COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS.

RECORDS.

1958/79

REPORT ON AN INSPECTION OF THE HALLS CREEK URANIUM PROSPECT

by

B. P. Walpole and C. E. Prichard

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SUMMARY

The Halls Creek Uranium Prospect is a Blind River type deposit consisting of radioactive quartz pebble conglomerate bands in less radioactive quartz greywacke. The rocks are cross bedded and contain heavy minerals such as magnetite and rutile. They form part of a geosynclinal sequence of Lower Proterozoic sediments.

The radioactive sediments crop out on the north-western shoulder of an overturned closed anticline. The limbs of the structure dip at about 60°. Photo interpretation indicates that they may extend around the structure for several miles beyond the prospect area.

Surface radioactivity is low but the rocks have been highly leached. The grade of surface samples of conglomerate was about 0.3 lb. U_3O_8 per ton. The rocks have been shown to contain gummite and clay uranophane - believed to be leach products of pitchblende - enclosed in shells of orthite. The high degree of leaching suggests that the grade may improve below the weathered zone.

The radioactive sediments average about 50 feet in thickness and crop out over an aggregate length of about 10,000 feet in the prospect area. This is probably only a small part of their actual extent and there is some reason to doubt that the prospect area is the most suitable locality for preliminary testing.

The grade of the unweathered rock cannot be estimated at the present stage of the investigation, but this can be readily tested by diamond drilling.

Available evidence points to the possibility of very large tonnages of low-grade uraniferous material. The prospect is of major importance and should be vigorously explored.

INTRODUCTION

An inspection of the Halls Creek Uranium Prospect was carried out from 3/9/58 to 6/9/58, on behalf of the Australian Atomic Energy Commission, by B.P. Walpole and C.E. Prichard of the Bureau of Mineral Resources, accompanied by P. Grenning of United Uranium N.L.

Location and Access

The prospect is in the East Kimberley Mineral Field, approximately 23 miles north-east of the new township of Halls Creek in the Ord-Victoria region of Western Australia. It is covered by A.P. 1603 H, held by United Uranium N.L. (See Plate 1).

Access to the prospect is by means of the Halls Creek-Wyndham road to a point about 14 miles north of Halls Creek and thence east for 16 miles across country suitable only for 4-wheel-drive vehicles.

Topography, Vegetation, Climate, and Water Supply

The prospect area is rugged and consists of numerous sharp watercourses and steep ridges. Figs. 1, 3 and 4 illustrate the topography. Vegetation is mainly spinifex and snappy gum: there is no local timber suitable for use in mines. The climate is monsoonal. The average rainfall is 20 inches per annum, and domestic, stock, and town water supplies in the surrounding area are obtained from bores. There is one small rockhole at the prospect containing about 80,000 gallons of water. The water is not potable but would suffice for a limited drilling operation. Dam construction would be required for large water supplies.

History

The Halls Creek Prospect was discovered late in 1954 by Messrs. Gordon and Coussins, two prospectors employed at that time by United Uranium N.L. on a grubstake basis. It was inspected by company representatives early in 1955 but was rejected as being of no economic importance. In 1957, as a result of publicity given to the discovery of uranium in the Westmoreland conglomerate of north-west Queensland, and of the availability of a number of publications on the Canadian Blind River deposits, the company decided to reinvestigate the Halls Creek Prospect. A.P. 1603 H (for uranium only) was granted by the West Australian Government in April 1958. The A.P. expires in April 1959.

REGIONAL SETTING

The prospect occurs within geosynclinal sediments of Lower Proterozoic age, which have been called by Traves (1955) the Halls Creek Metamorphics. These rocks consist of two facies assemblages: a greywacke assemblage, in which the prospect is located, and an assemblage marked by carbonate rocks. The greywacke assemblage consists of greywacke, greywacke siltstone, green calcareous greywacke, quartz greywacke, in places with thin lenses and bands of pebble conglomerate, siltstone, and minor lenses of thin bedded dolomite and siltstone. It crops out for about 18 miles east of the prospect area and is overlain unconformably to the east by Upper Proterozoic rocks. The carbonate assemblage crops out to the west of the prospect area. It includes siltstone, thin bedded dolomite and siltstone, carbonaceous siltstone, numerous small lenses of coarse marble, and minor greywacke. In places these rocks have been contact metamorphosed to calc-silicate hornfels.

The relationship between the two assemblages was not investigated in detail. However, the carbonate rocks do not appear to be repeated on the east limbs of any of the major fold structures east of the prospect. They probably interfinger with and underlie the greywacke sequence.

The sediments are intruded by the igneous rocks of the Lamboo Complex (Matheson and Guppy, 1949). In the area shown on Plate 1, this complex can be tentatively subdivided into basic and granitic rocks. The basic rocks were emplaced first and now contain numerous small tongues and apophyses of contaminated granite rich in basic xenoliths. Contact metamorphism by either or both of these intrusions has resulted in the formation of calc-silicate hornfels in the carbonate rocks in some places; some of the carbonate rocks appear to have been altered to amphibolite. An epidote-rich rock - probably altered calcareous grewyacke - crops out in the prospect area.

The sediments have been tightly folded and very strongly faulted. The axial trend of the major fold structures is about 20° magnetic. Most of the faults strike north. Regional metamorphism is commonly low-grade.

THE PROSPECT

General

The fold and fault pattern of the area shown on Plate 1 was determined by photo interpretation: no great accuracy of detail is claimed for this work. However, the major elements are reasonably clear, and show that the prospect is located on the north-western shoulder of a closed anticline. The fold is overturned to the east and strongly faulted on the east limb and obliquely across the northern nose. The limbs of the structure dip at about 60° to the west, the plunge north and south is about 35°.

The prospect consists of a formation composed of radioactive quartz greywacke with pebble conglomerate bands. It is overlain by greywacke and underlain by phyllite. The quartz greywacke is medium to coarse; in hand specimen it consists of subangular grains of quartz and feldspar in a matrix of fine quartz sericite and feldspar. The rock has a marked heavy mineral content composed mainly of magnetite. The quartz greywacke is cross-bedded - in some places thin bands of heavy mineral pick out the cusp-shaped current-bedding planes. (Fig. 6). In some places the heavy mineral bands are markedly radioactive. The conglomerate occurs as bands within the greywacke - some clearly defined and some grading raggedly into greywacke (see Figs. 5 and 6). Where the conglomerate grades into the quartz greywacke, the percentage of heavy mineral in the formation as a whole appears to be appreciably higher. Individual well-defined conglomerate bands do not exceed 12 inches in width.

The conglomerate contains rounded pebbles of quartz with minor fragments of feldspar and schist. Some rounded pebbles of sugary quartz - possibly originally silicified dolomite - were also noted. The pebbles range from about ¼ inch to 1 inch in diameter. The matrix is fine quartz, sericite, chlorite, and heavy mineral. Some boxwork after pyrite(?) was noted.

The formation averages between 50 and 55 feet in thickness. In those outcrops where the conglomerate bands are well defined, the aggregate thickness of the conglomerate is about 7 feet.

Grenning (1958) quotes a description of the conglomerate by Whittle of the South Australian Mines Department as follows:

> "The conglomerates consist of rounded pebbles of quartz with occasional fragments of highly fissile chloritic schist and felspar. All pebble components are highly stressed. Pebble size is very uniform within individual bands but varies from ¼ inch up to 1 inch diameter, over the aggregate. The rock matrix consist of fine quartz and subordinate sericite and chlorite. Metallic minerals occur exclusively within the rock matrix. Euhedral crystals of magnetite constitute the bulk of the heavy mineral

with subordinate amounts of hematite, rutile, zircon, orthite and leached pseudomorphs of pitchblende. The pitchblende pseudomorphs are of an ovate form usually about 0.2 mm. in length. They are closely associated with orthite grains within the matrix and in general have an external coating of orthite some 10-20 microns thick concentric with the internal layers of secondary uranium mineral. No primary mineral exists, and only portion of the secondary uraniferous mineral remains. The ovoids are, in fact, shells of orthite enclosing ultra fine grained yellow masses consisting of clay uranophane and gummite. From this structure, it is deduced that pitchblende once occupied the centres of the ovoids, probably as inclusions of orthite granules. Weathering and leaching has reduced the uranium values in these rocks to the order of .01-.02% U_3O_8."

The outcrops of the formation are strongly leached. Radioactivity is fairly uniform but is low, ranging from 5 to 7 counts per second* for the conglomerate and from 2 to 3 counts per second for the quartz greywacke. The conglomerate and the quartz greywacke both contain a number of local hot spots, but these are not considered to be important.

The weathered character of the outcrops and the lack of good exposures of the full width of the formation does not allow systematic surface sampling. In the writers' opinion, surface sampling of this deposit serves no real practical value; the results of sampling of a particular type of deposit such as this can be quite misleading (as was certainly the case at Blind River) if they are not interpreted in the light of the strong leaching which has obviously taken place.

Grenning (1958) collected random surface samples from the conglomerate at the three anomalies shown on Plate 2. The average assay quoted by Grenning for those samples was low - about 0.3 lb. eU_3O_8 per ton. No samples for assay were collected during the present inspection but the average reading of about 5 to 7 counts per second agrees fairly well with the radiometric assay of the random samples (based on a rough calibration used by most field geologists and prospectors of 13-15 counts per second = 1 lb. eU_3O_8 per ton).

The important features of the deposit other than its size, are the fairly uniform level of radioactivity in the conglomerate bands, the lower radioactivity of the quartz greywacke, and the strongly leached appearance of the surface outcrops. These indicate that no assessment of primary grade can be made from the surface rocks.

Three main outcrops of the formation occur at the prospect. They are referred to here as the Northern Anomaly, Central Anomaly, and Southern Anomaly (see Plate 2).

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* All radiometric readings quoted were taken with a Philips Monitor Geiger Counter.

Northern Anomaly

At the Northern Anomaly, the formation has been folded into a small overturned dome, strongly faulted on the eastern limb. The limbs of the structure dip at angles ranging between 60° and 70° (Plate 2). The fold structure may be due to drag on a major fault which cuts obliquely across the nose of the major anticline shown on Plate 1. The crest of the dome has been eroded by the east-flowing Saunders Creek, leaving the formation outcropping as a rim around the hills immediately north and south of the Creek (Fig. 1).

The conglomerate bands are welldefined on the western limb of the structure, where their aggregate thickness is about 7 feet. The formation seems to have undergone a facies change on the eastern limb of the dome south of the creek, and very little conglomerate is present in that locality. The radioactivity is also appreciably lower.

Grenning quotes a total strike length of 3,000 feet and an average thickness of 45 feet for the outcrop of the formation at the Northern Anomaly. If that part of the eastern limb severely affected by faulting and by facies change is excluded, the strike length of the undisturbed and more highly radioactive section should be reduced by about 1/3rd.

The formation crops out on the creek bank a few hundred yards downstream from the domal structure and on the eastern side of a major north-trending fault. This outcrop is probably part of the faulted eastern limb of the closed overturned anticline indicated on Plate 1.

Grenning notes that the formation has been intruded by "a green basic igneous rock" at the Northern Anomaly. The rock type seen during the inspection was an epidote-rich fine calcareous greywacke which crops out east of the anomaly.

Central Anomaly

The outcrop of the formation at the Central Anomaly is on the eastern slope of a sharp ridge and is mostly covered by scree and rubble. The dip is west at 55°. The formation can be traced for only about 600 feet; the width could not be determined. Photo interpretation suggests that the outcrop is a small wedge separated from the northern and southern anomalies by two north trending faults. On the ground, a strong zone of shearing is marked by fissile slates between the Central and Southern Anomalies, but the structure to the north is not clear.

Southern Anomaly

The formation has an exposed strike length of about 6,000 feet at the Southern Anomaly. The rocks differ from those of the Northern Anomaly in that the conglomerate pebbles are in places more dispersed and are not confined only to well-defined bands in the quartz greywacke; both rocks appear to have an appreciably higher heavy mineral content. The formation crops out as a sharp ridge (Fig. 3) which strikes at about 20° magnetic. The beds dip between 55° and 70° west and range from 50 to about 80 feet in thickness. The ridge rises to about 400-500 feet above the plain level.

POSSIBILITY OF OTHER OCCURRENCES

The photo-geological map (Plate 1) shows that the radioactive formation may extend for a considerable distance beyond the prospect area. This feature was apparently not recognized by United Uranium when the company's A.P. was pegged, and, in fact, if the photo interpretation is correct, it would appear that the A.P. covers probably the most inaccessible and most disturbed section of the formation.

The possible extensions shown on Plate 1 are tentative only. The existence of a simple cross fault as shown at the southern end of the southern anomaly is doubtful, but the interpretation of the major structure as a closed overturned anticline is believed to be correct.

The Southern Anomaly is pin-pointed by anomaly 43(b), Sheet 2 of the Wyndham-Halls Creek region DC3 anomaly map issued by the Bureau of Mineral Resources in 1955. It is significant that anomalies 44 and 43(a) both lie directly on the predicted extensions of the radioactive formation. Other anomalies detected during a recent reconnaissance of the area by the Bureau VH-MIN group also lie on these possible extensions.

The photo-interpretation covers only part of the Halls Creek one mile area and it is reasonable to expect that the radioactive rocks or similar formations may occur in the areas north and east of the Halls Creek sheet.

CONCLUSIONS AND RECOMMENDATIONS

The Halls Creek prospect is of very similar type to the Blind River deposits of Canada. The main point of difference is that the radioactive formation at Halls Creek is within a geosynclinal sequence and is not a basal unit as at Blind River. Further, the conglomerate bands are not as thick individually or in aggregate.

At Blind River the uranium content of the primary ore averages between 2.0 and 2.5 lb. eU_3O_8 per ton. The surface rocks are reported as having been strongly leached. The uranium content of the outcrops was negligible.

Evidence of leaching of the surface rocks at Halls Creek such as the presence of pyrite boxwork and minor gummite and uranophane as leach products of primary uranium minerals strongly suggests that the grade of surface rock indicated by surface grab sampling (0.3 lb. eU_3O_8 per ton) could be quite misleading as to the grade of any primary ore.

The quartz greywacke at the Halls Creek prospect would need to be mineable, as the conglomerate bands are individually too narrow and are too dispersed to be mined selectively.

The writers were informed that United Uranium N.L. have laid out a drilling programme of three holes, which is to be carried out early in 1959. If the photo interpretation of the region is correct in the major features presented, there is no certainty that the known prospect area offers the best target for preliminary testing. Most of the possible extensions of the radioactive formation lie outside the Authority to Prospect held by United Uranium. These extensions should be investigated.

The geology of the Halls Creek and Springvale 1-mile sheets and part of the Antrim 1-mile sheet should be mapped at photo scale.

The area covered by the VH-BUR airborne reconnaissance of the Kimberley region in 1954 should be reflown by light aircraft. The DC3 reconnaissance was certaintly successful in pin-pointing the Halls Creek Prospect: but the DC3 anomalies could best be inspected concurrently with the proposed light aircraft survey.

REFERENCES

FINUCANE, K.J., 1938 - The Halls Creek-Rube Creek Area, East Kimberley District. Aer.Surv. N. Aust. W. Aust. Rep. 27.

GUNNING, P., 1955 - Report on the Uranium Prospect A.P. 1603H Halls Creek area Western Australia. United Uranium N.L. Company Report.

HART, R.C., 1955 - Uranium Deposits, Algoma District. Can.Min. and Metall. Bull. May 1955.

HOLMES, S.W., 1958 - The Uranium-bearing Conglomerates of the Blind River-Algoma Area. Can.Min.Journ.Vol. 79, No. 4.

HOLT, E., 1956 - Mining at Propto. Can. Min. & Metall. Bull. May 1956.

MATHESON, R.S., and GUPPY, D.J., 1949 - Geological Reconnaissance in the Mt. Ramsay Area, Kimberley Division, Western Australia. Bur.Min.Resour.Aust. Rec. 1949/48.

TRAVES, D.M., 1955 - The Geology of the Ord-Victoria Region, Northern Australia. Bur.Min.Resourc. Aust. Bull. 27.

WESTERN MINING AND OIL REVIEW - Summary of Blind River Deposits. Vol. 29, No. 7, July 1956.

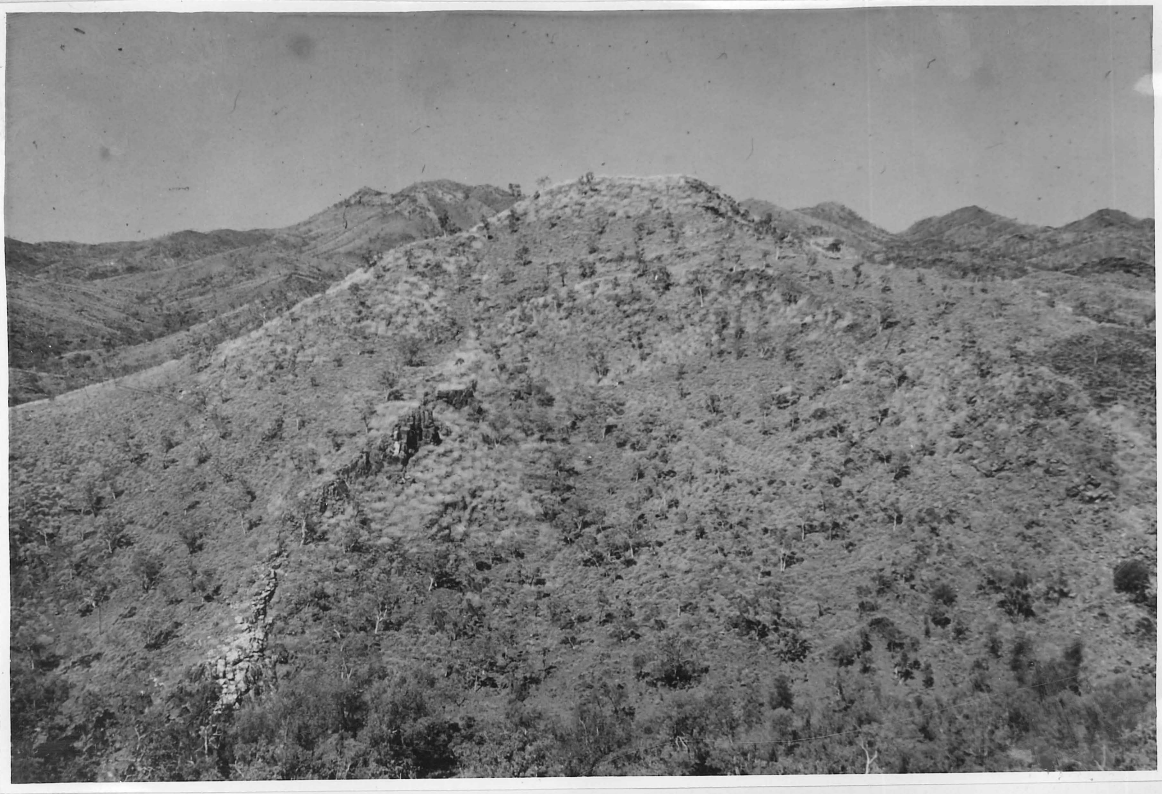

Fig. 1 Looking south across Saunders Creek from northern nose of dome at Northern Anomaly. Showing southern flank of dome. Central anomaly is situated on the east slope of the sharp peak in the left-middle background.

Fig. 2 Exposure of radioactive formation in creek bed, Southern Anomaly(looking south). The top of the formation is on the extreme top right of photo; the base of the formation in the extreme bottom left. The rocks dip at 70° to the west.

Fig. 3. Outcrop of radioactive formation, Southern Anomaly, looking south. The outcrop forms the prominent spur in the centre of the photograph.

Fig. 4. Photograph looking south from the high point shown on Fig. 3, showing continuation of radioactive formation to south. The sharp hills in the left background are on the east limb of the overturned anticline (Plate 1) and may represent the continuation of the formation around the structure.

Fig. 5 Well defined conglomerate band in quartz greywacke. Northern Anomaly.

Fig. 6. Poorly defined conglomerate bands grading into quartz greywacke, Southern Anomaly. Note also increased heavy mineral content of rock as compared to Fig. 5.

(Note: Compare Fig. 5 and Fig. 6 above with Fig. 1 and Fig. 2 p.107, Holmes 1958).

Fig. 7. Festoon current bedding picked out by heavy mineral layers in quartz greywacke, Southern Anomaly.

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PHOTO-GEOLOGICAL SKETCH MAP

PART OF HALLS CREEK ONE MILE AREA

WESTERN AUSTRALIA

Showing major structural elements and possible extensions of radioactive horizon, Halls Creek Uranium Prospect.
(Note: All detail shown on this map is from photo interpretation only)

Scale: 1 inch = 1 mile (approx.)

½ 0 1 2 3 MILES

REFERENCE

Upper Proterozoic (?) — Pu — Undifferentiated sediments

Lower Proterozoic

Lamboo Complex — Granitic rocks; Mainly basic rocks

Halls Creek "Metamorphics" — Plh — Undifferentiated geosynclinal sediments showing high grade contact metamorphism along boundaries of basic and granitic intrusions.

Sediments include:

(1) Well developed greywacke assemblage, mainly in eastern part of map area:- quartz greywacke, greywacke, greywacke siltstone, calcareous greywacke siltstone, minor lenses of thin bedded dolomite and siltstone, marker horizon of radioactive quartz greywacke and conglomerate.

(2) Assemblage containing carbonate rocks, mainly in central part of map area. Rocks include thin bedded dolomite and siltstone, carbonaceous siltstone, dolomite, siltstone - now mainly contact metamorphosed to calc silicate hornfels, marble, amphibolite, etc.

Known outcrops of radioactive formation.

Possible extension of radioactive formation.

Bedding trends from photo-interpretation with direction of dip where known.

Foliation trend (probably fracture cleavage).

Axis of inferred syncline with direction of plunge.

Axis of inferred anticline with direction of plunge.

Closed overturned anticline (inferred).

Fault.

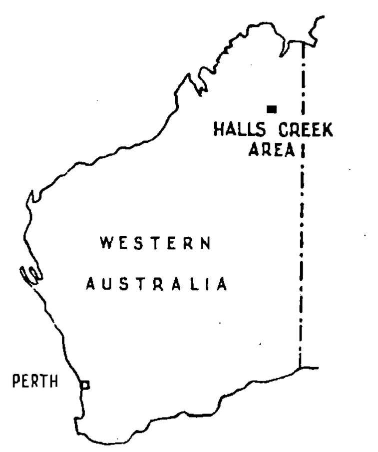
Probable fault.

Uranium prospect.

A ◯ Airborne (DC3) radiometric anomaly.

Trig. point.

LOCALITY MAP



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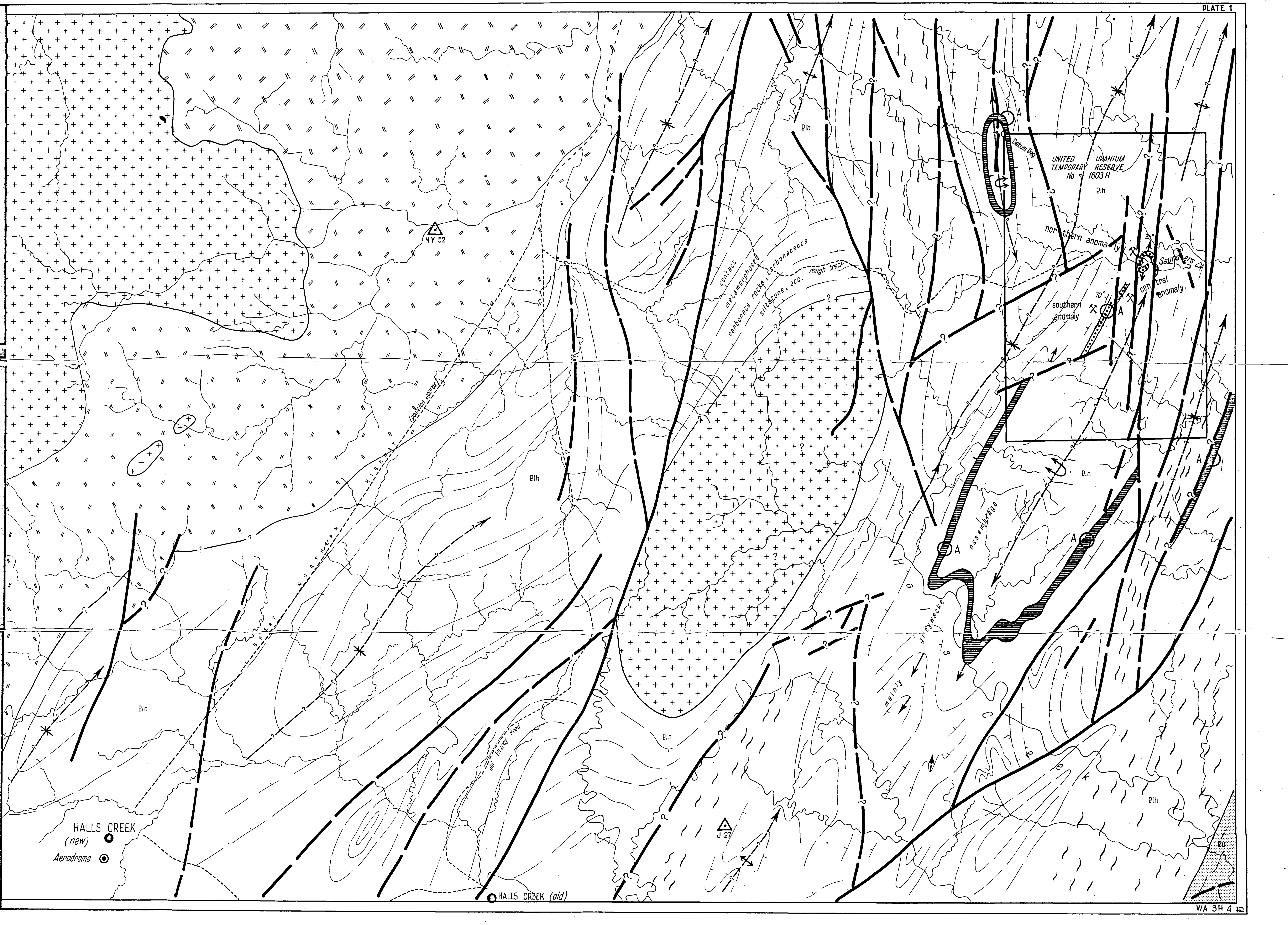

PLATE 2

SKETCH PLAN SHOWING DISTRIBUTION OF OUTCROPS OF RADIOACTIVE SEDIMENTS
HALLS CREEK URANIUM PROSPECT

(Details from United Uranium N.L. plan)

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