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GEOLOGICAL REPORT ON THE A.B.C. URANIUM PROSPECT, NEAR KATHERINE, NORTHERN TERRITORY.

by

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SUMMARY

At the ABC Prospect, secondary uranium minerals consisting mainly of phosphuranylite with subsidiary autunite and traces of torbernite have been deposited in ashstone forming an ore body that pitches at a small angle obliquely down the dip of the ashstone. The pitch length is 57 feet, the width horizontally, at right angles to the pitch axis, is 32 feet and the thickness is 10 feet. Ore reserves amount to 1050 tons averaging 0.4 percent eU_3O_8.

The ashstone occurs within a sequence of basic and probably intermediate lava flows. They form the B member of the Mt. Callanan Group, a conformable sequence, chiefly of sandstone, of Upper Proterozoic age, which is folded into a shallow basin. Tension fractures formed during repeated movements along a strong east-trending fault about 200 feet north of the prospect have been filled successively with quartz and with hematite. A major regional fault which trends generally to the north-east is flexed or curved in the vicinity of the Prospect. Later movement along it resulted in the development of a north-north-east trending fault, or series of faults arranged en echelon. They fractured the ashstone and provided the openings in which the uranium minerals have been deposited.

Recurrent movements along the faults have resulted in differential vertical displacements of several small fault blocks. The Prospect is situated in a relatively down-faulted block. The extension of it down the pitch into two uplifted blocks to the north has been largely or entirely removed by erosion.

The uranium minerals at the Prospect are entirely secondary. It has been suggested that they have been derived by weathering and oxidation of primary minerals virtually in situ, but this has not been proved, and the deposit may be wholly supergene.

INTRODUCTION

The ABC Uranium Prospect was discovered in September, 1953, by A.B. Clark, geologist of the Bureau of Mineral Resources, while doing regional mapping in the Katherine area. The following month shallow costeans were dug and sampled. The prospect was mapped in a rapid plane table survey and a preliminary report was written (Jones, 1954). Tracks were bulldozed to the Prospect from Nixons Crossing, opposite the Katherine Hospital, and from a point on the Stuart Highway 5 miles on the Darwin side of Katherine. Work was then suspended until after the wet season.

In May, 1954, diamond drilling was started at the Prospect, and in July, 1954, a detailed structural investigation commenced. The work was virtually completed by the end of September, 1954.

This report describes the work that was done on the Prospect. Additional geological investigations in the ABC Reservation are described by Gardner et al (1954) and geophysical investigations by Misz (1954). Anomalies discovered during a car-borne radiometric survey have been investigated geologically and described by Gardner (1954).

The Prospect is situated in a wide, flat-floored, north-westerly trending valley which is bordered on either side by steep or precipitous sandstone walls. Regional faults cross the valley at localities a mile to the south-east and 4½ miles to the north-west of the Prospect. Displacement of the sandstone walls has practically closed the valley at these localities, and the portion enclosed between the two faults is known as McAddens Pocket. Entrance to it is obtained through a gorge eroded along the southern fault line by McAddens Creek.

An adequate supply of good water is available 4 miles up the valley in permanent pools fed by springs. Other permanent pools occur across the valley in a gorge in the sandstone half a mile north of the prospect, but access to these is difficult because of deep loose sand in the gorge. During the wet season and for some months after it, from about December to the end of August, good water is available near the Prospect, in pools in McAddens Creek.

REGIONAL GEOLOGY

General.

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. A regional map of the area adjacent to the prospect, based on their work and supplemented with additional structural data, is shown in Plate 1. Sediments, predominantly arenaceous, and volcanics, of the Mt. Callanan Group, Upper Proterozoic in age, are folded into a basin which is elongated in a north-westerly direction. They are underlain, possibly with slight unconformity, by Edith Volcanics, and the latter with strong unconformity by sediments of the Lower Proterozoic Brocks Creek Group. Approximately 2 miles north-west of the Prospect the regional dip, seen in the underlying basal member of the Group - the A sandstone member - is 10 to 12 degrees to the north-east. Between this locality and the Prospect, several faults run eastwards from areas underlain by Edith Volcanics and by the Brocks Creek Group and cut the western part of the Upper Proterozoic basin. They are step faults resulting in progressive downward displacement, north-westwards from the Prospect. Near the boundary between the A sandstone and the B volcanic formations, they turn sharply to the south-east and continue as strike faults in the sandstone. They cause steep dragging of the adjacent beds resulting in dips up to 80 degrees in extreme cases. The regional dip in the vicinity of the Prospect is approximately 20 degrees to the north-east, but sharp local changes of dip have been brought about by several nearby faults.

The Mt. Callanan Group consists of the following five formations in descending order:

E Sandstone
D Volcanic; thin basic flow
C Sandstone, with subordinate siltstone
B Volcanic; principally basic flows containing a bed of acidic ashstone near the base; intruded by small acidic dykes. (The ABC Prospect occurs within this member.)
A Sandstone, with subordinate fine sandstone and siltstone, and thin bands of conglomerate.

<u>The A Sandstone Formation.</u> The estimated approximate thickness at the eastern edge of the basin, 3 miles east of the prospect is 2500 feet. This is based on a recorded dip of 50 degrees and needs to be checked by obtaining additional dip readings across the strike. On the western side of the basin step faults with an east-north-east trend have resulted in progressive relative uplift south of a point about 2 miles north of the prospect. North of this, as already noted, the sandstone is well developed; southwards it has largely been removed by erosion, and by down-faulting of its upper beds. Its lower 1500 feet is massive and cross-bedded, and from the base to possibly 1000 feet above it, contains numerous scattered quartz pebbles commonly about 2 inches in diameter. The remainder of the massive cross-bedded sandstone has few if any pebbles in it.

At about 1500 feet above the base the A sandstone formation loses its massive appearance and becomes well-stratified, although it remains thinly cross-bedded. Inter-bedded with it are thin bands of laminated fine sandstone. They are relatively easily eroded and tend to form flat-floored, narrow valleys at a slight depth below the general level. The stratigraphic thickness of this section is about 300 feet. It is succeeded by a thickness of approximately 300 feet of relatively coarse-grained beds which contain at least two thin units of fine-grained sandstone or siltstone. The sequence starts with pebbly and coarse granular sandstone which outcrops in well-marked bare dip slopes. This is succeeded by fine grained laminated sandstone, flaggy sandstone, and a resistant band of well-stratified cross-bedded sandstone, that forms strong, bare outcrops and well-marked dip slopes on the sides of gullies. Following it is a sequence in which two beds of pebble conglomerate, the lower 3 feet thick and the upper 1 foot thick are separated by about 3 feet of thinly cross-bedded sandstone. This is overlain by thinly cross-bedded sandstone that contains pebbly bands along the main bedding planes.

The upper part of the sandstone formation comprises thinly cross-bedded sandstone, flaggy sandstone, and several bands of finer sediment ranging in grain size from fine sandstone to siltstone. The top beds are typically well-bedded or flaggy sandstone, somewhat ferruginous.

At about 2½ miles north-west of the Prospect the conglomerate band is distant approximately 3000 feet from the boundary between the A sandstone and the B volcanic. At about 1 mile north-west the conglomerate band is between 400 and 500 feet from the boundary. It is exposed in the strong creek gully at that locality and has a dip of 80 degrees. North-eastwards across the strike towards the volcanic boundary the dip is about 30 degrees. It is clear that much of the flaggy and thinly cross-bedded sandstone that forms the upper part of the A sandstone further to the north-west is missing from here. South-eastwards along the strike towards the Prospect the conglomerate bed thins out. However, it can be clearly followed for about half a mile, and forms the second oldest unit in the following sequence (the dimensions given are approximate outcrop width):

1. Siliceous sandstone, cross-bedded, well-stratified (10 feet)
2. Coarse siltstone and thin beds of sandstone (15 feet)
3. Siliceous sandstone, cross-bedded, well-stratified (15 feet)
4. Siltstone (10 feet)
5. Thinly cross-bedded sandstone and inter-bedded siltstone (20 ft)
6. Massive cross-bedded sandstone (15 feet)
7. Pebble conglomerate, thin band (few inches)
8. Siltstone (? 10 feet)

Nearer to the Prospect, the conglomerate bed is represented by occasional rounded pebbles associated with fragments of siltstone and apparently occurring between the siltstone and overlying massive, cross-bedded sandstone. The upper four beds of the sequence are easily traced to within less than a quarter of a mile from the Prospect. The two sandstone beds are silicified and this is to be associated with the strike faulting that has caused their steep dips. They stand up as silicified walls 4 or 5 feet in width, and the outer one forms the edge of the scarp overlooking the volcanic valley. The upper beds of sandstone and coarse siltstone are absent about 2 miles west-north-west of the Prospect, apparently because of faulting. At this locality the siltstone of bed 4 forms the northern bank of the creek, and the sandstone of bed 3 forms a silicified wall near the edge of the valley. Beds 1 to 4 reappear about 500 feet west of the Prospect in a small down-faulted block (Plate 2). The sandstone in the "headlands" 100 feet east and 300 feet south of the Prospect consists of the massive cross-bedded conglomeratic type characteristic of the lower part of the A sandstone member. In the embayment south-west of the Prospect, about 300 feet from it, the sandstone appears to be better stratified and less massive, and small fragments of siltstone occur within the scree leading down to the costean below. This appears to be a small down-faulted block containing possibly units 5 and 6 of the sequence given above. Down-faulting of this sandstone may be correlated with down-faulting at the Prospect, discovered during the structural investigation of it.

<u>The B Volcanic Formation.</u> This formation has a thickness of 600 to 800 feet. Its constituent rocks are readily weathered and hence they form the bedrock in an alluviated valley between walls of resistant sandstone. The bedrock is exposed near the sandstone walls on either side, but is covered by alluvium in the middle part of the valley. The bedrock consists mainly of basic volcanic rock which appears in hand specimen to be in part amygdaloidal and aphanitic, and in part non-amygdaloidal and aphanitic or finely crystalline. Its contact with the A sandstone is not exposed at the surface. In the cores from two drill holes at the ABC Prospect a thin tuffaceous bed overlies the sandstone. At 200 to 300 feet across the valley from the edge of the sandstone, from about a quarter of a mile to at least 1½ miles north-west from the ABC Prospect, outcrops are found of a narrow, finely-laminated band which appears to be aphanitic acidic volcanic rock. Its strike and dip appear to be concordant with the strike and dip of the sediments and volcanics. Similar rock has been found by drilling to be 170 feet vertically above the sandstone at the Prospect and 150 feet stratigraphically above it at a site 0.4 miles west of the Prospect. The origin of the laminated rock has been in doubt. The fine banding suggests that it is an acidic tuff, but because of the block faulting drill holes have failed to find any continuation of it at an appreciable depth down the dip. Thin sections of laminated acidic rock from the Prospect have been described as quartzose ashstones (Appendix 1). The ashstone is overlain by basic volcanic rock, both amygdaloidal and non-amygdaloidal. This is covered by alluvium in the valley. At a point 1½ miles north-west of the ABC Prospect a laminated band is exposed about 500 feet across the valley from the A sandstone, i.e. apparently about 150 feet stratigraphically above it. Films of malachite occur between the laminae and as coatings on joint surfaces. The laminated band is underlain by a dense, hard, aphanitic, dark-green rock which may be an acidic flow, and is overlain by a finely crystalline, greyish-black andesitic (?) rock. The latter passes beneath alluvium about 15 feet stratigraphically above the laminated rock.

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 amygdaloidal near its top. The contact with the C sandstone is covered by scree. A flow a short distance below the sandstone is covered by detritus containing vuggy, encrusting quartz and chalcedony or silica, which is banded and red-brown when weathered. This may represent the filling of a flow-breccia formed at the advancing front of a flow. Similar flow breccia is exposed about 4½ miles north-west of the ABC Prospect. There, amygdaloidal basalt is broken into sub-rounded masses, 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 uppermost basalt flows, and at least one flow near the base of the B member contains greenish-stained amygdales which suggest an appreciable copper content. However, chemical tests show that copper is absent. Detrital fragments of quartz found near the top of the B volcanic member and also near the bottom of it, a little above the ashstone are stained green, presumably by copper (?) silicate. They possibly represent epithermal silicification and slight mineralization, but on the other hand, may be siliceous fillings of flow breccia, introduced by ground-water.

The remaining members of the Mt. Callanan Group are some distance from the Prospect. They will not be described here.

<u>Intrusive Rocks.</u> Rattigan and Clark mapped a swarm of east-north-easterly trending dolerite dykes west of the Upper Proterozoic basin, in Edith River volcanics and in Brocks Creek sediments. A similarly-trending fracture in the A sandstone south of the Prospect and another in the C sandstone east of it

are filled with basic rock which, though poorly exposed, appears to be fine-grained dolerite. Other east-north-easterly trending gullies in the sandstone, filled with sandstone scree, may represent weathered-out dolerite dykes. A magnetic anomaly within the B volcanics about 2000 feet north of the Prospect was shown by diamond drilling to be due to a dolerite dyke.

THE PROSPECT

General. The deposit outcrops in a low rounded knoll of basic volcanic rocks, bordered on the north by a creek bed running from the A sandstone and surrounded elsewhere by sandy alluvium. At the break of the slope on the north-west, towards the creek, altered and weathered ashstone over a small area gave counts ranging up to 5000 per minute on an Austronic P.R.M. 200 geiger counter. A few inches below its surface this rock contained abundant powdery, yellow uranium mineral, and gave a count in excess of 10,000 per minute. A radio-metric survey at the surface illustrated by the iso-rods on Plate 2A, suggested that the ore-body was elliptical in plan and elongated to the north-east. Sampling of shallow costeans seemed to bear this out. Later work has provided a somewhat different picture. The elongation of the ore body, both along its pitch and in plan, is towards the north (Plate 11). The apparent north-easterly elongation is due to two small near-surface concentrations of uranium minerals a short distance north-east of the ore body. An account of the preliminary mapping and sampling of the Prospect is given by Jones (1954). Regional geophysical investigations comprising self potential and magnetometer surveys were made in the surrounding area. Some of the traverses crossed the ABC Prospect but no anomalies were recorded there. The work is described in a separate report (Misz, 1954).

Method of Testing. The Prospect was investigated by diamond drilling and sampling, and by detailed structural mapping. A small number of rock specimens were thin-sectioned and examined petrographically. Drill holes were probed radiometrically to control sampling and depth of drilling.

Drilling. Diamond drilling was done with Edeco portable drills, using hydraulic heads. They are suitable for both vertical and angle drilling. "B" rods, which have a capacity of 400 feet, were used throughout. Bits used were types NM, BM and EX. The best core recovery, about 90 percent, was obtained with NM equipment. Further details are given in Appendix 2. Sludge was run into a container cut from a 44-gallon drum. Each 5 foot section was dried and made up into a sample which was kept for assay in case the core recovery happened to be low. Drill cores were stored on disused corrugated iron sheets.

Drilling of vertical holes was started at close intervals on a rectangular grid to sample and delineate the upper part of the Prospect. Since the surface iso-rods suggested that it was elongated in a north-east direction hole No.2 was an inclined one, depressed 50 degrees towards the south-west, to intersect a possible extension at depth and also to intersect the sandstone basement. Hole 36 was drilled vertically to the sandstone to enable correlation of data obtained in hole 2. Another deep vertical hole, No.54, was put down at a site approximately 400 feet north-north-west of the Prospect to gain information on the depth to the sandstone basement. The positions of the drill holes at the Prospect are shown on Plate 11, and of hole 54 on Plate 2A.

Radiometric Control of Drilling and Sampling. When a hole was considered to be deep enough it was logged radiometrically. The count recorded was used to indicate very roughly eU_3O_8 and this served as a guide to depth of drilling and to sampling of core. The core was split to form samples, generally in 1 foot lengths, and sent to Darwin for assay. It was found convenient while the work was in progress to construct sections on which the outline of the ore-body was shown by means of iso-rads derived from probing of drill holes. Sections constructed in this way are included in Plates 9 and 10.

Structural Mapping. The basic volcanic rocks surrounding the Prospect provide little evidence of structure at the surface. The adjacent sandstones which are resistant to weathering, provide a detailed record of faulting and fracturing. Ashstone at the Prospect is of special interest in that it is the host rock to the greater part of the deposit. These rocks are partly exposed in shallow trenches and mapped. Sub-surface structural data were obtained from drill holes.

GEOLOGY

Stratigraphy and Petrography. The Prospect is situated in the B volcanic formation of the Mt. Callanan group near its contact with the A sandstone and four or five hundred feet north-west of the north-east trending regional fault. Drill holes 2 and 36 (Plate 9) show that it is approximately 170 feet stratigraphically above the sandstone. The uranium-bearing rock at the outcrop is laminated acidic volcanic rock, altered and weathered. Specimens B7865 and B7866 obtained at depths of 5 feet 6 inches and 6 feet in drill hole 20 were thin-sectioned and determined to be quartzose ashstone. Petrographic descriptions are given in Appendix 1. The ashstone is underlain and overlain by basic flows, in part amygdaloidal, which appear to have a dip of approximately 20 degrees to the north-east. The ashstone dips 12 degrees in a direction 10 degrees west of north and this suggests that it is conformable with the flows.

Sections through the Prospect are given in Plates 7, 8 and 9. Plate 8 illustrates the succession and the rock types, based on examination of hand specimens. At the contact, the A sandstone is silicified and is more appropriately called quartzite. It is overlain by at least four flows of fine-grained and aphanitic, basic volcanic rock, in part amygdaloidal. The basalt in contact with the quartzite is in part fragmental and it appears to contain some quartz grains derived no doubt from the underlying sandstone, which may not have been consolidated when the lava was flowing. The fragmentation of the basal part of the flow gives it a somewhat tuffaceous appearance and is due probably both to fragmentation at the front of the advancing flow, and to later fracturing and brecciation. Specimen A400 described in Appendix 1 was taken from the basal part of the flow. The original compositions and textures of the flows are masked in places by abundant chloritic alteration.

Several bands above the sandstone distinguished by colour and by variations in numbers and types of amygdales are shown in section DD1, Plate 9, where they are numbered 1 to 6. Bands 1 to 5 may represent a single flow, its upper part being distinguished by an abundance of amygdales. All are aphanitic or very fine-grained in hand specimen. Their distinguishing characters are tabulated below:

Band	Colour	Amygdales
5	Chocolate brown	Abundant; bright green; chloritic
4	Greenish-black; richly chloritic	Medium to small; chloritic
3	Deep brown to dark grey	Medium to very small; chloritic
2	Light grey-green	Very small; mainly chloritic
1	Light brown	Abundant; medium size; bright green (chloritic) and reddish-brown, hematite-rich.

The colour banding probably represents bands of alteration and weathering parallel to the upper and lower surfaces of the flow. Band No.1 is further distinguished by dark-brown streaks along the flow-banding and reddish stains in numerous irregular fractures crossing the flow-banding. This points to the presence of iron-rich solutions, probably in ground-water percolating through the rocks near the contact with the sandstone. Some of it may be due to introduction of hematite into fractures by hydrothermal solutions. Band 6, like band 5, is distinguished by an abundance of amygdales. It differs from 5 in that it has fillings of silica and zeolites in addition to the usual chloritic ores. A specimen (A8379) from band 6 was sectioned and is described in Appendix 1. The basalt below band 6 in drill hole No.36 has been altered, possibly by siliceous solutions flowing along the adjacent faults. It is pinkish in colour, and flecked by small dark altered amygdales. In the hand specimen it has the appearance of a trachyte. A similar specimen (A8395) from drill hole No.1 is described in Appendix 1. Several different fillings are present in the amygdales, viz. silica, chlorite, zeolites and hematite, which may occur singly or admixed. The siliceous fillings are notably abundant near ashstone, near fine quartz stringers and near brecciated bands.

The contact between basic volcanics and ashstone is sharp. In thin section the ashstone appears to consist of micro-crystalline quartz, secondary sericite and irregular grains or dust of hematite, in a cryptocrystalline, devitrified groundmass. The quartz grains occur in bands which commonly alternate with bands noticeable richer in hematite. Specimens of ashstone C32 and A48, taken from costeans C and A at points 32 feet and 49 feet respectively from their south-eastern ends, are described in Appendix 1.

The laminated ashstone in outcrop, ranges from creamy-grey and fawn to red and green. In places it is comparatively soft and earthy, although some of it is hard and siliceous. Much of the laminated rock is finely veined with quartz, and some specimens contain a considerable proportion of hematite, both disseminated and in irregular earthy masses. Two specimens of the laminated rock (B7865 and B7866) from drill hole No.20, depths 5 feet 6 inches and 6 feet were thin-sectioned and determined as ashstone. Descriptions are given in Appendix 1. A specimen from the outcrop No. A.B.C. 1 and one from a shallow depth in costean F (No.F38/2) are also described in Appendix 1. Altered ashstone contains nearly all the uranium at the Prospect.

The basic lava extrusions were of the fissure type. An explosive phase is indicated by the ashstone that occurs on the western side of the Prospect, along the extensions of the line joining drill holes 42 and 12 (Plate 11).

<u>Structure.</u> The Prospect is situated between a major north-easterly trending regional fault, and a strong easterly-trending fault, near their intersection. Its structure is governed by these and by several smaller faults and associated fractures, shown in Plate 2B. Horizontal movements along the regional fault have resulted in block-faulting and tension-fracturing at the Prospect and in the sandstone to the south of it. The tension fractures trend N.70°W. Late fracturing at the Prospect indicates that the horizontal movements were recurrent. Vertical movements on the regional fault have resulted in slickensiding on the sandstone block south of the Prospect.

The east-trending fault near the northern edge of the Prospect is the eastern continuation of the step faults that border the volcanic valley further to the west. The movements along it were both vertical and horizontal. The horizontal displacement is about 60 feet, the northern block having moved to the west. The vertical movement is indicated by slickensides, observed in the sandstones to the west, as well as on the Prospect. Tension fractures associated with the fault have a trend about N60°E, and are well-developed in the sandstone, where hematite has been deposited in them. A third fault, trending east-north-east, is the displaced continuation of a fault that intersects the sandstones west of the Prospect. A fourth important fault trends north-north-east and can be traced in the sandstone block south of the Prospect. It resulted probably from stresses developed across the flexure in the regional fault during movement which had a horizontal as well as a vertical component. Displacements along it are very small. It is not continuous but consists of several short faults that are disposed roughly en echelon. On the Prospect these en echelon faults are intersected by fractures trending N.70°W, which represent the latest horizontal movements along the regional fault. The faults and fault fractures are shown on the sub-surface maps in Plates 4 to 6. They are steeply dipping and for convenience have been mapped as vertical. The prospect is separated by faults from the adjacent sandstone to the south-west.

The displacements on the faults have marked vertical components and strong evidence has been obtained that the triangular block containing the Prospect is relatively down-faulted. In drill hole No.54, 400 feet north-northwest of the Prospect, viz. in a direction obliquely down the dip, the sandstone basement is 40 feet higher than in drill hole 36 at the Prospect. Down-faulting is indicated by slickensides on the south side of the east-trending fault. It is evident in some of the fault fractures in the drill holes on the Prospect. For example, in section B-B1 (Plate 7) downward movement along the fault which borders the Prospect on the south-west is indicated by the acute angle at which the fractures meet the fault. However, the downward displacement of the triangle containing the Prospect is not great. Furthermore it was expressed not as bodily downward movement of the whole block, but as differential vertical movements and tilting of small blocks. These are bordered by faults and tension fractures that developed during recurrent movements along the two principal faults, viz. the east-trending fault and the north-east regional fault. The latest movements were along the regional fault. They resulted in movement along the faults at the south-western border of the volcanic triangle, displacing it towards the north-west. At the same time some of the small blocks were rotated slightly.

THE ORE BODY.

Dimensions and Attitude. The uranium mineralization is practically confined to an ore body which has the shape of a flattened ellipsoid with major axis 57 feet long, pitching at an angle of 12 degrees in a direction N.10°W. The intermediate axis, 32 feet long, is horizontal and the minor axis, corresponding to the thickness of the ore body, is 10 feet. The sub-surface map at R.L. 90 feet (Plate 4) and sections CCl and DDl (Plates 8 and 9) show that it consists mainly of altered ashstone, and its boundaries approximately coincide with those of the ashstone.

It occurs within a small triangular block, in which it outcrops towards the south of south-west and is limited down-dip in a northward direction, by two faults that converge towards the north-east. Two very small ore bodies occur at localities centred 60 feet and 110 feet north-east of the main outcrop.

Uranium Mineralization. The uranium minerals that have been found at the prospect are all secondary. The principal ones are bright yellow phosphuranylite, a hydrous phosphate or uranium $(U.O_2)_3 P_2O_8.6H_2O$, and paler yellow autunite, a hydrous phosphate of uranium and calcium $Ca(UO_2) P_2O_8.8H_2O$. Traces are found of torbernite, a hydrous phosphate of uranium and copper $Cu(UO_2)_2 P_2O_8.12H_2O$, and probably some yellow uraniferous minerals occurring in small amounts have not yet been identified. Descriptions of the minerals are given in Appendix I, specimen A9815.

The highest grade ore consists of ashstone in which earthy yellow minerals, principally phosphuranylite appear to be disseminated through the rock and to form films between laminae. Few small cavities are found partly or almost entirely filled with secondary uranium minerals. A specimen of this type of ore (No. 9815) is described in Appendix I.

A minor proportion of the ore consists of amygdaloidal basalt containing secondary uranium minerals, which occurs immediatel beneath the ashstone. It contains a higher proportion of autunite and a small amount of green uraniferous mineral, probably torbernite, which has not been recognised in the ashstone. These minerals form coatings on fracture surfaces and around the amygdaloidal fillings, but do not appear to be disseminated through any of the basalt. The small deposit 110 feet in a direction N.60°E from the main outcrop is contained mainly within a remnant of ashstone, and partly within underlying amygdaloidal basalt. The deposit 60 feet away in the same direction (N.60°E) is entirely within amygdaloidal basalt. Specimen A9814 taken from it is described in Appendix I. This was probably overlain by higher grade ore in ashstone, which has been eroded away.

It is not established whether the deposit represents primary minerals, weathered in stiu, or whether it is wholly or in part supergene. The occurrence of uranium as disseminated pockets or irregular small masses through ashstone, and as fillings of small cavities, suggests that it may represent earlier primary minerals. However, no gossanous material has been found, nor boxwork representing earlier sulphides. A little pyrite was found in borehole 39 adjacent to ashstone but no uranium is associated with it. Hence, if primary uranium minerals were initially deposited in the ashstone they must have consisted of pitchblende or uraninite with little or no associated sulphide minerals. Alternatively, they could represent an epithermal deposit in which the primary minerals were substantially the ones which now occur there.

The igneous source of the uranium mineralization may be the same as that of the lava flows. The ashstone has slightly higher inherent radioactivity than the basalts which are themselves unusually active. The three radioactive anomalies in the B volcanic valley are associated with ashstone outcrop.

Structural Control of Mineralization. Faulting governs closely the occurrence of the uranium minerals. As already noted the regional fault is curved in the vicinity of the Prospect. Displacements along it resulted in the north-north-easterly faulting, accompanied by intense fracturing. The ashstone is competent, homogeneous rock, and the stresses to which it has been subjected have produced only tight widely-spaced shear fractures. Some of these are coated with films of uranium minerals but the quantities are very small and only of academic interest.

The main orebody may at one time have followed the ashstone bed a considerable distance downwards near the east-north-east trending fault. If so its pitch length was much greater than that of the present day deposit. Its dimension at right angles to the strike of the fault. viz. to the west-north-west was the width of the deposit. This presumably extended unbroken for at least the west-north-westerly component of the limits between which mineralization is found at the outcrop. The latter distance is about 30 feet, and is equivalent to a width of 90 feet at right angles to the fault. The thickness of the initial deposit was that of the ashstone, viz. 10 feet. Post-ore block-faulting, illustrated in Plate 3 has resulted in relative elevation of some small blocks and depression of others. The principal orebody and the two subsidiary occurrences at the Prospect (Plates 8 to 10) occupy relatively down-faulted blocks. In between them the uranium bearing ashstone has been relatively uplifted and removed by erosion. In the small orebody 60 feet from the main outcrop the uranium minerals occur soleley within amygdaloidal basalt. This is mentioned above in the section dealing with Uranium Mineralization. It is considered that these minerals were derived from overlying ashstone which has since been eroded.

It is pointed out in the discussion of the geology of the Prospect that the blocks to the north are progressively uplifted. The orebody terminates at a south-west trending fault, shown in Plates 4 and 2B. The continuation of it in the uplifted block (Plate 2B) has been partly or wholly removed by erosion. The amount of the uplift is not closely known, and it is possible that a remnant of the Prospect remains in the northern part of the block, up to about 150 feet north of the known orebody. At this locality the area is crossed by the east trending fault, and the block north of it, containing drill hole No. 54, is still further uplifted. The east trending fault is an old one. Its effect on the mineralization is not known. In any case, the host rock of the deposit, the ashstone must have been removed, in part at least, by erosion.

Some evidence for the former occurrence of primary minerals in the ore body is presented above under the heading "Uranium Mineralization." The dissemination of the minerals and their occurrence within cavities is regarded as favouring the earlier occurrence of primary minerals, which became disseminated through replacement, and gave rise to cavities during weathering and leaching. The intense fracturing of the ashstone would probably result in a tendency to open readily between the laminations during sub-surface weathering and may be regarded as equally favourable for supergene as for hypogene mineralization.

ORE RESERVES.

The outline, dimensions and grade of the orebody are assumed to be represented by the assay contours of Plate 10. These are shown on horizontal planes that cut the deposit at vertical intervals of 1 foot. To facilitate graphic representation of results, the assay value of each sample, representing a 1 foot length of drill core, was assumed to represent the ore-grade at the middle of the 1 foot length. For each drill holes, grades so determined were plotted graphically against depth and estimates were made of assay values at the desired reduced levels. On a plan of each level, the positions of the drill holes and their estimated assay values were plotted. Assay contours were then drawn.

The area between each adjacent pair of assay contours was estimated by the method of counting squares. The average assay value within this area was assumed to be the average of the two contour values. The volume of ore of each average assay value was computed, and from it an estimate of tonnage was made on the basis of 15 cubic feet to the ton. The figures are tabulated below:

Tons	Average Assay
588	0.175
242	0.375
162	0.75
64	1.78
Total 1056	0.4% eU_3O_8

The deposit contains an additional 900 tons of average grade 0.075 per cent EU_3O_8. If this is included the total tonnage is 1950 and the average grade is 0.25 per cent eU_3O_8.

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APPENDIX I.

THIN SECTION PETROGRAPHY

by

W. B. Dallwitz

Quartzose Rocks.

Specimen C32 - Costean C. 32 Ft. from south-eastern end.

The hand specimen is red brown in colour, extremely hard and apharitic with an apparent lamination marked by alternations in shades of colour. Numerous circular patches of concentric banded chalcedony are present. The chalcedony contains an outer red and an inner pink band.

Microscopically, the minerals present are fine grained dusty and granular hematite, quartz (cryptocrystalline and grains up to 0.01-0.02mm.), minute sericite shreds and spherulitic, concentric banded chalcedony. Minute quartz veins transverse and parallel the banding. Under extremely high power a rare mineral moderate birefringence and relief (a ferromagnesian?) is observed.

The alternation of elliptical hematite-rich and hematite-poor areas result in a crude discontinuous banding. The hematite-poor areas consist of green-tinged felsitic, cryptocrystalline to isotropic quartz. The cryptocrystalline quartz is also present in the hematite-rich bands, but its presence is marked by hematite staining. Sericite and hematite are abundant in the hematite rich areas and the shreds of hematite and sericite tend to parallel the banding of the specimen.

The chalcedony is spherulitic and exhibits concentric colour banding with an intermediate large red-brown band and a small colourless inner and outer chalcedony band. The chalcedony is bounded by concave surfaces and is cut by a later generation of quartz veins, which also cut across the banding.

Where the banding is interrupted by the chalcedony areas, elliptical felsitic cryptocrystalline quartz rich areas are abundant around and parallel the conchoidal outer surfaces of the chalcedony. These felsitic quartz areas are separated from the chalcedony by a thin selvedge of hematite and sericite shreds, which also conform to the curved edges of the felsitic quartz and chalcedony. Some of the chalcedony is elongated parallel to the banding, but the chalcedony was apparently deposited after the elongation of the voids it now occupies, as the chalcedony is unstressed.

The above evidence suggests the following interpretation:

1. The Chalcedony are fillings of original amygdales in a volcanic rock.

2. The elliptical, felsitic, cryptocrystalline, green-tinged quartz areas represent original glassy areas which have been devitrified and recrystallised, perhaps assisted by heat.

3. The banding is a primary flow structure of a fine-grained volcanic rock.

4. The origin of the hematite and sericite is debatable. Weathering of pre-existing minerals could produce both. If it is accepted that heat assisted the recrystallisation of the felsitic quartz areas, a hydrothermal origin for the sericite is favoured.

The following sequence of events is invisaged:-

1. Outpouring, formation of amygdales, and quick cooling of an acid volcanic rock.

2. Recrystallisation and devitrification, perhaps assisted by heat with formation of sericite.

3. Introduction of chalcedony into the amygdales.

4. Quartz injection to form veins.

C.32 is most likely to be a devitrified, recrystallised and hydrothermally (?) altered glassy to cryptocrystalline acid volcanic rock.

Sample No. A49 - Costean A, 49 Ft. from south-eastern end.

The handspecimen is an aphanitic rock, which is banded in shades of dark red and green. The bands are continuous and curved, and the green bands are considerably narrower than the red bands. White-pink chalcedony (max. 1 mm.) specks are present and they are smaller and fewer than in C32.

Microscopically, the same minerals as in C.32 are present in A.49. The alternation of hematite rich and elliptical felsitic cryptrocrystalline quartz areas results in the conspicuous microscopic banding.

Many of the characteristics described in C.32 are present in A.49 and it will not be necessary to repeat their description here. The main difference between A49 and C32 is that the banding in A49 is more obvious and on a greater scale. Hence there is a greater mingling of the green felsitic quartz and hematite sericite areas, which result in the banding of the rock.

Other details noticed in addition to these in C.32 are:-

1. Quartz fragments are rarer and smaller in A.49 and the minute hematite and sericite shreds appear to swirl around them.

2. Rare quartz needles parallel the banding.

3. Sericite shreds are more abundant in the hematite bands. In these bands the sericite is evenly distributed and possesses a random orientation.

4. Quartz veins injected parallel to the banding prefer injection along the green felsitic quartz bands. The quartz veins consists of well developed unsheared crystals.

The similar minerals, textures and structures of C.32 and A.49 indicate a similar origin for the two rocks, i.e. a devitrified recrystallised and hydrothermally (?) altered acid volcanic rock. The greater flowage and lesser formation of amygdales in A.49, in comparison with C.32, is probably a reflection of the changing viscosity of the volcanic flow or their position in the flow.

Sample No. 9815 - Outcrop ABC Prospect, 15 Ft. S.W. of D.D.H.12.

Sample No. 9815 is a brownish, red, fine-grained, shale-like rock which is intersected in numerous directions by many minute quartz veins.

Four secondary radioactive minerals have been distinguished. The most abundant of these is pale yellow-green, micaceous, and fluorescent, and occurs as firmly-adhering encrustations on fracture surfaces, and as infillings of cracks.

The second is distinguishable from it by its very pale yellow colour, and by the fact that, though micaceous, it is not as firmly encrusted; it occurs as much less extensive coatings, and in small pockets, and it is fluorescent.

The third is pale yellow, fluorescent, and powdery.

The fourth is golden yellow and non-fluorescent, and is very sparsely distributed as thin encrustations measuring up to about a millimetre across.

In thin section the rock is seen to consist largely of dusty to granular hematite mingled with extremely fine material which can not be satisfactorily resolved even under a high magnification; some elongated grains in the fine material have the appearance of sericite. Pockets of fine-grained quartz are somewhat irregularly distributed throughout the rock, and a network of quartz veinlets from 1 mm. to less than 0.01 mm. wide ramifies through the slide. Only a few grains of yellowish-white micaceous radioactive mineral are visible in the section at hand.

The fluorescent radioactive minerals in this rock have not been identified with certainty. Optical determinations on two of them show rather disturbing discrepancies when compared with data set down for autunite, which they resemble in some ways. The refractive index liquids used have been checked with a somewhat crude type of refractometer, and were found to be correct within the limits of the instrument. This check was sufficiently accurate to indicate that the discrepancies found are, in all probability, real and significant. More precise checking of the liquids is not possible at present.

The non-fluorescing golden yellow radioactive mineral has refractive indices corresponding to those of phosuranylite; its grain size is so fine that an interference figure could not be obtained.

The fluorescent, powdery, pale yellow radioactive mineral is very finely crystalline, and shows aggregate polarization. Its mean refractive index is 1.595± and from this figure it is tentatively identified as meta-autunite. The aggregates are far too fine-grained to enable one to obtain an interference figure.

The very pale yellow fluorescent-micaceous radioactive mineral has properties close to those determined for one of the minerals found on sample No.A9813 described in my report of 16th September; this sample also came from the ABC Prospect. The mineral now under discussion occurs as poorly developed micaceous flakes, and is uniaxial or very low biaxial negative, with Z approx. = Y approx. = 1.563, and X approx. = 1.543. It is pleochroic from pale yellow to colourless. Refractive indices are low for autunite, but the mineral is providionally identified as such; possibly the low indices are explicable on the basis of an unusually high degree of hydration.

The pale yellow-green flurescent, micaceous, radioactive mineral has the following optical properties:

Z = approx. 1.565
Y = approx. 1.560
X = approx. 1.547

Optic axial angle variable - 40°-50° (estimated)
Sign: Negative
Pleochroism: Pale greenish yellow to colourless

Three rectangular cleavages were observed.

These properties, although differing from those arrived at for the mineral described immediately above, again suggest autunite. The refractive indices are almost identical with those recorded for (?) autunite in sample No. A9813, but the optic axial angle is quite different.

W. M. B. Roberts carried out microchemical tests on this mineral, with the following results:

Iron: Positive, trace (probably limonitic impurity)

Copper: Negative

Phosphate: Positive (could possibly be arsenate)

Calcium: Positive

Magnesium: Positive, but subordinate to calcium.

These tests indicate that the mineral is autunite; magnesium is recorded in at least one other complete analysis of this mineral, so it is not clear whether or not it is an essential constituent of our mineral.

Sample No. ABC1 - Outcrop ABC Prospect, 10 S.W. of D.D.H. 12.

The hand specimen is dark red brown extremely finely laminated, containing numerous white-cream circular area, which can be easily scrathed with the finger nail. The white areas are porous and cavities form readily on them and occasionally they are filled with yellow uranium ochre. Quartz veins are present but not as large or abundant as F38/2. The very fine lamination is remarkably continuous and straight.

Microscopically, the same constituents as in the previous specimen are present. Hematite is more abundant than in C.32, A49 and F38/2. Quartz fragments are present up to 0.01 mm. There is a slight banding due to alternation of hematite rich and hematite poor areas. The felsitic quartz present is extremely cryptocrystalline, finer grained than in the previous specimens, and almost isotropic (glass?). Some of the felsitic quartz areas contain fine grained aggregate sericite which suggests replacement structures. Hematite "haloes" are common around quartz fragments.

The white-cream patches seen in the handspecimen are hematite poor areas containing cryptocrystalline felsitic quartz and sericite shreds. These patches have curved and abrupt edges with the dense hematite areas.

Chalcedony is absent. Sericite shreds are at random orientation to the lamination.

The abundance of hematite obscures the origin of the banding (sedimentary or volcanic). The quartz fragments do not show any sign of magmatic corrosion; but this does not rule out the possibility that they are phenocrysts, as other evidence (felsite quartz areas) suggests rapid cooling of a volcanic rock, and hence there would not be much time for any magmatic reactions to take place.

Until more concrete evidence is assessed on the banding and cream-white patches, the origin of the rock is at present unsolved.

Sample No. F38/2 - Costean F, 38 Ft, from south-eastern end.

The handspecimen is red brown-green brown, hard, aphanitic containing a network of quartz veins. The banding is once again due to alternations in colour and it is broader (max. 1 mm.) more continuous and straighter than in C.32 and A.49. The continuous broad banding is offset by microfaults now occupied by quartz veins.

Microscopically, the same minerals as in C.32 and A.49 are present. Their relationships are also the same.

The main differences between F38/2, and C.32 and A.49 are the following:

1. Quartz veining is more prevalent.

2. At least two periods of quartz injection separated by crushing and shearing can be recognised in F38/2.

3. Sericite shreds and quartz fragments are not as abundant in F38/2.

4. Chalcedony is rare to absent.

5. The banding is broader and straighter in F38/2.

The above facts suggest that F38/2 is a chilled phase (edge or base) of the aphanitic acid volcanic rock represented by C.32 and A.49. F38/2 has undergone similar devitrification, recrystallisation and hydrothermal (?) alteration processes as C.32 and A.49, but because of F38/2 greater initial glassy content, these changed are less noticeable.

<u>Sample A8389</u> - D.D.H.1 4'6" - 5' 0"

This is a fine grained, red-brown rock, part of which shows well-developed, though irregular, flow banding or bedding, lying at an angle of about 45° to the length of the core.

In thin section the banding, although visible, is mush less quartzose clearly marked than in the handspecimen. The rock is ashstone, and therefore the banding represents bedding.

Set in a devitrified, almost isotropic base are grains of quartz (average size about 0.02 mm.), minute flakes of sericite, and small grains of hematite, and limonite. A few scattered quartz grains measure up to 0.4 mm. The hematite has probably been introduced, either by mineralizing fluids or during weathering as it is more abundant than would normally be expected in an acid igneous rock. Possibly the sericite has been derived from felspar by mineralizing fluids.

Banding shows up in thin sections as thin, discontinuous layers containing very few or no quartz grains.

Veinlets of quartz traverse the rock im various directions, and pockets of quartz and silicified clots, with or without sericite and brown chalcedony, are irregularly scattered through the slide.

<u>Sample B7865</u> - D.D.H.20, 5'6"

B7865 is essentially similar to specimen A8389, but no trace of bedding could be seen in the handspecimen or in the slide. Several fragments of devitrified glass measuring up to 1.2 mm. in length were noted in the section. Hematite granules are abundant throughout, and the coarse mottling seen in handspecimen is due to uneven concentration of hematite.

The rock is quartzose ashstone.

<u>Sample B7866</u> - D.D.H. 20,6'

Specimen B7866 is also an acid ashstone through which ramifies a complex system of closely spaced quartz veinlets. Mottling noted in the handspecimen is again due to uneven distribution of hematite.

No undoubted and persistent bedding is visible in thin section. A few packets of brown chalcedony are present.

<u>Basic Rocks.</u>

<u>Sample A400</u>,-DDH. No. 2 223'

This core consists of two different kinds of rock. The top portion appears to be altered purplish red to purplish grey amygdaloidal basalt with a smooth to soapy fell, and the lower part is purplish red to pink sandstone containing veins of quartz and greenish grey bands.

In thin section it is seen that the basalt has been entirely altered to hematite and a clay mineral, probably a member of the illite group. Clear traces of basaltic texture remain, particularly in those parts of the rock which are altered mainly to hematite. Vesicle fillings are largely illite, but in most of them dusty to granular hematite is scattered through the illite; many of them have a concentration of dusty hematite in the core.

The sandstone of the bottom part of the core consists of rounded to subangular grains of quartz (with very minor amounts of chert) set in a matrix of hematite, two unknown green minerals with a radiating structure, and limonite. The grains of quartz range in size from 0.04 mm. to 0.5 mm., the average being about 0.25 mm. Quartz makes up about 70 per cent of the rock.

Part of the slide represents one of the greenish-grey bands noted in hand-specimen. These bands are approximately parallel to the bedding, and are due to partial replacement of the hematite and limonite cement by green minerals. The more abundant of these appears to be a micaceous mineral, and the other has a columnar habit; both have, as noted above, a radiating structure. Further work will be necessary to establish the identity of these minerals.

A pleochroic golden-yellow mineral and zircon are rare accessories.

The rock is a fine-grained ferruginous sandstone.

Sample A9814 - Costean A, 47 Ft from south-eastern end.

No. A9814 is a friable, amygdaloidal rock, stained with hematite and limonite, and containing yellow and green radioactive minerals between the walls of the vesicles and the infillings, and in irregular cracks. The green mineral is flaky, and fluoresces yellow-green, but there is too little of it to carry out even optical determinations; it may be one of several rather uncommon minerals, or even a fluorescing variety of torbernite. The yellow mineral does not fluoresce.

In thin section the rock is seen to be a heavily altered amygdaloidal basalt, or similar basic rock. The felspar laths have been replaced by an indeterminate isotropic or slightly refracting doubly-mineral in finely-crystalline aggregates. Light brown, fine-grained serpentinous material, whose colour is probably mainly due to limonite-staining, has replaced the ferromagnesian minerals. Black iron-ore has been replaced by hematite and limonite, and quartz is a common byproduct of the general alteration which has taken place. The vesicles have been filled largely by chalcedony, but some quartz and fibrous or massive, serpentinous material are also present; some vesicles are filled by quartz and serpentine only. Most of the chalcedony shows concentric handling and coarse spherulitic structure, but some of it is extremely fine-grained, and shows aggregate-polarization. The cores of some of the vesicles are occupied by banded, spherulitic chalcedony stained bright red by hematite. One quartz veinlet was noted in the slide.

The yellow to golden yellow radioactive mineral is identical with that determined as phosuranylite in sample No. A9813. Its refractive index is 1.705 ±, and the sign is uniaxial negative. W.M.B.Roberts established the presence of phosphate by a micro-chemical test.

Sample A8379 - D.D.H. No. 2 124'

This is a coarsely brecciated rock consisting microscopically of green vesicular basalt, pockets of micaceous hematite up to an inch across, fragments of probable chloritised acid ashstone, and scattered pockets of light brown chalcedony.

Two thin sections were prepared. One represents highly altered amygdaloidal basalt, and the other breccia.

The amygdaloidal basalt now consists almost entirely of chlorite and quartz. Accessory minerals are hematite (as veinlets and small, irregular crack-fillings), leucoxene, sericite, and limonite. Traces of basaltic texture remain in the chlorite, and quartz pseudomorphs of small prophyritic crystals of felspar are present. Quartz also occurs as irregular pockets and with chlorite as vesicle-fillings.

In those vesicles where the main part of the filling is quartz, the succession from the border inwards is: quartz (narrow shell), chlorite (narrow shell), quartz and sericite (core). In one vesicle the core consists almost entirely of plumose sericite.

The breccia slide consists of fragments of partly chloritized ashstone, chloritized and silicified amygdaloidal basalt (containing leucovene and sericitized felspar), pockets of coarse-grained, brownish, radiating chalcedony, pockets and veinlets of quartz, pockets of chlorite and veinlets and pockets of hematite. The veinlets of hematite and quartz intersect the pockets of chalcedony as well as the rock fragments.

Sample A8395 - D.D.H. No.1 30'6" - 31'6".

A reddish brown fine grained rock containing numerous irregular amygdales measuring up to 4 mm. long - but generally 2 mm. or less - filled with a greenish-black mineral; a few ovoid amygdales containing whitish and green minerals are scattered through the rock, but none of these appears in the slide.

In thin section it is clear that the rock is an altered amygdaloidal basalt. None of the original minerals remains intact. Plagioclase has been almost entirely altered to a carbonate and certain indeterminate minerals resembling scapolite and prehnite; it is also stained with iron oxides. Ferromagnesian minerals have been converted to carbonate, hydrated iron oxides, and chlorite, and iron ores to leucoxene and hydrated iron oxides. Very little of the carbonate is calcite; most of it is probably a mexed variety carrying iron and magnesium as well as calcium.

The vesicles are filled with isotropic to very slightly doubly refracting chlorite, smaller quantities of minerals resembling scapolite and prehnite, and a little quartz. These latter minerals generally occupy a narrow zone lying wholly within the chlorite filling and approcimately parallel to the boundaries of the amygdale.

APPENDIX 2

DIAMOND DRILLING BY R. A. BRITTEN.

Hole No.	Co-ordinates		Reduced Level	Depth	% Core Recovery	Bit Size
1	71W	79N	98.4	67	91	NX & NM
2	141W	79N	95.5	231	100	"
3	106W	44N	97.7	62½	79	"
4	35W	115N	97.8	29	92	"
5	00W	79N	100.4	43½	86	"
6	18W	97N	100.6	39	90	"
7	36W	97N	98.0	18	95	"
8	146W	84N	95.9	24½	98	"
9	27W	108N	100.0	37	98	"
10	85W	65N	95.4	39	91	"
11	9W	89N	100.6	28	86	"
12	75W	55N	96.6	30	85	"
13	106W	36N	99.9	32	78	"
14	36W	81N	100.3	23½	91	"
15	70W	90N	98.3	27	96	"
16	97W	27N	101.1	38	95	"
17	98W	63N	98.8	31½	88	"
18	79W	18N	101.7	40	93	"
19	97W	54N	97.7	32	97	"
20	115W	36N	97.8	37	93	"
21	141W	10N	94.8	85½	92	"
22	123W	28N	99.0	44	89	"
23	142W	18N	98.8	37	58	BX & BM
24	79W	71N	98.7	32	97	NX & NM
25	106W	27N	100.0	32	95	"
26	61W	71N	99.9	38½	98	"
27	97W	27N	100.9	50	99	"
28	53W	62N	100.5	35½	95	"
29	89W	9N	101.8	35	97	"
30	71W	19N	100.6	43	94	"
31	71W	27N	102.0	38½	91	"
32	79W	36N	101.2	43	92	"
33	61W	54N	101.0	48½	96	"
34	89W	81N	100.3	40	94	"
35	9W	71N	100.6	30	98	"
36	71W	10N	102.5	183	98	"
37	18W	79N	100.6	36	80	"
38	26W	89N	98.9	38½	89	"
39	35W	97N	100.0	41½	95	"
40	44W	106N	97.8	32	90	"
41	52W	79N	100.0	35	97	"
42	106W	66N	96.5	35	90	"
43	106W	114N	95.5	51	96	"
44	106W	81N	95.5	20½	97	"
45	133W	55N	95.5	31	90	"
46	36W	186N	95.0	40	98	"
47	122W	80N	95.0	35½	80	"
48	24E	139N	99.7	48	73	"
49	71W	150N	95.0	43	96	"
50	35E	178N	94.0	13	54	"
51	101W	47N	97.8	23	91	"
52	00W	141N	94.5	26	90	"
53	92W	58N	97.8	23	93	"
54	222W	440N	100.0	141	58	BX & BM
55	485W	295N	101.5	49	72	BX & BM
56	224W	520N	101.0	33½	58	"
57	14W	336N	100.0	30½	95	"

Totals	2550	285	89	
	291	187	64	BM & BX
	2259	98	95	NM & NX

APPENDIX 3. MEAN ASSAY VALUES IN DRILL HOLES

REDUCED LEVEL (Ft.)			DRILL HOLE No. and % eU_3O_8																									
From	To	Mean	1	3	6	7	9	10	12	13	15	17	19	20	22	23	24	25	26	27	30	34	36	39	41	42	44	46
100	99	99.5			.04		.06			.05								.09	.04	.05	.1			.04				
99	98	98.5	.18		.06		.09			.08					.06			.13	.08	.06	.07		.2	.04				
98	97	97.5	.16	.08	.05	.05	.12			.05	.09			.32	.06		.04	.14	.12	.06	.06		.34	.04	.04			
97	96	96.5	.13	.08	.08		.11		.05		.09		.04	.36	.06		.04	.21	.11	.05	.06		.14	.05		.05		
96	95	95.5	.08	.12	.2		.1	.05	.16		.07		.05	1.18	.08		.04	3.18		.04	.05		.07		.05	.1		
95	94	94.5	.02	.22	.17		.09	.12	.36		.03		.05	.66	.05			4.29		.03	.05					.04	.05	
94	93	93.5		.5	.06		.07	.13	.46				.05	2.85	.09			.21		.05						.09	.11	
93	92	92.5		.72			.05	.14	.55				.04	3.09	.08			.26		.06						.15	.13	.11
92	91	91.5		.58				.35	.75					1.95	.06	.05		.3		.07						.25	.13	.36
91	90	90.5		.3				.56	1.01	.06			.05	1.29		.06		.3		.08						.25	.1	.33
90	89	89.5		.21				.22	1.06	.07			.07	.64				.22		.09						.18	.05	
89	88	88.5		.18				.13	.7	.07			.11	.46				.58		.1						.27	.05	
88	87	87.5		.11				.05	1.02	.06			.10	.13				.5		.04						.3	.07	
87	86	86.5		1.					2.74	.05			.08	.05				.06				.04				.07	.04	
86	85	85.5		.07					2.2	.04			.07					.05				.07						
85	84	84.5							.89				.06															
84	83	b83.5							.36																			
83	82	82.5							.19			.06																
82	81	81.5							.17			.05								.05								
81	80	80.5							.07											.06								

APPENDIX 4.

SUPPLEMENTARY NOTES AND COMMENTS

by M. A. Condon.

I made two very brief visits to the prospect. On the first visit I determined the dip of the sandstone and of the volcanics. On the second I examined the fine-grained laminated host rock and was satisfied that in all exposures it is a bed: the near-vertical occurrences having been caused by drag along faults. Amydales in the basalt on either side of one of these vertical occurrences are elongated parallel to the walls of the fine-grained hard host-rock.

In my opinion the limits of the deposit are determined by the fault-limits of the bed of quartzose ashstone. Extension of this bed in the area immediately outside the prospect area were not found. Elsewhere in the district radioactive anomalies are related to outcrops of this bed.

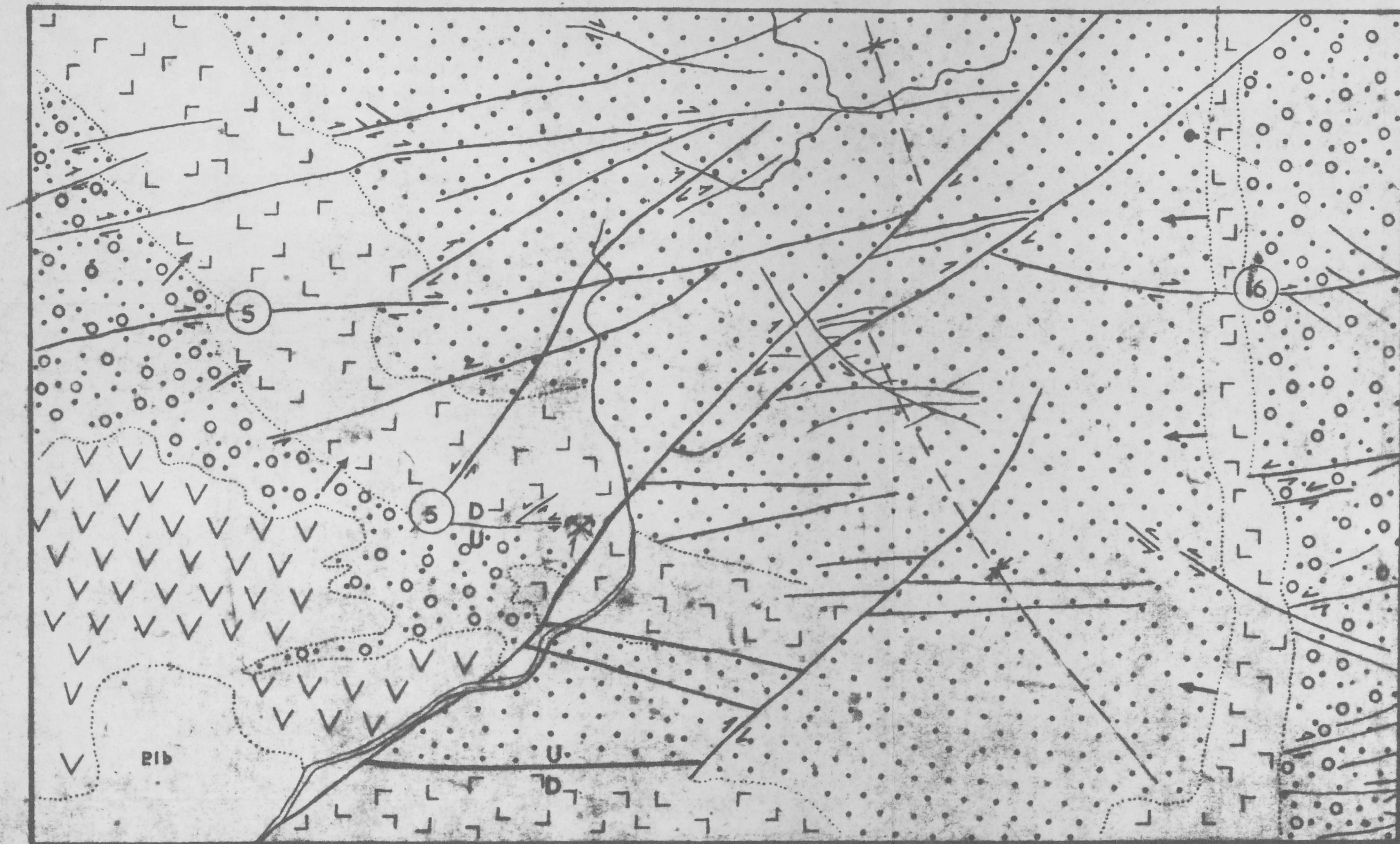
Mr. Dallwitz, after careful re-examination of thin sections, is sure that this host is pyroclastic. Dr. G. A. Joplin confirms this. In my opinion the disseminated uranium could have been part of the exploded pyroclastic material, derived from older (possibly Brocks Creek Group) uraniferous sediments.

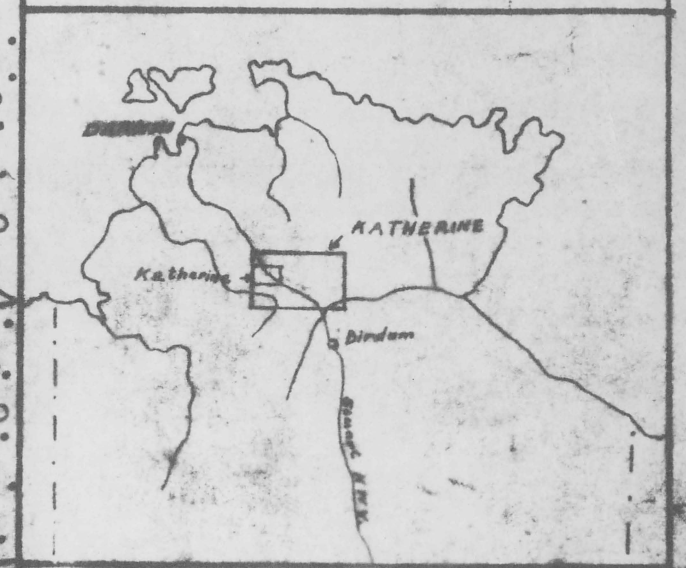
It was hoped to obtain fresh material in the deep bore on the east side of the valley but apparently the pyroclastic material was not present there.

The extent, nature and origin of the uranium mineralization in this area has not been proved, except that it is related to the quartzose ashstone bed.

Indications outside the A.B.C prospect are that this same bed has less uranium mineralization in other places. It is unlikely, therefore, that a large orebody exists although there may be other small concentrations similar to that at the prospect. Because of the close faulting the location and proving of such bodies would be difficult.

PLATE I.





Position of area dealt with in report and reference to Australian four-mile and one-mile series.

LEGEND:

UPPER PROTEROZOIC		Puc Є-E	Well bedded sandstone.
	MT. Callanan Group	Puc B	Basic & intermediate volcanics.
		Puc A	Massive conglomeratic sandstone.
	Edith River Volcanics	Pue	Andesites, dacites, pyroclastics.
LOWER PROTEROZOIC	Brocks Creek Group	Plb	Tuffaceous sandstone, slates, phyllites & hornfels.

- Syncline.
- Apparent movement along fault.
- Faults & fault fractures.
- A.B.C. Uranium Prospect.
- (16) Area of significant radiometric anomaly showing maximum times background.
- Regional dip.

Scale: 2400 feet to 1 inch.

Approximate True North

M.N.

BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
Geological Sketch Map
of portion of
A B C RESERVATION
Near Katherine N. T.
showing position of prospect

After Rattigan & Clark with addition by J. Rade.
Oct. 1954.

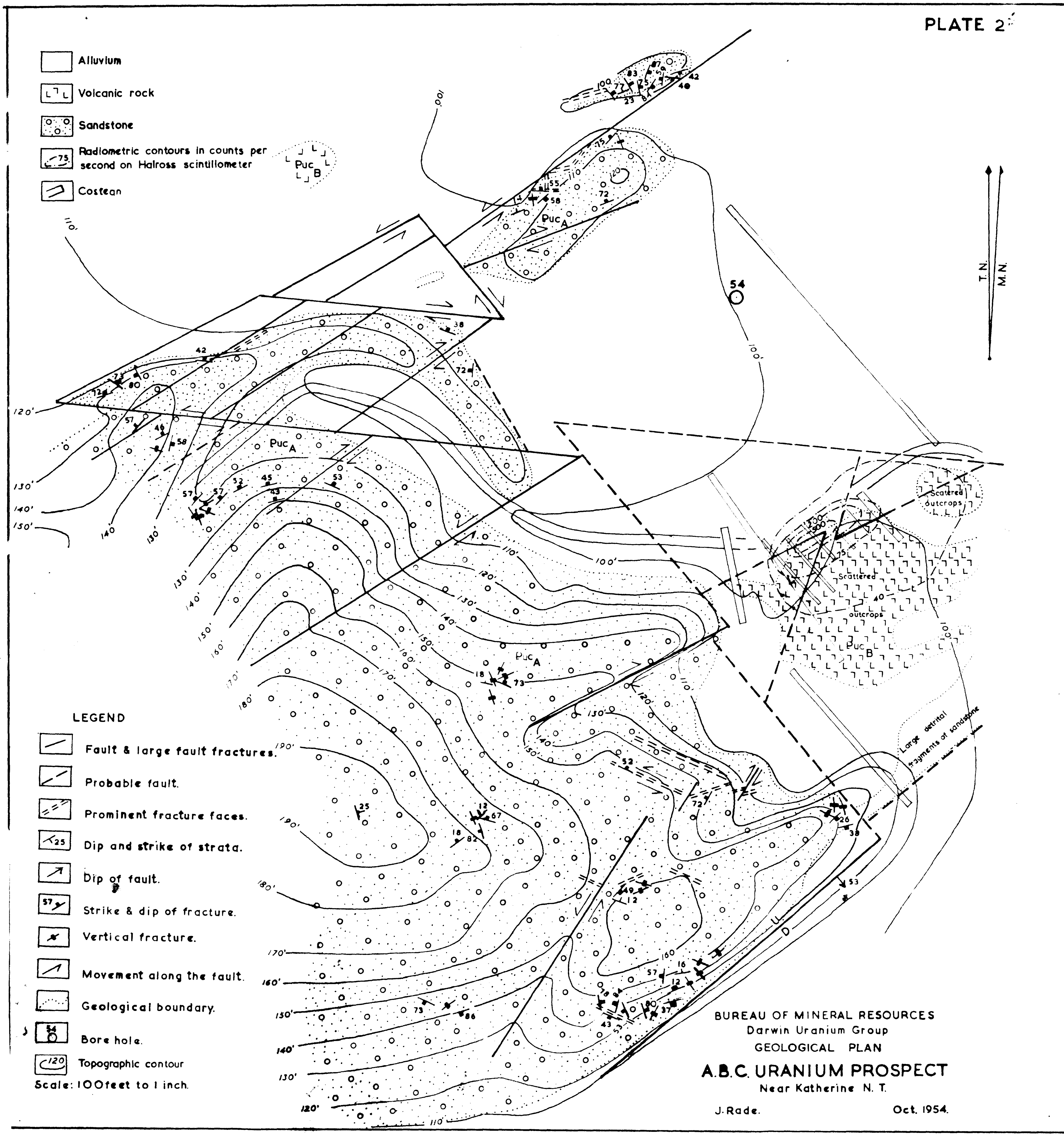
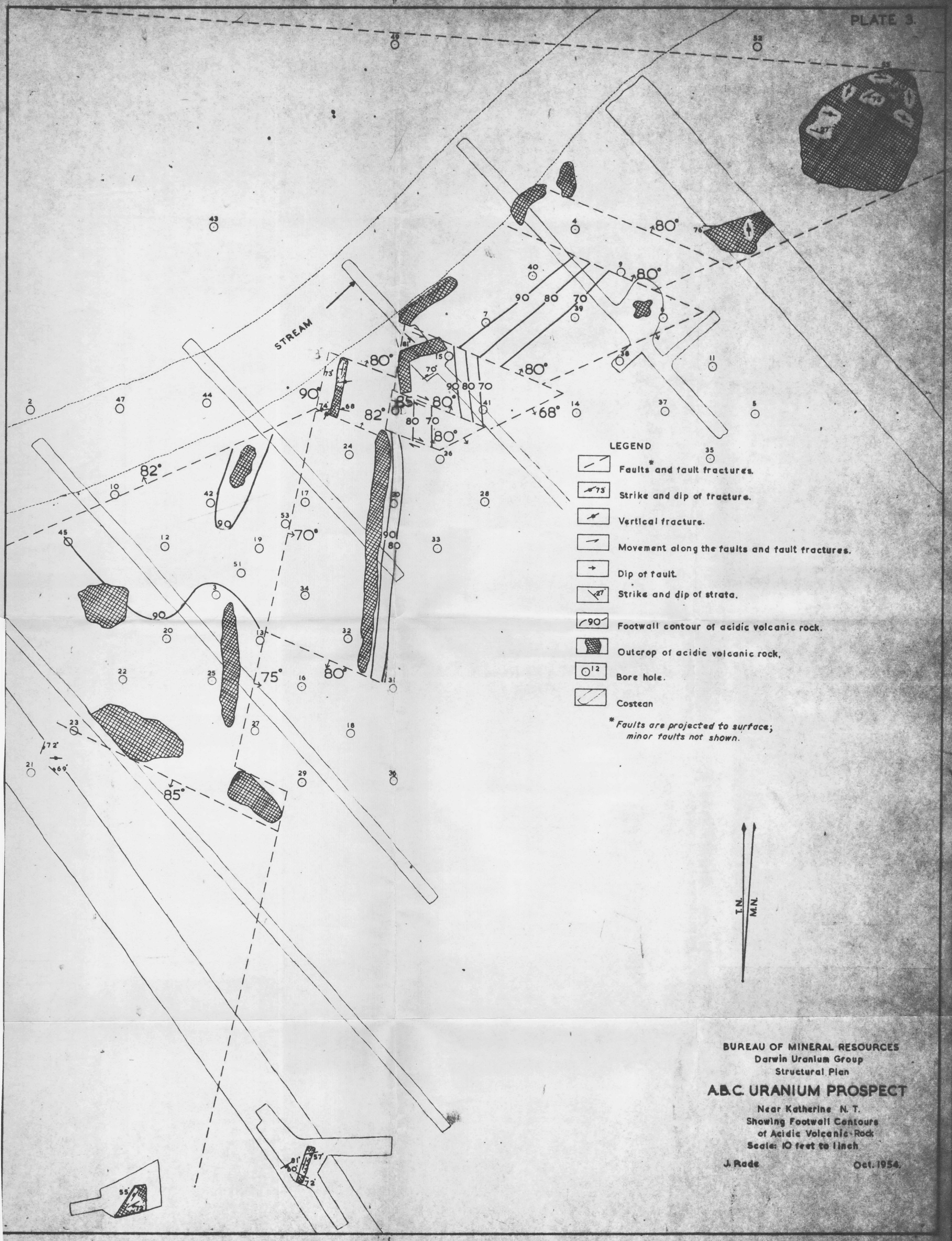


PLATE 2
Alluvium
Volcanic rock
Sandstone
Radiometric contours in counts per second on Halross scintillometer
Costean
LEGEND
Fault & large fault fractures.
Probable fault.
Prominent fracture faces.
Dip and strike of strata.
Dip of fault.
Strike & dip of fracture.
Vertical fracture.
Movement along the fault.
Geological boundary.
Bore hole.
Topographic contour
Scale: 100feet to 1 inch.
T.N.
M.N.
Scattered outcrops
Large detrital fragments of sandstone
BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
GEOLOGICAL PLAN
A.B.C. URANIUM PROSPECT
Near Katherine N. T.
J. Rade.
Oct. 1954.



BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
Structural Plan

A.B.C. URANIUM PROSPECT

Near Katherine N. T.
Showing Footwall Contours
of Acidic Volcanic-Rock
Scale: 10 feet to 1 inch

J. Rade Oct. 1954.

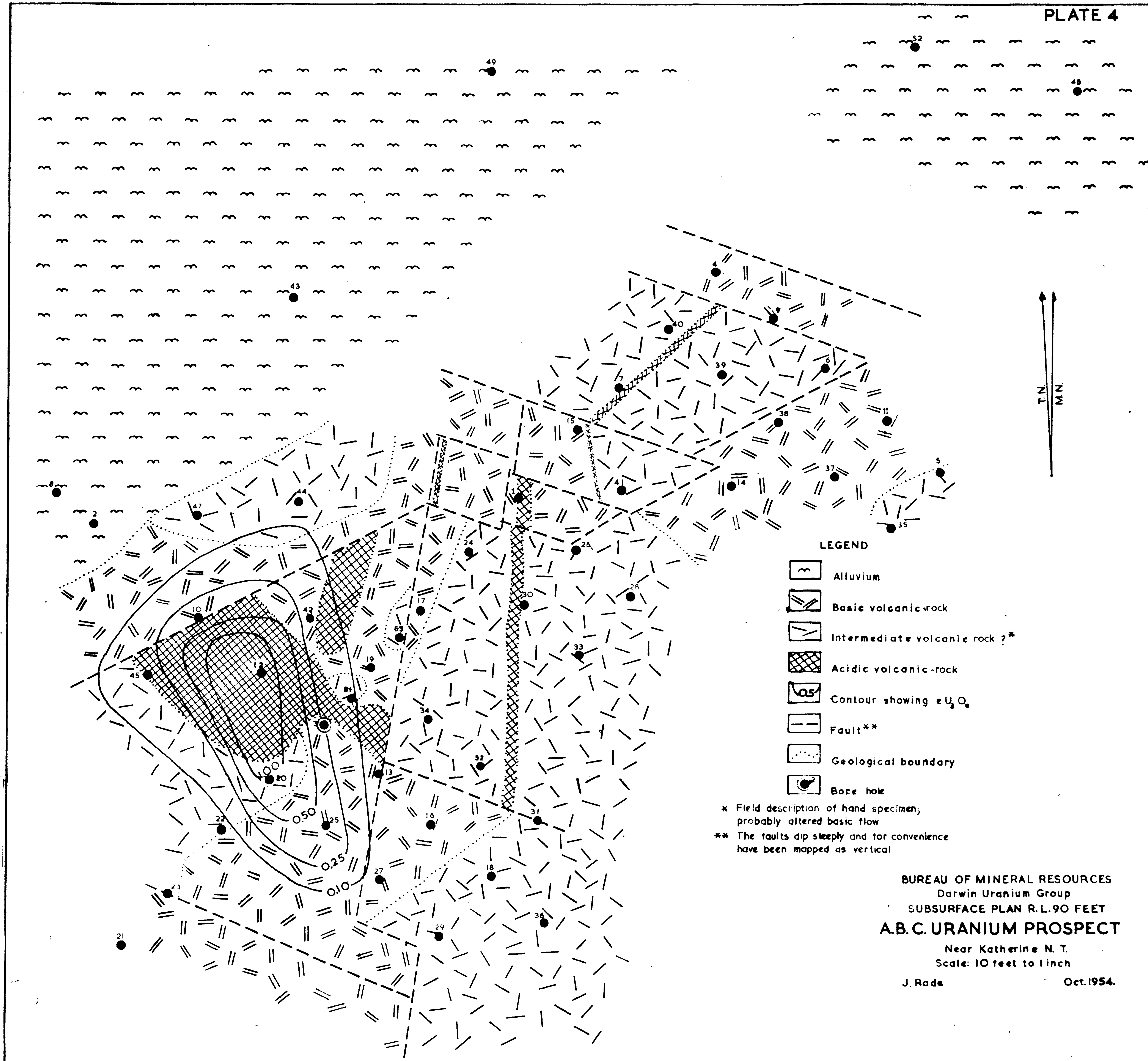


PLATE 4
LEGEND
Alluvium
Basic volcanic rock
Intermediate volcanic rock ?*
Acidic volcanic rock
Contour showing eU_3O_8
Fault**
Geological boundary
Bore hole
* Field description of hand specimen; probably altered basic flow
** The faults dip steeply and for convenience have been mapped as vertical
T.N.
M.N.
0.10
0.25
0.50
1.00
BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
SUBSURFACE PLAN R.L. 90 FEET
A.B.C. URANIUM PROSPECT
Near Katherine N. T.
Scale: 10 feet to 1 inch
J. Rade
Oct. 1954.

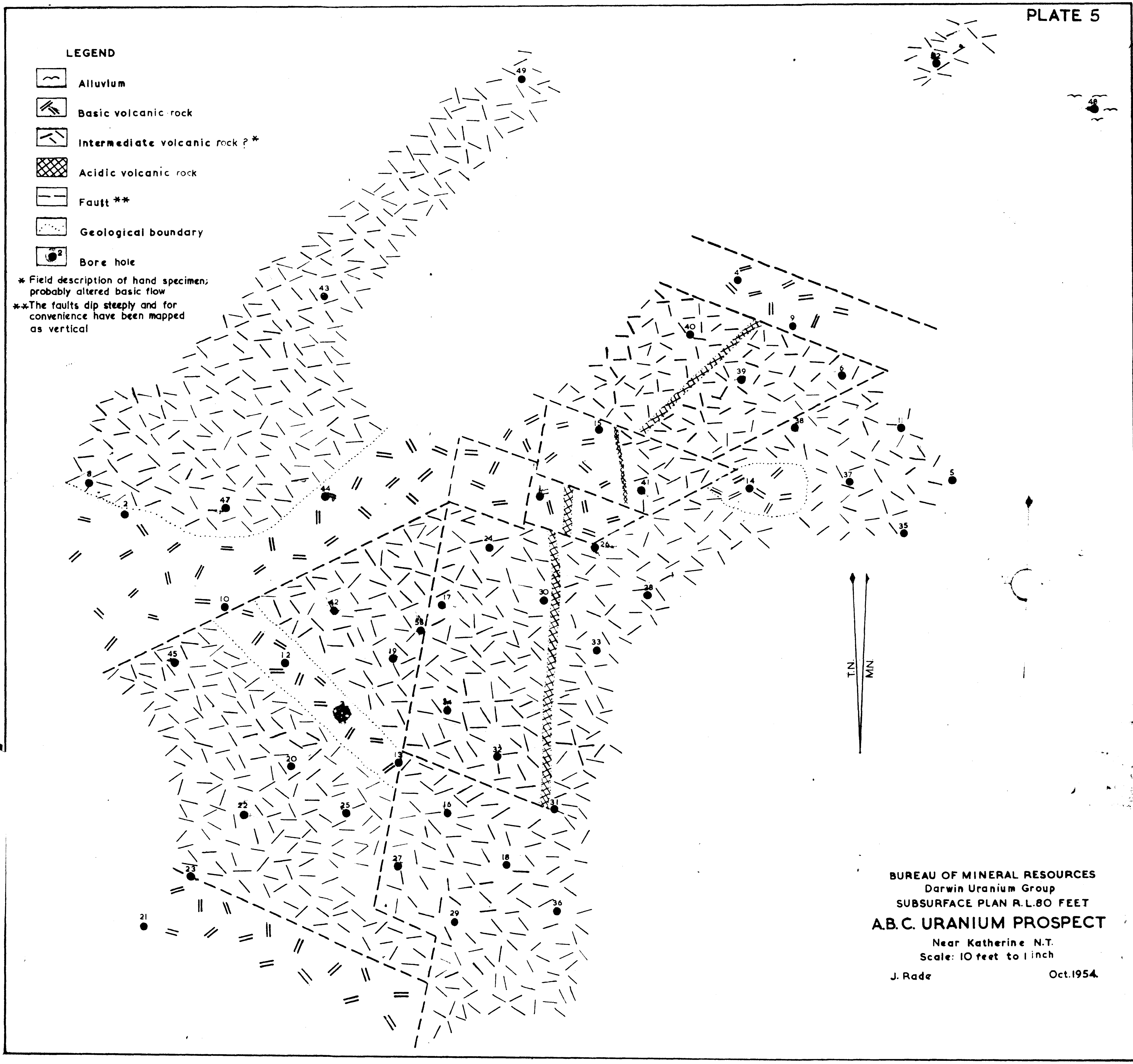


PLATE 5
LEGEND
Alluvium
Basic volcanic rock
Intermediate volcanic rock ? *
Acidic volcanic rock
Fault **
Geological boundary
Bore hole
* Field description of hand specimen; probably altered basic flow
** The faults dip steeply and for convenience have been mapped as vertical
T.N.
M.N.
BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
SUBSURFACE PLAN R.L.80 FEET
A.B.C. URANIUM PROSPECT
Near Katherine N.T.
Scale: 10 feet to 1 inch
J. Rade
Oct.1954

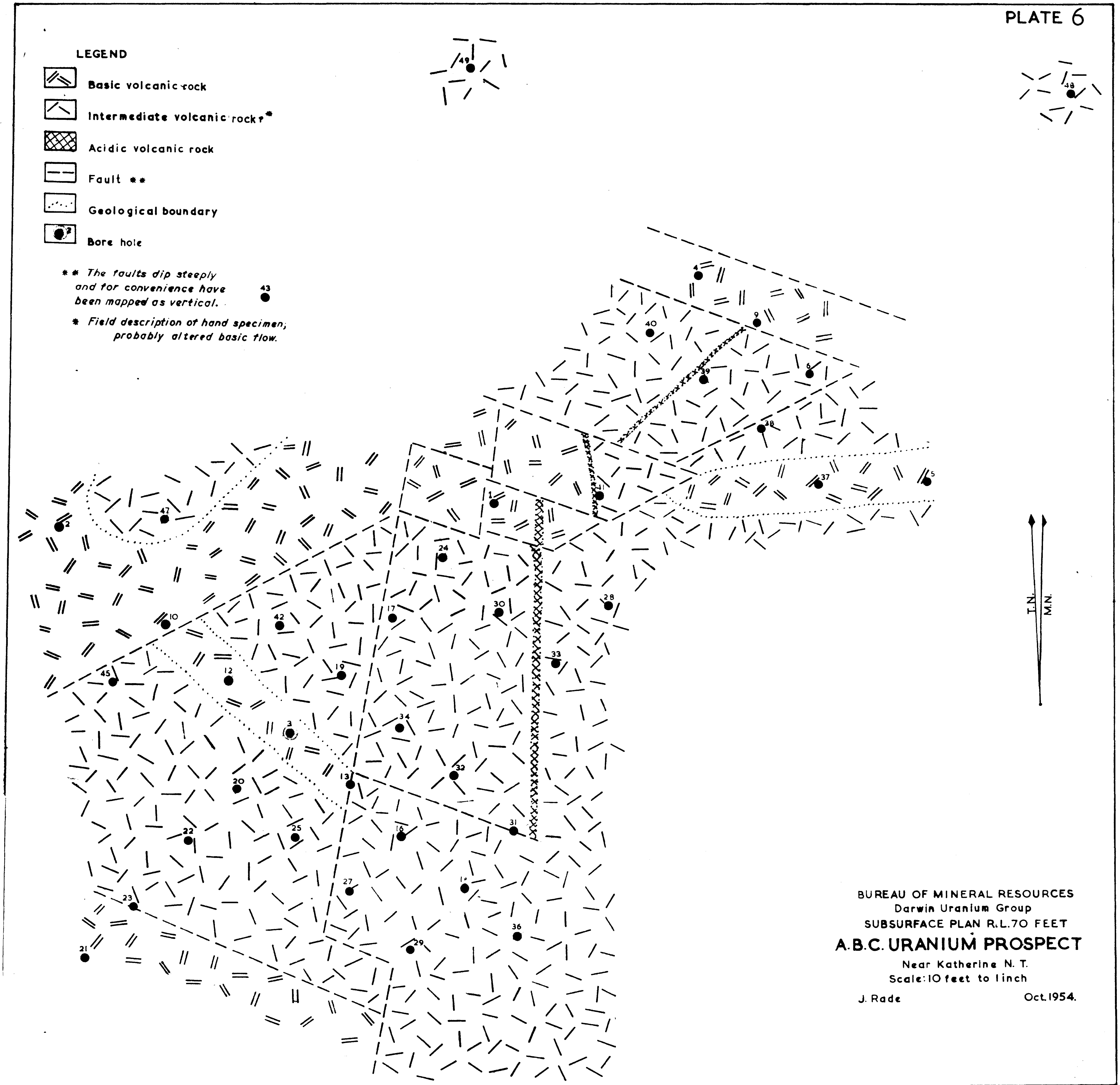


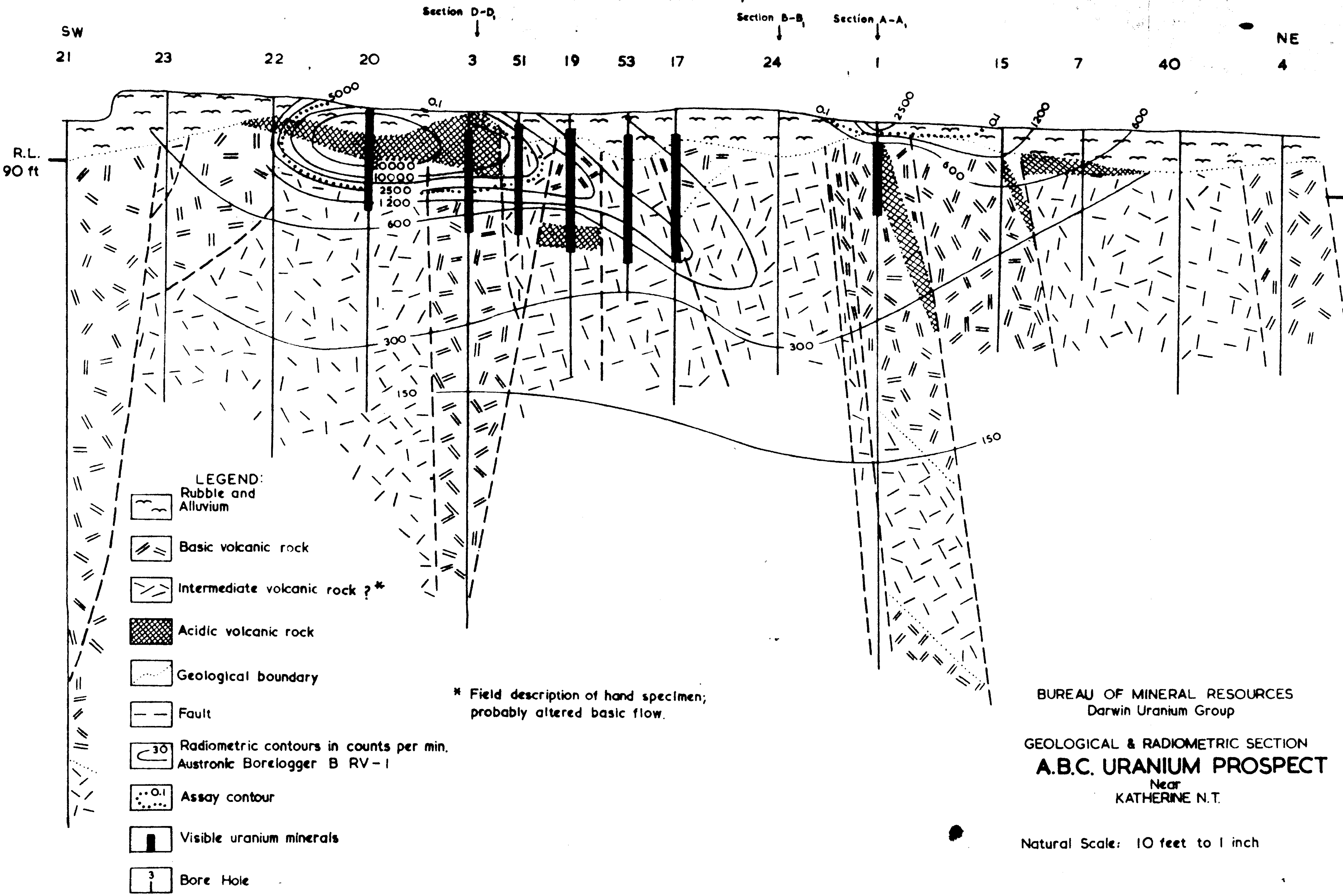
PLATE 6
LEGEND
Basic volcanic rock
Intermediate volcanic rock? *
Acidic volcanic rock
Fault **
Geological boundary
Bore hole
** The faults dip steeply and for convenience have been mapped as vertical.
* Field description of hand specimen; probably altered basic flow.
T.N.
M.N.
BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
SUBSURFACE PLAN R.L.70 FEET
A.B.C. URANIUM PROSPECT
Near Katherine N. T.
Scale: 10 feet to 1 inch
J. Rade
Oct. 1954.


PLATE 7.
SECTION A-A1.
Section D-D1
Section B-B1
Section C-C1
W.
E.
8
47
44
1
41
14
37
5
R.L. 90ft.
SECTION B-B1
Section D-D1
Section C-C1
Section A-A1
S.
N.
29
16
34
24
49
R.L. 90ft.
LEGEND
Rubble and Alluvium
Basic volcanic rock
Intermediate volcanic rock ?*
Acidic volcanic rock
Fault fracture
Geological boundary
Fault
Bore hole
* Field description of hand specimen; probably altered basic flow.
BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
Geological Sections
A.B.C. URANIUM PROSPECT
Near Katherine N.T.
Natural Scale: 10 feet to 1 inch.
J. Rade
Oct. 1954.

PLATE 8

SECTION C–C1

Section line shown on plate II



BUREAU OF MINERAL RESOURCES
Darwin Uranium Group

GEOLOGICAL & RADIOMETRIC SECTION

A.B.C. URANIUM PROSPECT

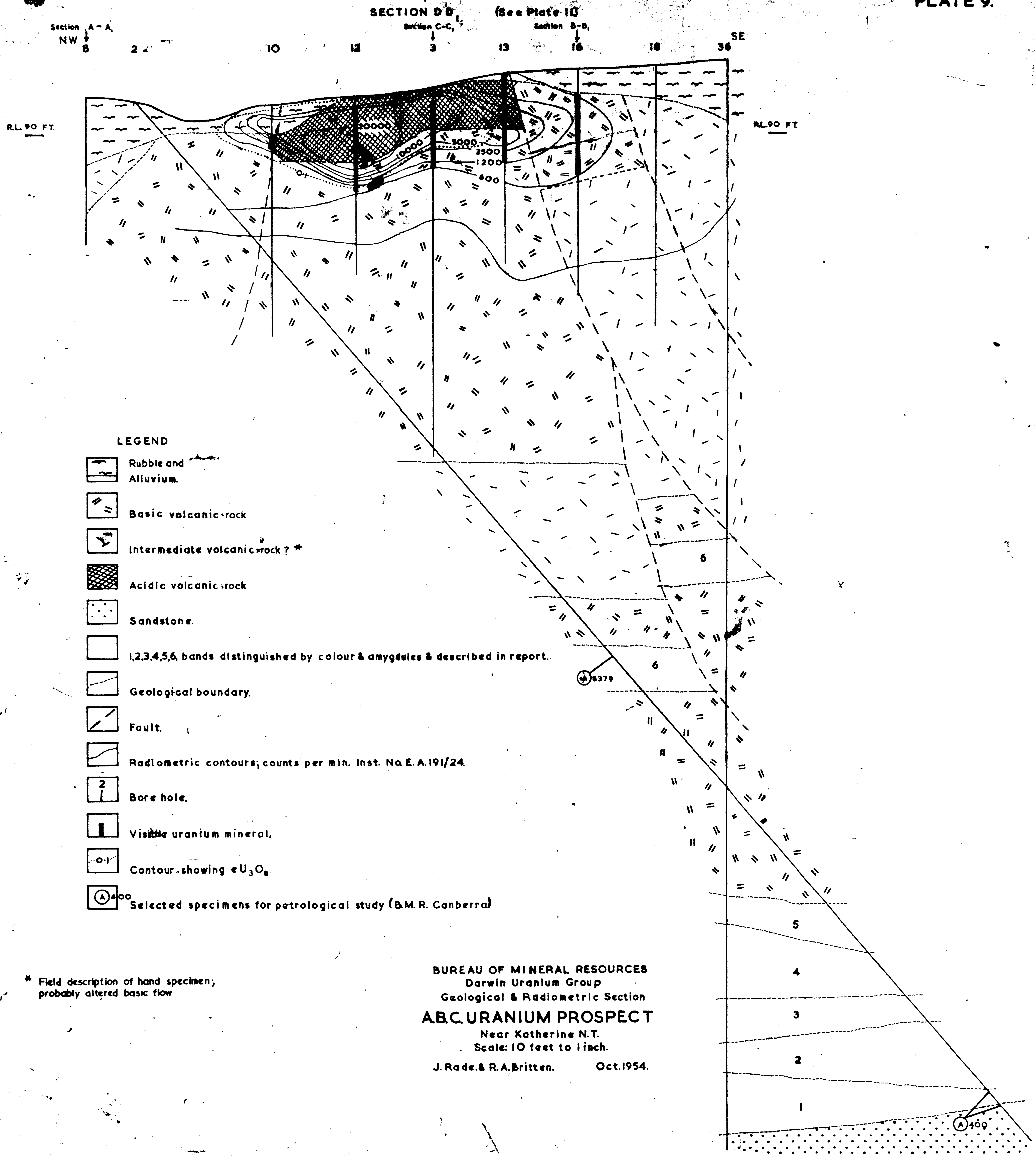
Near
KATHERINE N.T.

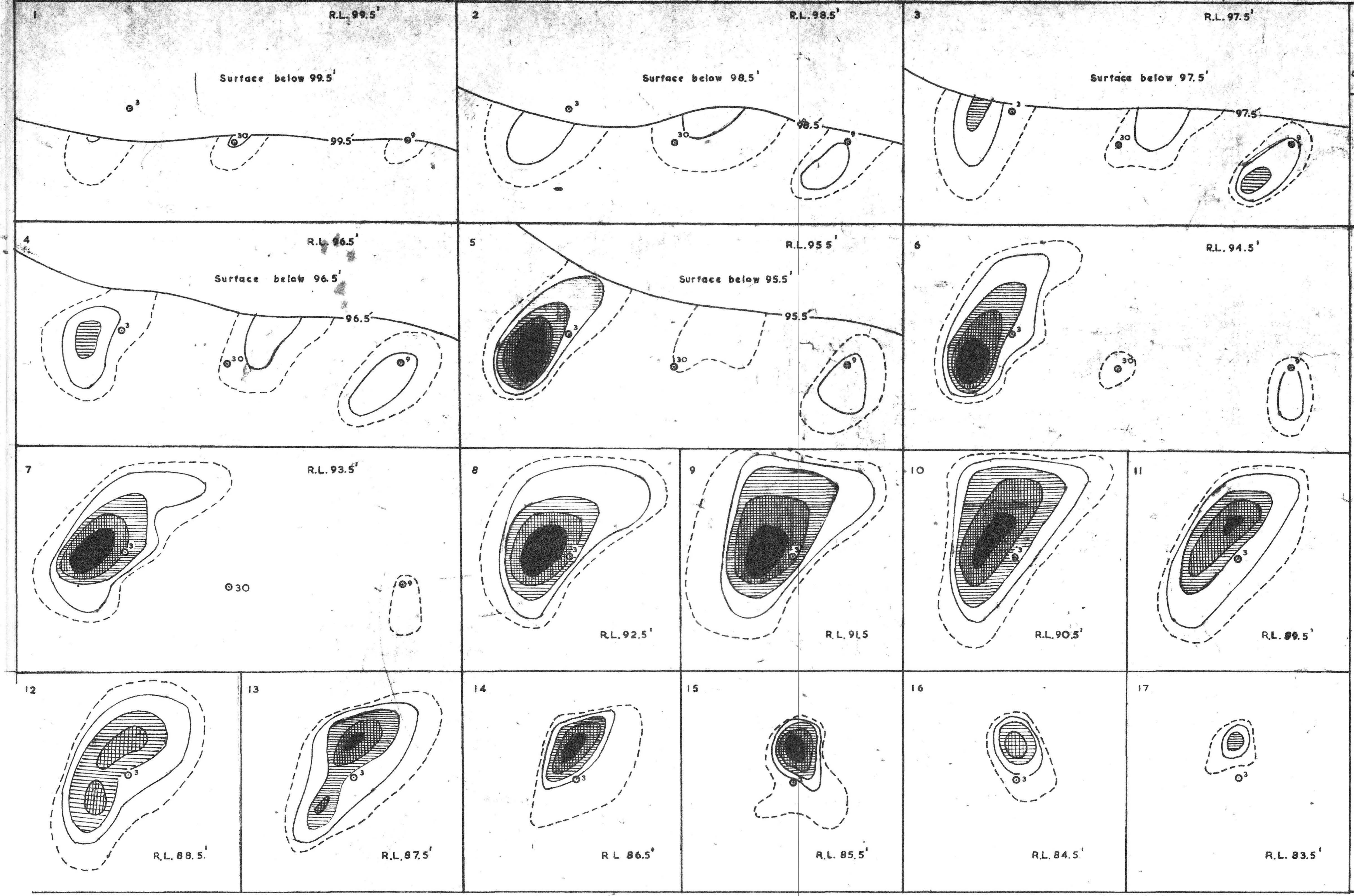
Natural Scale: 10 feet to 1 inch

R. A. Britten & J. Rade

Oct., 1954

PLATE 9.


SECTION D D1 (See Plate 10)
Section A - A1
Section C-C1
Section B-B1
NW
SE
8
2
10
12
3
13
16
18
36
R.L. 90 FT.
RL.90 FT.
20000
10000
5000
2500
1200
600
0·1
6
6
5
4
3
2
1
A 8379
A 400
LEGEND
Rubble and Alluvium.
Basic volcanic rock
Intermediate volcanic rock ? *
Acidic volcanic rock
Sandstone.
1,2,3,4,5,6, bands distinguished by colour & amygdules & described in report.
Geological boundary.
Fault.
Radiometric contours; counts per min. Inst. No. E.A. 191/24.
Bore hole.
Visible uranium mineral.
Contour showing eU_3O_8.
Selected specimens for petrological study (B.M.R. Canberra)
* Field description of hand specimen; probably altered basic flow
BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
Geological & Radiometric Section
A.B.C. URANIUM PROSPECT
Near Katherine N.T.
Scale: 10 feet to 1 inch.
J. Rade & R.A. Britten.
Oct. 1954.



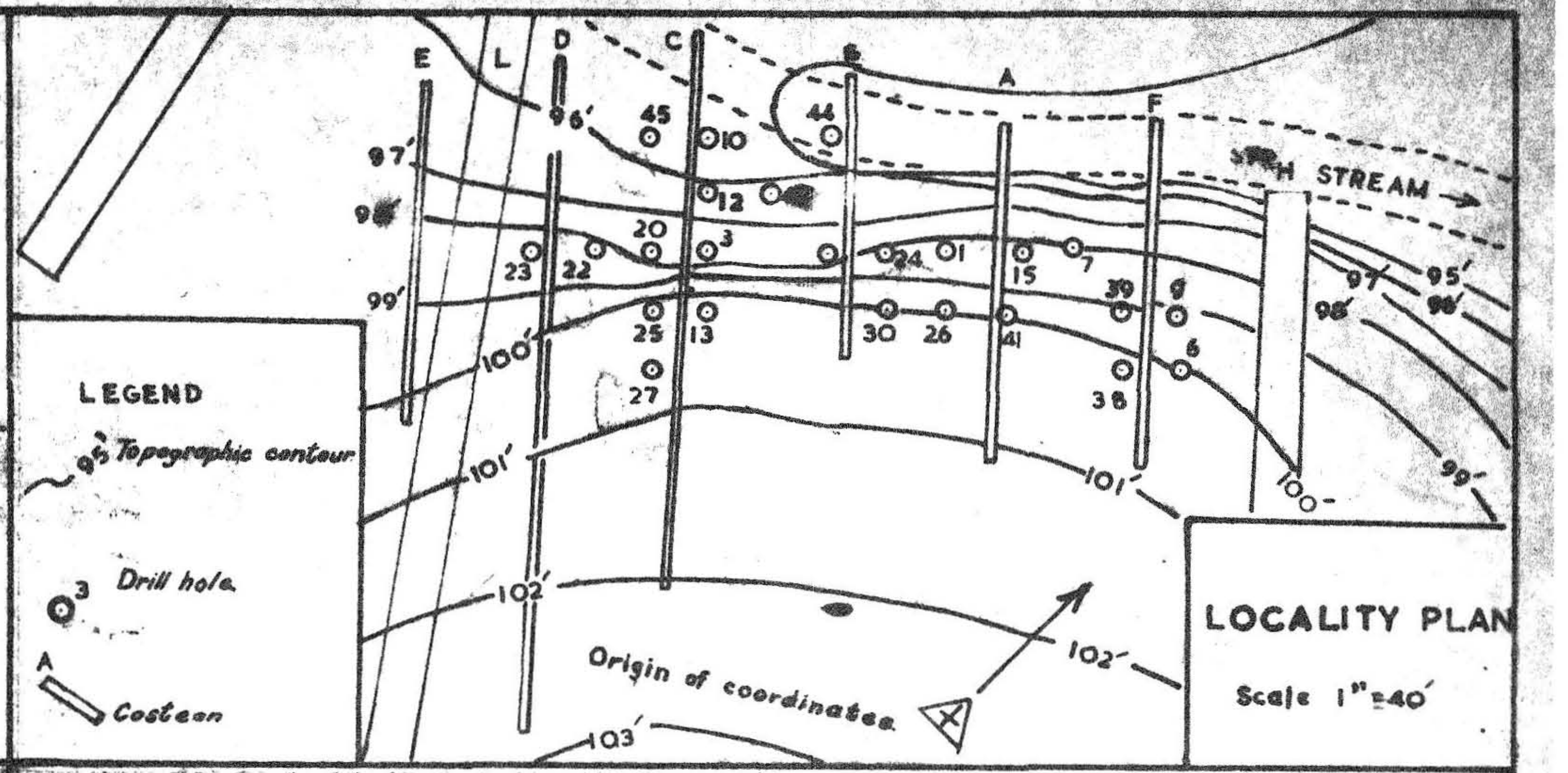


PLATE 10.

LEGEND

- Contours enclosing assays > 0.05 % e U_3O_8
- 0.10 to 0.25 % e U_3O_8
- 0.25 to 0.50 % e U_3O_8
- 0.50 to 1.00 % e U_3O_8
- > 1.00 % e U_3O_8
- O[3] Drill hole

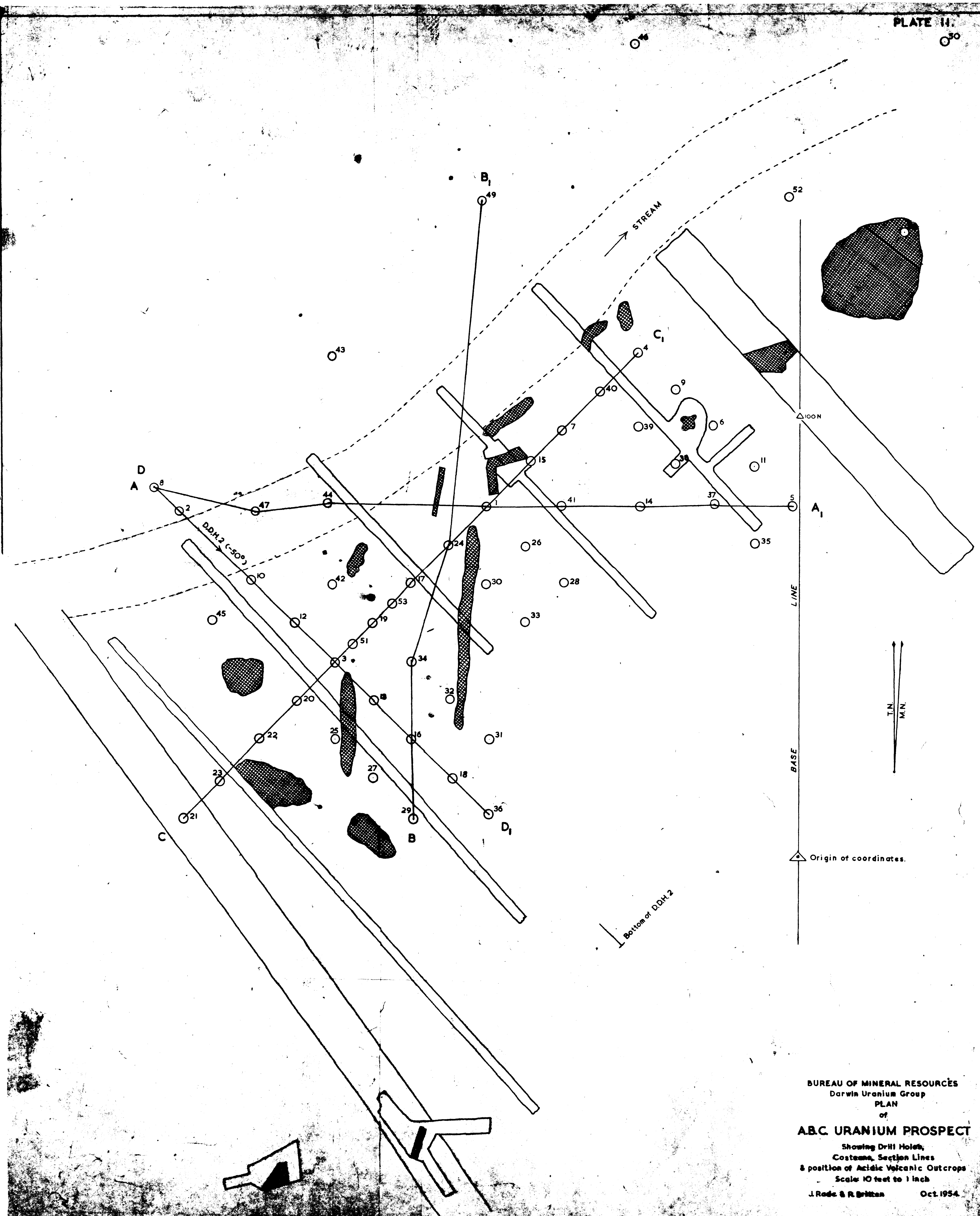
Diagrams 1 to 17 show assay contours on horizontal planes at vertical intervals of 1 foot

BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
Assay Plans

A.B.C. URANIUM PROSPECT
Near Katherine N.T.

R. A. Britten — Oct. 1954

PLATE 11.



BUREAU OF MINERAL RESOURCES
Darwin Uranium Group
PLAN
of
A.B.C. URANIUM PROSPECT
Showing Drill Holes,
Costeans, Section Lines
& position of Acidic Volcanic Outcrops
Scale: 10 feet to 1 inch

J. Rade & R. Britten Oct. 1954.