BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

RECORD 1987/52

A REVIEW OF MINERALISATION IN THE SOUTH ALLIGATOR CONSERVATION ZONE

R S Needham

March 1987

RECORD 1987/52

A REVIEW OF MINERALISATION IN THE SOUTH ALLIGATOR CONSERVATION ZONE

R S Needham

March 1987

CONTENTS

INTRODUCTION

The South Alligator Conservation Zone contains most of the South Alligator Valley Uranium Field, a belt about 10-20 km wide between Rockhole and Sleisbeck. Thirteen uranium deposits were mined out between 1952 and 1964; several also carried gold, and some of these are potential sites for disseminated fine gold deposits. Outside this belt, known mineralisation is limited to minor base metal prospects (Fig 1, Table 1).

Since 1970 and before commencement of the intensive work now underway at Coronation Hill, several drillholes were put down to test for extensions of the exhausted uranium mines with disappointing results. Track etch and emanometry surveys were used near faults, in addition to radiometrics, geochemisty and drilling, to test for buried uranium deposits. A deep drillhole investigating a gravity anomaly 10 km south-southwest of Big Sunday intersected Koolpin Formation beneath thickened Eocene and Mesozoic sequences, but failed to detect mineralisation. Interest in the region as a gold district developed in the 1980's, and in 1985 preliminary results were released indicating a potentially economic gold--platinum deposit adjacent to the Coronation Hill U/Au mine. However, restrictions on the processing of Exploration Licence applications and controls on exploration in mining tenements, introduced by Government in relation to the proposed extension of the Kakadu National Park, have severely limited the level of exploration since 1980.

The uranium and uranium--gold deposits were located on or close to faults in the Koolpin Formation, commonly where the faults had juxtaposed these rocks with sandstone or volcanics of the El Sherana Group. Primary mineralisation was in the reduced Koolpin Formation and accounted for about 65% of uranium produced from the region. The remainder, from oxidised ore, was hosted mainly by El Sherana Group sandstone or volcanics. The Coronation Hill gold--platinum prospect is, however, mainly hosted by altered volcanics of the El Sherana Group, and a different genesis is indicated. The base metal occurrences are mainly in quartz breccia zones in carbonaceous shale of the Masson and Koolpin Formations (Pb-Ag, minor Cu), shear zones in Zamu Dolerite (Pb-Ag), and supergene concentrations of Cu in the phosphatic Scinto Breccia.

REGIONAL GEOLOGY

The upper reaches of the South Alligator River flow along a northwest-trending belt of tightly folded Early Proterozoic geosynclinal metasediments about 60 km long by 10 km wide. These strata are deeply eroded and form strike ridges up to 200 m high in places, the tops of which are commonly capped by late Early Proterozoic to Middle Proterozoic felsic volcanics and sandstone. Basins of the felsic volcanics and sandstone flank this northwest-trending belt, which in its narrowest part contains most of the district's uranium deposits.

The Early Proterozoic geosynclinal sequence generally youngs eastwards, but forms a complex syncline in the central part where much of the western limb of the structure is concealed by younger

rocks. The **Masson Formation** is the oldest unit and contains mainly carbonaceous shale, siltstone, carbonate, calcarenite and sandstone. The pelitic rocks, particularly the carbonaceous ones, are strongly iron-stained to brick red shale at the surface, and form low undulating ridges. The calcarenite (porous sandstone at surface) and sandstone form continuous ridges which rarely exceed 60 m in height. The **Stag Creek Volcanics** is a sequence of poorly exposed altered basalt breccia, flows, tuff, and dark green tuffaceous shale conformably above the Masson Formation, and is about 1000 m thick. It is exposed along the southern flank of a prominent and continuous ridge commonly 100 m high formed by the unconformably overlying Mundogie Sandstone, which contains feldspathic quartzite and conglomerate.

Rocks of the South Alligator Group dominate the geosynclinal sequence in the valley and rest unconformably on older rocks, although owing to the strong folding clear unconformable contacts are seen only in fold hinges north of the area. The basal unit is the **Koolpin Formation,** containing interbedded dolomite, siltstone and carbonaceous shale. Its base is marked by a massive chert-banded ferruginous siltstone (carbonaceous shale with carbonate bands at depth), or by massive dolomite with algal structures. Strongly ferruginised or silicified beds form continuous ridges up to 40 m high but other strata rarely crop out. Tuff and argillite of the **Gerowie Tuff** are interbedded with the upper part of the Koolpin Formation, and thicken upwards as interbeds of Koolpin Formation rocks become progressively thinner. They are probably related genetically to the **Shovel Billabong Andesite**, a flow of variolitic andesite and microdiorite 100-300 m thick near the base of the Gerowie Tuff. The **Mount Bonnie and Kapalga Formations,** separated by the South Alligator Fault, form the uppermost part of the group and are similar assemblages of chert-banded ferruginous siltstone and shale, with greywacke, but only the Mount Bonnie Formation contains tuff. The fault may have been active during deposition, so that upward movement on the east side may have led to removal by erosion of any tuffaceous sediments deposited there during South Alligator Group time.

The **Burrell Creek Formation** is the youngest unit in the geosynclinal sequence, and contains a monotonous sequence of siltstone, feldspathic sandstone, phyllite, greywacke and arkose.

The **Zamu Dolerite** forms extensive sills mainly in the Koolpin Formation. The sills are folded with the geosynclinal sediments and comprise a tholeiitic differentiated suite of mostly quartz dolerite.

During a major orogenic event culminating at about 1800 Ma, the geosynclinal sequence was metamorphosed to low-grade (most sedimentary textures are preserved; pelitic rocks have a well developed slaty cleavage and contain sericite, chlorite and rare epidote, and psammitic rocks are commonly fractured and veined by quartz) and deformed into overturned tight to isoclinal folds with subhorizontal axes.

Following orogenesis, two suites of dominantly felsic volcanics and related volcanoclastics accumulated in a graben-like structure roughly coextensive with the South Alligator Valley. Each is

valley-fill in character and strongly unconformable at the base. The older El Sherana Group was deposited at about 1870 Ma (Needham & others, in press), and contains basal coarse sandstone of the **Coronation Sandstone**, massive rhyolite, ignimbrite and minor tuff of the **Pul Pul Rhyolite**, and interbedded greywacke and siltstone of the **Tollis Formation** which are hornfelsed by the **Malone Creek Granite.** These rocks are tightly folded in contrast to the generally gently folded rocks of the ~1850 Ma Edith River Group (Needham & others, in press), which includes basal polymicitic conglomerate and sandstone of the **Kurrundie Sandstone** overlain by an extensive sheet of ignimbrite with minor basalt of the **Plum Tree Creek Volcanics.** The two volcanic suites are intruded by granite dated as 1850-1800 Ma old outside this area, and probably of similar age to the Malone Creek Granite.

Earlier workers (Walpole & others, 1968) described volcanic vents in the Pul Pul Rhyolite, including one in the Coronation Hill uranium deposit, but more detailed examination (Needham & Stuart-Smith, 1987) indicates that exposure of intrusive centres in the area is confined to small syenite plugs along the South Alligator Fault near the Malone Creek Granite.

Intrusion of the **Oenpelli Dolerite** lopoliths at 1690 Ma probably represents the last igneous event in the Early Proterozoic. The dolerite and both volcanic suites form a very rugged terrain over which fluviatile sandstone of the Middle Proterozoic **Kombolgie Formation** was deposited with marked unconformity.

Faulting took place in the area in the episodes of geosynclinal sedimentation, igneous activity, and platform sedimentation, formed a graben as a repository for the volcanic and volcanicalstic rocks, and probably provided foci for extrusive pipes. Geosynclinal sequence rocks have been thrown against rocks of the volcanic suites and platform cover. Thickened sequences of Mesozoic and Tertiary rocks indicate that faults in the area have remained active until relatively recent geological time.

URANIUM $\pm$ GOLD DEPOSITS

Ten mines have produced a total of 722 tonnes at grades between 0.2 and 2.5% U_3O_8 (Table 2). About 1/3 tonne gold production is also recorded from three mines. The El Sherana and Palette pitchblende concentrates contained about 600 gm/tonne gold (Fisher, 1969), but no grade figures are available for gold produced at Coronation Hill. The gold formed veinlets cutting pitchblende ore, but recent work suggests that fine disseminated gold may have gone unnoticed.

The principal ore distribution controls are stratigraphy and structure. All deposits are entirely or mainly in carbonaceous shale or ferruginous silty shale of the Koolpin Formation and lie either along a fault, in between faults, or in an intensely faulted zone. All the ore zone faults displace Koolpin Formation against sandstone and/or volcanics of the Coronation Sandstone, although in some cases the juxtaposition of the two formations may not be apparent owing to erosion. Those deposits carrying gold tend to be within 250 m of the Palette Fault (Fig 2).

The uranium deposits differ from those in the Alligator Rivers and Rum Jungle areas by their association with Early Proterozoic sedimentary rocks higher in the sequence, and in most deposits, an association with felsic volcanic rocks; however they are similar in that they occur near an Early Proterozoic/Middle Proterozoic unconformity, and like the Rum Jungle deposits, occur in a low-grade metamorphic terrain.

An idealised uranium/+gold orebody in the South Alligator Valley has the following main features:

1) it occurs below the Early Proterozoic/Middle Proterozoic unconformity, usually in fractured cherty ferruginous and, at times carbonaceous, siltstones of the Early Proterozoic Koolpin Formation and adjacent sandstone lenses of the Coronation Sandstone juxtaposed by faulting

2) the mineralisation does not occur more than 100 m below the unconformity, and does not extend more than a few metres above it. About 70 percent of the production from the South Alligator Valley deposits has come from the Koolpin Formation as pitchblende/uraninite and the remainder from the Coronation Sandstone mainly as secondary uranium minerals

3) mineralisation is localised by major to minor faults, shears, and fractures

4) uraninite is either massive or occurs as veins and small lenses, and is associated with minor galena, chalcopyrite, pyrite, and native gold. Rutherfordine, niccolite, gersdorffite, clausthalite and coloradite have also been recorded

5) chlorite and hematite are common (but not ubiquitous) minor gangue minerals

6) in oxidised ore zones, phosphate-rich secondary uranium minerals predominate and include gummite, metatorbernite, autunite, phosphuranylite, uranophane, and soddyite.

Two of the more significant deposits exhibit some divergence from this idealised orebody. The Coronation Hill deposit lies mainly in a debris flow conglomerate in the Coronation Sandstone which contains clasts of altered El Sherana Group and blocks of carbonaceous shale. The Saddle Ridge deposit consists almost entirely of secondary uranium minerals in tuff and rhyolite of the El Sherana Group with only minor and bleached Koolpin Formation shales. Ayres & Eadington (1975) summarised the main features of some of the deposits (Table 3).

Hills & Richards (1972) and Cooper (1973) reinterpreted U and Pb isotope measurements obtained by Greenhalgh & Jeffrey (1959) on uranium ore specimens to indicate an age of 815 to 710 Ma, with a possible remobilisation or further phase of mineralisation at approximately 500 Ma. This is in agreement with the two generations of uranium mineralisation reported by Threadgold (1960) for ores from Rockhole, El Sherana, and Palette.

Apart from a geochemical and petrographic study by Ayres & Eadington (1975) of carbonaceous shales and acid volcanic rocks associated with the uranium mineralisation, there are no further substantive studies of this type. They concluded that U correlates with Cu, V, and Ga, but not with carbon, even though there is a close association between uraninite and carbonaceous shales.

A limited ^{34}S study of barren and ore zone sulphides has yielded features common to the Alligator River and Rum Jungle uranium deposits (Ewers & others, 1984). Sulphide in barren carbonaceous shale has a ^{34}S value compatible with derivation from a mantle sulphide source, while introduced ore zone sulfides have a ^{34}S range interpreted as indicative of the actions of sulphate reducing bacteria. The deposits may therefore have been generated by low temperature fluid transport of oxidised uranium, and reduction and precipitation when the fluid reached reduced zones.

The deposits are therefore epigenetic, with uranium, probably derived by leaching of the felsic volcanics in the Coronation Sandstone formation as well as other felsic volcanic units, transported by oxygenated groundwaters along interbeds of permeable sandstone in the Coronation Sandstone. Chemical reduction sites were provided by the carbon-rich metasediments of the Koolpin Formation thrown against the sandstone interbeds (Fig 3).

The Rockhole Group

Sporadic high-grade mineralisation extends along 1.5 km of the Palette Fault, which here is a southwest-dipping reverse strike fault. The fault has thrust Koolpin Formation shale and siltstone on the southwest side (Fig 4) up against the Kombolgie Formation, the Pul Pul Rhyolite, and the Coronation Sandstone on the northeast.

At the **Rockhole** mine most ore was won from a shear zone parallel to the reverse fault about 5-10 m into the hanging wall in cherty ferruginous siltstone and carbonaceous shale of the Koolpin Formation. The two largest orebodies were the 'No 1 Orebody' of 1200 t averaging 1.86% U308 and the 'No 2 Orebody' of 4500 t averaging 1.63% U308. Smaller orebodies were spread along the shear zone over about 180 m. About 20 t of near-surface rich secondary ore at **O'Dwyers** was not accompanied by primary mineralisation in depth.

Rehabilitation in 1961 intersected additional rich ore lenses along the Koolpin Formation/Coronation Sandstone contact, and a drive which linked up with the Sterrets workings delineated about 685 t ore containing 18 200 lbs U308 over 207 m. In a later phase of work in 1968, UUNL noted 'some small ore occurrences' below the Rockhole workings 'which could be mined with an established operation in the field', and considered the possibility of larger tonnages of lower-grade ore as worthy of further investigation.

At **Sterrets** patchy ore-grade pitchblende mineralisation occurred in graphitic and ferruginous shale of the Koolpin Formation close to the reverse faulted contact with sandstone of the El Sherana Group. In places, mineralisation extended into the sandstone hangingwall, which contained minor El Sherana Group tuff; 690 t of developmental ore containing about 18600 lbs U308 was produced.

Mineralisation at **Teagues** was contained in the faulted sandstone/siltstone contact, and in fractures within sandstone near the fault. Anomalous radioactivity with sporadic secondary mineralisation was disclosed along 30 m of the contact but did not persist in depth. No carbonaceous shale was recorded in the Koolpin Formation sequence.

El Sherana and El Sherana West

At **El Sherana**, mineralisation lies in a steeply dipping fault-bounded inlier of Koolpin Formation within Coronation Sandstone and Pul Pul Rhyolite. The ore zone was shallow, extending to about 50 m below surface and 30 m below the unconformity (Fig 5). A down-gradient carrot-shaped oxidised lens mainly in Coronation Sandstone overlay primary ore in Koolpin Formation. In-depth extensions of primary ore in Koolpin Formation about 250 m to the northeast were discovered by drilling self-potential anomalies in a deep valley, which were worked as the **El Sherana West** mine. A small open-cut was sunk at this locality to extract high near-surface oxidised ore (thought to be only a few metres below the unconformity plane, which has been removed by erosion), and adits driven southeast towards El Sherana intersected several small high-grade bodies. The adits followed the contact between ferruginous chert-banded siltstone and carbonaceous siltstone, the same favourable ore-bearing horizon established at El Sherana. Mineralisation was known to continue in depth when the mine closed in 1964 (Fisher, 1969).

Ore consisted of massive segregations, veins, and disseminations of pitchblende, mainly in fractures in cherty ferruginous siltstone and only rarely in carbonaceous beds (Taylor, 1969). In places, the massive pitchblende formed nodules up to 25 cm in diameter, commonly displaying radial and concentric cracks. Gold was found in one specimen in a concentric crack, suggesting it had formed after the pitchblende. Galena and anglesite stringers were widespread, and the lead content of pitchblende ore was locally as high as 5% (Shepherd, 1967). In places, massive pitchblende enclosed fragments or residuals of chert with minor arsenides. Rutherfordine ($(UO_2)(CO_3)$) was the most common secondary uranium mineral (Threadgold, 1960).

Palette

This mine was named after the colourful display of secondary uranium minerals at surface in Coronation Sandstone. The ore zone roughly followed the Coronation Sandstone/Koolpin Formation contact, variously a shallow-dipping unconformity or steep fault. The primary zone consists of veins in shears and fractures, and massive nodules, in carbonaceous shale mostly altered to chloritic shale. The secondary zone consisted of a disseminated halo in weathered carbonaceous and ferruginous banded shale and siltstone of the Koolpin Formation, and Coronation Sandstone. The mine is located near the intersection of several normal and reverse, shallow to steep faults, with the Palette Fault (Fig 6).

Palette was the richest deposit in the region with shoots of massive vein and nodular pitchblende. Some of the nodules showed

imperfect radial and concentric cracks (Shepherd, 1967). Significant quantities of gold formed veins up to several millimeters wide in pitchblende, along with minor pyrite, chalcopyrite, galena and marcasite. The ore also contained the exotic minerals clausthalite (PbSe) and coloradoite (HgTe). Pitchblende veins also passed into the sandstone, where the normally cream rock is altered to mottled grey-pink sandstone in which apatite is extensively replaced by phosphuranylite ($Ca(UO_2)_4(PO_4)_2(OH)_4.7H_2O$) up to 8 cm from the vein. The altered sandstone also carries hematite, sericite and minor tourmaline, all probably introduced at the same time as the pitchblende (Threadgold, 1960).

Phosphuranylite and uranophane ($Ca(UO_2)_2Si_2O_7.6H_2O$) were the most common epigenetic products in a wide range of secondary uranium minerals.

Saddle Ridge

The Saddle Ridge mine lies on a northwest-trending saddle joining a ridge capped by an outlier of Scinto Breccia to the south, and an isolated plateau of Kombolgie Formation sandstone to the north. The deposit was close to two easterly trending cross-faults about 1 km west of the Palette Fault (Fig 7). The faults displace carbonaceous shale of the Koolpin Formation against altered rhyolite and tuff of the Coronation Sandstone. Mineralisation was irregularly disseminated secondary uranium minerals, mainly metatorbernite ($Cu(UO_2)_2(PO_4)_2.8H_2O$) (Ostle, 1956) in Koolpin Formation. Sooty pitchblende was intersected by drilling about 85 m below the open cut (Shepherd & Grenning, 1961). No gold was recovered. A down-faulted block of Scinto Breccia within the ore body was unmineralised.

Coronation Hill

Uranium was first discovered in the region at this locality on Coronation Day, 1953. Minor green secondary uranium minerals occurred at surface about 200 m south of a small copper prospect associated with a quartz-filled fault.

The deposit occupied an intensely faulted and sheared zone about 250 m southwest of the Palette Fault (Fig 8). Host rocks were interpreted by Shepherd (1961) as volcanic agglomerate in a volcanic neck, but have been recently described as conglomerate and altered volcanics (mostly rhyolite) of the Coronation Sandstone by Needham & Stuart-Smith (1986). Primary mineralisation was associated with carbonaceous shale of the Koolpin Formation at the bottom of the workings, and higher up with fault slices of carbonaceous material within the conglomerate and rhyolite, and within the conglomerate where carbonaceous shale clasts were abundant. The ore zone formed a vertical cylindrical body about 20 m across with several rich steep shoots and broadened near-surface to a wider oxidised zone. Uranium mineralisation comprised disseminated and patchy sooty pitchblende, and native gold formed veinlets and disseminations mainly in association with pitchblende, but in places also as gold-only shoots.

Scinto 5

Secondary uranium minerals -- mainly torbernite ($Cu(UO_2)_2(PO_4)_2.8\text{-}12H_2O$) -- and minor pitchblende occurred in bleached white and red ferruginous chert-banded shale and grey phyllitic siltstone of the Koolpin Formation. The metasediments are tightly folded, strongly sheared and in places brecciated on an indistinct bedding parallel fault, about 50 m north of an east-striking minor cross-fault (Fig 9). Matheson (1960) indicated that the deposit carried gold, but there is no description of its mode of occurrence or production. Massive and brecciated silicified carbonate caps the ridge immediately north of the opencut. No evidence exists of altered volcanics in faulted contact with Koolpin Formation, as described by Dunn (1960).

Minor uranium mines

Four small mines each yielded 3 tonnes of U_3O_8, as a result of selective mining, where no substantial development was warranted. Mineralisation at **Koolpin** occurred within a shear zone in Koolpin Formation and consisted of sooty pitchblende and some thin stringers of pitchblende in fractures in black shale and phyllite. The mine lies on a northeast-trending cross fault between the Palette and Fisher Faults, and is about 50 m southwest of a concealed contact with Zamu Dolerite. This contact is possibly faulted, in which case the structure may be a splay off of the Palette Fault converging with the parent fault close to Palette mine. The **Skull** mine lies 250 m south of Palette on the Palette Fault and comprised irregular nodular concentrations of mainly pitchblende in shears within Koolpin Formation carbonaceous shale adjacent to the faulted contact with Kombolgie Formation sandstone. **Scinto 6** is in sheared altered rhyolite of the Coronation Sandstone and consisted solely of oxidised ore (autunite, torbernite, saleeite ($Mg(UO_2)_2(PO_4)_2.8H_2O$)) forming near-surface patches in the shear zone and adjacent joints.

Sleisbeck (outside the Conservation Zone) differs markedly from the other mines of the region in that it lies well away from the Palette Fault (by about 10 km), and is hosted by Kapalga Formation, in a wider variety of lithologies (phyllite, quartzite, mudstone -- Newton 1955; Crick & others, 1980). Although close to a major fault displacing the host rocks against Scinto Breccia and Kombolgie Formation sandstone and basalt, the ore zone rocks are generally unfractured at depth and grade into hematitic fractured quartzite, possibly originally calcareous, near the surface. This rock is phosphatic and probably related to the development of the Scinto Breccia. The uranium mineralisation was pitchblende at depth, but most was obtained from the breccia in the form of phosphatic minerals. Minor Cu, Ni and As minerals were also recorded.

Uranium prospects

Numerous uranium prospects were located in the 1950's and 1960's with hand-held or airborne geiger-counters. **Cliff Face** is the only one to contain significant primary mineralisation; pitchblende occurs in carbonaceous lenses in chert-banded siltstone of the Koolpin Formation in a cross-fault close to the Palette Fault, and is surrounded by a disseminated secondary halo. **Stockpile 1 and 2** has minor fine-grained pitchblende and yellow powdery secondaries in

altered Pul Pul Rhyolite close to small cross-faults. **Flying Fox, Palms, Clear Springs, Charvats** and **Saddle Ridge East** are similar to the Stockpile prospects, situated in altered Pul Pul Rhyolite on or close to cross faults. Charvats and Saddle Ridge East are the only two of these to have visible mineralisation, present in the latter as disseminated torbernite, some in vesicles within lava. Minor secondary minerals at **Christmas Creek** lie in a fault breccia juxtaposing Coronation Sandstone and conglomerate of the Kurrundie Sandstone. **Monolith** and **Koolpin East** are sites of anomalous radioactivity in chert-banded Koolpin Formation siltstone close to cross-faults. Matheson (1960) suggested that they may lie on an extension (or splay) of the Palette Fault, which also passed through the Koolpin mine and continued north to Charvats, but there is no evidence of a structure in this position. Anomalous radioactivity at **Airstrip** either side of the contact between chert-banded ferruginous siltstone of the Koolpin Formation and sandstone of the Coronation Sandstone has no associated mineralisation. Similarly, the investigation ofsurface anomalous radioactivity at **Coirwong Gorge** and **Barramundie Creek** in chert-banded siltstone with lenses of carbonate failed to discover mineralisation.

Three radon-emanometer anomalies near the northern flank of Mundogie Sandstone in Koolpin Formation at the **Gerowie Creek** prospect were drilled but no economically significant mineralisation was encountered. A number of radiometric anomalies clustered in the north of the region between Coirwong Gorge and the Black Jungle Range, overlying a range of rock types and formations, including the **5C** and **5G prospects**, were due to minor surficial concentrations of radioelements. Near-surface concentrations of up to 300 ppm U and 4850 ppm Th were responsible for the airborne anomalies at the **Sandstone** prospects in narrow sandstone lenses within the Plum Tree Creek Volcanics.

The **2J** prospect lies on the boundary between the Stag Creek Volcanics and Mundogie Sandstone in weathered zone tuffaceous sediments and minor mafic lavas. Irregular mineralised bodies in an area of 75 x 20 - 50 m and extending to 65 m deep contained average and highest values of 200 and 9780 ppm U respectively. Goethite and manganese oxides are present in this zone, and the only uranium mineral found was a 'yellow-green micaceous uranyl phosphate' (Foy & Miezitis, 1977).

Costeans at **Prospect 3/171** 11 km east of Big Sunday are cut into brecciated contact-metamorphosed siltstone and greywacke sandstone, which, owing to the presence of minor chert bands, are probably part of the Kapalga Formation. The breccia zones are commonly laced by quartz veins, in places sheared, and contain hematite, chlorite, and minor torbernite. Drilling found no extension to uranium mineralisation in depth, but minor chalcopyrite and trace galena were encountered in the pyritic quartz-veined sequence. Assay indicated traces of gold and silver.

Other costeans in Big Sunday Formation, 10 km west of Sleisbeck and in Pul Pul Rhyolite 12 km northeast of Sleisbeck (both outside the Conservation Zone), are probably related to uranium reconnaissance work.

BASE METAL OCCURRENCES

At the **Mary River Junction** copper mine, about 70 t of high grade copper ore was extracted from a small open cut and three shallow shafts. The lodes lie along a brecciated northwesterly contact between shale and quartzite of the Masson Formation; malachite-chalcocite bearing, brecciated quartz and gossan crop out nearby (Rix, 1964).

Malachite is present in fractures and veins in breccia surrounding a massive quartz lode striking east 100 m north of the Coronation Hill open cut at **Callanan's** prospect. Four of six holes (totalling about 300 m; put down in 1955) intersected a lode interpreted to be about 60 m long by 13 m wide, extending as a vertical parallel-sided body to about 60 m depth. The lode, however, assayed an average of less than 0.5% Cu and 0.005% U_3O_8 (Zimmerman, 1970).

Small pits near Saddle Ridge and 5.5 km east of El Sherana have exposed minor chalcocite, chalcopyrite, malachite and azurite below gossan, adjacent to caps of Scinto Breccia, over Pul Pul Rhyolite at Saddle Ridge, and in grey and minor chloritic phyllite and greywacke of the Kapalga Formation east of El Sherana.

A small copper prospect 3 km north of Namoona has a gossanous cap containing malachite on the surface and in the weathered zone. The prospect has been costeaned and drilled but there is no record of this work.

The gossanous ridge at **Namoona** contains visible galena, cerrusite and pyromorphite. A subsidiary parallel gossan on the northeast flank of the main ridge contains massive galena seams up to 0.6 m wide exposed in costeans only 1 m below surface. The gossans are developed on calcarenite which is interbedded with pyritic calcareous carbonaceous shale in a sequence dipping 60 ^{o} southwest. The mineralisation is interpreted as primary and stratiform where disseminated, and epigenetic where accompanying quartz or quartz-carbonate veins or breccia zones. The prospect lies close to and is aligned along the axial zone of a prominent northwesterly anticline; several minor prospects further northwest along this zone show encrustations of white secondary lead-zinc minerals in goethite or hematite gossans. Each has been costeaned and drilled, but ther is no record of the exploration work.

The **Zamu Creek** mine comprised several subparallel gossaneous veins in siliceous sheared altered dolerite breccia, striking northeast for 50 m along the contact between altered dolerite and a narrow band of Burrell Creek Formation schist, within a large ridge of Zamu Dolerite. About 20 tonnes of Ag-Pb ore was extracted, consisting of argentiferous galena and cerussite.

GOLD-PLATINUM OCCURRENCES

Recent exploration, following up gold values first obtained during uranium exploration in the mid 1950's in and close to the **Coronation Hill** U/Au mine, has confirmed the presence of a near-surface gold--platinum deposit in altered volcanics and minor sediments of the Coronation Sandstone east of the Coronation Hill

open cut (Noranda Pacific Ltd, 1985). The host rocks are cut by numerous shear zones and faults, and are hematitised, sericitised and silicified with minor pyrite, chlorite and quartz veining in the gold zone. The gold is finely disseminated and generally not visible, even in samples assaying up to 140 g/t. An average grade of 5g/t for 800 000 tonnes ore has been estimated over a surface area of about 500 by 300 m, with extensions likely, particularly to the east and south. Gold-bearing samples (>1g/t Au) average 0.62g/t Pt and 1.33 g/t Pd, indicating a potentially significant platinum-group deposit. The gold concentration appears to have a northerly strike and may be related to northerly trending cross-faults which intersect the Palette Fault about 400 m north of the prospect (Fig 10). Rock types in the zone are altered felsic volcanics, tuffaceous sediments, sandstone, felsic porphyry, carbonaceous shale,and minor altered mafic igneous rocks. These probably mostly belong to the Coronation Sandstone, with the shale belonging to the Koolpin Formation; the mafic igneous rocks are possibly part of the Zamu Dolerite.

The close relationship between gold and felsic volcanics suggests an epithermal origin at or soon after extrusion of the host rocks. Absolute ages of 500 Ma on the uranium ores of the region suggest no relationship with uranium mineralisation. Gold veins cutting pitchblende in several deposits indicate a late gold mobilisation with the metal source possibly being adjacent gold-rich volcanics in each case.

The genesis of the platinum-group elements (platinum, palladium) in the deposit is enigmatic. No ultramafic rocks are known in the region to support the usual mafic igneous-derivation or association. Possibly ore genesis was by remobilisation of Proterozoic platinum-group placers by paleo-supergene processes related to one of several late Early Proterozoic unconformities. Alternatively, platinum may have been introduced by hydrothermal fluids related to felsic igneous activity -- an association hitherto undocumented in any platinum deposit.

REFERENCES

AYRES, D.E., & EADINGTON, P.J., 1975--Uranium mineralisation in the South Alligator Valley. Mineralium Deposita, 10, 27--41.

COOPER, J.A., 1973--On the age of uranium mineralisation at Nabarlek, Northern Territory, Australia. Journal of the Geological Society of Australia, 19, 483--486.

CRICK, I.H., MUIR, M.D., NEEDHAM, R.S., & ROARTY, M.J., 1980--The geology and mineralisation of the South Alligator Valley Uranium Field. In FERGUSON, J., & GOLEBY, A.B., (Editors)--URANIUM IN THE PINE CREEK GEOSYNCLINE. International Atomic Energy Agency, Vienna, 273--285.

DUNN, P.R., 1960--Report on quarterly inspection of the South Alligator River uranium area, Northern Territory. Bureau of Mineral Resources, Australia, Record (unnumbered).

EWERS, G.R., FERGUSON, J., NEEDHAM, R.S., & DONNELLY, T.H., 1984--Pine Creek Geosyncline, N.T. In PROTEROZOIC UNCONFORMITY AND STRATABOUND DEPOSITS. International Atomic Energy Agency, Vienna, Tecdoc Series 315, 135--206.

FISHER, W.J., 1969--Mining practice in the South Alligator Valley. Atomic Energy, 12, 25--40.

FOY, M.F., & MIEZITIS, Y., 1977--Uranium mineralisation at Anomaly 2J, South Alligator Valley, Northern Territory, and its significance concerning regional structure and stratigraphy. Proceedings of the Australasian Institute of Mining and Metallurgy, 261, 1--11.

GREENHALGH, D., & JEFFREY, P.M., 1959--A contribution to the Precambrian chronology of Australia. Geochimica et Cosmochimica Acta, 16, 39--57.

HILLS, J.H., & RICHARDS, J.R., 1972--The age of uranium mineralisation in Northern Australia. Search, 3, 382--385.

MATHESON, R.S., 1960--Report on holdings of United Uranium N.L., South Alligator River area, Northern Territory (unpublished).

NEEDHAM, R.S., STUART-SMITH, P.G., & PAGE, R.W., in prep--Tectonic evolution of the Pine Creek Geosyncline and contiguous terranes, Northern Territory. Precambrian Research.

NEEDHAM, R.S., & STUART-SMITH, P.G., 1985--Stratigraphy and tectonics of the Early to Middle Proterozoic transition, Katherine-El Sherana area, Northern Territory. Australian Journal of Earth Sciences, 32, 219--230.

NEEDHAM, R.S., & STUART-SMITH, P.G., 1987--The Coronation Hill U-Au mine, Northern Territory -- An epigenetic deposit hosted by debris flow conglomerate. BMR Journal of Australian Geology & Geophysics, 10, 121--131.

NEWTON, H.J., 1955--The occurrence of uranium ore at Sleisbeck, N.T. Proceedings of the Australasian Institute of Mining and Metallurgy, 76, 1--15.

NORANDA PACIFIC LTD, 1985--Prospectus, 27 June 1985. Victoria.

OSTLE, D., 1956--Preliminary field report on the South Alligator --Sleisbeck Uranium Field. Bureau of Mineral Resources, Australia, Technical Files (unpublished).

RIX, P., 1964--Mary River Junction mine. In Minor metalliferous investigations, Northern Territory Resident Geological Section. Bureau Of Mineral Resources Australia Record 1964/22.

SHEPHERD, J.S., 1967--Uranium in Northern Australia. Ph.D.

Thesis, University of Queensland (unpublished).

SHEPHERD, J.S., & GRENNING, P.J., 1961--Ore bodies of United Uranium N.L. holdings, South Alligator River, N.T. (unpublished).

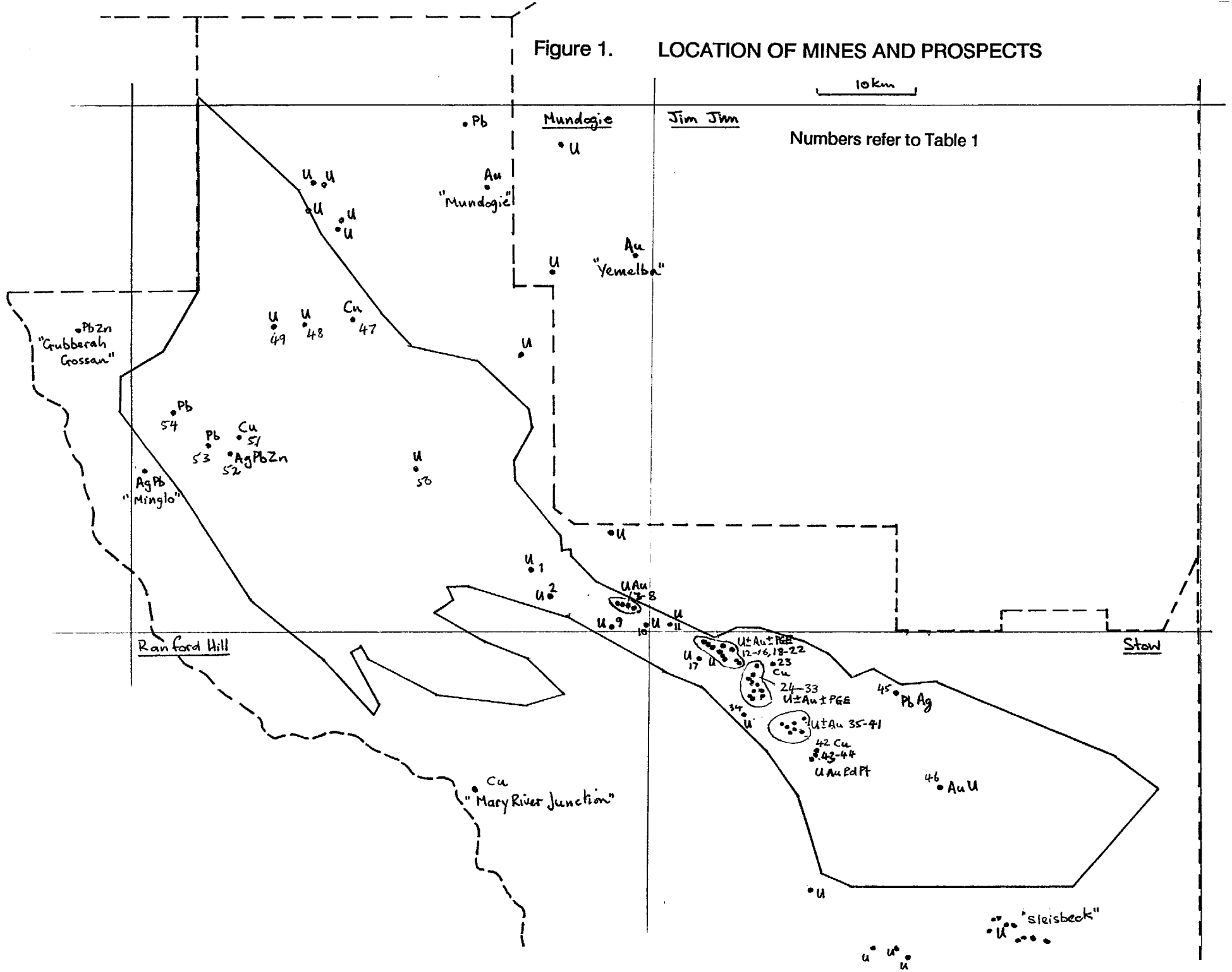
TAYLOR, J., 1969--Origin and controls of uranium mineralisation in the South Aligator Valley. Atomic Energy, Sydney, 12, 18--24.

THREADGOLD, I.M., 1960--The mineral composition of some uranium ores from the South Alligator River area, N.T. CSIRO, Melbourne, Mineragraphic Investigations Technical Paper 2, 53.

WALPOLE, B.P., CROHN, P.W., DUNN, P.R., & RANDAL, M.A., 1968--Geology of the Katherine--Darwin region, Northern Territory. Bureau of Mineral Resources, Australia, Bulletin, 82.

ZIMMERMAN, D.O., 1970--Report on Coronation Hill, South Alligator Valley. United Uranium N.L. and Joint Venture Group (unpublished).

Figure 1. LOCATION OF MINES AND PROSPECTS



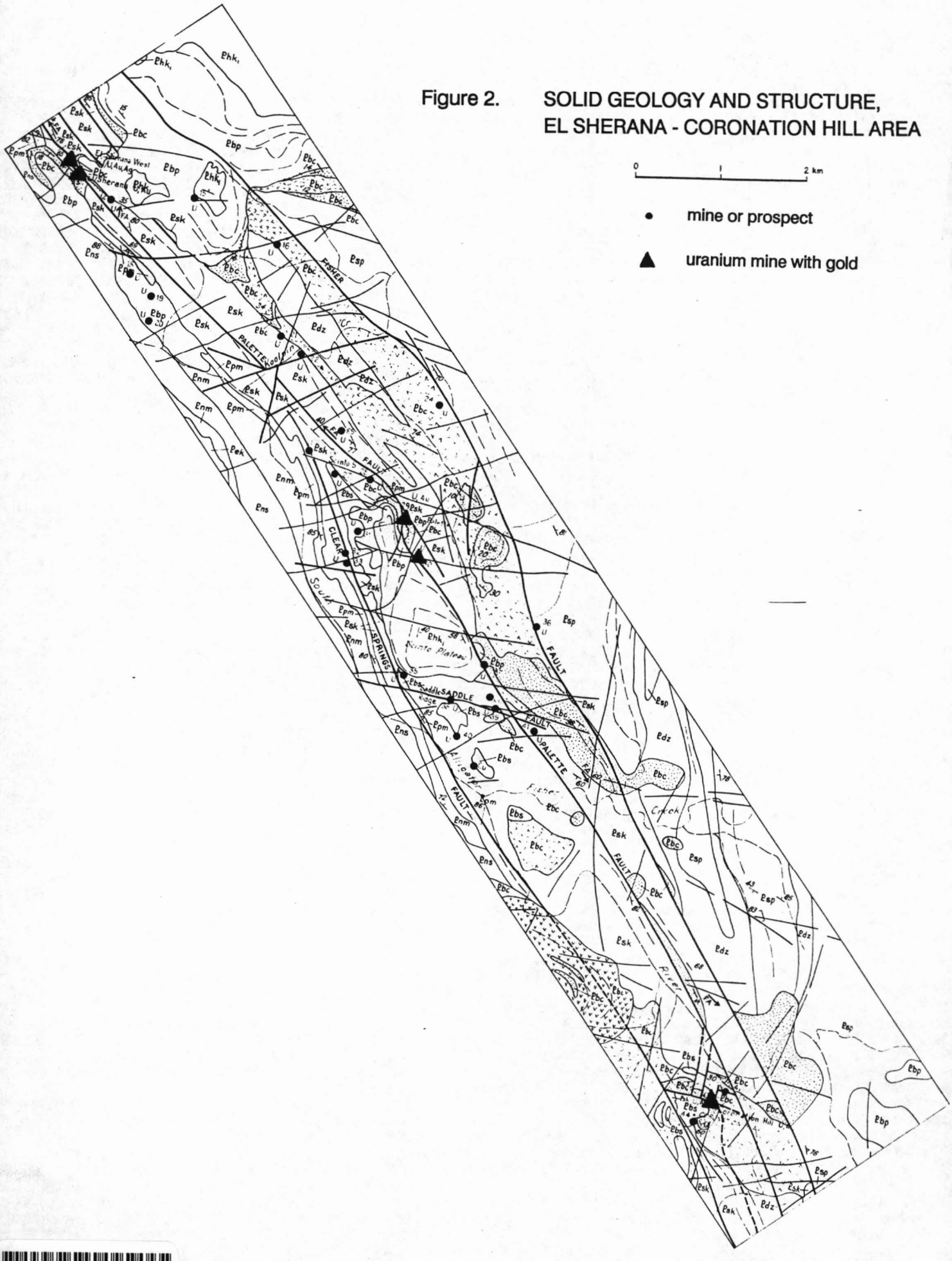


Figure 2. SOLID GEOLOGY AND STRUCTURE, EL SHERANA - CORONATION HILL AREA

Figure 3. TYPICAL SETTING OF SOUTH ALLIGATOR U ± Au DEPOSITS

secondary ore zone

primary ore zone

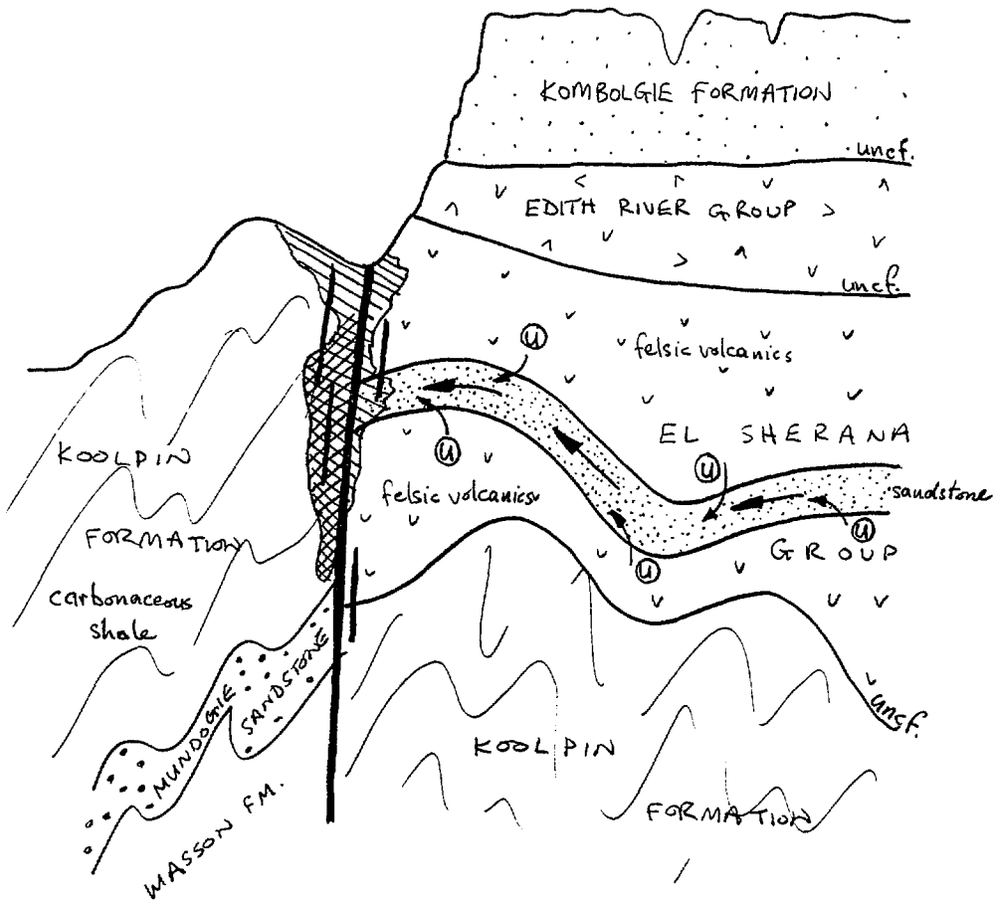
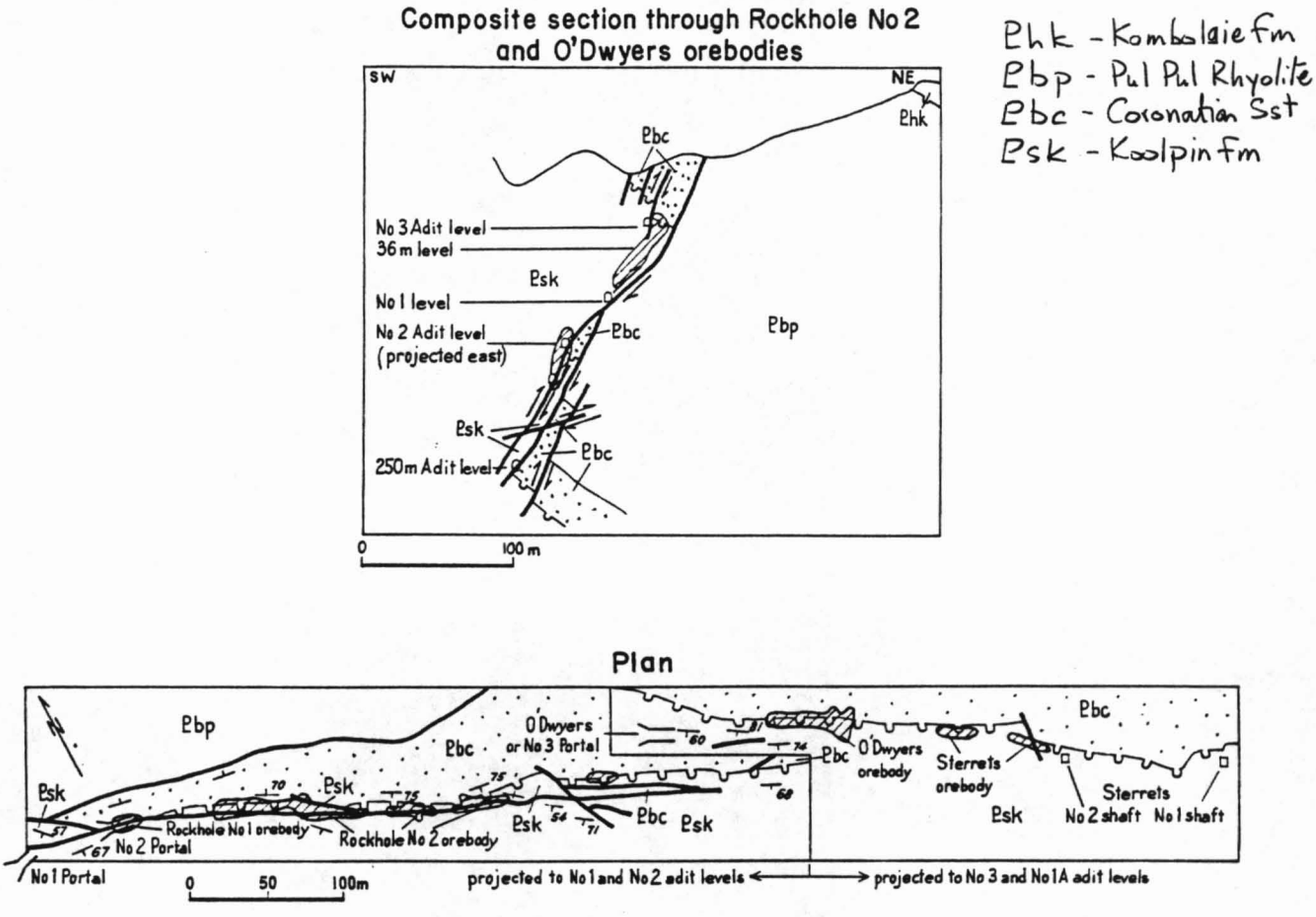


Figure 4. THE ROCKHOLE GROUP



Phk - Kombolgie fm
Pbp - Pul Pul Rhyolite
Pbc - Coronation Sst
Psk - Koolpin fm

Figure 5. EL SHERANA

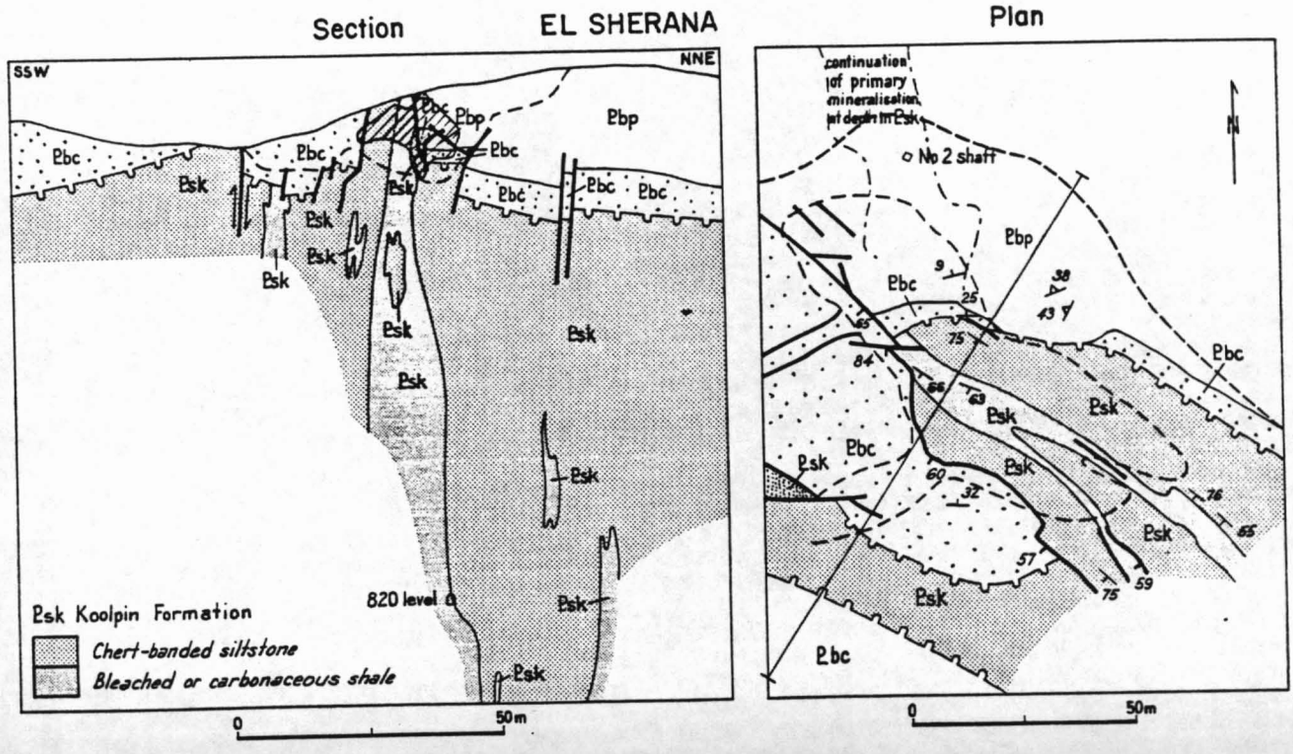


Figure 6. PALETTE

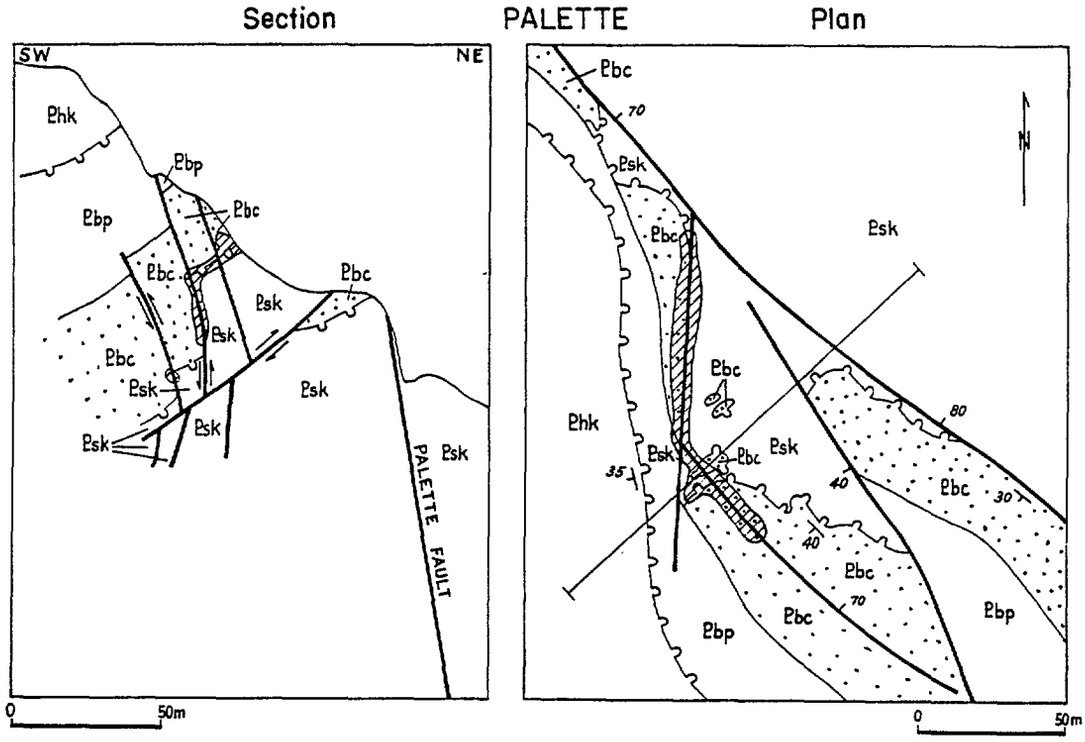


Figure 7. SADDLE RIDGE

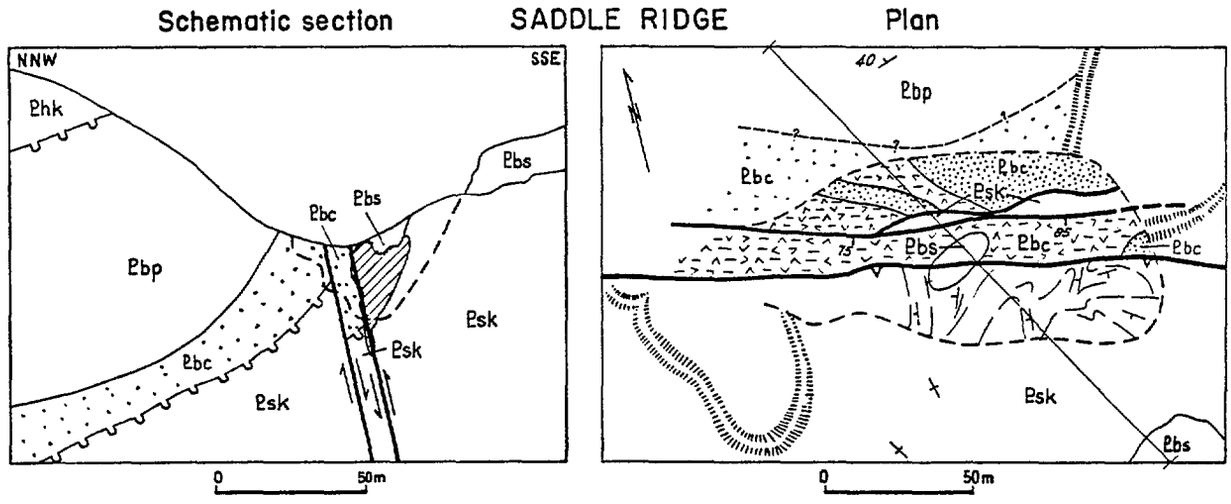
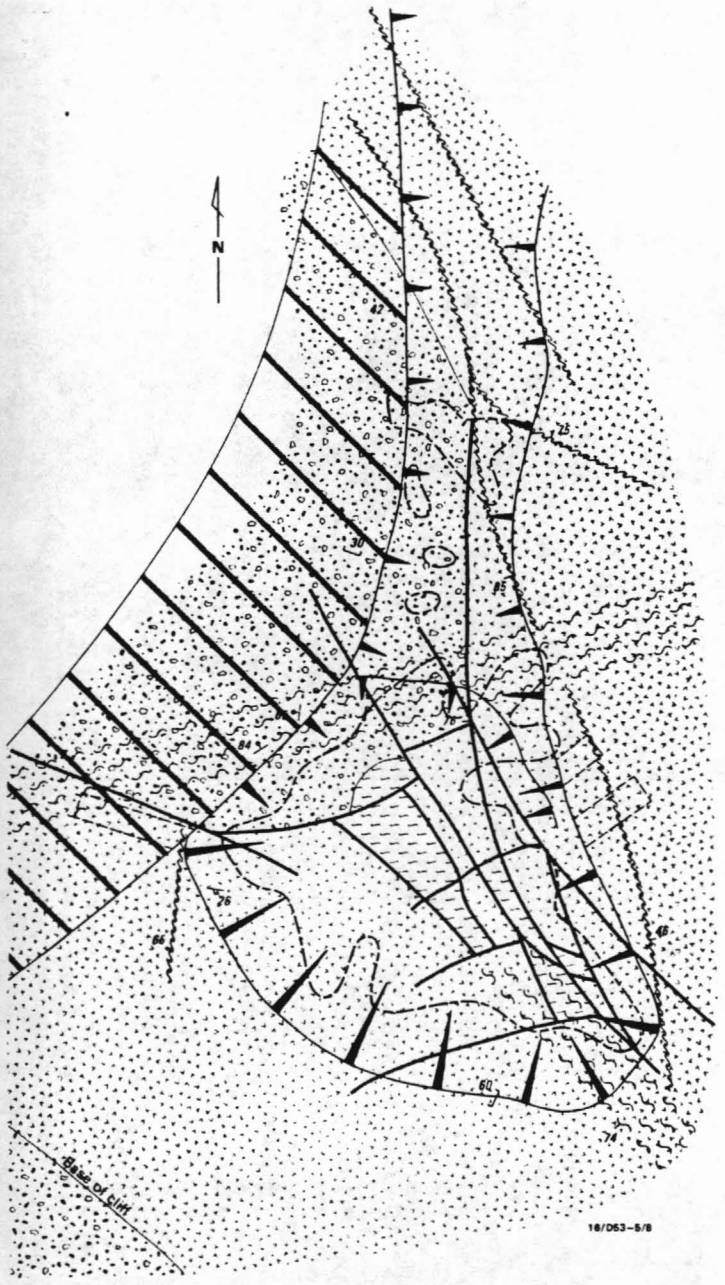


Figure 8. CORONATION HILL U-Au MINE



Coronation Sandstone
Debris flow conglomerate
Altered rhyolite, tuff, argillite
Koolpin Formation
Carbonaceous shale
Shepherd's "volcanic fissure"
Geological boundary
Fault with dip
Shear with dip
Shear zone
Dip of bedding
Dip of bedding with proven younging direction
Dip of joints
Dip of flow banding
Pit boundary
Open cross-drive
Ore outline projected from 1000' level
0 10 m

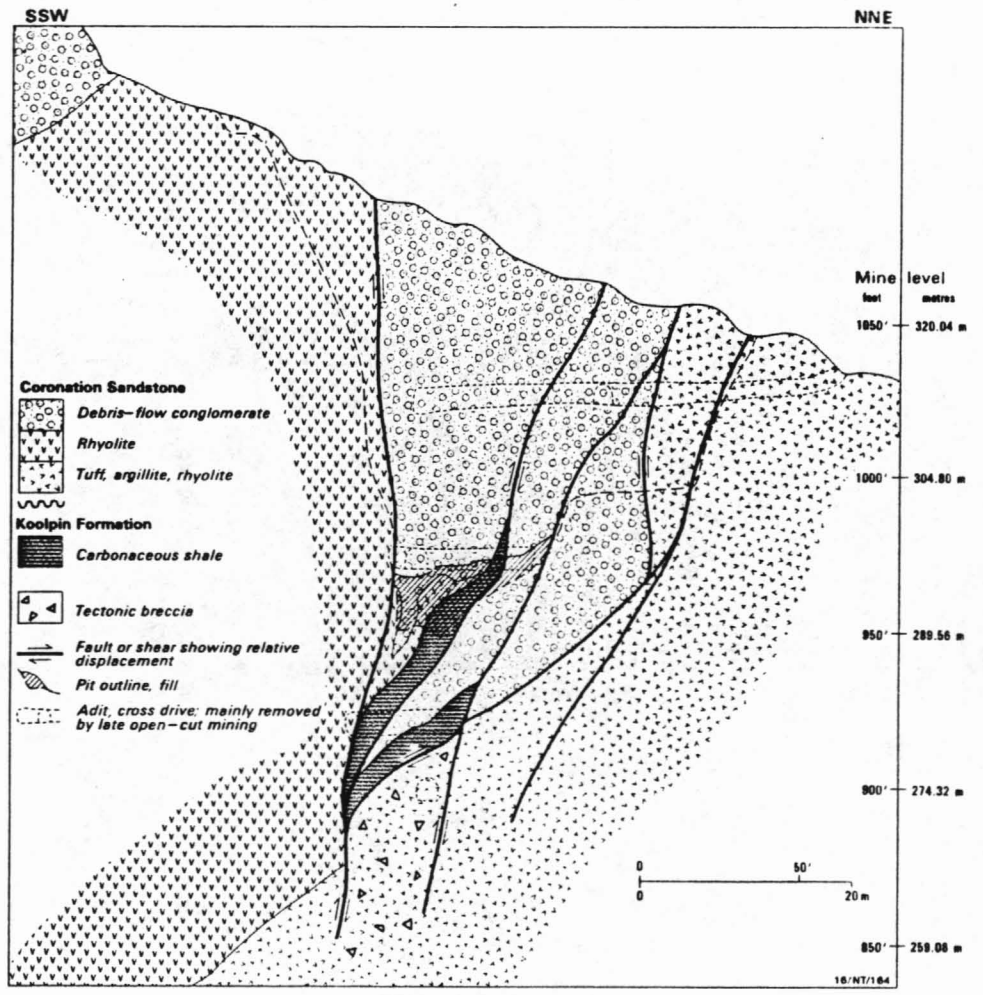


Figure 9. CORONATION HILL Au-PGE DEPOSIT

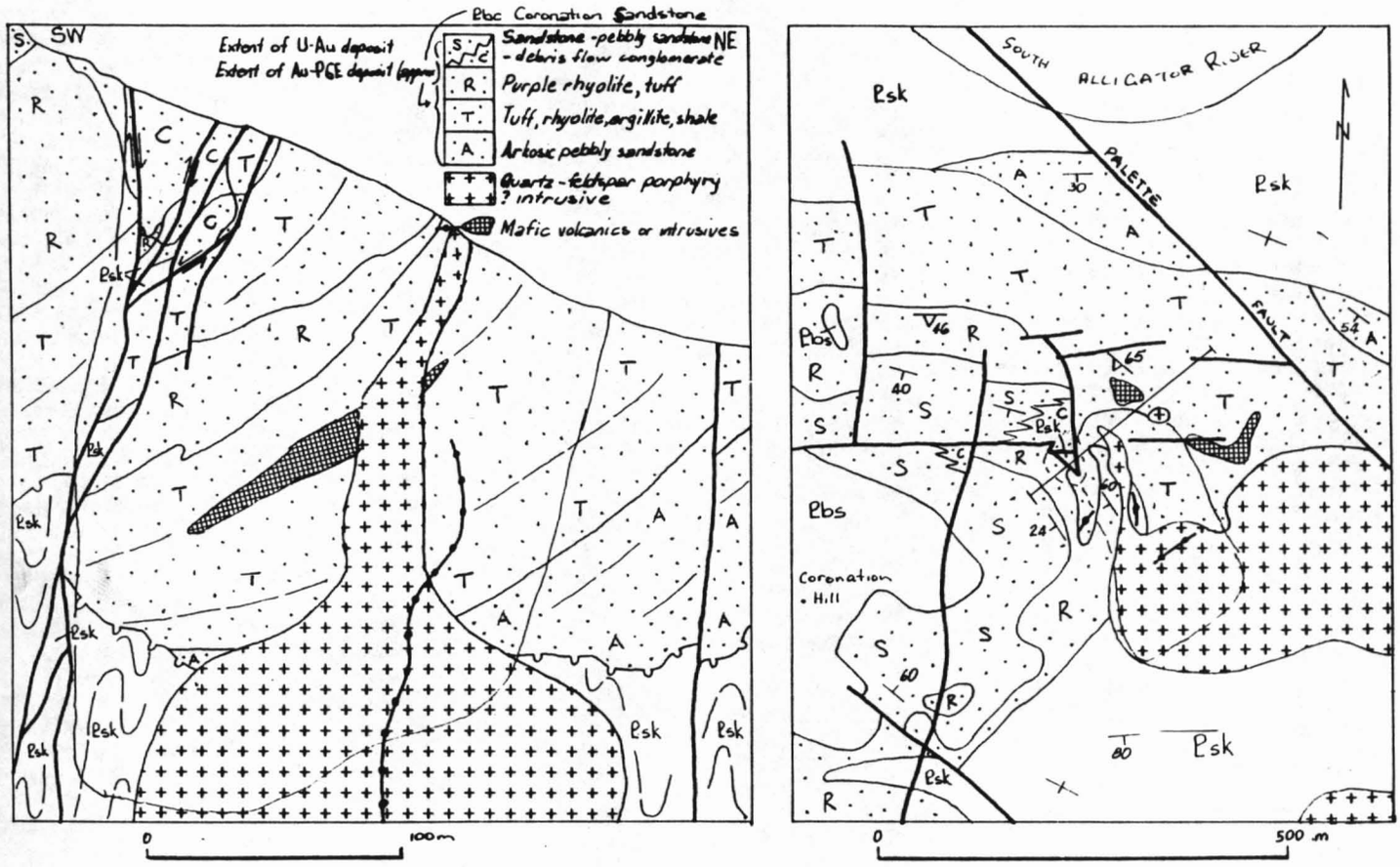


Table 1 Mine and Prospect data for the Conservation Zone

No	Name	Grid reference	Metal(s)	Status, production	Host rocks	Style	Ore mineralogy
1	2J	KF1513	U	prospect <0.98%U_3O_8	Ens altered amygdaloidal basalt, tuff tuffaceous shale	near-surface oxidation lens, nearby minor fault	uranyl phosphate
2	Sandstone (north)	KF1710	U	prospect	Pep sandstone lenses in andesite	near-surface irregular	no visible mineralisation
3	Teagues	KF2509			Psk, Pec carbonaceous or hematitic		<300ppmU_3O_8, <14ppm at depth
4	Rockhole No.1	KF2509		152tU_3O_8 @1.1% some gold	chert-banded shale, sandstone	irregular shoots 2cm-2m wide subparallel to Psk/Pbc faulted contact, also in joints and shears and forming fine veinlets	pitchblende, near-surface secondaries, accessory pyrite, trace marcasite, chalcopyrite, lead, iron, copper selenides, gold
5	Rockhole No.2	KF2509	U,Au	(included in			
6	O'Dwyers	KF2608		El Sherana Au			
7	Sterrets No.2	KF2608		production)			
8	Sterrets No.1	KF2608	U	prospect	Psk, Pec carbonaceous or hematitic chert-banded shale, sandstone	irregular massive <5cm along faulted Psk/Pbc contact	'low-grade pitchblende ore'
9	Sandstone (south)	KF2506	U	prospect	Pep sandstone lenses in andesite	near-surface irregular	no visible mineralisation <300 ppm U_3O_8; <14 ppm at depth
10	Airstrip	KF2906	U	prospect	Psk siltstone	near-surface irregular	no visible mineralisation x4 radioactivity
11	El Sherana North	KF3006	U	prospect	Psk ferruginous chert-banded siltstone	anomalous radioactivity	no visible mineralisation
12	El Sherana West	KF3105	U,Au,Ag	185tU_3O_8 @0.8% 0.007tAg	Psk cherty ferruginous siltstone, rare carbonaceous siltstone	irregular massive, <20m below Pbc unconformity, nearby faulted Psk/Pbc contact	veins, massive segregations (commonly nodular <25 cm) and disseminations of pitchblende cut by gold veinlets and minor galena and anglesite stringers
13	El Sherana	KF3105	U,Au	226tU_3O_8 @0.55% 0.33tAu	Psk cherty ferruginous siltstone, rare carbonaceous siltstone; Pbc sandstone	carrot-shaped mass broadening in oxidised zone above unconformity (ie. in Pbc), nearby faulted Psk/Pbc contact	as El Sherana West, also tail of secondary U minerals in oxidised zone, minor kasolite
14	High Road	KF3104	U	prospect	Psk ferruginous chert-banded siltstone	highly anomalous surface radioactivity	no visible mineralisation
15	Charvats Line	KF3205	U	prospect	Pbp rhyolite	irregular near-surface, nearby minor fault	secondary U minerals
16	Orchid Gully	KF3304	U	prospect			
17	Alligator Fault	KF3104	U	prospect			
18	Stockpile 1 (Boundary)	KF3204	U	prospect	Pbp altered rhyolite	near-surface disseminated; appear to lie close to small cross-faults	minor fine-grained pitchblende yellow powdery secondaries
19	Stockpile 2 (Boundary)	KF3203	U	prospect			
20	Flying Fox	KF3203	U	prospect			
21	Monolith	KF3403	U	prospect	Psk ferruginous chert-banded siltstone	anomalous radioactivity near minor cross-fault, close to Psk/Pbc unconformity	no visible mineralisation
22	Koolpin	KF3403	U	3tU_3O_8 @0.12%	Psk sheared carbonaceous shale	fracture fillings to 15m depth, minor cross-faults. On possible extension of Palette Fault	sooty and massive pitchblende
23		KF3704	Cu	prospect	Psp shales	patchy near-surface	malachite
24	Scinto 6	KF3503	U	3tU_3O_8 @0.15%	Pbc sheared altered rhyolite	near-surface patches in shear zone and adjacent joints	secondary U minerals (autunite torbernite, saleeite)
25	Koolpin East	KF3403	U	prospect	Psk ferruginous chert-banded siltstone	on NW extension of Palette Fault	no visible mineralisation
26	Scinto 5 (Daniels)	KF3402	U	22tU_3O_8 @0.4%	Psk bleached white and red ferruginous shale	irregular boundary adjacent to steep sheared contacts with Pbp altered volcanics	U secondaries, minor pitchblende
27	Scinto 5 South	KF3402	U	prospect	Psk ferruginous chert-banded siltstone	patchy mineralisation close to sheared Psk/Pbp contact	U secondaries
28	Cliff Face	KF3502	U	prospect	Psk ferruginous chert-banded siltstone with carbonaceous lenses	on NW fault, higher grades in carbonaceous lenses	pitchblende in carbonaceous lenses, disseminated secondary halo

29	Palette	KF3502	U,Au	124t U_3O_8 @2.5% some gold (included in El Sherana	Ebc mottled hematite apatite sandstone with reduction spots, Esk green siltstone and weathered ferruginous chert-banded siltstone	pipe inclined ~45, transgresses Ebc/Esk contact. Mineralisation in shears and fractures as veins and massive nodules. NW and N faults	vein and nodular pitchblende, veins of gold and minor pyrite, chalcopyrite, galena and marcasite. Phosphuranylite around pitchblende veins in in sandstone; clausthalite, coloradoite, pitchblende nodules
30	Skull	KF3601	U	3t U_3O_8 @0.5%	Esk carbonaceous shale	irregular nodular ore in shears; close to flexure in Palette Fault	pitchblende nodules
31	Scinto 1	KF3501	U	prospect	Ebp altered rhyolite	fractures near minor N	pitchblende, secondaries
32	Palm	KF3501	U	prospect	Ebp altered rhyolite	cross-fault	no visible mineralisation
33	Scinto Camp	KF3501	U	prospect	Ebp altered rhyolite	radioactive scree	no visible mineralisation
34	Christmas Creek	KF3400	U	prospect	Ebc sandstone, Eek conglomerate	anomalous radioactivity in brecciated Ebc/Eek fault contact	minor U secondaries
35	Clear Springs	KF3600	U	prospect	Ebp altered rhyolite		no visible mineralisation
36		KF3701	U	prospect	Ebc sandstone	talus	
37	Saddle Ridge North	KF3700	U	prospect	Ebc sandstone	anomalous radioactivity in breccia along Palette Fault	no visible mineralisation
38	Saddle Ridge (BMR No.2)	KF3600	U	78t U_3O_8 @0.2%	Esk bleached carbonaceous shales, Ebp rhyolite and tuff	steep tabular body on Esk/Ebp cross-fault contact	U secondaries, mainly metatorbernite, minor sooty pitchblende below orebody
39	Saddle Ridge East	KF3700	U	prospect	Ebp vesicular lava	irregular disseminated near-surface; on extension of Saddle Ridge cross-fault	disseminated torbernite, some in vesicles
40	Saddle Ridge South (BMR No.1)	KF3700	U	prospect	Ebs phosphatic hematitic cherty breccia over Esk carbonate	anomalous radioactivity in breccia near-surface, and in red clay pipes with carbonate at depth	no visible mineralisation
41	Saddle Ridge East Extended	KF3700	U	prospect	Esk ferruginous chert-banded siltstone	anomalous radioactivity, near Palette Fault	
42	Callanan's	KE4096	Cu	prospect	Ebc tuff, chert, sandstone	fracture fillings in and near quartz breccia filled cross-fault	malachite
43	Coronation Hill	KE4096	U,Au, Pd,Pt	U-Au orebody 75t U_3O_8 @0.3% some gold; Au-Pd-Pt prospect, reserves ~30t Au @5g/t, 7.5t Pd + Pt @<2g/t (December 1986)	Ebc polymictic debris flow conglomerate, altered volcanic s - rhyolite, tuff, argillite, porphyry, minor Esk carbonaceous shale	U-Au ore body - several steep shoots in a 20m cylindrical zone, some shoots of gold only; Au-Pd-Pt ore zone - low grade mainly non-visible very fine disseminated in massive finely brecciated rocks close to zones of intense faulting.	U-Au orebody - disseminated and patchy sooty pitchblende, native gold disseminations and veinlets; Au-Pd-Pt ore zone - finely disseminated native gold. Platinum group species not known
44	Coronation South (Coronation Hill Southwest)	KE4096	U	prospect	Ebc rhyolite, sandstone	fracture fillings in and near N cross-fault ~20m above Esk unconformity	minor U secondaries (autunite, torbernite) associated with wavellite
45	Zamu	KE5199	Pb,Ag	20tAg-Pb ore	Edz dolerite, wedge of Efb schist	several subparallel W veins in siliceous sheared altered dolerite breccia	argentiferous galena, cerussite
46		KE5690	Au,U	prospect	Efb siltstone	NW tourmaline quartz lodes, anomalous radioactivity	no visible mineralisation
47	Coirwong	JF9738	Cu	prospect	Esk pyritic siltstone, Edz dolerite	near-surface irregular	minor surface staining
48	Coirwong Gorge	JF9237	U	prospect	Esk chert-banded hematitic siltstone	minor anomalous surface radioactivity	no visible mineralisation
49	5G	JF8936	U	prospect	Epm sandstone/Enm siltstone fault contact	minor anomalous surface radioactivity	no visible mineralisation
50	Gerowie Creek	KF0323	U	prospect	Epm sandstone/Esk carbonaceous siltstone contact	radon anomalies along contact	no visible mineralisation
51		JF8527	Cu	prospect	Ens altered basalt and tuff	near-surface secondaries in shear zone	patchy malachite in gossan and weathered zone

52	Namoona	JF8424	Pb,Zn,Cu	prospect	Enm carbonaceous pyritic dolomitic shale, siltstone, dolomite	stratabound disseminated sulphides and massive shoots in veins and breccias	lead and minor zinc sulphides. Galena, with cerussite and pyromorphite, visible in gossan
53		JF8126	Pb,Zn	prospect	Enm shale	patchy surface secondaries in minor shear zone	minor smithsonite, hydrozincite in gossan
54		JF7729	Pb,Zn	prospect	Enm shale	patchy surface secondaries in minor shear zone	minor smithsonite, hydrozincite in gossan

TABLE 2. MINERAL PRODUCTION FROM THE CONSERVATION ZONE

mine	element(s)	tonnes metal	grade
Rockhole Group	U	152t	1.1%
	Au	minor	
El Sherana West	U	185t	0.8%
	Au	0.007t	
	Ag	minor	
El Sherana	U	226t	0.55%
	Au	0.33t	
Koolpin	U	3t	0.12%
Scinto 6	U	3t	0.15%
Scinto 5	U	22t	0.4%
Palette	U	124t	2.5%
	Au	included in El Sherana prodn.	
Skull	U	3t	0.5%
Saddle Ridge	U	78t	0.2%
Coronation Hill	U	75t	0.3%
	Au	minor	
NEARBY MINES			
Sleisbeck	U	3t	0.4%
	Pb)		
Zamu	Ag)	20t high-grade ore	
Minglo	Pb	6.8t	58%
	Ag	0.003t	138g/t

Table 3. Geological features of the larger uranium deposits (after Ayres & Eadington, 1975)

	El Sherana	Palette	Rockhole	Coronation Hill	Saddle Ridge	Scinto 6	Skull	Koolpin
Mineralogy	pitchblende, secondary U minerals; minor galena-clausthalite, pyrite, marcasite, Co-Ni arsenides, Cu sulphides	pitchblende, U secondary minerals; minor galena-clausthalite, coloradoite pyrite, marcasite, gold	pitchblende; minor clausthalite, eskebornite, pyrite, marcasite, chalcopyrite, rare U secondary minerals	pitchblende, U secondary minerals, minor pyrite, Cu sulphides	'secondary' uranium minerals trace pyrite; pitchblende in drillholes below pit	'secondary' uranium minerals only	pitchblende, secondary U minerals; minor gold, Cu mineralization	pitchblende, secondary uranium minerals
Electron microprobe analysis of pitchblende	U Pb Fe Si U/Pb 80.4 7.0 0.4 0.2 11.6 80.9 7.4 0.8 0.3 11.0	U Pb Fe Si U/Pb 77.5 10.7 0.6 0.2 7.3 74.1 11.3 0.3 0.4 6.6						
Gangue	red and grey chert, quartz veinlets	siliceous gangue, apatite, introduced in to host sandstone	siderite	chlorite, hematite, minor quartz veinlets	no introduced gangue, some chalcedony	no introduced gangue	no introduced gangue	no introduced gangue
Host rock	ferruginous silstone and carbonaceous shale, secondary deposit of open cut in sandstone and rhyolite	sandstone, carbonaceous shale	carbonaceous shale and chert, at higher levels near the unconformity, sandstone host	tuffaceous rocks, conglomerate, carbonaceous shale and siltstones	siltstone, tuffaceous sandstone and volcanics, carbonaeous siltstone	rhyolite	carbonaceous shale	carbonaceous shale and ferruginous silstone
Texture	lenticular pitchblende masses in a fault zone enveloped by secondary mineralization, abundant spherical nodules of pitchblende	rich ore shoots along a fault, spherical nodules of pitchblende imperfectly developed	narrow veins of pitchblende similar to Palette	sooty variety of pitchblende, some pitchblende veinlets	secondary U minerals filling joints and fractures, sooty pitchblende in depth	uranium ochres filling joints and fractures	pitchblende veinlets, nodules, sooty pitchblende	sooty pitchblende and secondary U minerals in thin stringers occupying fractures
Pitchblende	present	present	present	present	present	not present	present	present
Carbonaceous shale	present	present	present	present	present	not present	present	present
Gold	present	present	present	present	not recorded	not recorded	present	present
Fault	present	present	present	present	present	present	present	present
Shape	tabular ore body tapering with depth		ore shoots form a ribbon dipping to west along a fault zone	a number of ore shoots at higher levels, at lower levels ore body is pipe like				
Vertical extent	120 ft (36.6 m)	100 ft (30.5 m)	200 ft (61 m)	180 ft (55 m)	80 ft (24.4 m)	120 ft (36.6 m)	—	50 ft (15.2 m)
Size (tonnes ore)	61200	5100	13260	26520	30600	1734	534	2244
Setting	Complex partly faulted and partly unconformable contact between Koolpin Formation and El Sherana Group (Coronation Sandstone and Pul Pul Rhyolite)	along faulted Koolpin Formation/Coronation Sandstone unconformity	along reverse faulted contact between Koolpin Formation and El Sherana Group (Coronation Sandstone and Pul Pul Rhyolite)	intense area of faulting in sediments and volcanics of Coronation Sst; fault slices of Koolpin Formation in depth	faulted Koolpin Formation/ Coronation Sandstone contact	shear zones in Coronation Sandstone rhyolite	shears in Koolpin Formation	shears in Koolpin Formation