineral Resources as part of the field activities for the 1952 field season. Actual field work occupied five weeks in August and September. Most of this time was devoted to sampling individual greisen occurrences. In addition, a geological map of Yeuralba and the surrounding area was prepared on a scale of 1:25,000.

B. P. Walpole (leader) and B. J. Drew constituted the geological party.

In 1938, the Yeuralba area was investigated by the Aerial, Geological and Geophysical Survey of Northern Australia. This work was apparently confined, in the main Yeuralba field, to the "line" of greisen bodies which occur at the granite-sediment contact on the western watershed of Yeuralba Creek (Plate 1). No map was published with the report on this work.

H. J. Ward, of the Bureau of Mineral Resources, inspected the copper deposits in the Ludan area, seven miles east of Yeuralba, in 1950.

In 1951 deposits of alluvial tin in Sandy Creek and its tributaries were examined by geologists from the Bureau of Mineral Resources working on the Maranboy field, and it was decided to investigate the source of the alluvials during the 1952 field season. This work was greatly facilitated by the assistance given to the party by two local prospectors, J. A. Smith and J. Buchanan.

The area was visited by Dr. N. H. Fisher, Chief Geologist Bureau of Mineral Resources, in July 1952, and on his instructions bulk sampling of selected deposits and geological mapping of the field were carried out.

Situation and Access.

The Yeuralba Mineral Field is situated in the Northern Territory, latitude 14°13'S, and longitude 132°38'E, approximately 22 miles north of Maranboy Tinfield (Plate 1). An all-weather fireplough road connects the field with the Maranboy Government battery. From Maranboy, a formed gravel road runs 14 miles west to connect with the Stuart Highway, a bitumen highway connecting Alice Springs and Darwin, and with the Darwin-Birdum railway line at Maranboy Siding.

The field is approximately 33 miles, in a direct line, north-east of the township of Katherine: the present road distance is 62 miles. The nearest seaport is Darwin, 220 miles by road north of Katherine.

Climate, Vegetation and Water Supply.

The climate is semi-tropical with a pleasant winter "dry" season. The summer "wet" season is marked by monsoonal rains from November to February; the annual rainfall is about 40 inches.

The southern limit of the field is determined by an abrupt escarpment capped by Cretaceous sandstone. The edge of this escarpment is marked by stands of lancewood, an excellent timber for mining purposes. The tableland itself is a savannah woodland in which occur numerous clumps of cypress pine which is used extensively in the Northern Territory as a building timber resistant to white ants. Clumps of pandanus palms are found along creek banks, near springs, and on isolated patches of swampy ground. The granite and porphyry country and the low ridges formed by proterozoic sediments north-east and west of Yeuralba are mainly covered by low scrub with some cypress pines, or by stunted eucalpyts.

An abundant water-supply is available from the Katherine River, five miles north-west of Yeuralba, and permanent springs are found in several places at the contact of the igneous rocks with the overlying porous Cretaceous sandstone, at the base of the tableland. Bores sited on the field itself should produce good supplies of fresh water.

Topography.

Initiation of the present cycle of erosion has been attributed to warping and faulting late in the Tertiary (Noakes, 1949). The capping of Cretaceous sandstone, which then covered most of the area, has been partly removed by erosion by the Katherine River and its tributaries. With the exposure of the older rocks, the stream pattern in the area was markedly influenced by a well-developed system of joints and block faults, the two main members of which trend at 50° and 330° magnetic. The major tributaries of the Katherine River in the Yeuralba area - Yeuralba, Emu, Sandy Creeks - all follow the 330° direction. Minor watercourses in the Proterozoic sediments have a characteristic dentritic pattern.

The edge of the tableland is an abrupt escarpment 50 to 70 feet in height. Sandy Creek valley, in which the cassérite-wolframite-bearing topazites outcrop, is triangular in shape. The north-western and north-eastern sides are linear in plan and mark faulted contacts between granite and Proterozoic sediments. The southern side is irregular and is formed by the tableland escarpment. The valley formed by Yeuralba Creek is connected to Sandy Creek valley by a narrow saddle and its western side is formed by the "line" of quartz-wolframite greisens which mark the granite-sediment contact in this area. These greisen bodies rise as hills up to 100 feet in height, and from a distance are a distinctive dirty white colour.

The cassiterite-bearing tourmalites are dark blue-grey and brown in colour and occur as long low disconnected ridges, up to 130 feet in height, along faults in the granite.

The country north of Yeuralba to the Katherine River is undulating and composed almost entirely of rounded porphyry boulders and patches of alluvium.

HISTORY AND PRODUCTION.

The early history of the field is unknown, but mining has always been in a very small scale; the bodies are, for all practical considerations, almost completely undeveloped.

Mining methods have been limited to gouging with hand-steel, and hand-picking specimen stone from the broken ore. Most of this work has been, and still is, carried out by native labour. The selected stone is hand-dollied and then panned or jigged. Most of the wolfram won in the past few years has been screened and dry-blown from eluvial material immediately below the greisen outcrops. A return of two bags per week is not uncommon for one man, but it is quite obvious that none of the gougers on the field have either the capital or the resources to do more than scratch the deposits. At present (1952) six men are working on the field and only two of these can be said to be working constantly.

The nearest mill is the Government battery at Maranboy; but transport costs are prohibitive. A very poor recovery is obtained from the mill, which is in a poor state of repair, is not designed for treating wolfram ore, and has a very limited crushing capacity. Only small parcels of relatively high-grade ore are sent there from Yeuralba. The following are the available records of production from Yeuralba.

Table 1.
Production Records.

Year	Ore	Concentrate	
	Tons	Tons WO_3 Cons.	Tons SnO_2 Cons
1924	56.25		6.15
1925	16.5		1.1 (plus 1½ bags alluvial
1926			0.6
1927		N/A.	
1928			0.55
1929	13.75		0.35
1930	15		0.47
1931-34		N/A.	
1935	26		2.25
	44	1.5	
1936		N/A.	
1937	199.8	3.83	
1938	192.4	3.22	
		3.6 (eluvial)	
1939		6.18	
1940	28	0.50	
1941-45		N/A.	
1946		0.15	0.11
1947		N/A.	
1948		1.15	
1949	39	0.70	
1950		N/A.	
1951		2.28	
1952	122.75	1.34	
TOTAL	753.45	24.45	11.58

N/A = No record of production.

Average grade of tungsten from known tonnages is 1.77% WO_3 cons. from 625.9 tons of ore.

No record is kept of wolfram bagged on the field and sold to local dealers in Katherine.

Under existing conditions, few of the miners are getting a satisfactory financial return for their labour. This is due mainly to the inconstancy of their efforts, crude equipment, lack

of capital, and the fact that the deposits are essentially large low-grade bodies in which the rich shoots suitable for mining by gouging are limited to small pockets.

Production of tin from Yeuralba has been small. A small parcel of very rich ore was won from O'Sullivans Hill area probably in 1924 and some rich stone was broken from the Yeuralba King mine. This mine is located on a small Maranboy-type quartz-tourmaline-cassiterite lode. There has been no production in recent years.

Small amounts of gold and copper were obtained from the Ludan area seven miles east of Yeuralba, in the early days of the field.

GENERAL GEOLOGY.

Sedimentary Rocks.

The oldest rocks in the area are the metamorphosed sediments of the Brock's Creek Group of Lower Proterozoic age (Noakes, 1949). They consist essentially of contact-metamorphosed sandstones and tuffaceous sandstones. The degree of metamorphism is noticeably low. The dominant structure is a breached north-plunging anticline, with an angle of plunge of approximately 15°; the limbs of the structure dip at 40° to 50°. Steeper dips and drag-folding of the beds have been locally developed by a later shearing movement.

Unconformably overlying the Brock's Creek Group metamorphics are coarse-grained sandstones and procellanites of the Mullaman Group of Lower Cretaceous age (Noakes, 1949). Laterite is extensively developed on the tableland formed by these rocks.

Igneous Rocks.

General. The sediments of the Brock's Creek Group have have been intruded by the Yeuralba Granite and the Mt. Harvey Porphyry.

The Yeuralba Granite is probably an adamellite. Examination of thin sections shows the granite contains a very low percentage of ferro-magnesian minerals of which biotite is the most abundant. The plagioclase felspar is strongly saussuritised and the orthoclase is mostly present as a micrographic intergrowth with quartz.

The occurrence of Maranboy-type quartz-tourmaline-cassiterite hornsfels lodes in the Brock's Creek sediments intruded by the granite, and the occurrence at Maranboy of greisen bodies and schorl rocks identical with some types found at Yeuralba, indicate that this granite is also associated with the tin mineralization at Maranboy (Walpole, 1952).

The Mt. Harvey Porphyry outcrops over a wide area north and west of Yeuralba. It is apparently not affected by hydrothermal alterations and is considered to be older than the Yeuralba Granite. In thin section the groundmass has a granophyric fabric with large phenocrysts of potash felspar and quartz.

Approximately seven miles east of Yeuralba the sediments of the Brock's Creek Group are intruded by an epidiorite dyke, which outcrops as a large lenticular body approximately four miles in length and up to three quarters of a mile wide. The long axis strikes at 330° magnetic. In thin section the rock is composed dominately of laths of saussuritised plagioclase felspar, probably labradorite, and strongly chloritised hornblende. Several small/lodes are associated with the epidiorite.

Ore Deposits. Hydrothermal alteration of the Yeuralba Granite, with associated tin, tungsten, gold, and bismuth copper

mineralization, has taken place at the intersection of, and along, fractures developed in the granite by a regional tensional movement. In most cases, alteration reached an advanced stage with the development of greisen, tourmalite, and topazite. These secondary rocks are in some places closely associated but also occur as separate masses and groups of veins. In the larger bodies, alteration has taken place over considerable areas to give solid masses of the secondary rock. The felspar in the host granite has been completely replaced by the action of boron and fluorine vapours, and silica also has been added; in some cases quartz constitutes up to 95% of the rock material.

The main constituents of the secondary rocks developed within the granite mass are quartz, tourmaline, potash mica, and topaz, and all gradations between greisen, tourmalite, and topazite are present. Hydrothermal alteration along the contact of the granite and Lower Proterozoic sediments has given rise to a rock type which consists essentially of quartz.

The chief accessory minerals are fluorite, apatite, siderite, damourite, hematite, epidote, and the economic minerals wolframite, scheelite, cassiterite, gold and bismuthite. Traces of monazite and arsenopyrite are present in some places.

The modes of occurrences of these bodies are very much alike. In general they consist of solid masses of altered rock or as groups of closely-spaced veins formed at the intersection of major fractures. The fractures are part of a regional pattern the two dominant strike directions of which are 330° and 50° magnetic. A subsidiary direction trends north. The strike of the veins and of the main enrichments in the solid masses of secondary rock, follows the 330° direction; thus in the case of a body such as Ya 17 (Plate 1) a true cross section of the orebody would be almost parallel to the long axis.

The regional character of the fracture pattern suggests that it is not a superficial feature, which is important because lode formations in granite commonly tend to pinch out at shallow depths.

The secondary rocks have been subdivided into four distinct types. These are as follows:

(a) Quartz-wolframite greisens
(b) Cassiterite-bearing tourmalites.
(c) Cassiterite-wolframite-bearing topazites.
(d) Quartz-mica greisens.

Quartz-wolframite Greisens. Quartz-wolframite greisen occurs in the Yeuralba area along the western contact between the granite and the Brock's Creek Group sediments. The bodies form a line of steep hills immediately west of Yeuralba Creek.

The lodes are localised at the intersection of fractures striking 330° and 50° magnetic, and in some cases spread for some distance along the granite contact away from the point of intersection of these fractures.

Quartz is the dominant mineral present and constitutes up to 95% of the rock. The main rock type is not a true greisen inasmuch as mica is present only as an accessory mineral in most places. Other accessory minerals are apatite, purple fluorite, tourmaline, and the economic minerals wolframite, scheelite, and bismutite. Gold has been reported as being present in some of these bodies but its presence was not confirmed. The relative abundance of the accessory minerals differs from one body to the next.

The presence of scheelite in this particular type of greisen was first determined by the present survey. The mineral is most evident in the ore at "The Gates" Claim (Ya 17) where it occurs chiefly as small crystals disseminated through the rock.

Coarse crystals up to two inches in diameter were also noted. There is some evidence that the scheelite has partly or completly replaced wolframite. It is particularly abundant in the zone closest to the boundary between the granite and the greisen. Under ultra-violet light the scheelite fluoresces bluish-white. The apatite fluoresces orange-yellow. Quartz, tourmaline, wolframite, and a bismuth mineral, probably bismutite, are the major constituents of the ore from the Black Diamond lease (Ya 4), together with minor amounts of scheelite. Gold has been reported from "The Gates" Claim and the Ya 5 body, but its presence was not confirmed.

In general, ore in the wolframite greisens consists of the tungsten minerals disseminated throughout a gangue of quartz. The distribution of the richer shoots is quite irregular and the grainsize of the ore minerals, particularly of the wolframite, ranges from minute crystals to coarse crystals and cobs up to two inches in diameter. The coarse wolframite is mostly found along joints and cracks which follow the 330° strike of the dominant fracture pattern of the area.

"Spotted dog ore" is common on the Vivian (Ya 13) and Black Cat (Ya 14) leases.

Cassiterite is apparently absent in the quartz-wolframite greisens.

Cassiterite-bearing tourmalites. Tourmalites occur as closely-spaced groups of veins or irregular lenticular bodies infilling openings in granite, in quartz-mica greisen, and in partly greisenized granite. They probably constitute the end phase of hydrothermal alteration and occur at Yeuralba in the area surrounding O'Sullivan's camp. They also occur at Maranboy in the North Field.

The main body of this type of greisen at Yeuralba is four hundred yards east of "The Gates" Claim and forms the core of O'Sullivans Hill. The ore consists almost wholly of quartz and tourmaline, with cassiterite, damourite, and hematite as accessories. A trace of malachite was found in one specimen examined but this is regarded as exceptional. The distribution of cassiterite is irregular. The Mineral is ruby, amber, or dark brown in colour. Some veins are exceptionally rich in cassiterite, which may constitute up to 40% of the rock. In other lodes, particularly those on the western slope of O'Sullivans Hill, the mineral is apparently absent.

The lodes consistently strike at 330° and the zone of tourmalinization is terminated, at the crest of O'Sullivans Hill, by a fault-line striking at 50° and marked by an outcrop of quartz-wolframite greisen.

The material between the lodes or veins is incompletely altered granite. In some cases this resembles a luxullianite in which radial aggregates of tourmaline occur as an incomplete replacement of felspar. Small quantities of cassiterite are found in some places in the partly altered country rock.

Cassiterite-wolframite-bearing topazites. Topazites also occur as closely spaced groups of veins in incompletely altered granite. They also occur as massive bodies or as veins and segregations in quartz-mica greisen. In the Sandy Creek valley, disconnected bodies and groups of veins of this rock form a well-defined "line" striking 330° magnetic (Ya 23 to Ya 27, Plate 1). Topaz is only a minor constituent in the rocks at the south-eastern end of this "line" and the lode material in the Ya 27 body could be classified as a topaz-bearing tourmalite. The bodies at this end of the "line" also tend to be massive whereas at the north-western end the mode of occurrence is as groups of veins. Two of these veins are up to 17 feet in width and 500 feet in length.

The ore consists dominantly of cassiterite and wolframite in a gangue of quartz, tourmaline, topaz, fluorite, siderite(?), and minor epidote. Traces of arsenopyrite and monazite have been noted. Gold is an important constituent of the ore at the Ya 27 locality on the south-eastern end of the "line", where it is found both as a normal constituent of the rock and in some quartz veins and segregations associated with it.

Quartz-mica greisen. Quartz and a greenish coloured potash mica are the main constituents of this rock type. Tourmaline is present in varying quantities and an increase in the tourmaline content of the rock is, in some cases noted, associated with a decrease in mica and the presence of cassiterite. Field observations show that greisens of this type contain only minor amounts of the economic minerals, and for all practical purposes they are considered to be valueless. In secondary rocks of the other three types listed above it was also found that an increase in the mica content was associated with a decrease in the economic mineral content.

Sampling. Preliminary sampling was undertaken to show whether any of the bodies of secondary rock were worth consideration as possible orebodies suitable for mining by open-cut methods. Four main methods were adopted, each method depending largely on the character of the individual body and the time available for this work. It was found that eluvial material between the lodes in the O'Sullivans Hill area (Ya 20) contained very little cassiterite, whereas the eluvial material in and surrounding the Ya 23 area contained a considerable percentage of this mineral. This feature is noteworthy as the actual ore on O'Sullivans Hill is of a higher grade than that in the Ya 23 area.

Grab-sampling was carried out on all the bodies mapped and the crushed sample panned in each case. Two tin-bearing areas, Ya 20 and Ya 23, were then selected for more detailed sampling.

In the Ya 23 area, sample-lines were laid out at 100-foot intervals across the strike of the lodes. A piece of surface detritus or outcropping rock was picked up at random every three feet along the sample-line and bagged at every 100-foot section. The bagged samples were then dollied and assayed by panning. Plate 3 shows the values obtained and the distribution of the sample-lines. Samples from selected sections of the area were then bulked, mixed, and quartered with a Jones sampler, and the quarterings assayed by three different assayers. The results of these assays are given in Table 2 below.

Table 2.

Sample No.	Calculated pan assay. $\%SnO_2$	Chemical Assay. C.M.Hallett Assayer		N.S.W.Mines Dept. Assayer		Orr & Welch Assayer		Chemical Assay Average
		%Sn	$\%WO_3$	%Sn	$\%WO_3$	%Sn	$\%WO_3$	%Sn.
Y1	0.53	0.37	0.21	0.1	0.1	0.40	Tr.	0.29
Y2	0.34	0.37	0.17	0.1	0.1	0.38	Tr.	0.28
Y3	0.51	0.37	0.10	0.3	0.1	0.42	Tr.	0.36
Y4	0.60	0.21	0.05	0.4	0.1	0.52	Tr.	0.37
Average	0.49%SnO_2					Average 0.32%Sn.		

The Y4 section of this area was tested further by choosing closer sampling-lines at 25 foot intervals and increasing the quantity of stone picked up. A costean 20 feet in length was cut in the surface outcrop (Plate 3) and the material from the costean was added to the surface stone collected to make a total bulk of 17 tons 10 cwt. This material was crushed at the Maranboy battery and a head sample taken by scooping a sample from the battery box immediately beneath the stamps at ten minute intervals. Recovery was 0.52% of SnO_2 concentrates assaying 51% Sn. The head sample assayed 2.36% Sn and 0.12% WO_3.

The bottom of the costean was cleaned and a 2" by 2" channel-sample cut in the fresh topazite. The average of the assays was 0.19% Sn.

Channel sample assays are shown on Plate 3.

Two small costeans were cut in the inter-lode material in the Ya 20 area to test the degree of residual enrichment and to examine fresh inter-lode material. It was found by panning that enrichment was negligible. A bulk sample from an area 1000 feet in length and 600 feet in width was taken by running sample-lines at 25 foot intervals across the strike of the lodes. The interval was increased to 50 feet on the eastern side of the hill, in order to counteract the steeper slope and richer ore which was known to occur in that area. Ten tons 13 cwt. of tourmalite were collected and crushed at the Maranboy battery for a return of 0.33% of SnO_2 concentrates. The head assay was 1.18% Sn.

Grab-sampling was carried out on six other bodies. In each case the sample consisted of approximately 60 lbs. of rock picked up at random from the outcrops and mullock dumps. The areas sampled in this manner were Ya 4, Ya 5, Ya 9, Ya 17, Ya 20, Ya 27 and Ya 28. The results are given in Table 3.

Table 3.
C. M. Hallett, Assayer.

Sample	Assay.			
	Tin (%Sn.)	Tungsten (%WO_3)	Gold (dwt. per ton)	Bismuth (%Bi_2O_3)
Ya 4	No assay	0.95	No assay	0.46
Ya 5	" "	0.65	" "	No Assay
Ya 9	" "	0.60	" "	" "
Ya 17	" "	0.85	" "	" "
Ya 20	0.57	No assay	" "	" "
Ya 27	0.05	Tr.	2.6	" "
Ya 28	0.13	No assay	No assay	" "

The results given in table 3 of this type of grab-sampling should be taken as an indication only, as it is considered that the samples were not of sufficient bulk to be truly representative. The comparison of the assay figure of the grab-sample of the Ya 20 area (0.57% Sn) with the head assay of the bulk sample (1.18% Sn) illustrates this point.

Of interest also is the assay of the Ya 27 grab sample. Tungsten is shown as a trace; yet this body is at present being worked for wolframite from lode and eluvial material. Accidental salting of the sample by inclusion of an excessive quantity of high-grade ore is also a danger, although care was taken to avoid this.

Samples taken by the Aerial, Geological and Geophysical Survey of Northern Australia in the Ya 13 area "over a continuous length of 115.25 feet averaged 0.38% WO_3." (A.G.G.S.N.A., 1938).

A major problem in the final analysis of the above sampling results is the degree of reliability which can be placed on assay figures of low-grade tin ore. Experience has shown these to be somewhat erratic and variations of up to 0.3% Sn have been noted.

Dimensions of individual deposits. Preliminary testing of the thirty bodies mapped in the Yeuralba area has shown that seventeen warrant further investigation. In each case the bodies are of sufficient size to permit mining by open-cut or caving methods. The tonnage per vertical foot and, where available, preliminary sampling results for these bodies are shown in Table 4 below:

TABLE 4.

Summary of dimensions and sampling results of ore occurrences.

Locality	Rock Type	Length Feet	Average Width Feet	Total Tonnage per Vertical Foot	% Ore Sampled	Known Economic Minerals	Assay Results. %Sn	%WO_3	Au.dwt. per ton	%Bi_2O_3	Remarks.
Ya 4	Quartz-tourmaline-wolframite greisen	400	300	8,900	100	Wolframite, scheelite, bismutite.	N.A.	0.95	N.A.	0.46	Grab sample 60 lbs. wt. Bismuth present as carbonate. M.L. 43D" Black Diamond" lease. Worked for wolframite.
Ya 5	Quartz-wolframite greisen	300	100	2,220	100	Wolframite, gold(?)	"	0.65	"	N.A.	Grab sample 60 lbs. wt. Gold reported but not confirmed.
Ya 6	" "	600	100	4,440	100	Wolframite	"	N.A.	"	"	No sample taken - has been worked for wolframite in past.
Ya 7	"	400	100	2,960	100	"	"	"	"	"	" " " " "
Ya 9	"	600	100	4,440	100	"	"	0.60	"	"	Grab sample 60 lbs. wt. Not worked at present.
Ya 12	"	200	100	1,480	100	Wolframite & scheelite"		N.A.	"	"	No sample taken.
Ya 13	"	1,000	50	3,710	100	" " " "		0.38	"	"	Last crushing recovered 0.55% WO_3 cons. Samples (A.G.G.S.N.A. 1938) over continuous length 115.25 feet averaged 0.38% WO_3. Worked for wolframite. M.L. 36D "Vivian Lease".
Ya 14	"	900	100	6,670	100	Wolframite	"	N.A.	"	"	No sample taken. Worked for wolframite from lode and eluvial material at present M.L. 41D. "Black Cat" Lease.
Ya 17	"	1,400	300	31,100	100	Wolframite, scheelite and gold(?)	"	0.85	"	"	Grab sample 60lbs. wt. Not worked at present. "The Gates" Claim.
Ya 18	"	400	100	2,960	100	" "	"	N.A.	"	"	No sample taken. Has not been worked.
	Total tonnage per vertical foot of Wolframite type			68,860							
Ya 20	Tourmalite	1,100	800	65,200	50	Cassiterite	0.59	"	"	"	Detailed bulk sample (see plate 2) of to tons 13 cwt. of tourmalite only. Head assay 1.18% Sn. Recovery 0.33% SnO_2. Grab sample approx. 60 lbs. wt. assayed 0.57% Sn. Worked in past for rich tin leaders, O'Sullivans Hill area. Lode material extends beyond area sampled.
Ya 21	"	600	150	6,670	75	"	N.A.	"	"	"	No sample taken.
	Total tonnage per vertical foot			71,870							
Ya 23	Topazite	2,200	400	65,200	50	Cassiterite and Wolframite	0.16	0.60	"	"	Only topazite sampled. Average of assays from section 1100 feet in length see plate 3.
Ya 24	Topazite	800	300	17,780	75	" "	N.A.	N.A.	"	"	Not sampled. Is worked for wolframite.
Ya 25	"	300	150	6,670	75	" "	"	"	"	"	Not sampled.

TABLE 4 (Cont'd.)

Locality	Rock Type	Length Feet	Average Width Feet	Total Tonnage per Vertical Foot	% Ore Sampled	Known economic minerals	Assay Results. % Sn	% WO_3	Au.dwt. per ton	% Bi_2O_3	Remarks
Ya 26	Tourmalite topazite	300	150	3,335	80	Cassiterite, wolframite, gold	N.A.	N.A.	N.A.	N.A.	Not sampled
Ya 27	" "	300	300	6,670	100	" " "	0.05	Tr.	2.6	"	Grab sample 60 lbs. wt. Worked for wolframite. Also contains scheelite and bismuth (?)
Total tonnage per vertical foot				119,655							
TOTAL TONNAGE PER VERTICAL FOOT OF ALL TYPES				260,385							

N.A. - No Assay.

The % Sampled column refers to the estimated volume percentage of mineralised rock present in each particular area; in each case only mineralised material was included in the sample. The tonnage per vertical foot refers to the total tonnage of all rock types in a particular area. Assay results shown in column 8 are reduced to agree with the percentage sampled and hence refer to the total tonnage per vertical food.

Other Ore Deposits.

Alluvial and eluvial deposits. Alluvial tin deposits occur in the bed of Sandy Creek and its tributaries and in O'Sullivans Creek. In all cases examined the quantity of alluvial material available was too small to permit the deposits to be worked on other than a very minor scale.

The eluvial material at the base and on the crest of the cassiterite-wolframite-bearing bodies and the quartz-wolframite greisens is in some places up to five feet in depth and carries cassiterite, wolframite and some gold depending on the parent rock. In some places, eg. the Ya 4, Ya 14 and Ya 27 areas, this material is being worked by dry-blowing for its wolframite content. A sample of eluvial material taken at a depth of 4 feet from the Ya 23 area assayed 0.09% Sn.

Cassiterite-bearing quartz-tourmaline lodes. Several small leaders and lodes of Maranboy-type quartz-tourmaline lodes occur in the sediments of the Brocks Creek Group. These are generally unimportant. The Yeuralba King tin mine is situated on a lode of this type which outcrops on the track from Yeuralba to Eva Valley Station. The mine has been abandoned for a number of years and apparently only a small tonnage was produced.

Copper deposits. A number of small copper deposits of the Brocks Creek type are associated with a dyke of epidiorite which outcrops approximately seven miles east of Yeuralba. The hematite blows, the surface expression of the copper lodes, are discontinuous, mainly en echelon to each other and grouped in one major shear-zone striking at 330°, with associated quartz stringers and blows. A small tonnage of high-grade oxidized ore was produced from two small shoots. The deposits are considered to be economically insignificant.

CONCLUSIONS AND RECOMMENDATIONS.

The total tonnage per vertical foot of the various lode-types present at Yeuralba indicates that a large scale open-cut and caving mining venture is possible in this area, providing an overall economic grade of ore is present.

Sampling carried out by the present survey was mainly confined to surface outcrops and was not done in sufficient detail to provide other than an indication that payable ore might be present. The results show however that further testing is definitely warranted.

Detailed mapping of each of the deposits to be tested should precede, and be used to guide, sampling operations. The character of the ore suggests that diamond drilling as a means of testing the deposits would not be satisfactory unless supplemented by deep costeaning. A crushing plant capable of handling large sample parcels would be necessary.

It is suggested that the Ya 17 ("The Gates Claim") and Ya 20 (O'Sullivans Hill) deposits are most suitable for any preliminary investigation. Both are of a size (see Table 4) which would permit open-cutting, are adjacent to each other and are representative of the two main ore-types present on the field.

A full assessment of the potential of the Yeuralba field is a large-scale undertaking and is considered to be outside the scope of a government organization.

It is recommended that the field be brought to the notice of a mining organization capable of carrying out such an undertaking.

ACKNOWLEDGEMENTS.

The writers wish to record their thanks to Messrs. J. A. Smith, J. Buchanan, and D. Guidicatti, of Maranboy, for the assistance they rendered to the geological party.

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35.

APPENDIX.

REPORT ON TWO SAMPLES FROM THE YEURALBA DISTRICT, by W. B. Dallwitz.

1. Sample from the Sample-line through the costean, Y4 section of the Ya 23 area.

328 grams of this sample were crushed to pass through a 40-mesh sieve. Panning yielded a concentrate weighing 0.9882 grams, and estimated to have the following volume percentage composition:

Cassiterite	- 60
Topaz	- 30
Tourmaline	- 5
Carbonate (probably siderite)	- 5

Allowing roughly for specific gravities of these minerals the following weight percentages result:

Cassiterite	- 75
Topaz	- 19
Tourmaline	- 3
Carbonate	- 3

From this it follows that the rock contains about 0.23% cassiterite, or, to allow for some loss, say 0.25%. - not had recovery.

A test for tungsten carried out on portion of the concentrate was negative.

The carbonate effervesced slightly with gold concentrated HCl; it is heavily iron-stained, and is undoubtedly an iron-bearing carbonate, such as siderite, ankerite, or pistomesite.

Difficulty was experienced in panning, because the rock contains about 25% topaz and much tourmaline, in addition, of course, to quartz.

2. High grade tourmalite ore, O'Sullivans Hill, Ya 20 area.

High grade tin ore. Cassiterite makes up about 35% by volume of the slide; the remainder is largely quartz. A little grey-blue tourmaline is associated with the cassiterite, and a few small pockets of fine-grained damourite occur in the quartz.

Relict structures prove that this rock has been almost completely reconstituted during the process of mineralization. These structures take the form of veinlets of quartz and hematite, in which part of the quartz has been coarsely recrystallized, so that individual grains are optically continuous over an area covering the trace of the vein and some space on either side of it; in these cases the course of the vein is clearly marked by well-defined bands of dusty hematite particles.

Tourmalite. The rock consists almost entirely of quartz and brown to bluish-grey zoned tourmaline. Only three small grains of cassiterite appear in the slide. A little damourite occurs interstitially as pocket-fillings between the quartz grains. Limonite and hematite are rare constituents.

Cassiterite percentage in sample of tin concentrate, by J. Ward.

A sample of tin concentrate from the Ya 20 area was subjected to magnetic separation on the Isodynamic Separator. With a longitudinal inclination of 25°, a traverse inclination of 8° and with amperages ranging from 0.45 and 0.65, a non magnetic fraction consisting of cassiterite was separated. The magnetic fraction consisting of tourmaline was found to contain a small percentage of cassiterite. Weighing and grain-counting of the fractions gave the following composition of the sample:

Weight of sample separated = 0.260 grams
Cassiterite = 62.4%
Tourmaline = 37.6%

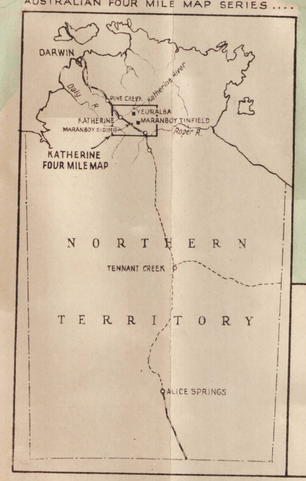
GEOLOGICAL MAP
YEURALBA MINERAL FIELD
NORTHERN TERRITORY

PLATE 1

SCALE OF MILES
1 ½ 0 1 2

Katherine River
TRACK
porphyry
Emu Creek
soil and rubble cover
Plb
Klm
scattered granite outcrops
small greisen lodes in granite
prominent quartz reefs
lateritised and rubble covered
strongly sheared
epidiorite
OLD WORKINGS on minor mineralised (copper) shear
OLD SHAFT
quartz hematite bodies with minor boxwork — malachite &c
ALLUVIAL TIN WORKINGS
Sandy Creek
small bodies of sheared greisen (no Sn)
COSTEAN
scattered granite outcrops
alluvial tin showing
greisen leaders in sheared granite with scattered greisen detritus
ZIMMONS CLAIM (WO3-Sn)
LYNAS CLAIM (WO3 Sn Au)
tourmalite detritus and leaders
closely spaced stanniferous tourmaline lodes and stringers in granite
SULLIVANS HILL
SULLIVANS CAMP
"GATES CLAIM" Wolfram and scheelite
ELUVIAL WOLFRAM WORKINGS
"BLACK CAT" (ML41D)
"VIVIAN" (ML36D)
Yeuralba Ck
granite
tourmaline lodes
"BLACK DIAMOND" (ML43D)
YEURALBA JUMP UP
Springs
string
fracture
cleavage
SOIL
YEURALBA KING TIN MINE (abandoned)
tourmalite lodes
greisen (trace Sn)
greisen
Scattered granite outcrops in alluvium
EVA VALLEY STATION H.S.
THOMPSONS "JUMP UP"
Permanent Water
TO MARANBOY

MAP SHOWING AREA DEALT WITH IN REPORT AND REFERENCE TO AUSTRALIAN FOUR MILE MAP SERIES....



Reference

RECENT — Alluvium
LOWER CRETACEOUS (Mullaman Group) — Klm — Sandstone, porcellanite &c
Brocks Ck Group — Plb — Metamorphics, schist, slate, altered tuffaceous sandstone, &c
Granite
Porphyry
Epidiorite
Greisen, tourmalite, topazite &c
Quartz Reefs
PROTEROZOIC
Strike and dip of strata
Fault
Shear or joint
Workings
Sample locality
Track

TRUE MAG

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H.E.S.

PLATE 2

CONTOUR PLAN
O'SULLIVAN'S HILL - Ya20 AREA
YEURALBA

APPROXIMATE POSITIONS OF SAMPLE LINES

SCALE
100 50 0 100 200 300 FEET

TRUE
MAG.

QUARTZ-WOLFRAMITE GREISEN OUTCROPS AT CREST OF HILL

230'
220'
214'
210'
202'
200'
199'
190'
186'
180'
169'
174'
170'
165'
161'
160'
153'
150'
140'
139'
130'
123'
120'
114'
110'
108'
112'
107'
108'
100'
100'
90'
80'
70'

POOR VALUES(?)

ALLUVIAL WORKINGS

TIN SHOWINGS IN ALLUVIUM

O'Sullivan Creek

OLD WORKINGS

TIN SHOWINGS IN ALLUVIUM

SOIL COVERED

GRANITE BOULDERS

SCATTERED TOURMALITE OUTCROPS IN SOIL COVER

To Yeuralba North

To Maranboy

NT 23-13
H.E.S

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PLATE 3

SAMPLING PLAN
Ya 23 AREA
YEURALBA NORTH
showing distribution of sample lines and Y1, Y2, Y3 & Y4 samples

SCALE
100 50 0 100 200 300 FEET

Reference
- 3/4 — Sample length and pan assay (% SnO_2)
- (0·17) — Chemical assay (% Sn)
- Granite outcrop
- Ore outcrop on sample line

	AVERAGE CHEMICAL ASSAY (Sn)	CALCULATED PAN ASSAY (SnO_2)
Y1	0·29%	0·5%
Y2	0·28%	0·3%
Y3	0·36%	0·5%
Y4	0·37%	0·6%

TRUE MAG

CHIEFLY RUBBLE

Y1

Y2

Y3

Y4

COSTEAN
SEE INSET "A"

CHIEFLY RUBBLE

NO SAMPLE
Length 6.0'
Bearing 48° M.

INSET "A"

ASSAY PLAN
CHANNEL SAMPLES IN COSTEAN
SCALE
5 0 5 10 FEET

NIL (0·18) (0·17) (0·82) (0·16) (0·23) (0·46) (0·34) (0·17)

AVERAGE (WEIGHTED) 0·19% Sn.

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