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1955/49

PROGRESS REPORT ON REGIONAL GEOLOGICAL MAPPING KATHERINE-DARWIN REGION 1954

by

B.P. Walpole and D.A. White

CANBERRA.

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B.P. WALPOLE AND D.A. WHITE

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SUMMARY

Sedimentary rocks of Lower Proterozoic age crop out in an area approximately 200 miles in length and 120 miles in width in the Katherine-Darwin region. The sediments were deposited in what is now known as the Pine Creek Geosyncline. The environment of sedimentation within the geosyncline is suggested. The sediments are folded and intruded by granitic rocks and a mechanism of the intrusion is postulated. Part of the Lower Proterozoic sedimentary pile is subdivided into formational units.

The Lower Proterozoic rocks are unconformably overlain by rocks of Upper Proterozoic, Middle Cambrian and Cretaceous age.

INTRODUCTION

GENERAL

This report deals specifically with the regional geological mapping carried out by the parties of the radioactive minerals group, Bureau of Mineral Resources, in the Katherine-Darwin region during the 1954 field season. The mapping carried out by previous workers is considered in less detail and is shown, together with the 1954 work, on the map of the region (Plate 1) included with this report.

During the 1954 field season, an area of approximately 4500 square miles was mapped on a scale of 1 inch = 1 mile. The work was carried out as part of the Bureau of Mineral Resources programme of uranium search in the Northern Territory and included the Tipperary, Ban Ban, Burrundie, Table Top, Mt. Stow, and parts of Burnside and Mt. Evelyn 1 mile areas of the army four mile series. In addition to this mapping, a reconnaissance survey of the eastern shelf area of the Pine Creek geosyncline was carried out.

Field sheets on a scale of 1 inch = 1 mile were compiled from photomosaics, and distributed through the Darwin Office of the Bureau of Mineral Resources as the work progressed. As planimetric base maps become available, data from the field sheets are to be replotted onto the controlled base maps and published.

A progress map on a scale of 1 inch = 9.21 miles was prepared, showing the 1954 season's work and mapping by previous workers. Included on this sheet is mapping carried out in 1954 by geologists of the Rio Tinto Company Ltd.

The photomosaics, planimetric base maps and one inch = 9.21 miles base map were compiled by the National Mapping Section, Dept. of the Interior, from photographs provided by the Royal Australian Air Force.

Geologists who took part in the 1954 field work were B.P. Walpole, Senior Geologist, D.A. White, Geologist Grade 3, and R.G. Smith, P.R. Dunn, J.R. Stewart, D.J. Malone and

H. Quinlan, geologists Grade 1.

PROSPECTING WORK

A radiometric prospecting team consisting of two survey hands under the guidance of a field geologist prospected large areas of the 1 mile sheets covered. Only one prospect was discovered, the Burrundie Prospect (Stewart 1954), in conjunction with the geological mapping.

Reconnaissance prospecting in the South Alligator River area led to the discovery of Hales Prospect and the relocation of Cowans Prospect. As a direct result of this latter work, which was undertaken specifically to stimulate interest in this area, a number of private companies began prospecting in the area, and several prospects of major importance were discovered.

The regional and reconnaissance mapping established a relationship between the environment of sedimentation and uranium mineralization (Condon and Walpole, 1955).

PREVIOUS WORK

Noakes (1949) has summarised the geological investigations carried out in the Katherine-Darwin region before 1948. Most of this work was performed by the Aerial, Geological and Geophysical Survey of Northern Australia.

A number of geologists of the Bureau of Mineral Resources have since worked in the region. Walpole and Drew carried out regional mapping in the Lower Proterozoic, Upper Proterozoic and Middle Cambrian sequences in the Maranboy, Yeuralba and Waterhouse River areas in 1951 and 1952. Matheson, Carter, Frankovich, Dodd, Firman, Joklik and others mapped the geology of the Rum Jungle-Waterhouse area; Walpole, Drew, White, and Britten carried out reconnaissance mapping in the Goodparla-Coronation Hill area in 1953; and Rattigan and Clarke (1953) provided the first detailed information on the Upper Proterozoic sequence in the Katherine Area.

The data compiled by all these workers have provided a background for the detailed regional mapping discussed in this report. In addition, some of the mapping carried out by geologists of Rio Tinto Coy. Ltd. and Territory Enterprises Pty. has been used.

STRATIGRAPHY

GENERAL

Geosynclinal sediments of Lower Proterozoic age in the Katherine-Darwin region crop out in a broad belt between Darwin in the north and Maranboy in the south (Plate 1). The belt is approximately 140 miles in width and extends from Jim Jim Creek in the east to Daly River Police Post in the west. Noakes (1949) defined this belt as the Pine Creek Geosyncline and grouped the sedimentary rocks of the geosynclinal pile into one unit which he called the Brocks Creek Group.

The sediments have been folded and intruded by granite and both sediments and intrusions are unconformably overlain by sediments and volcanics of Upper Proterozoic age. Middle Cambrian sediments and volcanics in turn overlie the Upper Proterozoic rocks with regional unconformity and are in turn unconformably overlain by sediments of Lower Cretaceous age.

The stratigraphical succession, with details of rock types involved, is given in Table 1.

TABLE 1.

Age	Unit: Group	Unit: Formation	Type Locality	Thickness (approx)	General Description
Tertiary to Recent					Laterite, soil and alluvium developed on rocks of all ages.
		Unconformity			
Lower Cretaceous	Mullaman Group		Mullaman Tableland west of Pine Creek. Tabletop 1-mile area.	100'	Noakes (1949) has recognized a marine (Darwin Formation) and a freshwater (unnamed) formation within this group. Freshwater sediments are poorly consolidated sandstones and conglomerates with plant remains. Marine sediments are sandstones, shales, and sandy shales. All members are strongly lateritised.
		Unconformity			
Middle Cambrian	Daly River Group		Daly River Basin		Mostly undifferentiated. In area investigated maximum thickness is less than 2,000 feet of discontinuous beds of limestone, sandstone, siltstone and shale with intercalated basalt flows. Fossils in limestone near Maranboy siding, Katherine and Tipperary - chiefly Biconulites hardmanni, Acrotreta, Linguletta, Redlichia, and fragments of other Brachiopods and cystids. Sequence is gently folded and extensively faulted on margins of basin probably by rejuvenation of old faults in basement rocks. Bell (1952) reports a much thicker sequence in Elsey station area 25 miles east of Mataranka.
	Relationships not definitely established.				
Lower Cambrian or Upper Proterozoic (?)		Stray Sandstone	Stray Creek	Western margin of the Pine Creek Geosyncline	100'	Flaggy Sandstone and micaceous shale and Siltstone at Stray Creek underlain by pink quartz sandstone with abundant ripple marks and worm tracks	The Depot Sandstone crops out on the eastern western and northern fringes of the Daly River Basin and in the Dook Creek area east of Maranboy. The formation was previously called "Buldiva Quartzite" by Hossfeld (1937).
		Depot Sandstone	Depot Creek			
	Relationships not known				
Proterozoic (?)		Callanan "Beds"	"Mt. Callanan"- Alligator River Area	?	Clastic rocks chiefly. Thickness and distribution to be determined.
	Unconformity between A.B.C. Group and Daly River Group				
Upper Proterozoic	A.B.C. Group	Sleisbeck Area			
		Bronzewing formation		1,000'+	Mostly undifferentiated sequence of coarse clastic rocks, greywacke, felspathic sandstone, quartz sandstone, agglomerate, arkose, tuff and volcanics. Folded into dome, basin and monoclinal structures and extensively fractured. The sequence forms the Arnhem Land Plateau and partly determines the eastern outcrop margin of the rocks of the Pine Creek Geosyncline. The sedimentary formations are locally separated by flow rocks and hence the provisional nomenclature listed applies to local areas only. In a regional sense, the rocks are best considered as one unit of group rank.
		Birdie Volcanics		700'	
		Fenny Creek Formation	General area of A.B.C. uranium prospect 12 miles E.N.E. of Katherine	2,500'+	
		Disconformity			
		Edith River Volcanics		1,500'	
		A.B.C. Area			
		E. Sandstone		1,000'	
		D. Volcanics		370'	
		C. Sandstone		650'	
		B. Volcanics		740'	
		A. Sandstone		3,000'	
		Disconformity			
		Edith River Volcanics		2,770'	The Edith River Volcanics are an assemblage of rhyolitic and dacitic flows with tuffaceous sediments, sediments and fine ash beds.

Age	Unit: Group	Unit: Formation	Type Locality	Thickness (approx)	General Description
		Fergusson River Area			
		Fergusson Volcanics		500'-1,000'	The Fergusson Volcanics are mostly acid lavas (toscanites) associated with hypabyssal rocks.
		Unconformity			
		Granitic intrusions. Cullen, Litchfield, Rum Jungle, Waterhouse, Brocks Creek, Shoobridge, Prices Springs, Margaret Granites, Mt. Bundey Syenite, Middle Creek Granite, Fenton Granite, Grace Porphyry, Yeuralba Granite, Naranboy Porphyry, Soldiers Creek and Muldiva and Reynolds River Granite			The Cullen, Litchfield, Rum Jungle, Brocks Creek, Shoobridge, Price's Springs and Margaret Granites are microline-perthite-albite-granites. Ferromagnesian present is hornblende and/or biotite. Micrographic intergrowths are common between contacts of microcline and albite felspars. Fenton Granite is a cataclastic microcline-biotite granite. Middle Creek Granite is a micrographic perthite granite. The presence of fluorite and the abundance of micrographic intergrowths in the Shoobridge and Middle Creek Granites indicate that the "roof" of these granites is at present exposed. Mt. Bundey Syenite is a sphene-hornblende syenite containing radioactive cryolite. Grace Porphyry is best called a granophyre: it varies between a granophyric hornblende-quartz porphyry and a granophyric hornblende granite-porphyry. Evidence to date suggests that the Cullen and Litchfield Batholiths and the Prices Spring Granite were emplaced along faults or other pre-existing weaknesses in the Lower Proterozoic rocks. Soldiers Creek, Muldiva and Reynolds River Granites have not been studied.
		Unconformity			
		Basic rocks	Brocks Creek and Burrundie area, Sleisbeck Coronation Hill Goodparla and Mt. Masson areas.		The petrology of these rocks has not yet been studied. Possibly altered basic sills, diorite sills etc. Some exposures are altered calcareous sediments. The sills are folded with the intruded sediments.
		Unconformity			
Lower Proterozoic.	Brocks Creek Group	Burrells Formation	Burrells Creek 89 miles south of Darwin	8,000'	Has previously been called "Union Slates", "Pine Creek Series" "Muldiva Stage" etc. Essentially trough-type sedimentation with dominant greywacke and siltstone lithology. Prominent marker is "tombstone greywacke" which is commonly calcareous and has been silicified at surface. The Formation thins out to both east and west and overlaps older rocks in sequence.
		Gradational content	Mt. Bonney area		
		Knights Formation	Knights Creek, Burrundie area.	5,000'	Previously called "Golden Dyke Series" but most typical section is at Knight Creek. Lithology varies from east to west. In the east chert is dominant rock type. At Knights Creek are interbedded quartz siltstone and chert with some limestone, carbonaceous siltstone, banded iron formation. Further west chert lithology is absent except for small lenses in banded iron formations.
		Masson "Beds"	Mt. Masson area	Not known	Occupy old delta and are in part slope facies, in part shelf facies. Slope-type sediments are interbedded quartz greywacke, greywacke conglomerate, siltstone, limestone and banded iron formations. Prominent slumping on western margin of delta particularly along boundary with Knights Formation. Sediments east of Mary River have not yet been mapped in detail but include sedimentary types listed above as well as a biohermal reef facies.

Age	Unit: Group	Unit: Formation	Type Locality	Thickness (approx)	General Description
		Rum Jungle "Beds"	Rum Jungle area		Sequence of limestone, carbonaceous siltstone, quartz siltstones, conglomerate and coarse clastics with reef breccias, pyritic quartz sandstone and pyritic siltstone. (Not considered in detail in this report). The Rum Jungle "Beds" are stratigraphically equivalent to the sequence between Mt. Masson and South Alligator River. In both areas sedimentation is restricted and there is no continuity between the Masson "Beds" and the Rum Jungle "Beds".
Lower Proterozoic	Brocks Creek Group				
		Nanambu Granite	Nanambu Creek		Garnetiferous Granite. Felspars are similar to those of the granites intrusive into sediments of the Pine Creek Geosyncline i.e. microcline-perthites and albite. The garnets are unstable and are partly altered to biotite. Relationship to sediments in Pine Creek Geosyncline not definitely established but is tentatively considered to form part of older basement from which these sediments were derived.

NOTE: All nomenclature given in Table I is tentative and may require revision when mapping programme is completed.

MESOZOIC AND PALAEOZOIC

Little work has been done on the Mesozoic and Palaeozoic sequences in the Katherine-Darwin region by the present survey. Noakes (1949) has summarized the stratigraphy and lithology of the various units present and hence only brief comments are pertinent to this report.

Lower Cretaceous

Hullaman Group: This Group was named by Noakes (1949) from the Hullaman Tableland, a few miles west of Pine Creek.

The sediments crop out as a thin veneer of horizontally disposed rocks laid down on an irregular basement of older rocks. The sediments cap ridges, mesas, and buttes in the Katherine-Darwin region, and the thickness of the rocks is largely determined by the contours of the basement on which they were deposited.

Peneplanation in Cainozoic times has resulted in the removal of most of the Cretaceous in the Katherine-Darwin region and the residual outcrops of the Hullaman Group, in general, have been strongly lateritized.

Middle Cambrian

Daly River Group: A fossiliferous limestone member determines the age of the group as Middle Cambrian. Outcrops of the limestone have been found in the Fenton Airstrip area (Tipperary 1 mile sheet), at Roper Creek (Waranboy 1 mile sheet) and at Elsey Station on the Roper River. The fossil content includes Biconulites hardmanni as well as Acroteta, Lingulella, Redlichia, and fragments of undetermined cystids and brachiopods.

Most of the area of outcrop of the Cambrian rocks shown on Plate 1 consists of only a thin veneer of volcanics, limestone, sandstone, siltstone and shale. The beds crop out as low ridges, or, in the case of the limestone members, as scattered flat slabs of rock lying in soil.

The thickness of the sequence in the Daly River basin is probably less than 2000 feet.

Included in the Daly River Group by the present survey is the Elliot Creek Formation (Noakes, 1949).

Depot Sandstone

Stray Sandstone Sequence: The distribution of these units is shown in Plate 1. The Depot Sandstone is named from the section exposed in Depot Creek (Plate 6) and consists of a very uniform well ripple-marked pink quartz sandstone. Worm tracks have been noted in these rocks by several workers. The overlying Stray Sandstone is a flaggy sandstone with thin bedded shale lenses.

The formation in the type section is 700 feet thick. The Stray Sandstone has a thickness of 100 feet.

Hossfeld (1937, 1953) refers to a formation which he calls the "Buldiva Quartzite" - the basal formation of the "Buldivan Series". Hossfeld considers that this "Series" is partly Upper Proterozoic and partly Lower Cambrian in age.

Noakes (1949) used Hossfeld's nomenclature but confined the age of the Buldiva Quartizite to Upper Proterozoic. Since 1949 the term "Buldiva Quartzite" has been widely but, in the

light of recent investigations, erroneously used as a stock name for the whole Upper Proterozoic sequence in the Katherine-Darwin region.

There is little doubt that the Depot Sandstone is actually the same unit as Hossfeld's Buldiva Quartzite. However the use of the name "Buldiva Quartizite" has caused so much confusion in the past four years that the writers have dispensed with it entirely and substituted Depot Sandstone. The formation is not composed of quartizite.

The age of the Depot Sandstone is probably Cambrian: the formation forms the basal unit of a normal sedimentary succession and crops out around almost the whole margin of the Daly River Basin. Overlap by the younger Daly River Group sediments is apparent in the northern section of the Daly River Basin (Plate 1). An unconformity is present between the Depot Sandstone and the basal member of the Daly River Group in the Waterhouse River area. It is suggested that the Depot Sandstone may be Lower Cambrian in age.

An attempt is to be made during 1955 to establish the age of Depot Sandstone, and the final decision on age and nomenclature can conveniently be left till that work is carried out.

UPPER PROTEROZOIC

Detailed work on the Upper Proterozoic sequence to date has been confined to the area east of the Stuart Highway.

Rattigan and Clarke (1953) give the first accurate detailed information of the Upper Proterozoic succession from work in the Katherine area. Their work has been extended by the 1954 survey. A rearrangement of the various units previously recognised in the Upper Proterozoic sequence is now necessary.

The sequence in the Katherine area is now referred to as the A.B.C. Group - named from the general area surrounding the ABC Uranium Prospect, approximately 14 miles N.E. of Katherine. The Group includes the Phillips Creek Sandstone and the Sandstone members separated by Rattigan and Clarke (1953). The "minor" unconformity between the Edith River Volcanics and the A. Sandstone Formation postulated by Rattigan and Clarke, is now considered a disconformity.

The Upper Proterozoic succession in the Katherine-Darwin region is complicated by discontinuity of units or members of the succession from one area to another. For example, in the Sleisbeck area, the Fanny Creek and Bronzewing Formations are of essentially the same lithology, and are separated by the Birdie volcanics. The volcanics lense out to the east and south-east and the Fanny Creek and Bronzewing Formations become one unit. The same general conditions hold in the Katherine area.

For this reason, the Upper Proterozoic sequence is treated in this report as a unit with the rank of Group and the subdivision of this group into formational units is applied to local areas only.

TABLE II

TENTATIVE CORRELATION OF ROCK UNITS SHOWING PREVIOUS AND PRESENT NOMENCLATURE AND IDEAS OF AGE RELATIONSHIPS.

Hossfeld 1937-1953	Noakes (1949)	South Alligator Area 1953.	Katherine Area 1953	Relationships Age (1954)	Unit (1954)	Adelaide River - Stray Creek Area (1954) Lt. Tolmer	Bleispeck Area (1954)
Part of Buldiva Series (Upper Proterozoic to Cambrian)	Buldiva Quartzite (Upper Proterozoic)	Mt. Callanan Group. Volcanic Sill.		Age not yet established		Stray Sandstone Depot Sandstone	Callanan Beds (probably Formation rank)
		Unconformity					Unconformity
		Edith River Group (Undifferentiated)	Mt. Callanan Group E. Sandstone D. Volcanics C. Sandstone B. Volcanics A. Sandstone	Upper Proterozoic			Bronzewing Formation. Birdie Volcanics Kenny Creek Formation
			Minor Unconformity		A.B.C. Group		Disconformity
Buldiva Quartzite			Edith River Volcanics Phillips Creek Sandstone				Edith River Volcanics

Sleisbeck Area

The distribution of the formational units described below is shown on plate 7.

Bronzewing Formation: The type section of this formation is exposed in Bronzewing Creek (Plate 7). The formation consists of arkose, agglomerate, tuffaceous sandstone, felspathic sandstone, and quartz sandstone, with a thickness, in the Sleisbeck area, of about 1000 feet. The beds are lenticular and dips range up to 15°.

Birdie Volcanics: These comprise intermediate to basic flows similar in type to, and occupying the same stratigraphical position as, the B volcanics of the ABC area. (Rattigan and Clarke 1953). The Birdie Volcanics are approximately 700 feet thick.

Fanny Creek Formation: The type section is exposed in Fanny Creek (Plate 7). The basal member of the formation is a lenticular bed of agglomerate which is particularly well exposed on the scarp immediately south of the Sleisbeck prospect. The agglomerate passes up into coarse tuff and tuffaceous sandstone, felspathic sandstone, conglomerate and arkose. The upper member is quartz sandstone. The formation has a thickness in the Sleisbeck area of about 2500 feet and occupies the same stratigraphical position as the A sandstone of Rattigan and Clarke.

A feature of the agglomeratic member is the abundance of rounded material of the same composition as the underlying Edith River Volcanics. Rattigan and Clarke (1953) describe a volcanic conglomerate in the A Sandstone at Edith Falls which occupies the same stratigraphical position as the agglomerate member of the Fanny Creek Formation at Sleisbeck.

Two interpretations are possible: the close of the Edith River volcanic epoch was marked by slight warping which produced an erosional break, better referred to as a disconformity than an unconformity; or the rounded pebbles of volcanic material are ejecta which were thrown out by a final eruptive phase of the volcanic epoch, the rounding of the pebbles being due to attrition in the vent.

At present the writers accept both possibilities but consider the relationship between the Edith River Volcanics and the overlying sediments as disconformable rather than unconformable. For this reason the Edith River Volcanics are now considered as part of the A.B.C. Group.

Edith River Volcanics: This formation has been traced from the head of Katherine Gorge (Plate 1) to Coronation Hill. It underlies the Fanny Creek Formation in the Sleisbeck Area and unconformably overlies the Middle Creek Granite near the head of the South Alligator River. As at Edith River (Rattigan and Clarke, 1953) the formation consists of acid volcanics - rhyolites and dacites with thin intercalations of sediments. Flow banding is prominent in some members north of Sleisbeck, and fine ash beds and micaceous and tuffaceous sandstones are also present.

LOWER PROTEROZOIC

General

Plate 8 shows the area mapped by the 1954 survey and areas covered by other workers since 1948.

From detailed study of the Lower Proterozoic sediments

of the Pine Creek Geosyncline during 1954 the Brocks Creek Group (Noakes, 1949) has been partly subdivided into formational units. The spatial distribution of the units and their relationships to each other in regard to the evolution of the geosyncline are now established. A shelf facies, slope facies, and trough facies are recognised.

The shelf facies on the eastern margin of the Pine Creek Geosyncline has been studied in reconnaissance detail only and must necessarily be considered briefly in this report.

Plate 9 shows the broad outline of the eastern shelf margin of the geosyncline. The western shelf in the Katherine-Darwin region is covered by the upper member of the Lower Proterozoic succession. The Pine Creek geosyncline is a shallow trough with an irregular margin complicated further by the presence of at least one large delta; by variations in type of provenance and rate of deposition; by overlapping of the youngest member of the sequence from the trough back on to the shelf areas; and by regional foreset bedding and intense slumping of the beds of the slope facies, particularly those at the distal end of deltas.

Analysis of the geosyncline from the evidence available at present indicates that the trough zone is roughly oval and is centred on the Hayes Creek area (Pl to 3). The sediments exposed in this area are about 13000 feet thick. They are folded and the formations are repeated by complicated domal structures and regional change of pitch. The cores of the domes are occupied by granite. The pitch-change axes commonly strike north-east and are marked by zones of strong fracturing. A second direction of shearing strikes north-west to north and is well developed in the Pine Creek-Burrundie area. The break between shelf and slope facies on the eastern margin of the geosyncline is marked by a linear zone of block faulting (the South Alligator Fault Zone - Walpole, 1953) which strikes in a north-westerly direction. The intensity of tectonic folding decreases to the east towards the shelf area. The beds in the Mt. Masson-Frances Creek area (Plate 6) appear to be tightly folded, but the beds are contorted largely by regional slumping and regional foreset bedding. These rocks form part of the delta, shown on plate 9.

Reconnaissance mapping has shown that the youngest formation of the sequence overlaps the shelf and slope deposits with the result that abutment contacts between the Burrells Formation and Masson "Beds" occur on the southern margin of the delta. Mapping of this area has yet to be completed.

A prominent unit of the shelf facies is a bioherm al reef and reef breccia member which extends from Sleisbeck in the south to beyond Coirwong in the North (Plate 9). This unit in its varying facies is the dominant stratigraphical control of uranium mineralization in the Katherine-Darwin region. The importance of this control has been pointed out by Condon and Walpole (1955) and need not be further considered here.

The units recognized in the Lower Proterozoic sequence are described below. For the purpose of this report the sequence in the Rum Jungle area will be treated as one unit, the "Rum Jungle Beds", and will not be considered in detail.

Brocks Creek Group

Burrells Formation: The formation is named after Burrells Creek, a tributary of the Adelaide River. The beds are very well exposed in road cuttings on the Stuart Highway between Adelaide River Township and Burrells Creek. The formation has been named previously from several localities by different workers.

Previous names included Union Slates, Adelaide River Series, Pine Creek Series and Huldivan Series, Agicondi Series etc. given by various workers prior to 1940, and Snake Creek "Beds" (Frankovich and Firman, 1953). The present survey has proved the formation rank of this unit and its continuity between the numerous localities from which it had previously been named.

The known distribution of the formation is shown on plate 1.

Greywacke, siltstone and greywacke siltstone are the dominant rock types present. The beds are lenticular, commonly buff colour and are considered to be typical trough-type deposits. A prominent member is a bed which is referred to by the field name of "tombstone greywacke". This member is a calcareous greywacke which typically crops out as flat slabs of rock, grey in colour and commonly silicified in the surface exposures. Other rock types present within the formation are conglomerate, sandstone, tuffaceous sandstone, calcilutite, and impure limestone.

The thickest measured sections of the Burrells Formation are in the Hayes Creek area, where about 8,000 feet of sediments are present.

The beds thin out to both east and west. Reconnaissance mapping in the Mary River-Alligator River area shows that the formation in this region is only a few hundred feet in thickness. The same conditions hold in the Daly River area, where Searl and Frazer (Rio Tinto Coy. personal communication) have mapped approximately 2,500 feet of sediments belonging to this unit.

In most places in the area mapped, the contact between the Burrells Formation and the underlying Knights Formation is faulted of is complicated by asymmetrical folding, incipient faulting, and slumping in chert members of the Knights Formation. In the Mt. Bonney area, however, a gradation between the two units is present.

Knights Formation: The type section for this unit is exposed at Knights Creek (Plate 6). The formation is mainly composed of quartz siltstone and chert. Less dominant members are carbonaceous rocks, limestone, greywacke and thin bedded calcilutite and siltstone. The formation is extensively intruded by sills of a complex suite of basic rocks, which have been folded with the sediments.

East of the McKinley River (plate 1) the main rock type within the formation is chert. In the Knights Creek area, the chert member is interbedded with quartz siltstone and carbonaceous rocks and with minor limestone lenses. Further west in the Cosmopolitan Howley-Bridge Creek area (plate 3) the massive chert member is absent and the rock types present are quartz siltstone, "banded iron formation" (consisting of pyritic and hematitic siltstone interbedded with thin lenses of chert), thin bedded calcilutite, carbonaceous rocks, and limestone.

The distribution of the chert and quartz siltstone members suggests an eastern provenance for the chert and a western or northwestern provenance for the clastic rocks.

A belt of lineated mica schists with associated tin-bearing pegmatites crops out in the area between the Cosmopolitan Howley Mine and Mt. Shoobridge (plate 3). This belt coincides with what is considered to be the centre of the trough zone of the geosyncline.

Masson "Beds": Quartz greywacke, siltstone, banded iron formations, greywacke conglomerate, quartz conglomerate, and limestone crop out east of the McKinley River (plates 4 and 6) and extend to the east beyond the Mary River. The sequence has been tentatively named the Masson "Beds" from Mt. Masson Tin Mine area.

Further mapping is required before the rank of this unit is established.

The north and western boundaries of the unit are against cherts of the Knights formation.

The western boundary is marked by intense slumping of both the Masson Beds and the Knights Formation and by a linear belt of basic intrusives. The general picture is one of steeply dipping foreset bedding, complicated by slumping and incipient faulting and later tectonic folding.

The southern boundary of the Masson Beds is against the Cullen Granite on the Burrundie Sheet (plate 6). Reconnaissance mapping on the track between the Mary River and Goodparla Station has indicated an abutment contact between Masson Beds and Burrells Formation (Plate 9).

The Masson Beds mapped to date appear to form part of a large delta. (Plate 9). The distal edge of this delta is on the western margin of the Masson Beds adjacent to the McKinley River.

Reconnaissance mapping has shown that the eastern shelf area of the geosyncline lies east of the Mary River Area.

Correlation Between Rum Jungle "Beds" and Mt. Masson "Beds"

A broad correlation may be drawn between these areas on the basis of a similar sedimentary environment. The main marker facies - the biohermal limestone member - is present in both areas and a similar stratigraphical control of mineralization is present. The areas must however be considered as separate entities, as there is no likelihood of continuity of outcrop of the shelf facies between each area or continuity of the sediments involved at depth. The Rum Jungle Beds possibly represent an island arc within the Pine Creek geosyncline, or represent a portion of the western margin of the geosyncline which has not been covered by overlap by the upper members of the Lower Proterozoic succession.

GRANITIC ROCKS

Several petrologically similar granitic bodies intrude the Lower Proterozoic sediments. The granites are biotite granites with local variations in texture.

The largest granite mass is the Cullen Batholith (Noakes 1949), Plate 1., a transgressive granite mass which is divided into two arms by a narrow embayment of Lower Proterozoic sediments. (Plate 5). The western arm extends to the north as far as Hayes Creek; the eastern arm steps over to the east, north of Esmeralda Homestead, and then continues in a broad curve north to the Mt. George area. A cupola of the Cullen Batholith, the McKinlay Granite, is exposed in the embayment between the eastern and western arms.

The Cullen Granite is remarkably uniform in composition and texture in the area mapped during 1954.

Rattigan and Clarke (1953) noted different "hybrid" types of granite within the batholith - the "Edith Crossing type", "Keenie Creek type" etc. Later petrological examination by D.A. White has shown that these "different" types are actually sharp variations in texture without variation in composition.

Other but much smaller granitic bodies have been mapped. These are listed in Table 1 and shown on plate 1.

The mechanism of intrusion of the granites warrents further study. Any such mechanism must explain the large size and the shape of the Cullen and Lithfield Batholiths; the uniform character of the Cullen; the rarity of country-rock xenoliths in the granites; the intrusion of granite bodies such as the Middle Creek and Litchfield granites into the shelf areas of the geosyncline; the apparently thin cover available to some of the intrusive masses. Some granites such as the Brocks Creek Granite were intruded into the cores of domal structures. Other granites such as the eastern arm of the Cullen were intruded along pre-existing lines of weakness - the southern edge of the deltaic deposits (Masson Beds) and a system of arcuate fractures. The shape of the Prices Springs Granite is partly determined by the fold pattern and partly by fracturing.

Granite intrusion along the lines of fracture was quiet in nature and where an obvious fracturing control is present, contact effects are very slight. In the Fergusson River area intrusion was more violent and was followed by dyke /and emplacement/the outpouring of volcanics (Fergusson River Volcanics). In this area the "different" types of granite noted by Fisher (1952) and Rattigan and Clarke (1953) occur. It is probable that a minor cauldron subsidence with accompanying vulcanism took place.

Small patches of gabbro and syenite have been noted on the edge of the Cullen Batholith near Frances Creek (Plate 6). These are not regarded as seperate intrusions but as local concentrations of volatiles.

Contact effects generally are slight and in some places are negligible. Spotted hornfels and, where carbon is present in the intruded sediments, chiastolite - bearing rocks, are the main metamorphic rocks produced. Andalusite schists have been formed on the eastern margin of the Litchfield Batholith in the Daly River area.

A garnetiferous granite crops out in the Nanambu Creek area (plate 1). This granite is possibly part of the basement complex from which the sediments of the Pine Creek geosyncline were derived.

RECOMMENDATIONS FOR FUTURE WORK

Future work should trace the extent of the biohermal reef environment along the eastern edge of the Pine Creek geosyncline north of Coirwong Gorge.

The presence of deltaic deposits in the Mt. Masson-Frances Creek area suggests that the portion of the Alligator River Valley north from near the present U.D.P. reservation to Coirwong Gorge may not be a suitable sedimentary environment for uranium deposition. Prospecting for new deposits should be carried out north of Coirwong. The recommended areas are indicated on plate 9.

There is little possibility of a major discovery of uranium ore being made in the Katherine-Darwin region outside

this zone - the shelf area of the Pine Creek geosyncline - although further discoveries of the dimensions of the Adelaide River and Fleur deLys mines may be made.

A programme of mapping designed to complete the study of the Pine Creek geosyncline will be carried out during the 1955 field season. This will include mapping on a scale of 1 inch = 1000 feet where warranted; close study of the western margin of the outcropping Lower Proterozoic rocks; further study of the Upper Proterozoic succession; and closer correlation of the Rum Jungle sequence with units mapped during 1954.

Regional gravity and aeromagnetic work has been planned to assist in the interpretation of the geosyncline.

REFERENCES

A.G.G.S.N.A., 1935-1940 - Periodical Reports of the Aerial Geological and Geophysical Survey of North Australia.

Condon, M.A. and Walpole, B.P., 1955 - Sedimentary environment as a control of uranium mineralisation in the Katherine-Darwin Region, N.T. Bur.Min.Resour. Aust.Rec. 1955/6.

Dapples, E.C., Krumbein, W.C., and Sloss, L.L., 1948 - Tectonic Control of Lithologic association. Bull.Amer. Ass.Petrol.Geol., 32, 1924-1927.

Firman, J.B., 1955 - Diamond Drilling at the Burrundie radioactive prospect. Bur.Min.Resour.Aust.Rec. 1955/7.

Hossfeld, P.S., 1937 - The Tin Deposits of the Buldiva-Collia Area, Daly River District. Aer.Surv.N.Aust.Rep. N.Terr. 18.

Noakes, L.C. 1949 - A Geological Reconnaissance of the Katherine-Darwin Region, Northern Territory. Bur.Min.Resour.Aust.Bull. 16.

_____, 1953 - Structure of the Northern Territory. Vth Emp.Min.Congr. 1, 284.

Rattigan, J.H. and Clark, A.B., 1953 - Geology of the Katherine, Mt. Todd, Lewin Springs One Mile Sheets, N.T. Bur.Min.Resour.Aust.Rec. 1955/54

Stewart, J.R., 1954 - Reconnaissance geological report Burrundie radioactive prospect reservation. Bur.Min.Resour. Aust.Rec. 1954/43.

Sullivan, C.J. and Iten, K.W.B., 1952 - The Geology and Mineral Resources of the Brocks Creek District, Northern Territory. Bur.Min.Resour.Aust.Bull. 12.

Trefethen, J.M., 1947 - Some Features of the Cherts in the vicinity of Columbia, Missouri. Amer.J.Sci., 245, 1, 49-55.

Voisey, A.H., 1937 - Geological Report on the Woolwonga Area, Pine Creek District. Aer.Surv.N.Aust.Rep.N.Terr. 12.

_____, 1939 - Notes on the Stratigraphy of the Northern Territory of Australia with special reference to the Jurassic. Proc.roy.Soc.N.S.W. 72: 136.

Walpole, B.P., 1952 - The Maranboy Tinfield Progress Report. Bur.Min.Resour.Aust.Rec. 1952/31.

_____, 1953 - Coronation Hill Uranium Prospect, N.T. Bur.Min.Resour.Aust.Rec. 1953/148.

White, D.A., 1954 - Some Observations on Laterites on the Northern Territory. Aust.J.Sci. 17, No.1.

_____, 1954 - Preliminary Report on Cowan's and Hale's Prospect South Alligator River Area. Unpublished.

White, D.E., 1947 - Diagenetic Origin of Chert Lenses in Limestone of Soyatal, State of Queretaro, Mexico. Amer.J.Sci., 245, 1, 49-55.

PROGRESS MAP
REGIONAL GEOLOGY • KATHERINE-DARWIN

Grid as shown is Index to 1 Inch to 1 Mile Military Series.

Bureau of Mineral Resources, Geology and Geophysics : March 1955.

SCALE OF MILES

10 5 0 10 20 30 40

RECENT
- Qed — Soil and alluvium
- TmP — Laterite over Proterozoic

LOWER CRETACEOUS
- Klm — Mullaman Group

PERMIAN
- Ppk — Port Keats Group

MIDDLE CAMBRIAN
- Cmd — Daly River Group
- Cl — Leight Creek Volcanics
- Ccv — Collia Volcanics

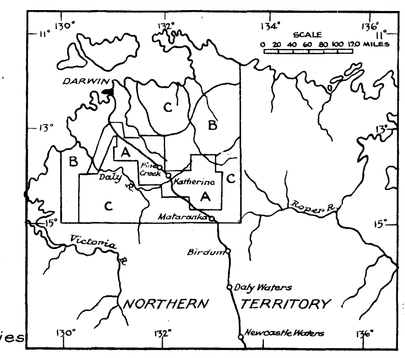
UPPER PROTEROZOIC
- Pus — Stray Sandstone
- Pu — Undifferentiated
- Pud — Depot Sandstone [Buldiva Quartzite?]
- PuA — A.B.C. Group (Undifferentiated)
- Puw — Bronzewing Formation
- Puv — Birdie Volcanics
- Puf — Fanny Creek Formation
- Pue — Edith River Volcanics
- Puv — Volcanics (Undifferentiated)

LOWER PROTEROZOIC
- PlB — Brocks Creek Group (Undifferentiated)
- Plb — Burrells Formation
- Plk — Knights Formation
- Plm — Masson Beds
- Plr — Rum Jungle Beds
- Pld — Dorothy Creek Volcanics

IGNEOUS ROCKS
- Granite
- Basic rocks
- Grace Porphyry
- Fergusson Volcanics
- Marenboy Greisens and Porphyries

U — Uranium Mines and Prospects

Note: Geological Information to 1954.

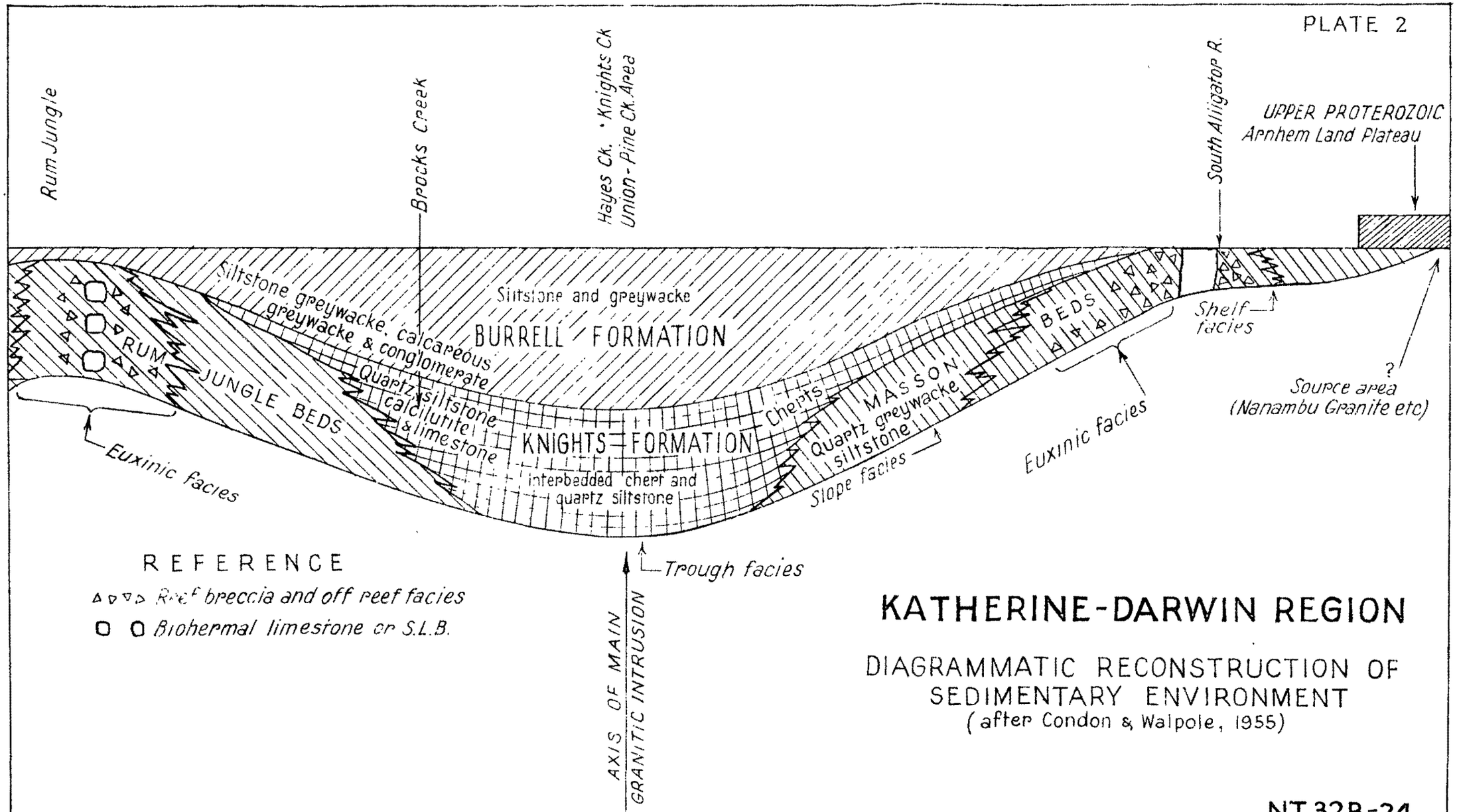


RELIABILITY DIAGRAM

- A — Detailed Mapping
- B — Reconnaissance
- C — Sketchy

NTG 33/1

PLATE 2



REFERENCE

▲▽▲▽ Reef breccia and off reef facies

O O Biohermal limestone or S.L.B.

KATHERINE-DARWIN REGION

DIAGRAMMATIC RECONSTRUCTION OF SEDIMENTARY ENVIRONMENT

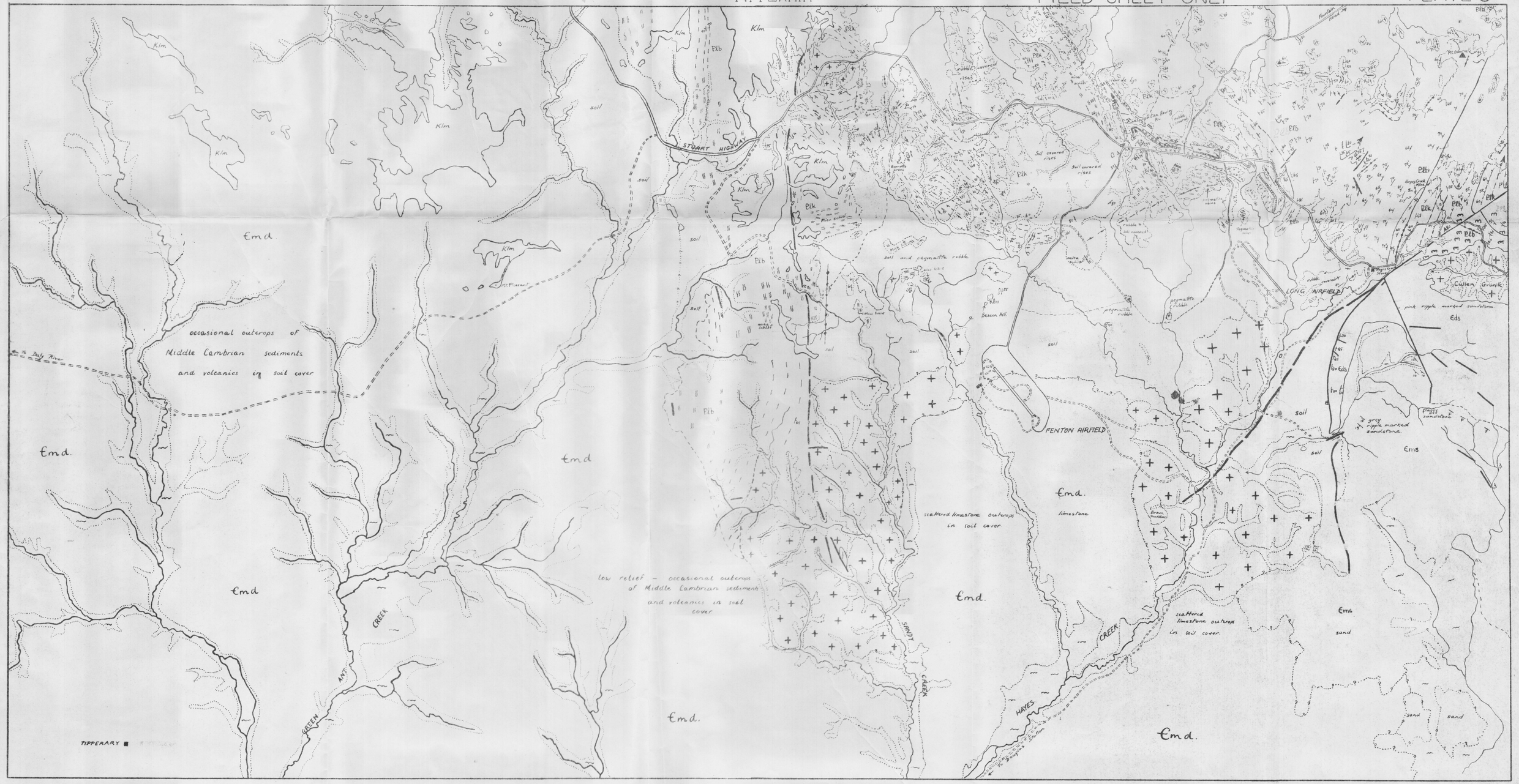
(after Condon & Walpole, 1955)

NT 32B-24

Bureau of Mineral Resources, Geology & Geophysics - May 1955

M.S.

TIPPERARY FIELD SHEET ONLY PLATE 3



BAN BAN WEST

FIELD SHEET ONLY

PLATE 4

BAN BAN EAST

FIELD SHEET ONLY

PLATE 4

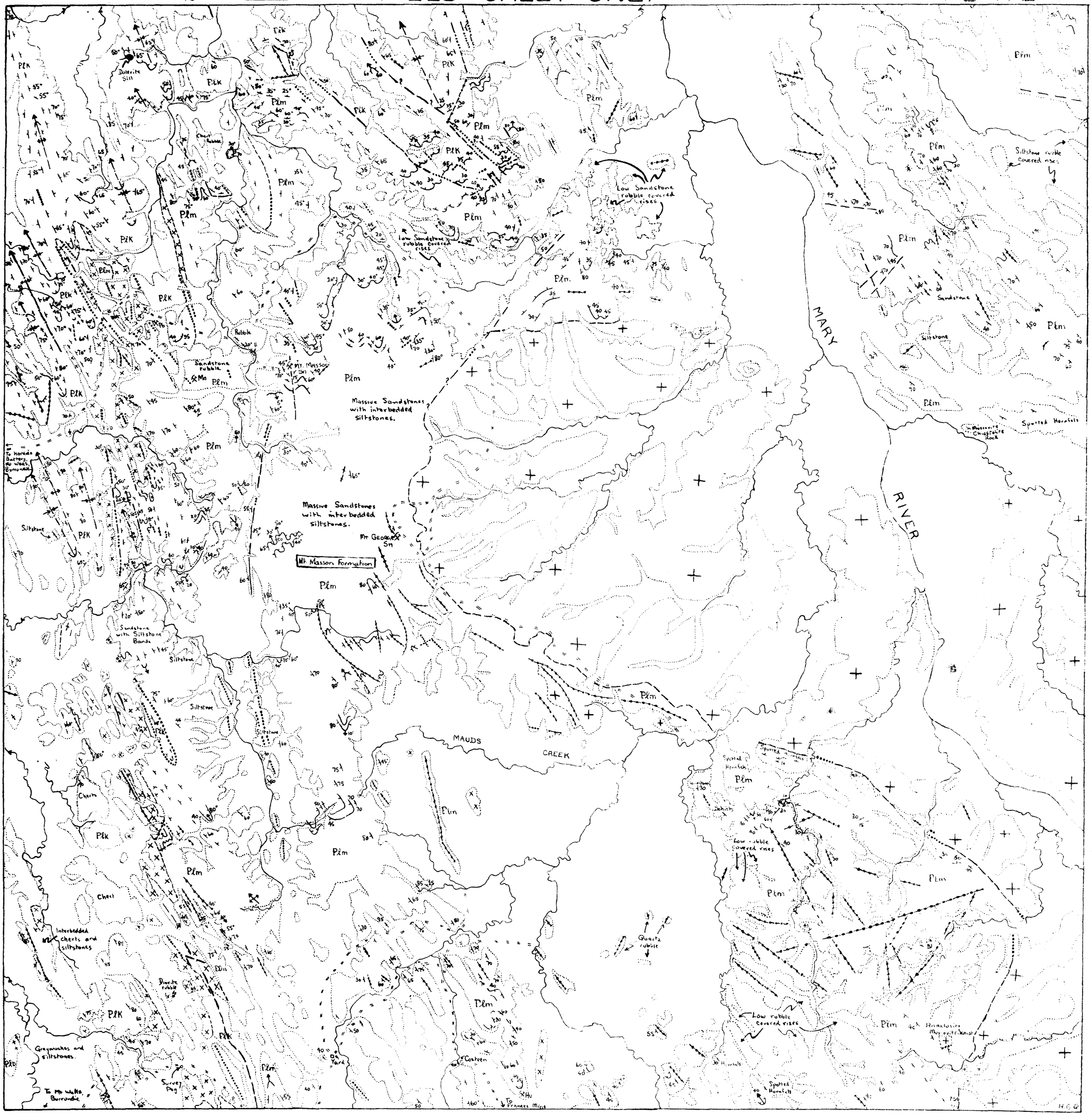


TABLE TOP WEST

FIELD SHEET ONLY

PLATE 5

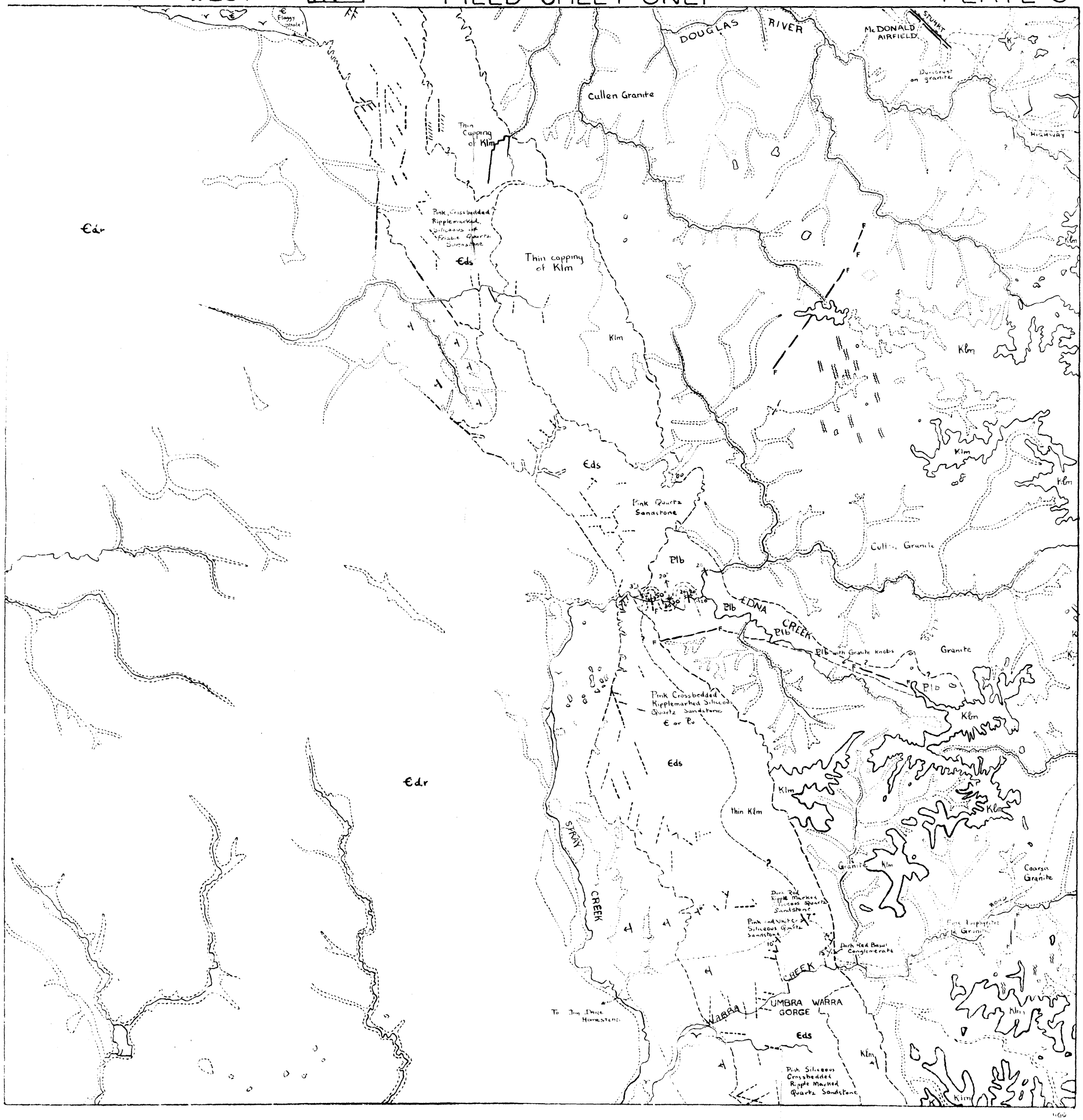


TABLE TOP EAST

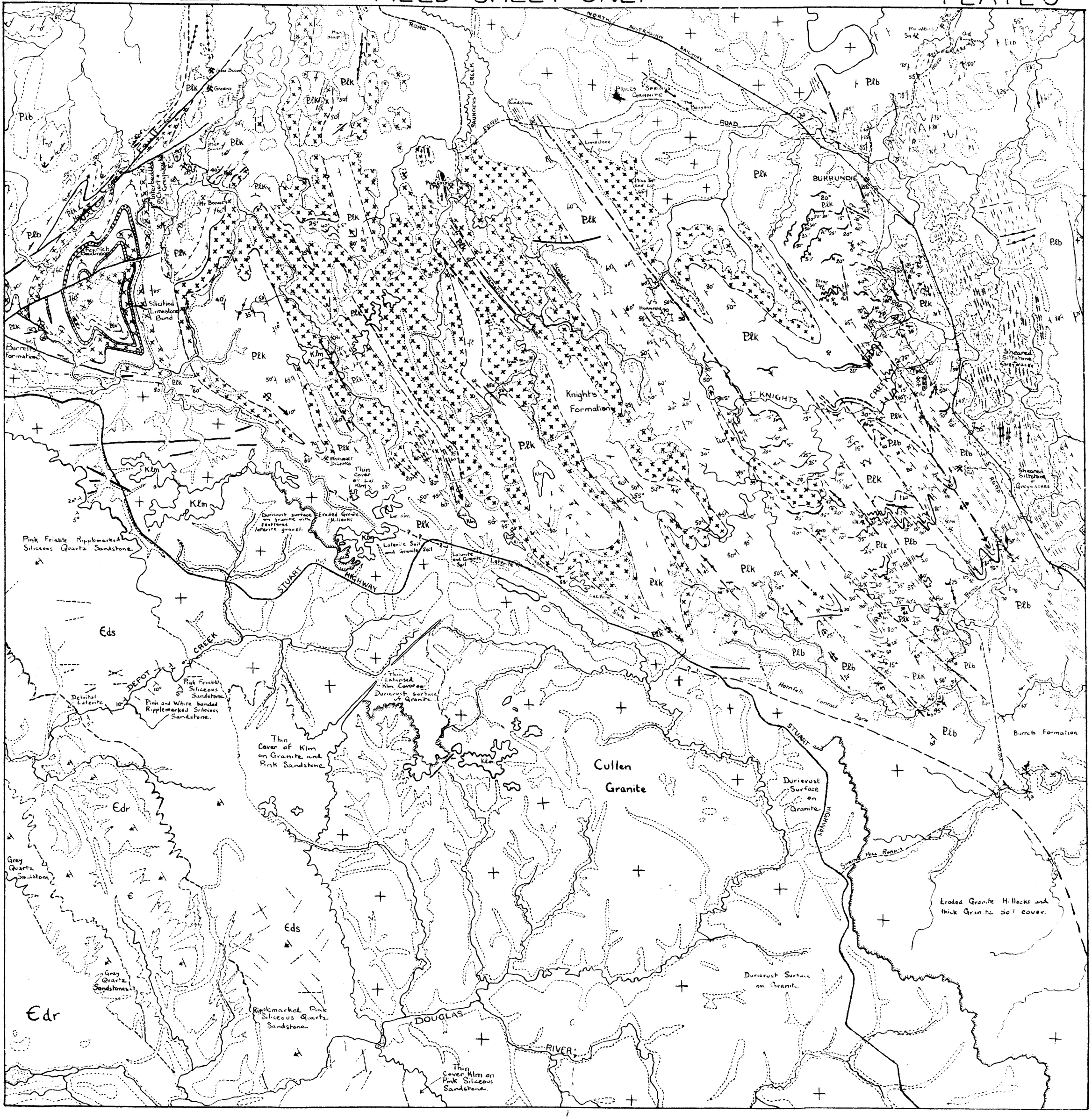
FIELD SHEET ONLY

PLATE 5

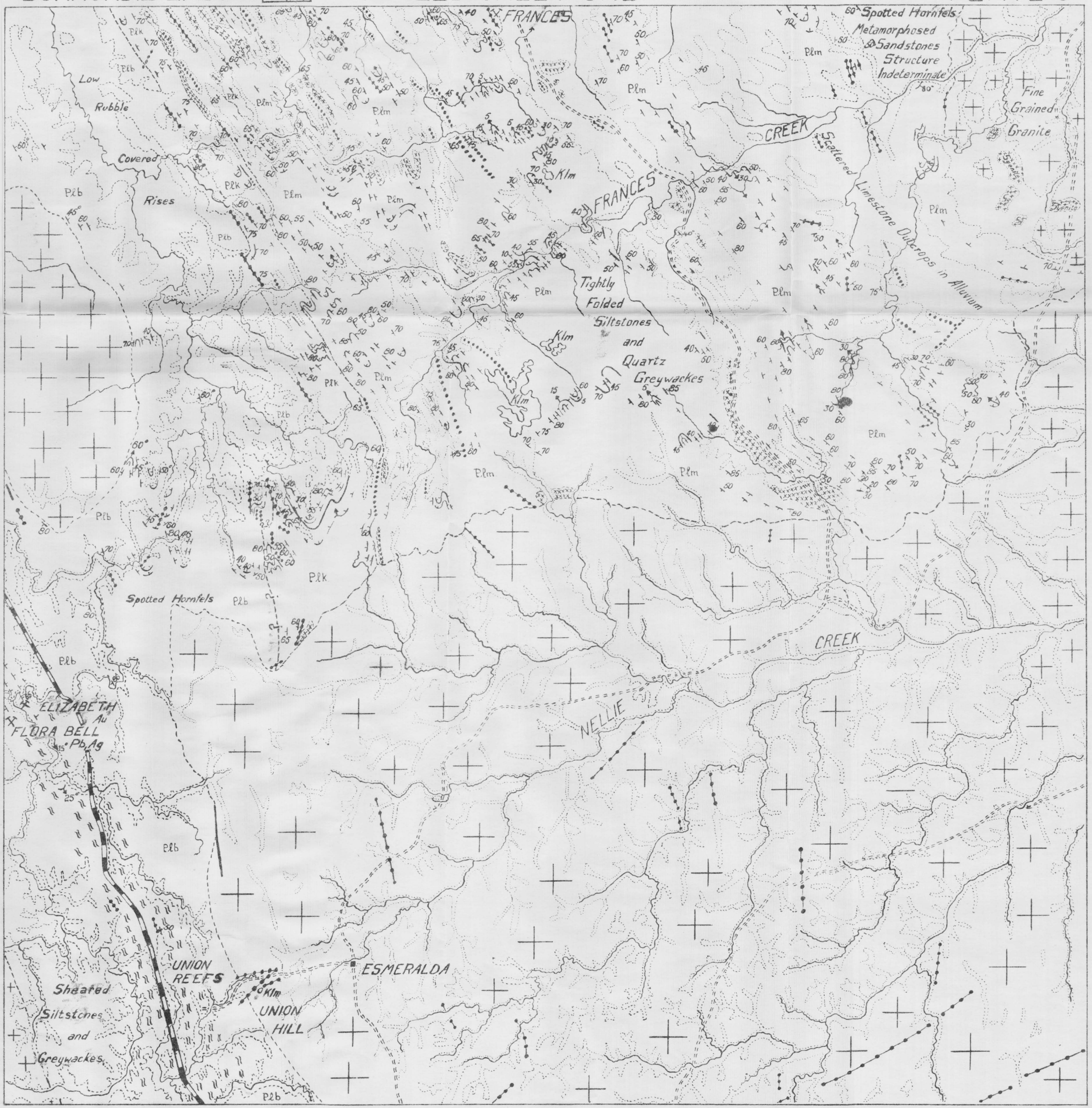
BURRUNDIE WEST

FIELD SHEET ONLY

PLATE 6



BURRUNDIE EAST ▭ FIELD SHEET ONLY PLATE 6



GEOLOGICAL MAP OF THE SLEISBECK DISTRICT NORTHERN TERRITORY

SCALE : 1 INCH = 1 MILE

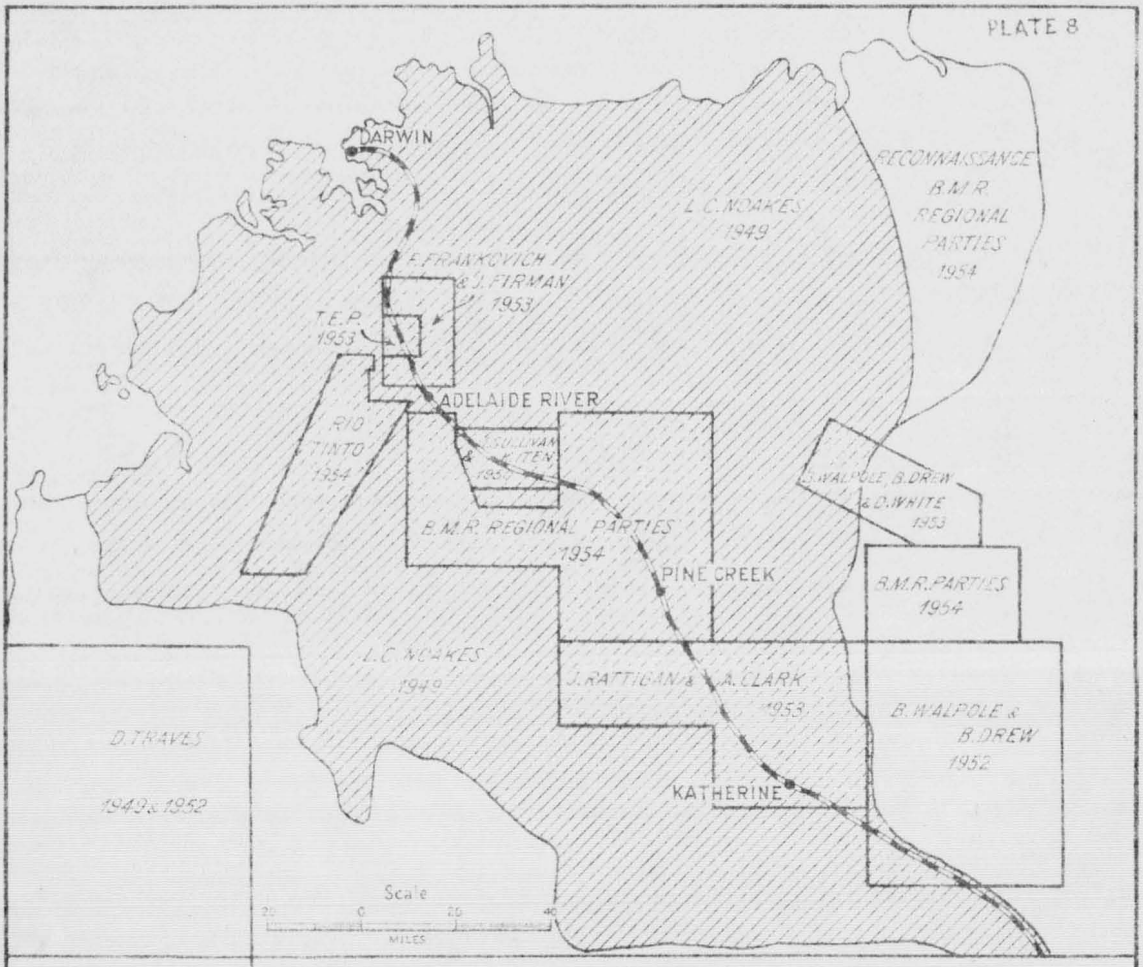
MAPPED DURING AUG. & SEPT. 1954
BY B. WALPOLE, E. MALONE, R. STEWART, P. DUNN.

FIELD SHEET ONLY

Mt. Evelyn 1 mile area.
Mt. Stow 1 mile area.
Mt. Harvey 1 mile area.

Bureau of Mineral Resources, Geology and Geophysics.

PLATE 8



Geological Mapping

KATHERINE-DARWIN REGION N.T.

1949-1954

BUREAU OF MINERAL RESOURCES

L.C.NOAKES, 1949-8 miles to 1 inch (shaded)
J.SULLIVAN & K.ITEN, 1950-1 mile to 1 inch
D.M.TRAVES, 1949 & 1952-4 miles to 1 inch
B.WALPOLE & B.DREW, 1952-1 mile to 1 inch
J.RATTIGAN & A.CLARK, 1953-1 mile to 1 inch
F.FRANKOVICH & J.FIRMAN, 1953-1 mile to 1 inch
B.WALPOLE, B.DREW & D.WHITE, 1953-1 mile to 1 inch
B.M.R.REGIONAL PARTIES, 1954-1 mile to 1 inch
TERRITORY ENTERPRISE PTY. 1953-½ mile to 1 inch
RIO TINTO CO. 1954

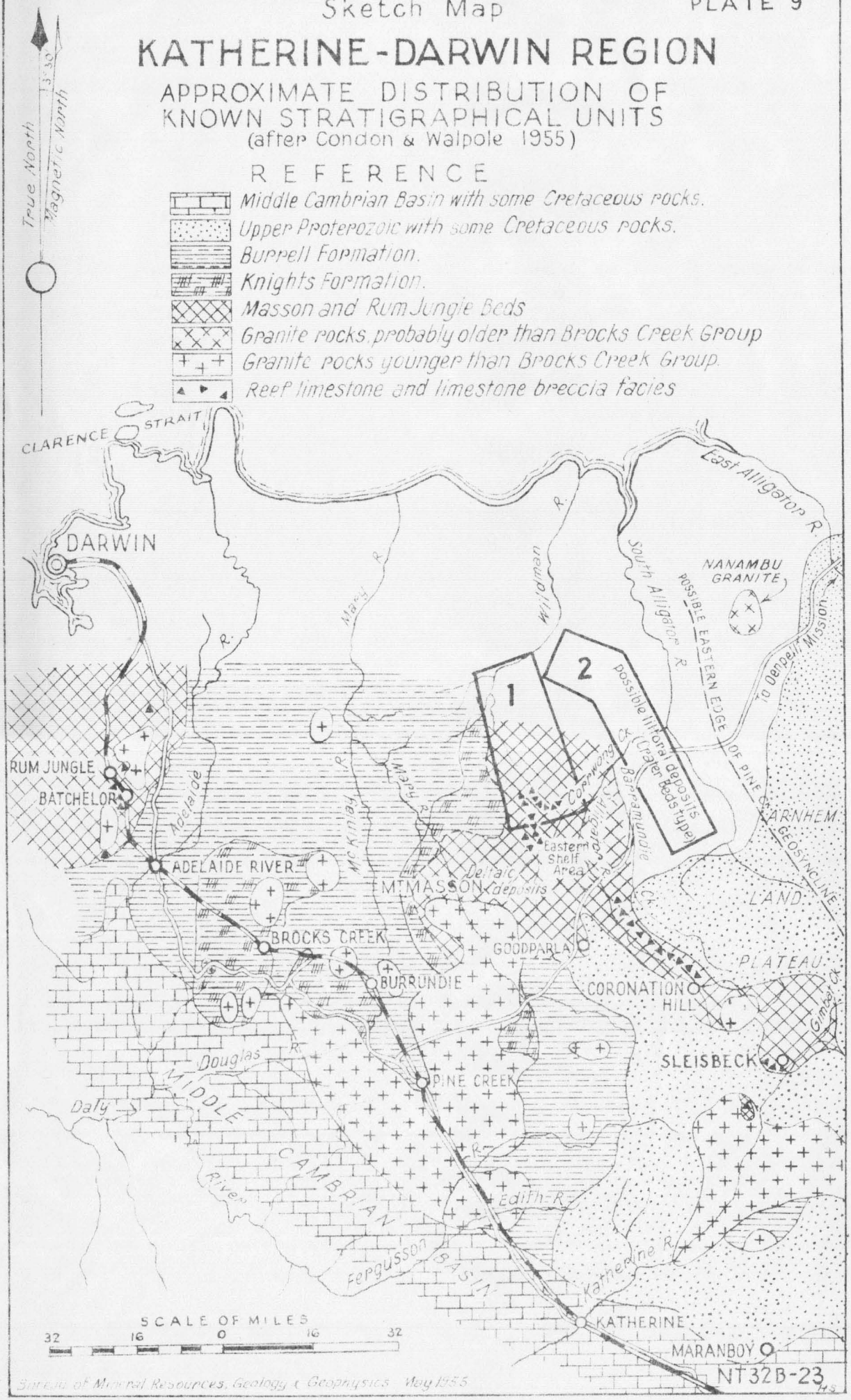
Sketch Map

PLATE 9

KATHERINE-DARWIN REGION

APPROXIMATE DISTRIBUTION OF KNOWN STRATIGRAPHICAL UNITS

(after Condon & Walpole 1955)



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NT32B-23