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INSPECTION OF RADIOMETRIC ANOMALIES "A.B.C."

RESERVE KATHERINE N.T.

by

D.E. Gardner

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CONTENTS.

SUMMARY.

A car-borne radio-metric survey of the B-volcanic formation within the reservation surrounding the A.B.C. uranium prospect indicated 32 small areas in which the radio-activity was a little in excess of 1½ times, and in places a little higher than twice the background count of the alluvium in the valley. Testing of each area with an Austronic P.R.M. 200 failed to reveal any sources of higher radio-activity. Most of the anomalies are due to a comparatively high background count given by exposed basalt. Four anomalies found in black or dark soil in damp portions of the valley are considered to be due to traces of radio-active elements absorbed by humus. One anomaly appeared to be due to traces of radio-active material contained in "lateritized" alluvium. The other anomalies are in alluvium, and are due either to the presence of basalt a few inches from the surface, or to traces of radio-active matter deposited from seeping ground-water. Radio-metric contouring, with a view to possible costeaning, has been recommended in a small area within exposed basalt, where counts of approximately 200 per minute were obtained. No additional work is recommended on any of the other anomalies.

INTRODUCTION.

A car-borne radio-metric survey of the B-volcanic formation of the Mt. Callanan Group within the reservation surrounding the A.B.C. uranium prospect was made by M. Stephens between early July and mid-September, 1954. The radio-metric anomalies were plotted by him onto sheets enlarged to a linear scale 10 times that of the air-photos of the area. They were inspected by D.E. Gardner on 11th and 30th August and 12th and 13th September, 1954. The area covered by each anomaly was tested by means of an Austronic P.R.M. 200 in an attempt to find localities giving higher radio-activity. The rocks exposed at each anomaly were examined briefly. A search was made for acidic dykes and laminated acidic rocks similar to those occurring at the A.B.C. prospect, and for gossanous outcrops.

GEOLOGY AND TOPOGRAPHY.

The regional geology was mapped by Rattigan and Clark during 1953 and is shown on Sheet D53-9-97 of the Bureau of Mineral Resources 1-Mile Geological Series. Sediments, predominantly arenitic, and volcanics, of the Mt. Callanan Group, are folded into a basin which is elongated in a north-westerly direction. Its southern portion, which has an axial length of 4 miles, has been displaced downwards and to the south-west by a major north-easterly trending fault. Backward cutting of streams or creeks draining towards the fault line has resulted in the erosion of relatively weak beds or formations, which now occupy valleys between the resistant sandstone members. The valleys and intervening ridges follow around the structure of the basin.

The B-volcanic formation forms the floor of one of these valleys. On the eastern side of the basin the dips are steep, and the width of the valley is ½ mile or less. On the western side the dips are less than 20 degrees except where steepened by strike faulting. Where such faulting has occurred, it has been normal faulting, with a steep dip towards the valley, and it has thus had the effect of widening the valley by letting B-volcanic down in place of a strip of the A sandstone that forms its outer wall. The inner wall of the valley is marked by steep scarps of the C-sandstone member. The valley is traversed by a longitudinal creek and by lateral gullies that emerge from breaks in the sandstone walls. Its floor is mostly flat or gently sloping towards the creeks or gullies. In the vicinity of the major faults displacement of the volcanic member and

resultant closing of the valley entrance by sandstone has permitted erosion of only narrow gorges into the valley, and at these localities the topography is more rugged. At the time of the investigation the creeks were dry and could be crossed by 4-wheel drive vehicles without much deviation from a set course. Much of the valley floor is covered by alluvium, made up of angular fragments of sandstone, sand, and clay. It is deepest in the middle part of the valley, where, even in steep creek banks, the bedrock is exposed at only a few localities. Approaching the inner wall of the valley near the scarp of C sandstone, the valley floor rises noticeably and in places steeply above its general level. Here, the underlying volcanics are well exposed in many places, but their contact with the sandstone is covered by scree from the sandstone. Approaching the outer wall of the valley, near the dip slope of the A sandstone, or the fault scarp, where longitudinal faulting has taken place, the valley floor rises more gently. In the wide valley on the western side of the basin volcanics crop out in low rises between some of the gullies that run north-easterly from the A sandstone. In the eastern side of the basin, where the valley is narrow, the floor adjacent to the A sandstone is almost entirely formed of alluvium and exposures of bedrock are few. In some of the creek banks the unconsolidated alluvium is seen as a thin cover over "lateritic" alluvium in which sand and angular detrital sandstone are cemented by cellular iron oxide.

The volcanics in the lower part of the formation, near the contact with the A sandstone consist of amygdaloidal basalt, aphanitic in hand specimen, and of fine-grained or micro-crystalline non-amygdaloidal basalt. Bore cores obtained from the A.B.C. prospect contain a thin tuffaceous band at the contact with the sandstone, and a flow of intermediate volcanic rock, possibly trachytic in composition, at a little less than 50 feet above it. At about 50 feet stratigraphically above the sandstone near the A.B.C. prospect and for at least 1½ miles north-westwards from it outcrops are found of a narrow thinly laminated band which appears to be aphanitic acidic volcanic rock.

Its strike and dip and that of the laminations appear to be concordant with the strike and dip of the sediments and volcanics. Drill holes have failed to find any continuation of it at an appreciable depth down the dip and presumably it represents small sill-like apophyses of acidic dykes which occur at the same localities. The laminated band is overlain by amygdular and non-amygdular basalt, which passes beneath alluvium in the valley. At a point 1½ miles north-west of the A.B.C. prospect, a laminated band is exposed about 500 feet across the valley from the A sandstone. Films of malachite occur between the laminae and as coatings on joint surfaces. It is underlain by a dense hard, aphanitic, dark green rock which may be an acidic flow. It is overlain by a finely crystalline greyish-black rock, probably andesitic, which has a thickness of at least 15 feet, where it passes under alluvium. Detritus consisting of vuggy encrusting quartz and chalcedony or cherty silica, which is banded and red-brown when weathered may be flow-breccia filling, weathered from basalt. The upper part of the B-volcanic formation consists of three or more flows of fine-grained or micro-crystalline basalt, each of which is amygdular near its top. The contact with the C-sandstone is covered by scree. A flow a short distance below the C-sandstone appears to be characterized by brecciation of its advancing front. This flow breccia is best exposed about 4½ miles north-west of the A.B.C. prospect. There, amygdaloidal basalt is broken into sub-rounded masses, up to several feet in diameter, by an irregular or reticulate veining of vuggy encrusting quartz and cherty silica. This was probably deposited from ground-water percolating through the brecciated band. One or more of the upper-most basalt flows contains greenish stained amygdules which suggest an appreciable proportion of copper. However, chemical tests show absence of copper, and the green colouration must be due to some other ion.

Some detrital fragments of encrusting quartz, found both near the top of the formation, and near the bottom of it, a little higher than the laminated rock, are stained green presumably by (?) copper silicate. They possibly represent epithermal silicifation and slight mineralization, but on the other hand, may be silicious fillings of flow breccia, introduced by ground water.

The small acidic dykes mentioned above are observed at several localities. At the A.B.C. prospect they are mostly less than 2.5 feet wide, probably less than 20 feet long, and they cut the basalt at steep angles. At a locality approximately ½ mile west of the prospect a similar small acidic dyke has been exposed in a costean. A few small flakes of autunite were found in a detrital fragment of acidic dyke rock several feet away from it. At this locality and at the A.B.C. prospect the dykes occupy tension fractures formed as a result of faulting. Near the south-east corner of a down-faulted block of B-volcanic east of the A.B.C. prospect acidic dyke-rock appears to form a stockwork in fractured basalt. At a locality approximately 1½ miles north-west of the A.B.C. prospect, uranium minerals have been found in a fragment of acidic dyke rock. It is noteworthy that this has been the host rock at each of the three localities where uranium minerals have been found within the A.B.C. reserve. Possibly, the uranium minerals and the acidic intrusive rock are genetically related.

RADIO-METRIC ANOMALIES.

General:

The localities which gave anomalous radio-activity were plotted by M. Stephens onto maps which he enlarged from air-photos. Photo-coordinates of a centrally placed spot in each anomaly are given below, as well as the alphabetic designation used by M. Stephens on his maps. Except at the A.B.C. prospect, where a high-order anomaly was obtained, the anomalies are weak. They constitute areas which give counts exceeding 1½ times and in some cases twice the background count of the alluvium in the valley. This background count is approximately 40 per minute on Austronic P.R.M. 200 Geiger Counter.

In the following paragraphs the anomalies are grouped into types and described in the order of their relative abundance. Descriptions of individual anomalies, in effect a copy of the field notes made at each locality, are held at Darwin office in file 84NT/15.

1. Outcrops of Basalt.

Outcropping basalt has a background count ranging from 80 to 120, and as a result, each mass of basalt exposed in the valley yields a radio-metric anomaly. Generally, the basalt appears to be massive. Although it must have been fractured, openings were not readily made within it. Tension fractures found in some localities have been filled with fine quartz stringers. These have not been found to be more radio-active than the massive basalt. The acidic dykes already described may have entered earlier fractures. The evidence for the supposition is that, at the A.B.C. prospect, they are finely veined with quartz. These intrusive rocks generally seem to have the same background count as the basalt, or perhaps a slightly higher count. However, they, with or without adjacent basalt, and acidic sills, are host rocks to the uranium minerals at all known prospects within the A.B.C. reserve. The most highly radio-active basalt in the eastern part of the basin appears to be the slightly cupriferous (?) flow near the contact with the C-sandstone. The basalt containing encrusting quartz is not more highly radio-active than massive basalt.

An outcrop of basalt in the vicinity of a strong fault 4½ miles north-west of the A.B.C. Prospect gave counts of nearly 200 per minute within an area of a few square feet. A map of the locality on a

scale of 40 feet to 1 inch was prepared by J. Rade. A shallow costean exposed little-altered basalt which gave no increase in the count-rate. A close radio-metric contouring of the locality was started, with the intention of seeking a site for additional costeaning. A separate report will be written on this anomaly. Apart from it, no additional work is recommended on anomalies localized on outcrops of basalt. Following are photo-coordinates of central points in such anomalies, and their alphabetical designations as shown on M. Stephens maps:-

	Photo-reference; Survey 314, Katherine 1 - Mile Sheet.				
Run.	Photo No.	Coordinates.	Diagonal.	M. Stephens.	
		Inches.	Inches.	Anomaly.	Sheet.
2	107	2.52N/1.20W	2.92	A	B
		2.88N/0.75W	3.0	B	
		2.16N/0.74W	2.32	C	
		2.34N/0.11W	2.34	D	
		1.98N/0.05W	1.98	E	
		1.94N/0.34W	1.96	F	
		1.65N/0.84W	1.85	G	
		1.44N/1.28W	1.96	H	
		1.31N/1.75W	2.20	I	
		1.01N/1.16W	1.56	J	
3	73	0.18N/2.16W		F	C2
	74	3.45S/1.07E	3.64	L	C3
		2.80S/0.55E	2.86	N	
		3.20S/0.72W	3.30	P	C4
		2.35S/2.25W	3.27	Q	C4 & C5
		2.32S/2.97W	3.79	S	C5
		2.90S/2.66W	3.94	R	
		2.27S/3.81W	4.44	U	

2. Humus-rich Soil:

At four localities in the eastern part of the reserve the valley floor contains areas a few hundred feet in length and 50 feet or so in width where the soil is exceptionally rich in humus. The ground supports a dense growth of grass and small herbaceous plants. Apparently it remains damp for considerable periods after the wet season. At least two of these localities are close to breaks in the C-sandstone caused by erosion along fault lines, and probably prolonged seepage of ground-water along these breaks is the reason for the dampness. Counts at these anomalies range from 80 to 100, and 120 at a few spot localities. At a shallow depth the dark soil gives place to white or grey quartz-sand, which gives a count of 40 or less. The slight anomalies are due to traces of radio-active material absorbed by humus from the ground-water. Following are the localities where these anomalies were found:-

	Photo-reference: Survey 314, Katherine 1 - Mile Sheet.			
Run.	Photo No.	Coordinates.	M. Stephens.	
		Inches.	Anomaly	Sheet.
2	110	0.60N/0.08E	A	C1
		0.30N/0.30E	B	
		0.32N/0.32E	C	
		0.64N/0.52E	D	

3. Detritus in Outwash and Detritus Covering Basalt.

At several localities counts slightly above the background, viz. counts of 60 to 80 and nearly 100 at isolated spots, are obtained in alluvium or scree which forms small accumulations of outwash a few hundred feet in dimensions near gullies in the sandstone walls of the valley. The area of higher count tends to be localized around the marginal part of the outwash, a short distance up-slope from its junction with the sandy valley-floor. A careful search with an Austronic P.R.M. 200 failed to locate on any of these anomalies a count higher than 100 per minute. The slight radio-activity is thought to be due to traces of radio-active material carried down the gully into the outwash by seeping groundwater. The clearest anomaly of the type is situated as follows:-

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	Photo-reference: Survey 314, Katherine 1 - Mile Sheet.			
Run.	Photo No.	Coordinates.	M. Stephens.	
		Inches.	Anomaly	Sheet.
2	74	0.93S/1.90E	1	C3

A slight increase in count is obtained at some localities where thin detritus covering basalt rises from the flat valley-floor, towards the sandstone scarp. The radio-activity, like that in the outwash accumulations, is probably due to traces of radio-active material carried in seeping ground water, and is too feeble to be significant. The source of the seeping ground-water is, in some cases, the fracture zones in the sandstones, demarked by gullies running laterally into the valley. Anomalies of this type, viz. where basalt has a thin detrital covering, were found at the following localities:-

	Photo-reference: Survey 314, Katherine 1 - Mile Sheet.			
Run.	Photo No.	Coordinates.	M. Stephens.	
		Inches.	Anomaly	Sheet.
3	73	2.1N/2.28W	E	C2.
		00 N/2.06W	G	
		0.09S/1.94W	H	
	74	3.11S/0.10E	O	C4

4. Lateritic Alluvium.

One small anomaly, which gives a count of 80 per minute compared with 40 to 60 per minute in the creek and the surrounding alluvium is underlain by ferruginous "laterite", consisting of angular fragments of sandstone cemented by cellular iron oxide. Apparently

the ferruginous cement, which gives a count of 80 where exposed in the creek bank, has absorbed a trace of radio-active material. The locality of the anomaly is:-

	Photo-reference: Survey 314, Katherine 1 - Mile Sheet.				
Run.	Photo No.	Coordinates.	Diagonal.	M. Stephens.	
		Inches.	Inches.	Anomaly.	Sheet.
3	74	3.28S/1.27E	3.56	K	C3

5. Indefinite Anomalies in Alluvium.

The remaining anomalies, four in number, occupy small areas covered by alluvium. The counts range from 60 to 80, and the cause of the slight increase over the common count of 40 in the alluvium is not clear. The localities are listed below. At J, basalt underlies the alluvium, and at M "laterite" similar to that described in 4 above. These may be the causes of the slight anomalies. At T1 and T2 alluvium only is exposed. It may be underlain by basalt at a shallow depth, but on the other hand the slight increase in count here, and also at J and M, may be due to a variable distribution of traces of radio-active material carried in ground-water. The anomalies are too weak to warrant additional work. Their localities are:-

	Photo-reference: Survey 314, Katherine 1 - Mile Sheet.				
Run.	Photo No.	Coordinates.	Diagonal.	M. Stephens.	
		Inches.	Inches.	Anomaly	Sheet.
3	74	2.92S/1.40E	3.27	J	C3
		3.34S/0.53E	3.40	M	
		2.72S/3.60W	4.50	T1	C5
		2.74S/3.75W	4.65	T2	