DEPARTMENT OF NATIONAL RESOURCES

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1977/20

A PRELIMINARY GEOLOGICAL AND GEOCHEMICAL INVESTIGATION OF THE UNA MAY URANIUM PROSPECT, SEIGAL 1:100 000 SHEET AREA, NORTHERN TERRITORY

by

A.G. Rossiter

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CONTENTS

TABLE

FIGURES

SUMMARY

The Una May uranium prospect was discovered by the Bureau of Mineral Resources in 1975 during a regional stream-sediment survey of the Seigal 1:100 000 Sheet area. More detailed stream-sediment work was followed by geological mapping and reconnaissance soil sampling. An area exceeding 3 km^2 has been outlined in which the soil is enriched in arsenic, beryllium, bismuth, copper, fluorine, lead, lithium, molybdenum, niobium, rubidium, thorium, tin, tungsten, uranium, and yttrium. The anomaly is associated with a granite stock about 2 km^2 in area. Peak uranium values are at the northwestern end of the stock within an area bounded by a circular fracture. Copper is associated with a greisen zone peripheral to this ring fracture. The area warrants further prospecting for a large-tonnage low-grade uranium deposit similar to the Rössing orebody in Namibia.

INTRODUCTION

Location

The Una May uranium prospect lies in the Northern Territory adjacent to the Queensland border about 350 km north-northwest of Mount Isa (Fig. 1). Road access is via Doomadgee Mission, 100 km to the east.

Discovery

The first indications of the prospect were obtained during a regional stream-sediment survey of the Seigal 1:100 000 Sheet by the Bureau of Mineral Resources during 1975. Later in that year more detailed stream-sediment sampling and reconnaissance soil sampling were carried out in the area. This was followed in 1976 by geological mapping, additional stream-sediment and soil studies, and preliminary surface rock sampling. Early in the program, Una May was regarded primarily as a copper prospect (Rossiter, 1976a), but later work suggests that its greatest potential lies in the possibility of a large-tonnage low-grade uranium deposit.

Climate and vegetation

The study area has a semi-arid to subhumid tropical climate. The average annual rainfall is about 700 mm; rain is confined almost entirely to the period November to April. Temperatures are moderate to high all year, and the average daily maximum is around 32^{o}C.

The long dry winters result in the predominance of drought-resistant plants such as snappy gum (*Eucalyptus brevifolia*) and spinifex (*Triodia* spp.).

Topography and drainage

The topography of the Una May area is quite rugged, and local relief approaches 150 m. The sky-line is dominated by three features:

1. Tracey's Table (Fig. 1), a mesa capped by Cretaceous sandstone.
2. Another flat-topped hill consisting of aplite with some Cretaceous rubble about 2 km due south of Tracey's Table.

3. The prominent ridge formed by the quartz filling of the Calvert Fault.

The remainder of the area consists of lower hills of rhyolite and granite, except for a narrow strip of flat country in the central part. The flats are underlain by granite.

The prospect is drained by two tributaries of Pandanus Creek, and lies ultimately with the watershed of the Nicholson River. As a consequence of the seasonal rainfall the streams are dry during the winter. The nearest permanent water-hole is on Pandanus Creek near Norris' copper mine, about 4 km to the northwest (Fig. 1).

Land tenure

A number of companies have held Exploration Licences over Una May, but at present (June, 1977) there are no leases covering the prospect. For the time being, at least, the area is declared unalienated land for the purposes of the Woodward Commission into Aboriginal land rights. In 1974, R. Foster applied for an exploration licence in the area which includes the prospect, but processing of his application awaits clarification of the land-rights issue.

Previous investigations

Uranium mineralisation in the Pandanus Creek area was first inspected by Lord (1955). He examined two leases about 2 km southeast of the Una May prospect, and noted traces of autunite in a quartz vein.

The Bureau of Mineral Resources has carried out regional geological mapping in the area at scales of 1:250 000 (Firman, 1959; Roberts, Rhodes & Yates, 1963) and 1:100 000 (Sweet & Slater, 1975). The acid volcanics and granites of the region are discussed by Mitchell (1976) and Gardner (in prep.), respectively.

GEOLOGY

The Una May prospect lies within the Murphy Tectonic Ridge - a belt of Lower Proterozoic and Carpentarian igneous and metamorphic rocks about 200 km long and up to 30 km wide (Plumb & Sweet, 1974). The rocks near the prospect belong to the Cliffdale Volcanics and the Nicholson Granite Complex (Fig. 2).

CARPENTARIAN

Cliffdale Volcanics

The Cliffdale Volcanics in the study area consist mainly of greenish-black ignimbritic dacite which assumes a reddish hue on weathering. The volcanics are cut by quartz veins and rhyolite dykes; greisenised zones are present but rare. No signs of mineralisation were observed in these rocks.

Nicholson Granite Complex

There are two major phases of the Nicholson Granite Complex in the area of the Una May prospect.

The older phase is a pink granite (unit Pgn_5 of Gardner, in prep.) in which orthoclase is about three times as abundant as plagioclase. Green-brown biotite, commonly partly altered to chlorite, is the most abundant ferromagnesian mineral, and small amounts of hornblend,e, epidote, sphene, allanite, and iron ore may also be present. Greisenised zones consisting of quartz, muscovite, sericite, and limonite are common in the pink granite; malachite staining occurs in a number of these greisens. Quartz veins and rhyolite and porphyry dykes commonly intrude the granite.

The younger phase (unit Pgn_8 of Gardner, in prep.) is generally white, although it may assume a pinkish hue locally as a result of oxidation. The white granite differs from the pink in containing muscovite, more quartz and plagioclase, and microcline instead of orthoclase. Potassium feldspar and plagioclase are more or less equally abundant. Accessory minerals are apatite, chlorite, fluorite, iron ore and zircon. Preliminary scanning electron microscope studies suggest that uranium occurs in a variety of minerals in the oxidised zone. These comprise silicates - uranothorite

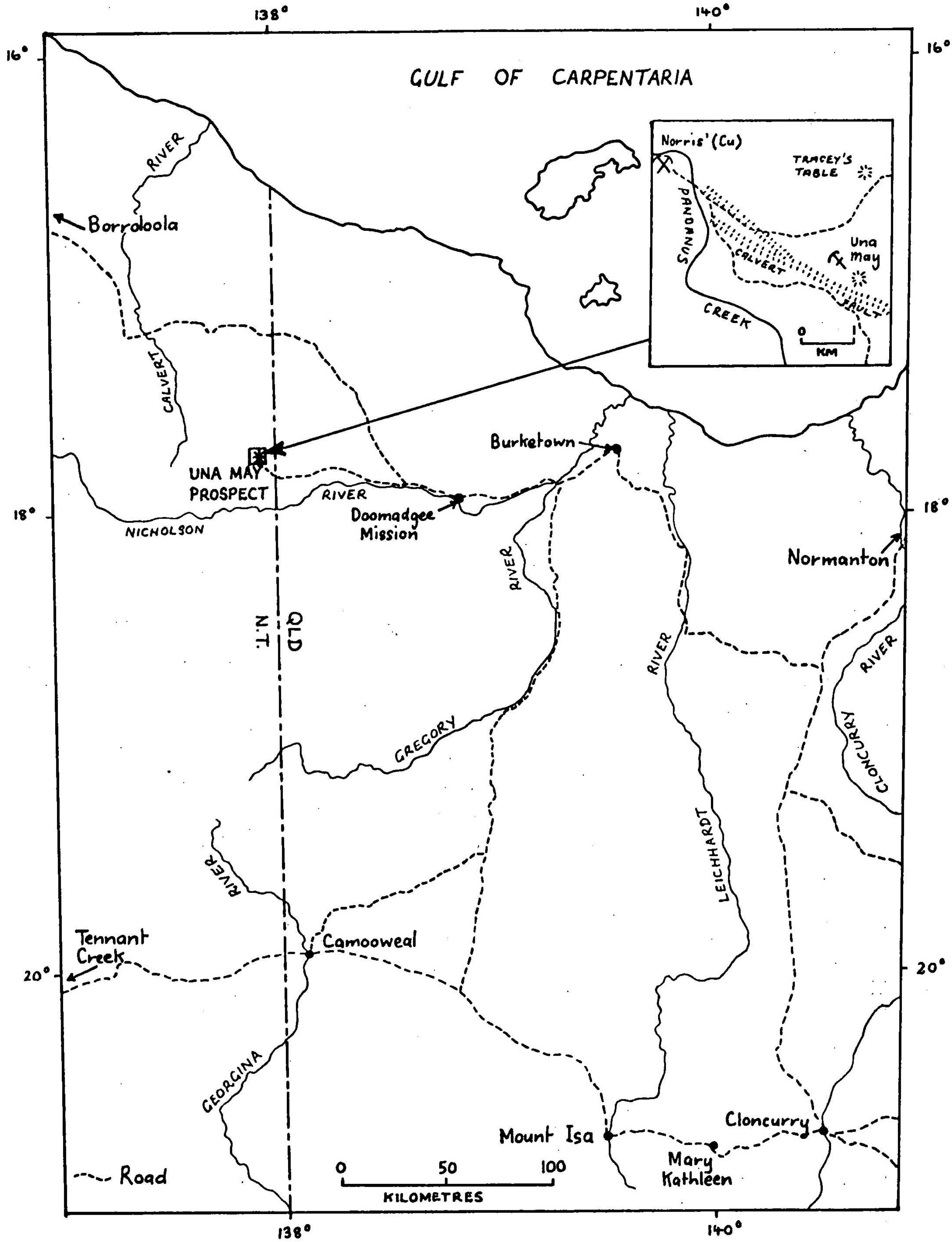
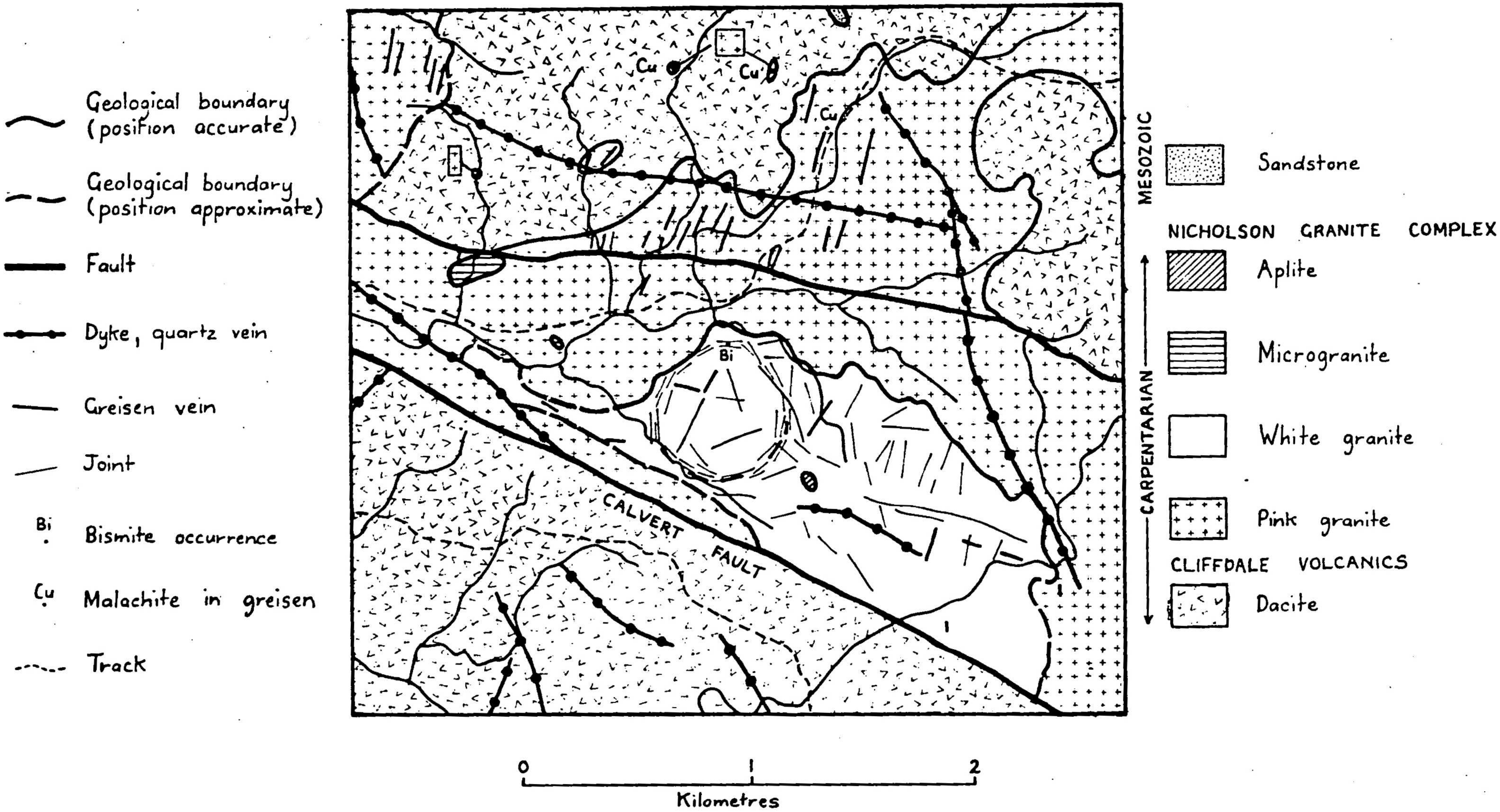


Figure 1 : Location map.

Record 1977/20

NT/A/544

Figure 2 : Geology of the Una May prospect.



(Th, U) SiO_4 and uranophane $Ca(UO_2)_2\ (SiO_3)_2\ (OH)_2.\ 5H_2O$ have been tentatively identified - and niobates - possibly including betafite (U,Ca) (Nb, Ta, Ti)$_3$ O_9. nH_2O.

The white granite occurs as a small stock roughly 2 x 1 km truncated to the south by the Calvert Fault. The stock is highly fractured, and many of the fractures are filled by quartz, rhyolite, aplite, or greisen. The joints and dykes are too numerous for them all to be shown in Figure 2, but the general pattern of distribution is indicated. An interest is a ring fracture in the north-western part of the stock. A peculiar, altered rock consisting of quartz, limonite, and an unidentified clay mineral, and containing finely disseminated bismite (Bi_2O_3) occupies the ring fracture at one place (Fig. 2).

Two small bodies of micrIogranite crop out northwest of the white granite stock. The microgranites contain more orthoclase than plagioclase, and are characterised by graphic intergrowths of quartz and feldspar. They probably belong to unit Pgn_7 of Gardner (in prep.).

MESOZOIC

Tracey's Table consists of a prominent mesa of Cretaceous sandstone. Similar sandstone occurs as rubble on an aplite hill about 2 km to the south - this represents the remnants of a capping all but removed by erosion.

GEOCHEMISTRY

Sampling and Analytical procedures

Stream-sediment samples were sieved to minus 180 um using plastic sieves fitted with nylon-bolting cloth. Soil samples were collected from a depth of about 20 cm, and were also sieved to minus 180 um. Rock samples were collected from surface exposures using a sledge hammer.

10

All samples were analysed for beryllium, copper, lithium, and zinc by atomic absorption spectrophotometry and for bismuth, lead, rubidium, thorium, tungsten, uranium, and yttrium by X-ray fluorescence spectrometry. Arsenic, cerium, fluorine, molybdenum, niobium, and tin determinations were also made on selected samples by X-ray fluorescence spectrometry.

Stream sediments

The Una May prospect was first detected during a regional stream-sediment survey of the Seigal 1:100 000 Sheet area. Anomalous beryllium, bismuth, copper, lead, lithium, niobium, rubidium, thorium, tin, tungsten, uranium, and yttrium were found in streams draining a considerable area (Fig. 3). Initially copper was considered the element of primary economic importance, although the high uranium levels were also interesting, particularly heavy-mineral studies and lack of anomalous cerium values in the sediments indicated that neither detrital allanite nor detrital monazite was present in significant quantities.

Soils

Reconnaissance soil sampling has confirmed the existence of an area exceeding 3 km^2 anomalous in the same elements as the stream sediments. Results for the elements of greatest interest - bismuth, copper, lead, tungsten, and uranium - are shown in Figures 4-8. Tin is very erratic in its distribution, and is probably not of economic significance. Also now known to be slightly enriched in the soils of the area are arsenic, flourine, and molybdenum, although fewer data are available for these elements. No high zinc values have been found.

Some of the elements show an interesting zonal distribution. Anomalous uranium levels are confined very largely to the white granite stock, the highest values being in an area bounded roughly by the ring fracture. Lead is similarly restricted to the white granite. This is to be expected, as most of the lead, rather than being primary, is probably the result of the decay of uranium (Rossiter, 1976b). Copper forms a halo around the zone of highest uranium levels i.e., outside the area bounded by the ring fracture. High copper values are almost invariably associated with greisen zones. To a degree bismuth follows copper in its distribution, but some enrichment occurs in the central uranium-rich area.

Rocks

With the exception of the pink granite all the rock types of the Una May area show anomalous geochemistry (Table 1, Fig. 9) when compared with the average granite of Taylor (1964, 1968). The most important deviations from the average are as follows:

The white granite is enriched in copper, lithium, thorium, tungsten, uranium, and, to a lesser degree, beryllium and lead, but zinc is low.

The micrograniites are high in thorium, slightly enriched in uranium, and low in lithium and zinc.

The greisens are high in arsenic, bismuth, lithium, thorium, and tungsten but lead and zinc are depleted. The distribution of uranium is very erratic. Copper is surprisingly low, given the strong spatial association of anomalous copper in soils and this rock type. Perhaps this element is being leached from the rocks, and in some way concentrated in the soils.

The rhyolites are high in copper, thorium, tungsten, and uranium, and are sometimes enriched in arsenic and beryllium. Lithium and zinc are low.

The altered ring - fracture rocks are rich in arsenic, bismuth, copper, and tungsten, but beryllium, thorium, and zinc are low.

MINERALISATION

Geochemical studies at Una May suggest that the entire white granite stock contains weak uranium mineralisation. There is, however, a marked uranium concentration at the northwestern end of the stock where the ring fracture is located. A possible explanation is that a later intrusion in this area did not reach the present surface but came close

12

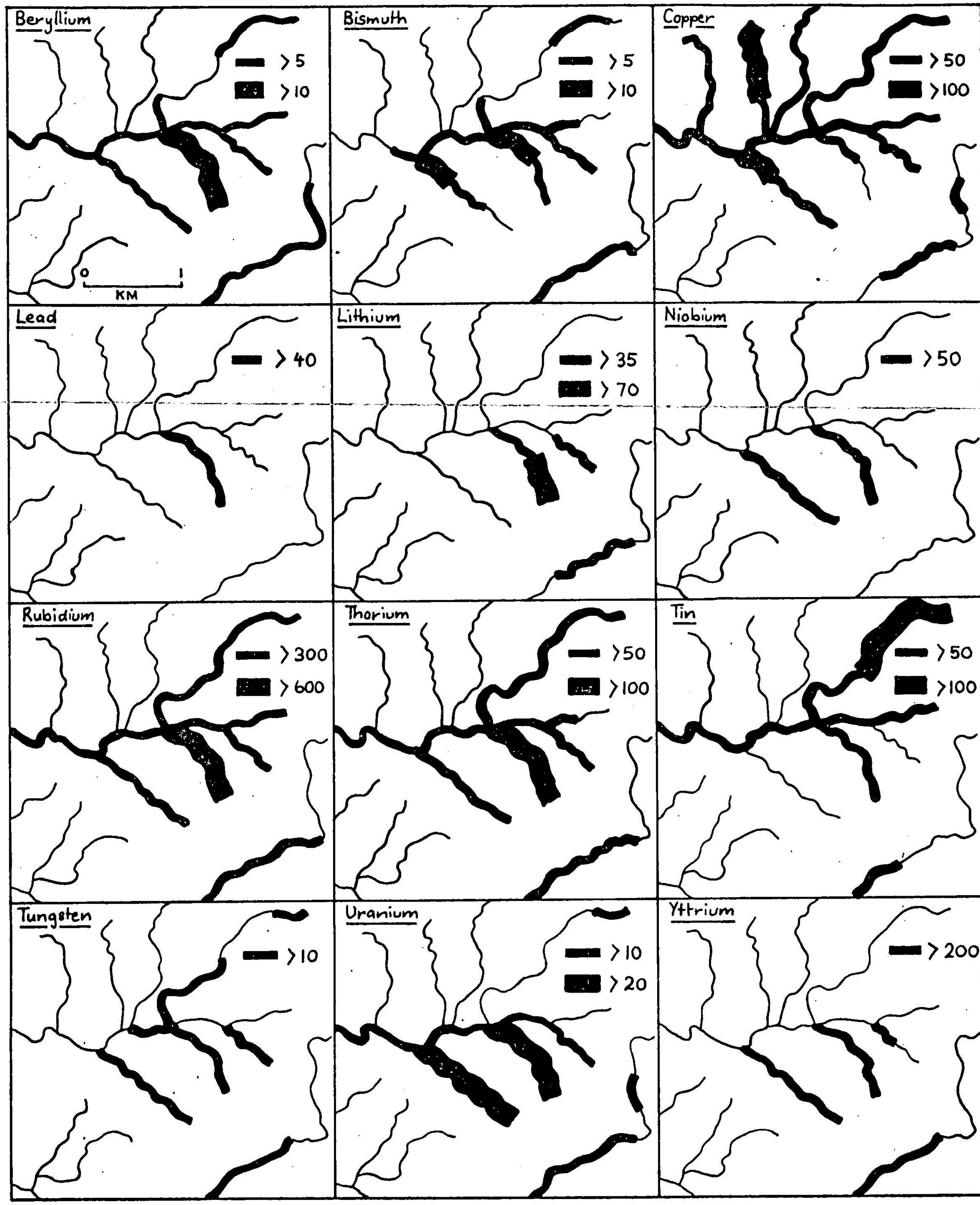


Figure 3 : Stream-sediment geochemistry of the Una May prospect. All values are in parts per million.

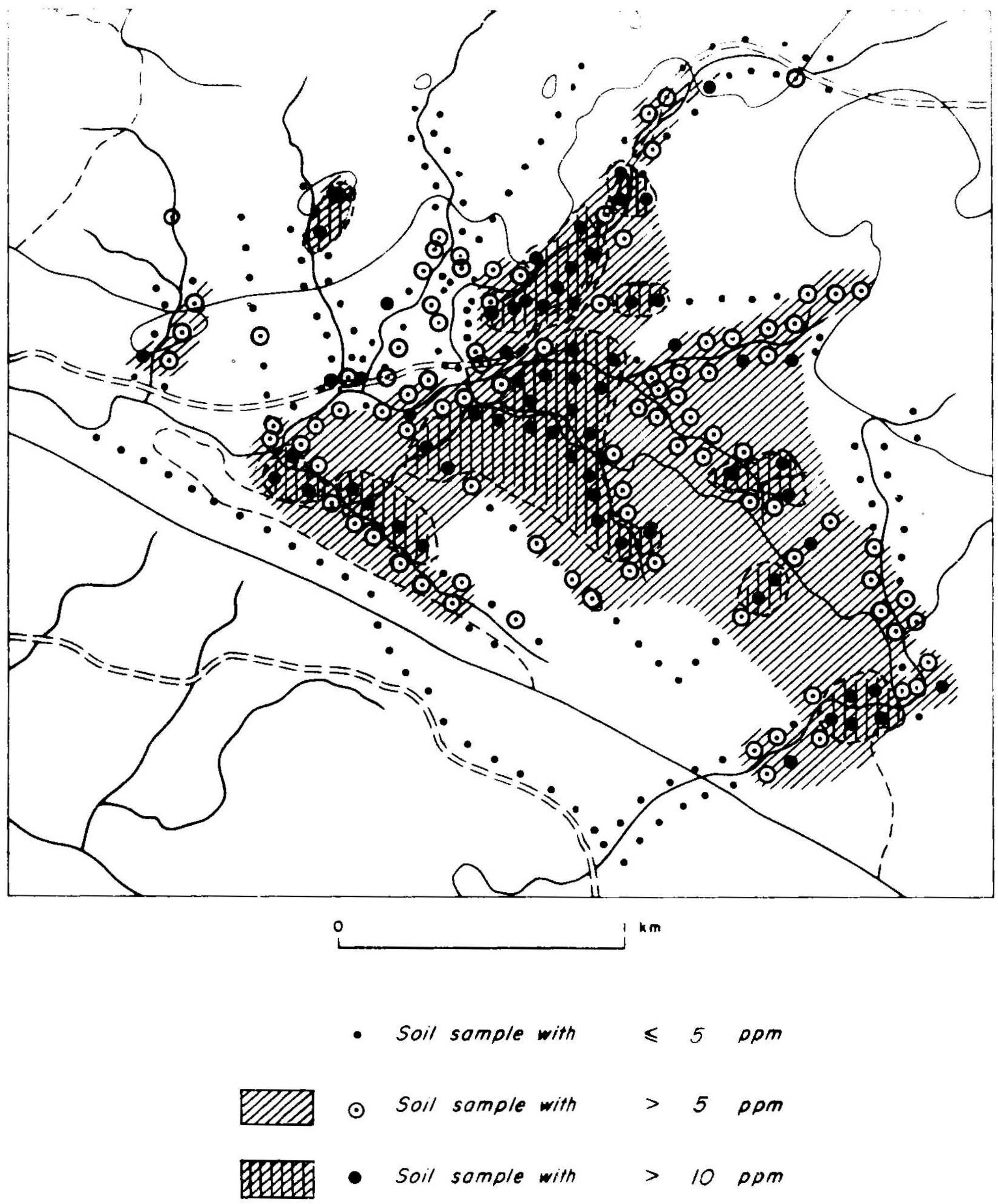


Fig 4 Bismuth in soil, Una May prospect

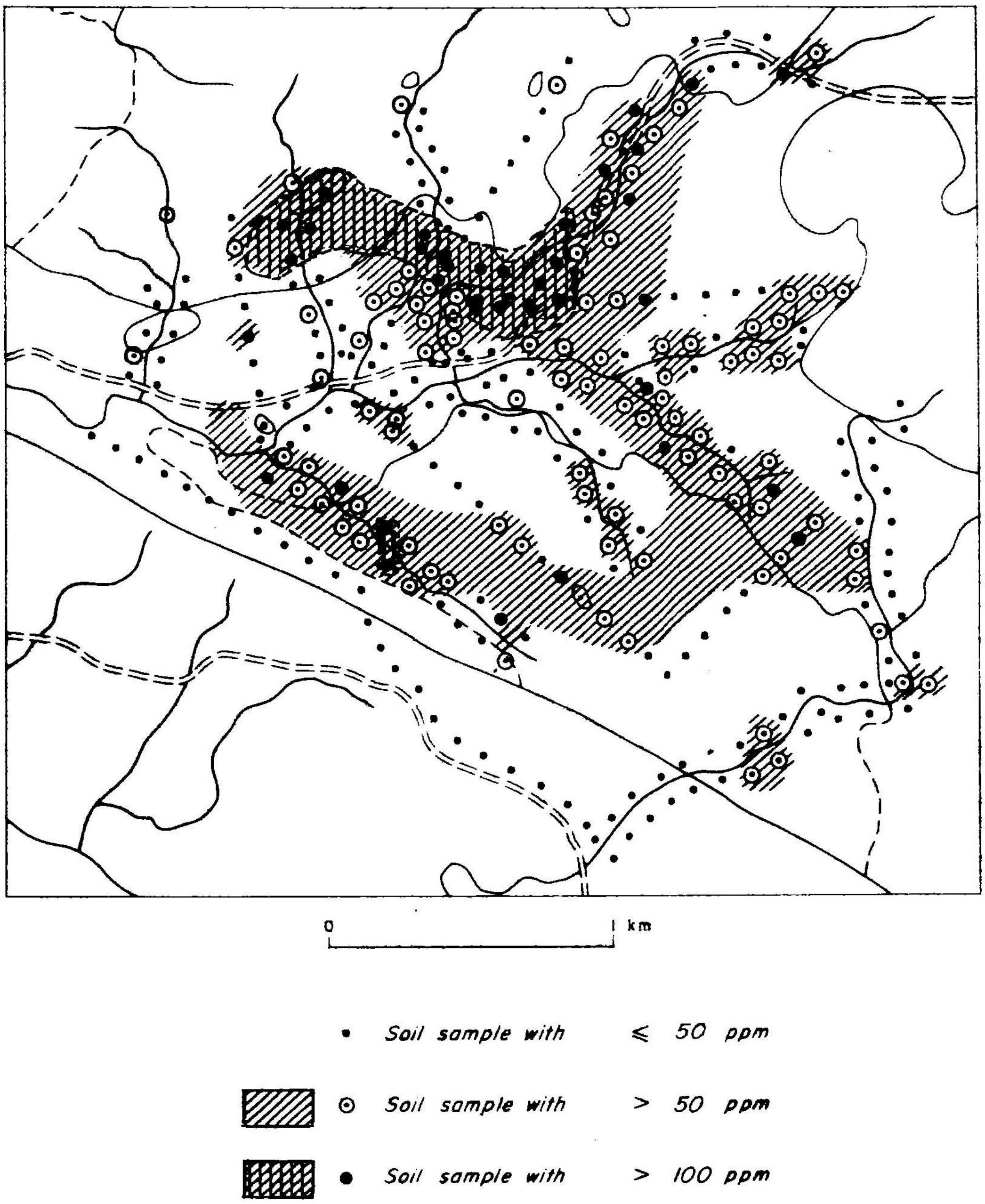


Fig 5 Copper in soil, Una May prospect

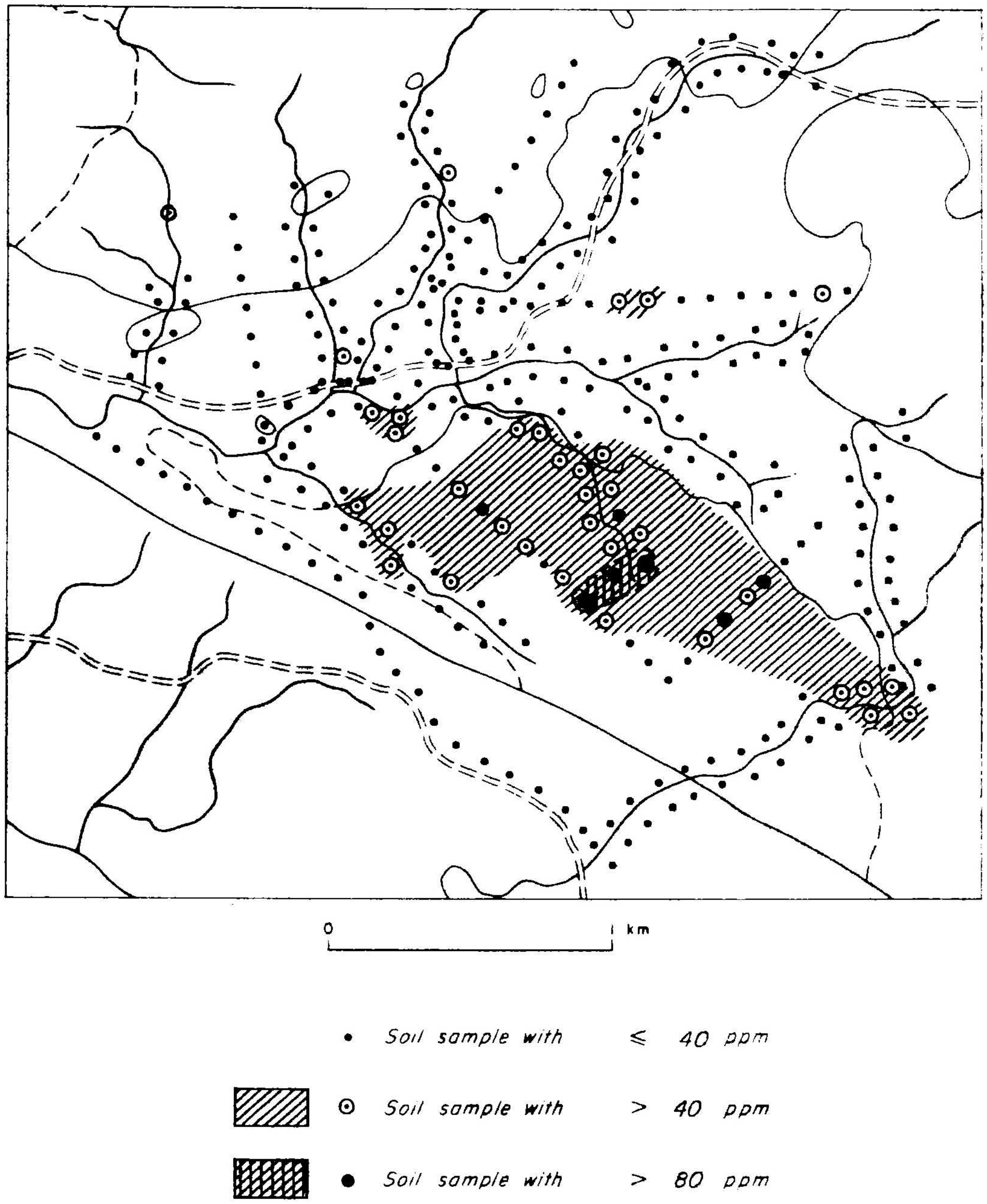


Fig 6 Lead in soil, Una May prospect

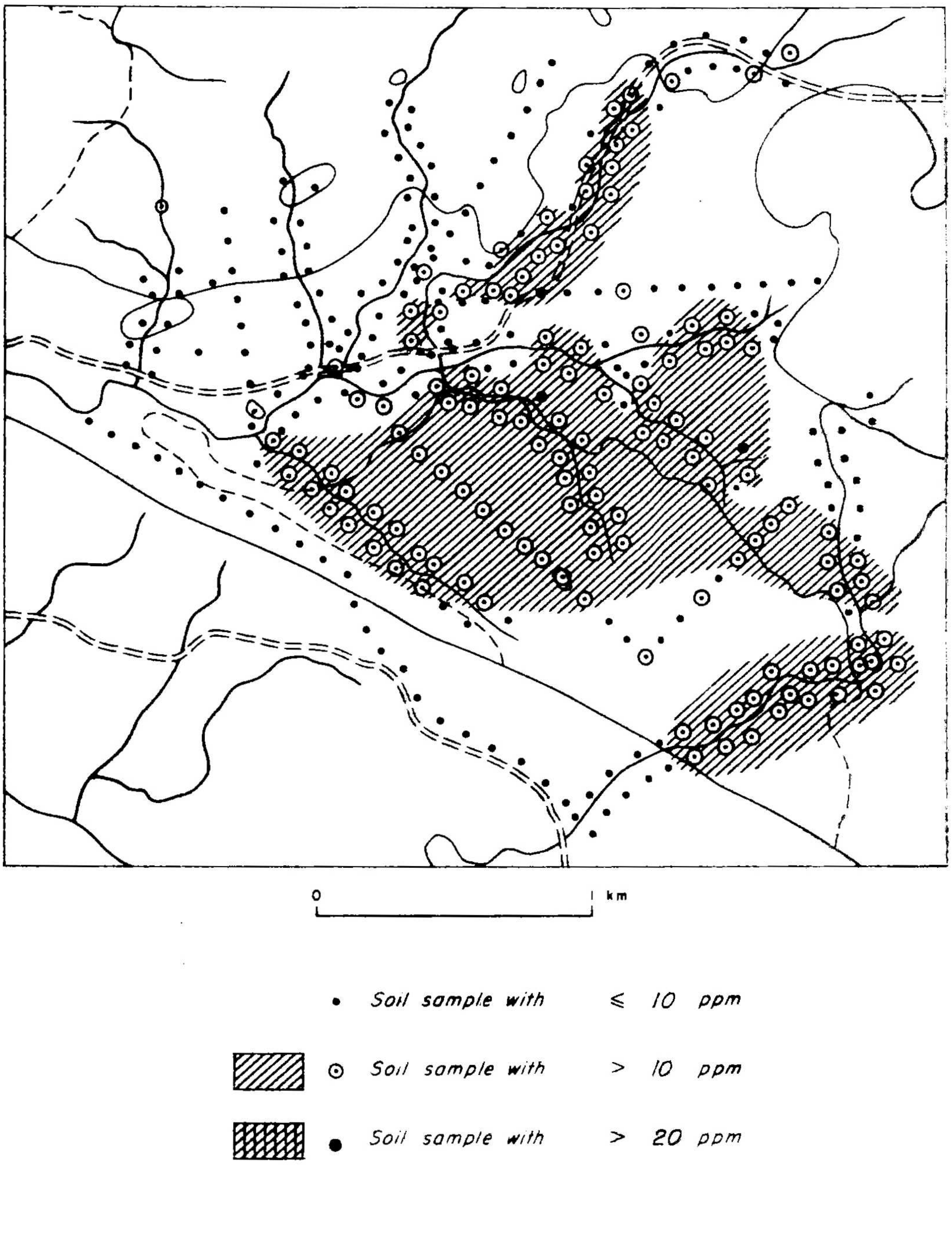


Fig 7   Tungsten in soil, Una May prospect

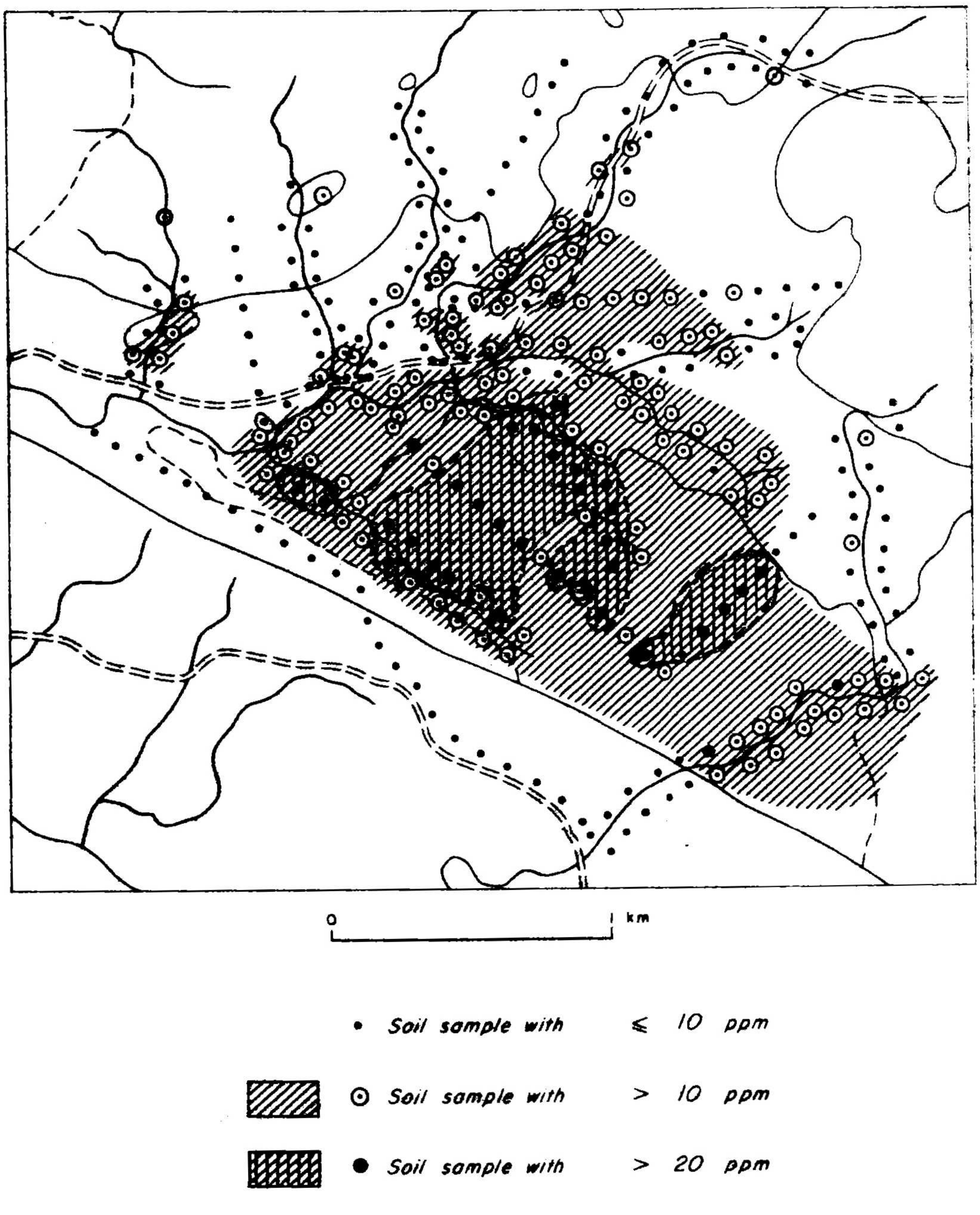


Fig 8 Uranium in soil, Una May prospect

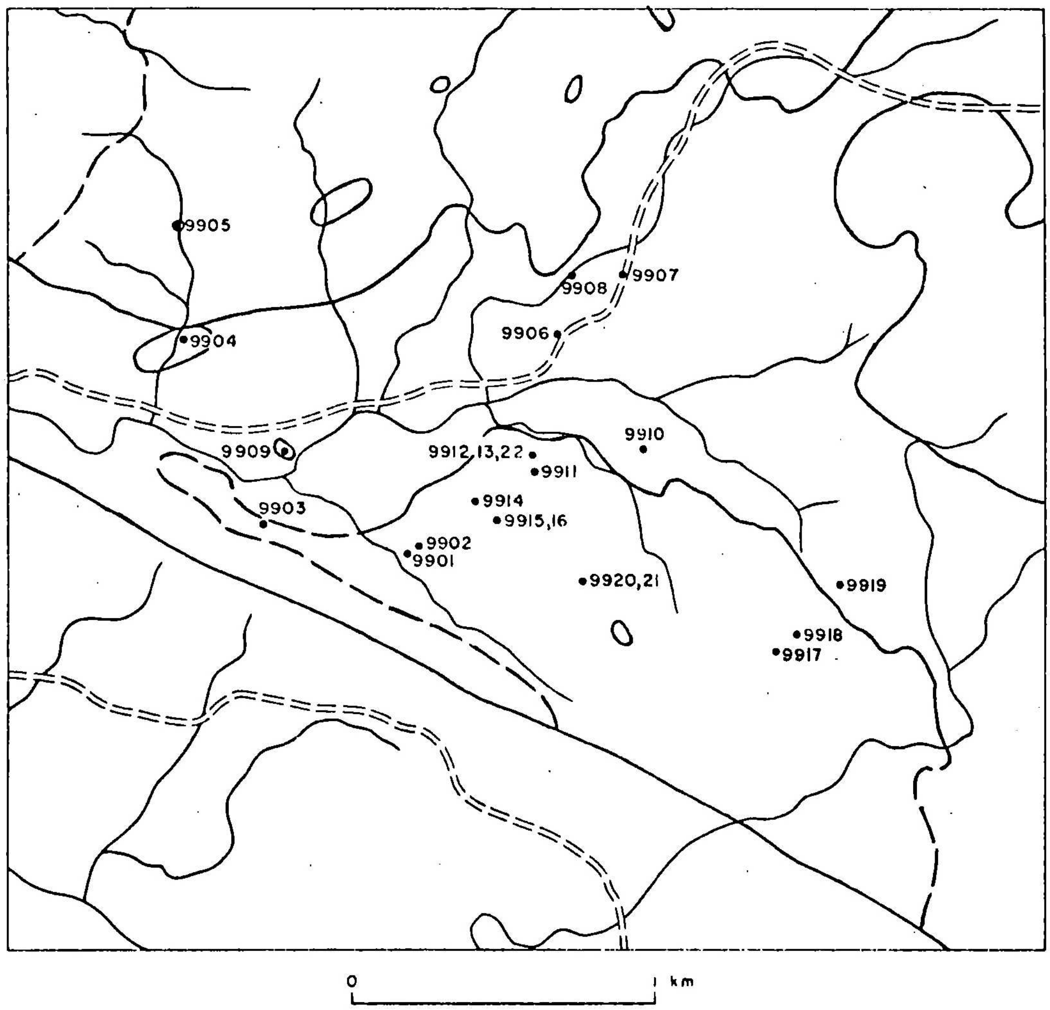
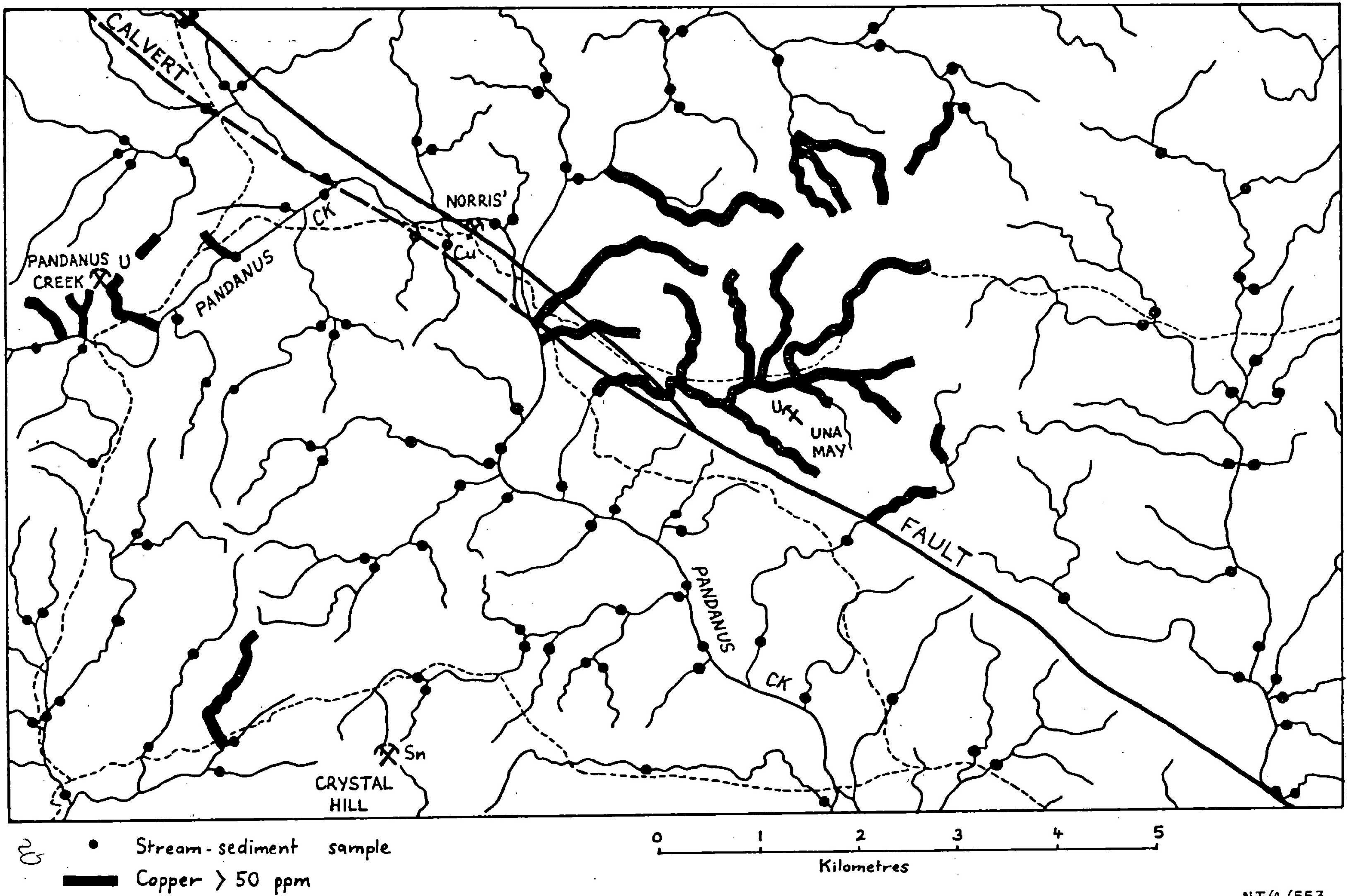


Fig 9 Rock sample locality map

Figure 10 : Copper in stream-sediment samples surrounding the Una May prospect.



Record 1977/20

NT/A/553

enough to cause the formation of a ring fracture and extensive uranium enrichment.

It is almost certain that the copper and uranium at Una May are cogenetic. Throughout the area surrounding the prospect there is a close relation between the two metals. The fact that the two main copper anomalies in the area are both associated with zones of uranium mineralisation (Fig. 10) can hardly be coincidental.

At Una May the copper occurs mainly in greisens which appear to from a halo around, and may therefore be related to, the inferred buried intrusion mentioned above. The halo effect may be the result of a temperature gradient away from the intrusion, such that the copper precipitated at a lower temperature than the uranium.

Economic potential

The Una May area appears to have little promise for the discovery of a copper orebody now that it has been established that this metal occurs in greisen zones unlikely to have sufficient tonnage to be economically attractive.

The prospect has more potential for a large-tonnage, low-grade uranium orebody. The geochemical studies completed so far indicate that the uranium mineralisation is very extensive; however, the primary grade is unknown. In these times of escalating labour costs the trend is to open-cut mining, and, at the Rössing deposit in Namibia, ore containing as little as 400 ppm uranium is worked profitably by this method. As uranium is often leached from the oxidised zone, a primary grade in excess of 400 ppm may well underlie soils at Una May containing up to 64 ppm and surface rock samples containing up to 20 ppm uranium.

It seems unlikely that during any future mining operation at Una May there would be any other metals of economic importance as byproducts. Possible exceptions are bismuth, gold, and tungsten. The presence of gold has not yet been established, but this metal occurs in the Pandanus Creek uranium deposit which, as discussed in the following section, is probably genetically related to Una May. Too little is known about molybdenum and niobium in the area to say whether these elements have any economic significance.

Relationship between the Una May prospect and the Pandanus Creek uranium deposit

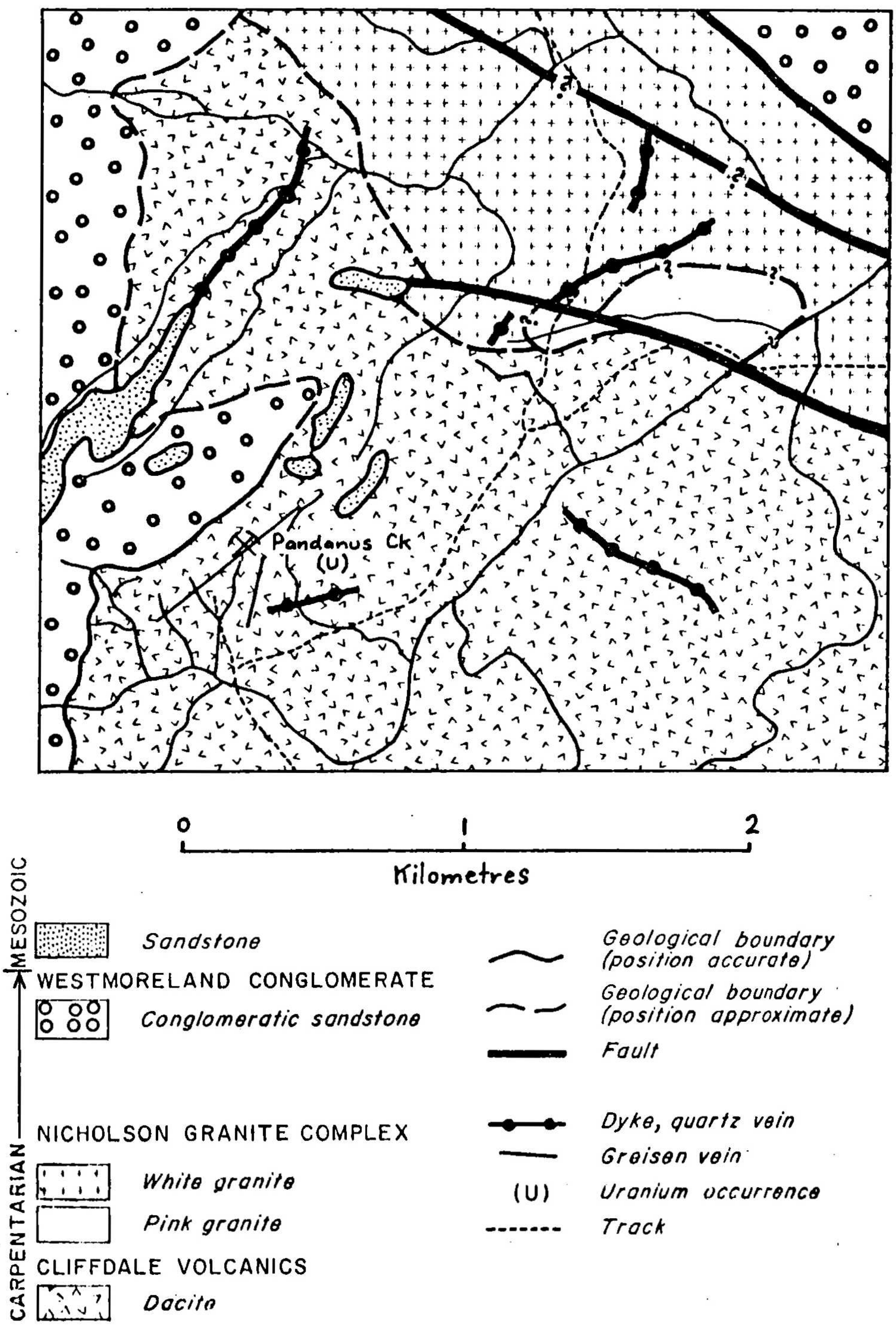
A number of geological and geochemical features of the Una May prospect have analogues at the Pandanus Creek uranium deposit (Fig. 10).

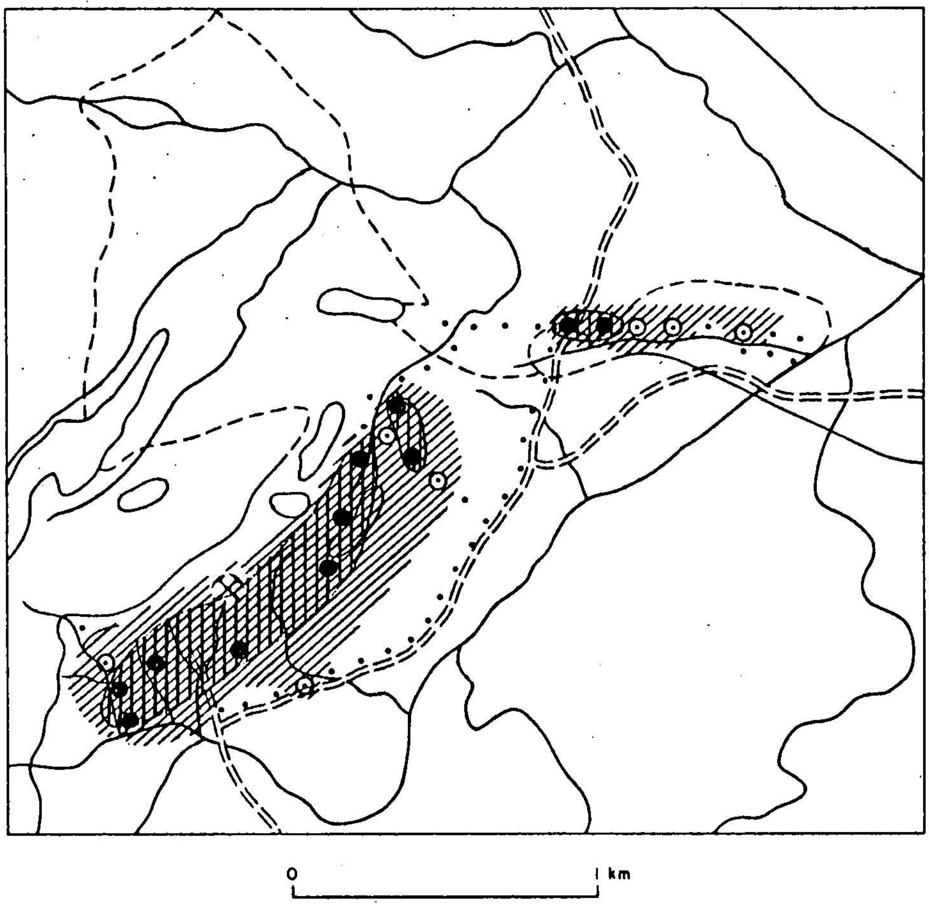
Although most outcrops near the Pandanus Creek deposit are Cliffdale Volcanics, there is a small area of granite, similar to the Una May white granite, about 1.5 km northeast of the old workings (Fig. 11). In addition, a concealed granite body has been intersected in holes drilled into the deposit (Morgan, 1965).

Elements enriched in the stream sediments and soils near the Pandanus Creek deposit include beryllium, bismuth (Fig. 12), copper (Fig. 13), lithium, rubidium, tin, tungsten (Fig. 14), and uranium (Fig. 15) - all anomalously high at Una May. The geochemical anomalies at Pandanus Creek, like those at Una May, cover a large area, and suggest extensive low-grade mineralisation.

These similarities strongly imply a genetic relation between the two mineralised areas, and it is not unreasonable to speculate that Una May and Pandanus Creek are two parts of a single larger complex disrupted by movement along the Calvert Fault. A dextral displacement of about 7 km would account for the present positions of the two mineralised areas (Fig. 10). Though there is insufficient geological evidence available to prove movement of this magnitude, there are no convincing data to refute the idea either.

Figure 11: Geology of the area surrounding the Pandanus Creek uranium mine.



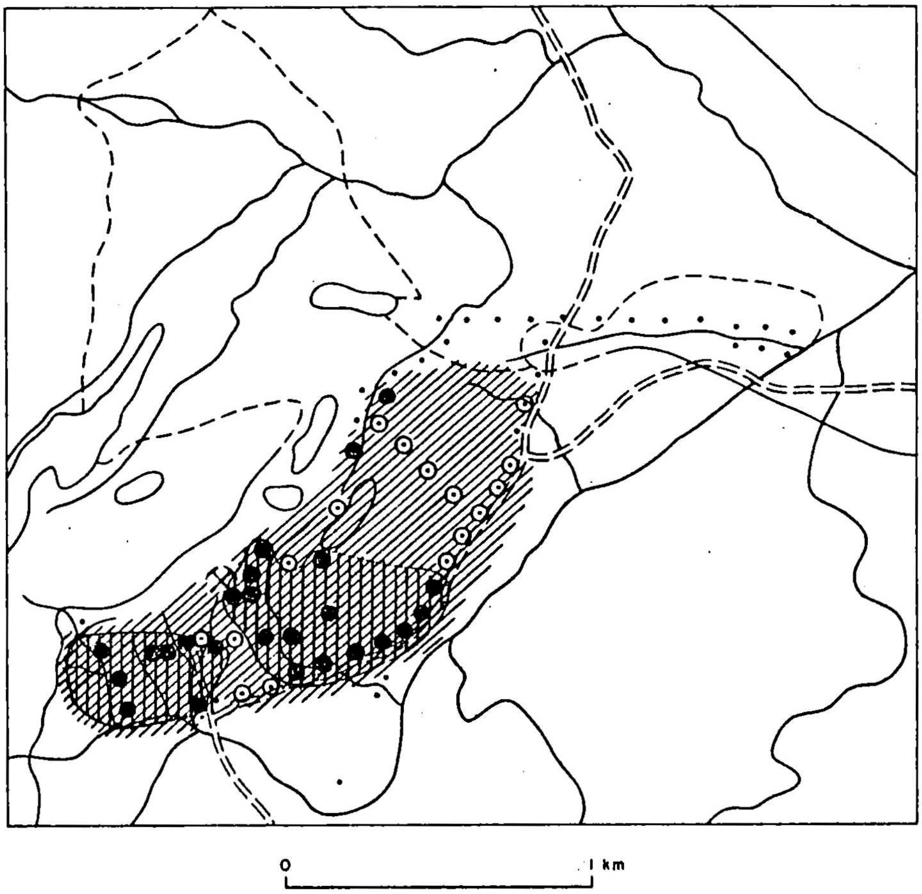


• Soil sample with ⩽ 5 ppm

⊙ Soil sample with > 5 ppm

● Soil sample with > 10 ppm

Fig 12 Bismuth in soil, Pandanus Creek



• Soil sample with ≤ 50 ppm

⊙ Soil sample with > 50 ppm

● Soil sample with > 100 ppm

Fig 13 Copper in soil, Pandanus Creek

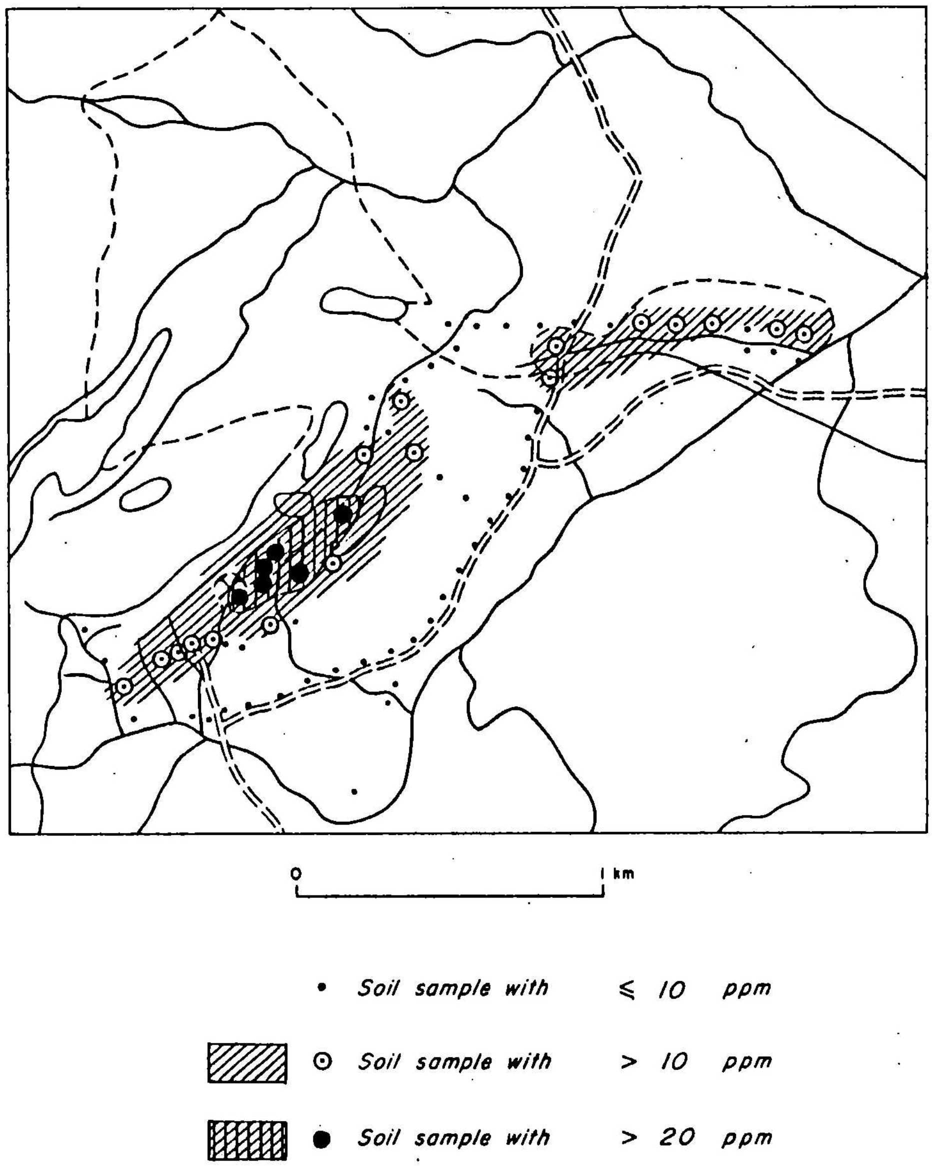


Fig 14 Tungsten in soil, Pandanus Creek

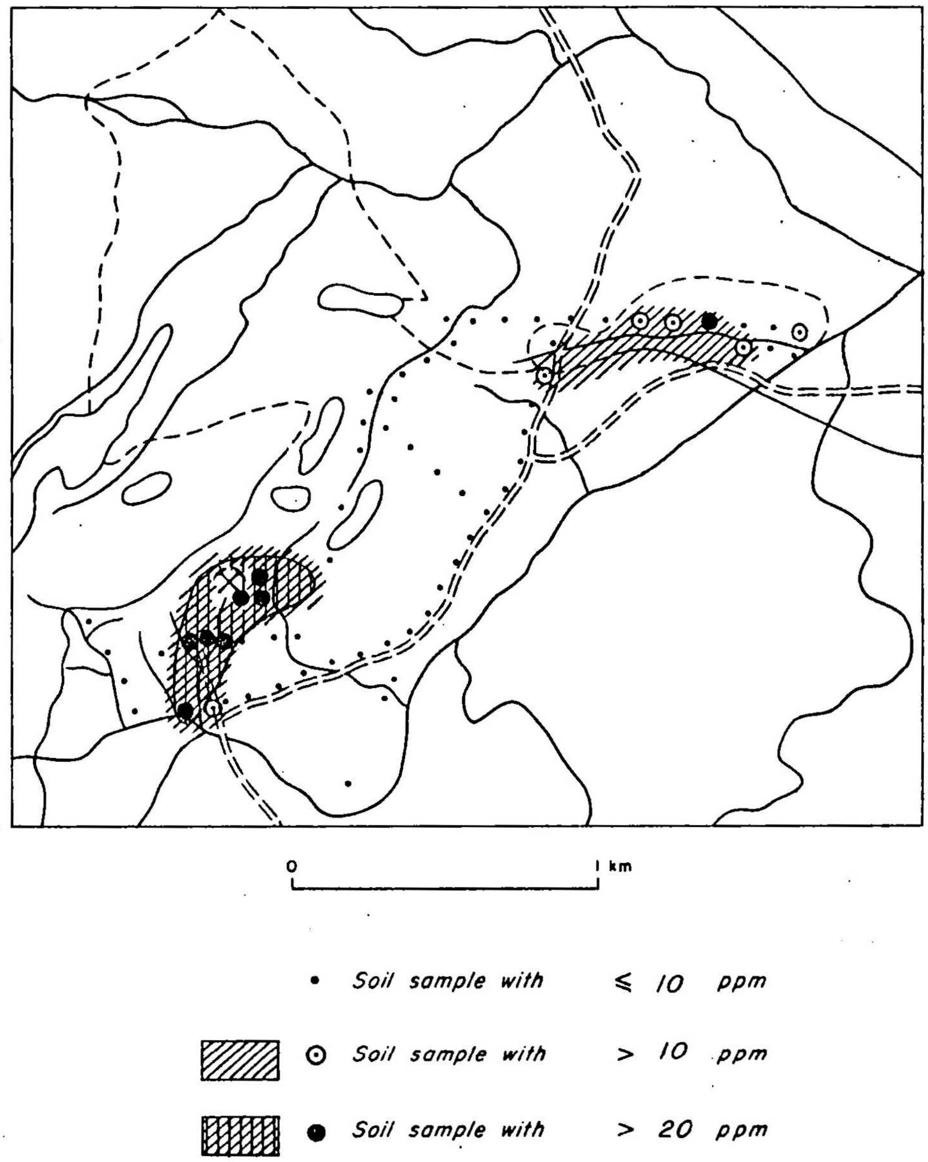


Fig 15 Uranium in soil, Pandanus Creek

CONCLUSIONS AND RECOMMENDATIONS

Future work at the Una May prospect should be directed towards exploring for a large-tonnage low-grade uranium deposit amenable to mining by open-cut methods. This work should be concentrated in the area of the ring fracture at the northwestern end of the white granite stock.

Soil sampling and a surface radiometric survey on 50 x 50 m geometric grid are recommended so that diamond-drill targets can be delineated. It is imperative that the drill holes penetrate below the oxidised zone so that the grade and mineralogical characteristics of the primary uranium mineralisation can be ascertained. Bismuth, gold, and tungsten levels in the primary zone should be evaluated as possible mining byproducts, and more work on molybdenum and niobium is warranted.

The Pandanus Creek uranium deposit should be reassessed adopting a large-tonnage low-grade philosophy; all exploration at the deposit to date has been aimed at delineating high-grade vein-type mineralisation.

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Sample No.	PINK GRANITES 9905	9908	9910	9919	Average	WHITE GRANITES 9901	9903	9911	9914	9917	9918	Average	AVERAGE GRANITE (Taylor 1964, 1968)
As	1	1	1	1	1	1	1	ND	1	1	2	1	2
Be	4	4	3	4	4	5	7	8	7	8	6	7	5
Bi	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	ND	ND	ND
Cu	7	7	8	13	9	61	9	8	24	43	17	27*	10
Li	19	9	14	26	17	46	18	164	54	35	76	67*	30
Pb	27	36	26	35	31	29	29	81	35	39	34	41	30
Th	30	33	25	23	28	40	33	27	43	47	42	39*	17
U	5	4	4	4	4	14	12	20	18	10	18	15*	5
W	3	4	ND	4	3-4	8	6	11	9	9	6	8*	2
Zn	49	27	13	59	37	11	8	26	14	24	21	17*	40

Sample No.	MICROGRANITES 9904	9909	Average	GREISENS 9902	9906	9907	9916	9921	Average	RHYOLITES 9915	9920	Average	ALTERED RING-FRACTURE ROCKS 9912	9913	9922	Average
As	2	1	2	4	16	39	3	12	15*	2	10	6*	11	21	7	13*
Be	4	5	5	3	4	4	4	3	4	8	2	5	1	1	1	1*
Bi	ND	ND	ND	2	9	12	6	7	7*	ND	ND	ND	30	15	290	112*
Cu	14	7	11	14	24	18	16	14	17	18	25	22*	895	375	496	589*
Li	5	5	5*	71	90	30	60	89	68*	10	10	10*	30	48	45	41
Pb	34	40	37	10	ND	2	6	10	6*	24	9	17	9	16	61	29
Th	55	51	53*	53	27	51	33	37	40*	121	104	113*	ND	ND	ND	ND*
U	7	11	9	26	ND	1	3	11	8	26	21	24*	6	2	3	4
W	5	3	4	10	14	11	10	11	11*	8	8	8*	6	9	6	7*
Zn	17	14	16*	13	24	16	13	13	16*	23	4	14*	5	7	3	5*

TABLE 1: Rock analyses - Una May prospect. For sample localities see Figure 9. All values are in parts per million. Asterisks indicate values differing from the average granite by a factor of more than 2. ND = not detected.