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THE GEOLOGY OF THE COTTER RIVER AND URIARRA AREA, AUSTRALIAN CAPITAL TERRITORY.

by

D.K. Malcolm.

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GEOLOGY OF COTTER - URIARRA AREA

SUMMARY.

The results of the first detailed survey of the Cotter River and Uriarra Area are recorded.

A Middle Silurian formation, the Paddy's River Volcanics, was mapped and defined. The undifferentiated Upper Silurian volcanic rocks, extending from Mount Stromlo in the east to Pig Hill in the west, were mapped in detail, and two formations, the Dacite Porphyry and the Uriarra Volcanics (which contains the Walker, Tarpaulin, Swamp Creek and Vanity Members) were defined.

The northern end of the Murrumbidgee Fault was mapped and a major normal fault, the Winslade Fault, running north-westerly through the Cotter Pool area, was discovered. The southerly extension of the previously mapped Pig Hill Fault was located.

INTRODUCTION

This work was undertaken to provide a detailed geological map of the Cotter River Uriarra area. Certain problems arising from a previous regional survey of the area were investigated in detail. These were:

(a) Determination of the nature and extent of the Cotter "porphyry"

(b) Division of "undifferentiated" Silurian lavas, tuffs and porphyries into units;

(c) the location of the continuation of the Murrumbidgee Fault, if present, in the lower Cotter River area.

PREVIOUS INVESTIGATIONS.

Regional surveys in the area had been carried out by student geologists Orme and Harris (Noakes, 1948a and Walpole, 1949); other work has been limited to detailed investigation of proposed dam-sites on the Cotter River, Pierces Creek (Noakes, 1946 a & b, 1948b), and Coree Creek (Burton and Johnstone, 1948).

GEOLOGICAL MAPPING

The field work was carried out in interrupted periods from early January to mid-May 1954 under the supervision of L.C. Noakes and G.M. Burton. Personnel engaged were student geologists G.E. McInnes, V.G. Swindon, K.L. Williams and D.K. Malcolm in January and February, P.A. Hoelscher and Malcolm in February and March, and Malcolm from March to May.

The Brindabella East 1-mile Sheet, supplemented by a full coverage of aerial photographs, provided a basis for geological mapping. A large number of closely spaced detailed foot and Jeep traverses was carried out. The route of each traverse was plotted in the field on aerial

photographs. Geological data were later plotted on the base map on a scale of 40 chains to the inch.

STRATIGRAPHY

The stratigraphical succession of the area is set out in the accompanying table. New nomenclature has been introduced in the classification of the Upper Silurian volcanic succession. *(See Footnote).

ORDOVICIAN

FRANKLIN FORMATION

The Franklin Formation, previously named and described in the upper Cotter Valley, was laid down mainly as shale, quartzose sandstone, tuffaceous sandstone and subgreywacke, and has been modified by regional metamorphism into phyllite, silicified sandstone and quartzite. In general the grade of regional metamorphism is very low. Hornfels and high rank quartzite occur close to the granite intrusions.

The formation has a roughly northerly trend and is strongly folded. The main belt running northwards from the upper Cotter River through Coree Creek and Urayarra Trig. Point is a large overturned anticlinal structure plunging at a low angle to the north. Lower Devonian rhyolites of the Mountain Creek Volcanics lie unconformably upon or are faulted against the western boundary. To the east the formation dips under dacitic lavas of the Middle Silurian Paddy's River Volcanics; indicating overturning. Owing to folding of the Ordovician and Middle Silurian successions this disconformable contact appears conformable.

The thin belt of quartzite and phyllite along the western bank of the Murrumbidgee River is overlain to the west by Middle Silurian volcanics, and to the east is bounded by the Murrumbidgee Fault with Upper Silurian dacite porphyry on its eastern or down-throw side.

The only fossils so far obtained from the formation are middle Upper Ordovician graptolites from a few widely scattered localities - Mount Murray Military Sheet co-ordinates (940313), and Mount Franklin. Possibly some of the quartzite and phyllite now included in the Franklin Formation is of Lower Silurian age, i.e. the equivalent of the Tidbinbilla Quartzite.

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* Some of the names have not been published (See Table 1). They should therefore not be used in any publication without formal definition.

TABLE 1 - STRATIGRAPHY AND LITHOLOGY

	Name and Classification	Subdivision	Lithology	Thickness
Lower Middle Devonian	* Condor Granite		Hornblende microgranite	-
Lower Devonian	Mountain Creek Volcanics		Ashstone and agglomerate venta Rhyolite and rhyolite breccia	 1000' +
Lower Devonian or Upper Silurian	* McDonald Granite Murrumbidgee Granite		Dacite porphyry Granite porphyry Biotite granite	unknown - -
Upper Silurian	* Uriarra Volcanics	* Vanity member * Swamp Creek member * Tarpaulin member * Walker member	Dacititic lavas and tuffs Tuffs and lavas. (pink felspar types). Fine-grained tuff Pyroxene dacite, dacite with lenses of tuff and shale	3000' + 3000' + 20-50' 5000' +
	Deakin Volcanics		Lavas and tuffs	50' +
Middle Silurian	* Paddy's River Volcanics		Dacitic volcanics with lenses of lst. and sh. (highly sheared)	5000' +
Ordovician	* Franklin Formation		Quartzites, phyllites and sandstones etc.	unknown

* Name not formally defined and published. See Footnote p. 2

MIDDLE SILURIAN

PADDY'S RIVER VOLCANICS

The Paddy's River Volcanics is a thick formation of bedded lavas, mainly dacite, and coarse and fine grained tuffs. Intercalated in these volcanics are thin lenses of limestone, shaly limestone, siltstone, calcareous shale and phyllite. The type locality is along the lower reaches of Paddy's River immediately above the Cotter River junction.

The beds strike north-north-west and are steeply folded and highly sheared. In the Paddy's River area the formation lies disconformably upon and has been folded with the underlying Franklin Formation. West of Paddy's River the formation is cut off by granite of the Murrumbidgee Batholith. Selective metasomatic replacement of favourable beds (limestone, calcareous shale) has produced several metal deposits along the granite contact. These deposits consist dominantly of magnetite with minor galena, chalcopyrite, and sphalerite.

The maximum exposed thickness of the formation is in the Uriarra area. Here the formation, overturned steeply to the west, is overlain by the Ordovician Franklin Formation to the west and cut off by the Pig Hill Fault to the east. No accurate estimate of thickness can be made because of the severe folding and incomplete exposure. The formation is probably at least 5,000 feet thick.

The age of the formation has not been accurately established. The only fossils discovered are in the recrystallized limestone in Paddy's River and cannot be determined. It is suggested that the volcanics are of Middle Silurian age for the following reasons:

(a) The volcanics rest disconformably upon the Upper Ordovician Franklin Formation. The Lower Silurian Tidbinbilla Quartzite is either entirely absent in this area, or more likely, is included in the Franklin Formation.

(b) In the Uriarra area the Paddy's River Volcanics are on the upthrow side of the Pig Hill Fault. On the downthrow side are the Uriarra Volcanics, an unsheared, moderately folded Upper Silurian formation.

UPPER SILURIAN.

DEAKIN VOLCANICS

Small inliers of Deakin Volcanics occur as pendants in the dacite porphyry around the flanks of Mount Stromlo. This formation, previously described by Opik from the Canberra area, consists of acid volcanics, tuff, and fine-grained tuffaceous sandstone. The beds, which dip gently to the north-east, are not more than 50 feet thick.

URIARRA VOLCANICS

This previously undescribed formation consists of a very thick succession of lavas and tuffs. Petrologically the volcanics are all intimately related dacitic types.

However, division can be more or less accurately made in the field on specific textural and mineralogical characters. The type area is in the area including "Uriarra" Homestead, Uriarra Forestry Settlement and Uriarra Forest; hence the derivation of the name.

The formation has been divided into four members for which the names Walker, Tarpaulin, Swamp Creek and Vanity are proposed.

The volcanics, which in the field appear fresh and unsheared, dip constantly to the southwest at 20-40 degrees. Provided the dip is constant, the formation is about 17,000 feet thick; but if, as is suspected, shallow folded structures, concordant intrusions, or strike faults are present in the succession then the true thickness is considerably less.

The age of the formation is considered to be Upper Silurian. Though fossil evidence is lacking in the area investigated an Upper Silurian fauna has been obtained from a limestone lens in the northward continuation of the Walker Member.

As the formation is overlain disconformably in the Uriarra area by Lower Devonian rhyolites there appears little doubt that the formation lies wholly within the Upper Silurian.

The south-western and north-eastern boundaries of the formation have not yet been mapped as they lie outside the present area of investigation. To the west and north-west the formation is bounded by the Pig Hill Fault, which has faulted it against the Middle Silurian Paddy's River Volcanics. The eastern and south-eastern boundary is the Winslade Fault which cuts across the Franklin Formation, Murrumbidgee Granite and Dacite Porphyry. Thus structurally the formation consists of a large downfaulted, and probably infaulted, wedge.

Walker Member. Although the type area is in the vicinity of Uriarra Crossing the member is named from Walker Trig (967436) to avoid confusion of nomenclature. The dominant lithological type is a massive medium-grained dacite. It is rich in pyroxene in the Uriarra Crossing area, but pyroxene is replaced by biotite in the Cotter area. At Uriarra Crossing this dacite is underlain by a 20-foot band of shale and the shale by a medium-grained massive tuff that weathers to a distinctive reddish-brown colour.

The field occurrence of the pyroxene dacite has been the subject of considerable controversy. W.R. Browne (personal communication) considers it to represent an "intrusive" tuff. Other workers consider the dacite to be a concordant intrusion. The present writer inclines to the view that the dacite is a flow and that the apparently intrusive relationship between the dacite and the underlying shale is due to the flaking off and incorporation of shale fragments in and at the base of a flow. No conclusive evidence to support any of these contentions is at present available.

In the Cotter Dam area a massive medium-grained biotite dacite is exposed. In the past this dacite has been referred to by the local name of "Cotter Porphyry". The presence of banding and other flow structures and the non-intrusive nature of the contact with the overlying Tarpaulin Member strongly suggest that the dacite is a flow rather than an intrusion. Fine-grained and medium-grained tuff, which where weathered has a distinctive reddish tinge, underlies the dacite. This tuff, dipping 30-40° SW, is poorly exposed along the road east of Mount McDonald. Underlying the tuff are dacitic lavas characterized by an abundance of pink tabular feldspar. The best exposure of this type is at the western end of the Murrumbidgee River bridge (960371).

The type section indicates a thickness of at least 5,000 feet of predominantly dacitic lavas and tuffs. This is probably not the total thickness of the member as the eastern boundary has not been established.

Tarpaulin Member. The type locality for the Tarpaulin Member of the Uriarra Volcanics is on the Uriarra Road (940434). The name is derived from the nearby Tarpaulin Creek. The unit consists of a massive fine-grained dark-grey tuff, which in places is prominently banded. Weathering to a very pale grey, this member forms a distinctive horizon and a very useful marker in the formation. The thickness ranges from 20 feet in the Cotter River Valley to 50 feet in Uriarra Creek.

Swamp Creek Member. The type locality is along the upper reaches of Swamp Creek from which the name is derived. Although the lithology appears monotonously uniform in the field, petrological investigation has revealed the presence of both lavas and tuffs of medium-grained dacitic type, characterized by abundant tabular reddish feldspar phenocrysts and large irregular dark green chloritic patches in the groundmass. The member is up to some 3,000 feet thick.

Vanity Member. The type area for the Vanity Member is in the vicinity of Vanity's Crossing, in the upper Cotter Valley. Because of the rugged terrain the full extent of this member has not yet been determined, nor has the lithology been examined in detail. Essentially it consists of a sequence of medium-grained and fine-grained dacitic lavas, interbedded with fine-grained tuffs. The thickness is estimated to exceed 3,000 feet.

MURRUMBIDGEE GRANITE.

The Murrumbidgee batholith covers a large area south of the Winslade Fault and west of the Murrumbidgee Fault. It is emplaced in Ordovician sediments and Middle Silurian volcanics, inliers and pendants of which occur within the main granitic mass. The intrusion is concordant and meridional in trend. In general the granite does not greatly modify the intruded sediments. Metamorphism is confined to the production of a few narrow zones of hornfels and quartzite in the Franklin Formation and mineralization of limestone and shale lenses in the Paddy's River Volcanics.

Little variation can be noted within the granite in this area. Essentially it is a massive porphyritic biotite-rich variety with sporadic porphyroblasts of feldspar up to 2 inches long. Along the margins small areas of granite

are gneissic.

McDONALD GRANITE.

The small sill-like body of granite porphyry intruding the Uriarra Volcanics in the Mount McDonald area is named, for convenience of reference, the McDonald Granite. The sill, which extends northwards from McDonald for about 2 miles, is concordant and dips gently westwards. Though it is basically a granite porphyry, much of the mass consists of hybridized types.

The McDonald Granite is considered to be a sill-like extension from the roof of the Murrumbidgee batholith. If so the Murrumbidgee batholith, in this area, must have been emplaced at the end of the Silurian or the beginning of the Devonian.

DACITE PORPHYRY.

An intrusion of dacite porphyry occupies a large area east of the Murrumbidgee River. To the north-east it is bounded by the Winslade Fault and to the south-west by the Murrumbidgee Fault. The eastern boundary lies outside the area under investigation and has not been mapped. The porphyry intrudes Deakin Volcanics, pendants of which remain around the flanks of Mount Stromlo. Vents filled with, and dykes of, ashstone and agglomerate occur in the porphyry.

Lithologically the porphyry is a medium to coarse porphyritic biotite dacite with abundant phenocrysts of quartz and plagioclase. Tuffaceous xenoliths are abundant locally. The porphyry is unstressed though locally closely veined with quartz-epidote or quartz-hematite.

This dacite porphyry appears to be part of the Mount Painter Porphyry of Opik (1954) (to which it is lithologically similar) but the eastern boundary of the intrusion must be defined before this view can be confirmed or disproved.

LOWER DEVONIAN

MOUNTAIN CREEK VOLCANICS.

The Mountain Creek Volcanics, previously described by Walpole (1949, 1952), consist of a thick sequence of rhyolite and rhyolitic agglomerate.

Two separate outcrops occur in the area mapped. In the Uriarra area a thin meridional belt of rhyolite lies disconformably on Upper Silurian Uriarra Volcanics. To the west the sequence is faulted by the Pig Hill Fault against Middle Silurian Paddy's River Volcanics. The strongly flow-banded rhyolites dip to the south-west at 30-40 degrees. The maximum thickness in the area mapped is approximately 1,000 feet.

In the Mount Coree area a very thick succession of rhyolites overlies the Franklin Formation. At present there is insufficient evidence to indicate whether the contact is faulted or unconformable. At the northern end of Blue Range near the Two Sticks Road, rhyolites are faulted against a thin wedge of highly sheared dacitic volcanics

closely resumbling those of the Paddy's River Volcanics.

In Condor Creek the rhyolites are intruded by the Condor Granite.

ASHSTONE AND AGGLOMERATE VENTS.

Several large dyke-like bodies and vents of extremely fine-grained ashstone and coarser agglomerate occur in the dacite porphyry west of Mount Stromlo. These steeply dipping dyke-like bodies, which generally strike north, range in thickness from a few feet to 100 feet. The age of emplacement is uncertain. Opik states that they closely resemble the Narrabundah Ashstone of the Canberra area.

YOUNGER THAN LOWER DEVONIAN.

CONDOR GRANITE

The transgressive Condor Granite, occupying an area of about $1\frac{1}{2}$ by $\frac{3}{4}$ mile, crops out in the headwaters of Condor Creek. It intrudes quartzite and phyllite of the Franklin Formation and rhyolite of the Lower Devonian Mountain Creek Volcanics. Lithologically it is a hornblende microgranite unrelated to either the Murrumbidgee or McDonald Granites.

The stratigraphical position of this intursion cannot be determined apart from the fact that it is younger than Lower Devonian. Lithologically the granite closely resembles Tabberabberan types from other areas.

STRUCTURAL GEOLOGY

FOLDING

Both the Franklin Formation and the Paddy's River Volcanics have been more or less intensely folded and the incompetent beds highly sheared. The apparently conformable contact between the two formations and the apparent conformity of the folding strongly suggest both were folded together (at or near the end of the Middle Silurian). Evidently the Benambran orogeny did not show a strong development in this area.

The median belt, consisting of the Franklin Formation and Paddy's River Volcanics, is essentially a large anticlinal structure, overturned in part, that plunges gently to the north. The exact location of the axis of the structure has not been determined.

As the overlying Upper Silurian and Lower Devonian formations consist entirely of volcanics it is difficult to determine the nature of the folding that affected them. It seems they were subjected to tectonic stresses that produced broad shallow folds. In the area mapped both Upper Silurian and Lower Devonian formations show a constancy of dip - 20-40 degrees to the west. Though the age of the folding cannot be accurately determined it is most likely attributable to the Tabberabberan orogeny.

FAULTING.

Three major faults are present in the area under investigation. The Murrumbidgee Fault, which had previously

been located, has now been accurately delineated. The Pig Hill Fault has been traced in a southerly direction to Vanity's Crossing, and a previously unknown fault (Winslade Fault) striking north-east has been mapped. All faults appear to be high-angle normal types of considerable, though varied, displacement. As sediments are almost entirely lacking in the area no quantitative estimate of the displacement of any faults can be made.

Murrumbidgee Fault

This is a large meridional high-angle normal fault with Upper Silurian dacite porphyry on the eastern or downthrow side and Ordovician sediments and Middle Silurian Volcanics on the west side. The throw of the fault decreases northwards: to the south towards Kambah, Upper Silurian dacite porphyry is faulted against Upper Ordovician sediments, whereas at the northward end of the fault the dacite porphyry of the same age is faulted against Middle Silurian volcanics.

The fault can be traced north to the Cotter River, where it is cut off by the Winslade Fault. No trace of the fault was found in the Upper Silurian Uriarra wedge.

The fault is probably related to the Bowning Orogeny. To the south it postdates the Murrumbidgee granite, and in the vicinity of Mount McDonald where granite of supposedly Bowning age intrudes Upper Silurian Volcanics, the fault does not appear.

Pig Hill Fault.

This meridional high-angle normal fault was first located and named by Walpole (1949). It has now been traced south to Vanity's Crossing and possibly links up with the Cotter Fault to the south.

The fault is most probably of Tabberabberan age, because in the Uriarra area Lower Devonian rhyolites are faulted against Middle Silurian Volcanics.

Winslade Fault.

The Winslade Fault is a high-angle normal fault and strikes north-east. The name is derived from Winslade Homestead on which holding the fault was first located. The fault has a large downthrow to the north near the Cotter River but the throw decreases to the east where Uriarra Volcanics are faulted against the Upper Silurian Deakin Volcanics and dacite porphyry. At its eastern end the fault is marked by numerous quartz reefs. To the south in the vicinity of Vanity's Crossing Upper Silurian volcanics are faulted against the Upper Ordovician Franklin Formation.

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APPENDIX 1.

LOCALITY INDEX OF SPECIMENS & THIN SECTIONS

Brindabella East (No.450) & Canberra (No.451)
1-Mile Series Military Sheet

Field Specimen Number	Thin Section	Location (Co-ordinates)	Unit	Rock Type	B.M.R. Museum Number
			in Form		
2628	X	B962361*	Franklin Formation	Indurated tuff	R6565
505	-	B926351	" "	Quartzite	R6566
568A	-	B877414	" "	Quartzite	R6567
568B	-	"	" "	Phyllite	R6568
267	X	B957365	Paddy's River Volcanics	Dacite	R6569
259	X	B956364	" "	"	R6570
284	X	B95835	" "	"	R6571
287	X	B957354	" "	Tuff	R6572
288	X	B957354	" "	Sheared Tuff	R6573
288A	X	B957354	" "	Dacite	R6574
291	X	B957358	" "	Tuff	R6575
292	X	B957355	" "	Dacite	R6576
296A	-	B959355	" "	Shaly limestone	R6577
296B	-	B959355	" "	Calcareous shale	R6578
298A	-	B960354	" "	Sheared dacite	R6579
299	-	B961352	" "	" "	R6580
404	-	B965341	" "	Dacite	R6581
405	-	B966341	" "	Agglomerate?	R6582
423A	-	B970336	" "	Banded Tuff	R6583
553	-	B902456	" "	Tuffaceous sandstone	R6584
554	-	B903458	" "	Sheared dacite	R6585
555	-	B902456	" "	Dacite	R6586
564	-	B885402	" "	Sheared Tuff?	R6587
584	-	B910449	" "	Sheared Dacite	R6588
132B	X	B000358	Deakin Volcanics	Tuff	R6589
149B	X	C018362*	" "	"	R6590
632A	-	C012365	" "	Dacite	R6591
148A	X	C016364	" "	Tuff	R6592
650	-	C012401	" "	Tuff	R6593

* Prefix B indicates Brindabella East Sheet, prefix C Canberra Sheet. First three figures give easting and last three northing.

197	X	B976386	Uriarra Volcanic Walker Member	Pyroxene dacite	R6594
200	X	B981397	" "	" "	R6595
213	X	B989389	" "	?	R6596
641A	X	B963469	" "	Pyroxene dacite	R6597
641B	-	B963469	" "	Tuff	R6598
361	X	B970383	" "	Hematized pyroxene dacite	R6599
643	-	B972419	" "	" "	R6600
352	X	B975390	" "	Biotite dacite	R6601
354	X	B970384	" "	Dacite (pink feldspar)	R6602
251	X	B966391	" "	Pyroxene dacite	R6603
643	-	B972419	" "	" "	R6604
645	-	B981423	" "	" "	R6605
648	-	B007408	" "	" "	R6606
87	X	B950376	" "	Dacite	R6607
72A	-	B954374	" "	"	R6608
83	-	B953368	" "	"	R6609
88	-	B948377	" "	Tuff	R6610
265	X	B955367	" "	"	R6611
301	-	B948373	" "	Dacite	R6612
316	-	B943387	" "	Tuff	R6613
367	-	B861385	" "	Dacite	R6614
368	X	B958383	" "	Dacite (pink feldspar)	R6615
523	-	B940434	Tarpaulin Member	Tuff	R6616
600A	X	B940365	" "	Banded Tuff	R6617
58	X	B93699	Swamp Ck Member	Dacite (pink feldspar)	R6618
533	-	B939432	" " "	Dacite Tuff(pink feldspar)	R6619
538	-	B938420	" " "	" " " "	R6620
541	X	B940407	" " "	" " " "	R6621
600B	-	B940365	" " "	" " " "	R6622
503	-	B927354	Vanity Member	Dacitic Tuff	R6623
504	-	B926351	" "	" "	R6624
516	-	B890326	" "	Pyroxene dacite	R6625

10	-	B924343	Murrumbidgee Granite	Biotite granite	R6626
282B	X	B953358	"	Porphyritic biotite granite	R6627
295	-	B946357	"	" "	R6628
429	-	B965331	"	Biotite granite	R6629
54A	X	B949401	McDonald Granite	Quartz feldspar porphyry	R6630
82A	-	B956388	" "	Granite porphyry	R6631
548	-	B954415	" "	" "	R6632
103	X	B982356	Dacite Porphyry (U.Sil)	Dacite porphyry (pink feldspar)	R6633
132F	X	B000458	" "	" " " "	R6634
138	X	B007382	" "	Hematized dacite porphyry	R6635
162A	X	C011354	" "	Quartz-epidote vein	R6636
172	X	C019355	" "	Dacite porphyry	R6637
250C	X	B962369	" "	Hybridized dacite porphyry	R6638
262A	X	B962361	" "	Dacite porphyry	R6639
637	-	C022379	" "	" "	R6640
182	-	B007369	" "	" "	R6641
700	X	C143369	Painter Porphyry	Dacite porphyry	R6642
557	-	B842433	Mountain Creek Volcanics	Rhyolitic agglomerate	R6643
558	-	B85435	" " "	Rhyolitic pitchstone	R6644
580	-	B918448	" " "	Rhyolite	R6645
589	-	B923424	" " "	"	R6646
611	-	B809346	" " "	Rhyolite pitchstone	R6647
178A	X	B977369	Ashstone & Agglom. vents	Ashstone	R6648
296A	X	B005368	" "	Agglomerate	R6649
233	X	B983379	" "	Tuff	R6650
621	X	B855384	Condor Granite	Hornblende microgranite	R6651

APPENDIX 2.

PETROGRAPHY OF SELECTED SPECIMENS

Specimen number : B.M.R. Museum R6633

Locality : Brindabella 982356

Formation : Dacite porphyry

Rock Name : Dacite porphyry.

In thin section the rock consists essentially of phenocrysts of quartz, plagioclase, biotite, and pseudomorphs after pyroxene, in a very fine groundmass of quartz and feldspar.

The quartz occurs as subhedral and anhedral grains up to 4 mm. in diameter. Typically the crystals show pronounced marginal resorption and are commonly deeply embayed. Inclusions of fine dusty iron ore, apatite and sericite-biotite are common. Many phenocrysts are fractured and many contain prismatic epidote along the fracture planes.

Plagioclase, in subhedral to euhedral laths up to 3 x 1 mm., is the most abundant phenocryst. The larger phenocrysts are commonly completely altered to an aggregate of sericite, epidote and chlorite, whereas many of the smaller laths are quite fresh. The composition of these small laths approximates to An.50. No potash feldspar was identified in the section examined.

Biotite is normally subhedral in crystals up to 4 x 1 mm. It is a strongly pleochroic variety, from lemon yellow to very deep brown. Minute inclusions of apatite and zircon abound. Many of the biotite flakes are partly altered to chlorite and fine granular iron ore.

The other porphyritic ferromagnesian mineral is difficult to identify. Relics suggest that it is, or was, a pale grey or colourless pyroxene. In nearly every instance the original mineral has been completely pseudomorphed by a greenish yellow serpentine, green chlorite, granular iron ore and minor epidote.

The very fine grained groundmass consists essentially of quartz and feldspar. Iron oxide minerals occur as euhedral to anhedral grains up to 0.5 mm. across; most are probably derived by the alteration of ferromagnesians. Primary accessory minerals are represented by a few grains of apatite and zircon.

The rock is a quartz feldspar porphyry of granodioritic composition, i.e. a dacite porphyry.

It is representative of the most common lithological type in the area.

2. Specimen No. : B.M.R. Museum R6637

Locality : Canberra 011355

Formation : Dacite porphyry

Rock Name : Dacite porphyry.

This strongly porphyritic rock contains phenocrysts of quartz, plagioclase and biotite in a very fine-grained groundmass of quartz and feldspar.

Quartz is the predominant phenocrystal constituent. It occurs as crystals, up to 5 mm. in diameter, which are euhedral, rounded or sharply angular with a shard-like form. Marginal corrosion is quite common and some grains are deeply embayed. Some crystals contain inclusions of very fine dusty iron ore(?) and others contain rutile.

The plagioclase occurs as euhedral to subhedral phenocrysts; most are extensively altered. The composition of the unaltered feldspars ranges from An.55 - An. 60 (Section 1, (010)). Alteration is quite varied. Incipient albitization and chloritization is common and some crystals are completely sericitized.

A few small untwinned crystals, less than 1 mm. in diameter and partly kaolinized, may be potash feldspar; positive identification is difficult.

The biotite forms ragged shreds up to 2 x 1 mm. and is almost completely altered either to chlorite (variety penninite and iron minerals or to iron-rich epidote and chlorite.

The iron oxide mineral which occurs as subhedral grains up to 0.5 mm. diameter is presumably ilmenite as it shows marginal alteration to leucoxene.

The groundmass is extremely fine grained-fluxional. Fluidal structure is emphasized by the presence of oriented stringers of hematite. The groundmass appears to consist of quartz and feldspar with abundant fine-grained iron oxide minerals, epidote and chlorite.

Primary accessory minerals include a few fine-grained prisms of apatite and zircon.

The rock is a dacite porphyry containing many more phenocrysts and less plagioclase than the preceeding specimen (R6633).

3. Specimen No. : B.M.R. Museum R6634
Locality : Brindabella 000358
Formation : Dacite porphyry
Rock Name : Dacite porphyry.

In hand specimen the rock is distinctive because of the presence of phenocrysts and veins of pink feldspar. In other respects it resembles the typical dacite porphyry (R6633).

In thin section the rock is seen to consist essentially of phenocrysts of quartz, plagioclase, biotite, and chlorite pseudomorphs in a fine-grained groundmass. Fine ramifying veins of feldspar cut the section.

The plagioclase occurs both as phenocrysts and in veins. The phenocrysts are generally subhedral to anhedral with a maximum size of 3 mm. Alteration is so extreme that the composition could not be determined: most phencrysts are almost completely kaolinized or are partly replaced by kaolin and partly by chlorite. The turbid kaolinized feldspar is faintly stained by hematite.

The pink feldspar veins consist of subhedral interlocking laths of plagioclase generally less than 0.3 mm. long. The laths are normally wholly or partly kaolinized.

The pink feldspar that is so distinctive in hand specimen is highly kaolinized plagioclase and the colour is due to finely divided hematite in the kaolin.

Quartz phenocrysts measure up to 4 mm., are normally anhedral, and show strong resorption. Deep embayments are common and many crystals are fractured. Fractures in some of the crystals are infilled with secondary quartz.

Ferromagnesian minerals are represented by a few phenocrysts of biotite, up to 1 x 0.5 mm., now partly altered to chlorite and iron oxide. Pseudomorphs of yellow-green serpentine apparently represent completely altered amphibole or pyroxene.

The groundmass is very fine-grained and partly fluidal, is very turbid, and appears to consist essentially of kaolinized feldspar with minor quartz. A few grains of apatite and zircon are present in the section examined.

The rock is an altered dacite porphyry.

4. Specimen No. : B.M.R. Museum R6639
Locality : Brindabella 962361
Formation : Dacite porphyry
Rock Name : Hybridized dacite porphyry.

The rock consists essentially of phenocrysts of quartz, plagioclase and chlorite pseudomorphs in a fine-grained quartz-feldspar groundmass.

Quartz, which makes up approximately half the rock, occurs as anhedral and subhedral phenocrysts up to 6 mm. in diameter. Some crystals are very angular whilst others are rounded, strongly resorbed and deeply embayed. Undulose extinction is pronounced in some crystals. Inclusions of zircon, apatite, iron oxide minerals and chlorite are fairly common.

Plagioclase (An 55-An.60) occurs as euhedral and subhedral phenocrysts up to 3 mm. in diameter. Most crystals are partly altered, generally to chlorite and/or sericite.

Chlorite is very abundant; it makes up about 20% of the rock. Irregular patches, commonly intergrown with a carbonate and containing inclusions of apatite and zircon, measure up to 3 mm. in diameter. Some zircon inclusions in the chlorite possess faint though distinct radiohalos. Although some of the chlorite evidently represents pseudomorphs after ferromagnesian minerals the bulk of the chlorite and carbonate is probably due to deuteric action.

The cryptocrystalline, almost isotropic, groundmass appears to consist of quartz, feldspar and chlorite peppered with fine granular leucoxene. A few small stellate clusters of prismatic epidote occur in the groundmass. Primary accessory minerals include apatite and zircon (fairly abundant).

The rock is a dacitic porphyry which appears to have incorporated some extraneous material giving it a somewhat tuffaceous appearance in thin section.

5. Specimen No. : B.M.R. Museum R6638
Location : Brindabella 962369
Formation : Dacite porphyry
Rock Name : Hybridized dacite porphyry.

In thin section the rock consists of phenocrysts of quartz and plagioclase in an equidirectional fine-grained groundmass of quartz and feldspar. Secondary quartz, plagioclase and carbonate are very abundant.

Quartz phenocrysts, up to 5 mm. in diameter, are normally anhedral but many are embayed. Undulose extinction is pronounced in most grains.

Plagioclase occurs in subhedral phenocrysts up to 2 mm. in diameter. Normally slightly turbid due to incipient kaolinization, some laths also are partly altered to chlorite and/or sericite. The composition could not be determined in the section examined.

No ferromahesian minerals occurs in the rock.

A large part of the rock consists of a mosaic of fine-grained secondary quartz. Secondary plagioclase occurs in irregular patches and small veins; so too does the very abundant carbonate.

The groundmass is a fine-grained mosaic of quartz-feldspar most of which may be due to secondary replacement or recrystallization of the original groundmass.

Anhedral iron oxide minerals up to 0.5 mm. in diameter are fairly numerous. Ilmenite, showing slight perpheral alteration to leucoxene, is the main iron mineral. Fine granular hematite is dispersed through the rock. A few subhedral prisms of apatite are present in the section examined.

The rock is a quartz feldspar (dacite) porphyry which has been subjected to extensive late or post magmatic alteration.

6. Specimen No. : B.M.R. Museum R6565
Locality : Brindabella 962361
Formation : Franklin Formation
Rock Name : Indurated Tuff.

The rock is a fine-grained, very-poorly-sorted tuff containing angular fragments of quartz and feldspar in a very fine matrix of feldspar, quartz, sericite, chlorite, zircon and apatite. The coarser fragments, up to 1 mm. in diameter, are very angular and commonly have a shard-like form. The feldspar*(microcline) most of which is partly kaolinized or chloritized.(*consists of both plagioclase and potash feldspar)

The rock is microscopically veined. The veins are dominantly quartzose though some contain appreciable untwinned feldspar and a carbonate mineral.

The rock is a fine grained tuff (probably redistributed)

7. Specimen No. : B.M.R. Museum R6569
Locality : Brindabella 957365
Formation : Paddy's River Volcanics
Rock Name : Porphyritic dacite.

The specimen is porphyritic and has phenocrysts of plagioclase, quartz, biotite and chlorite pseudomorphs in a fine-grained equigranular groundmass of quartz and feldspar.

Plagioclase, which constitutes approximately two thirds of the phenocrysts, occurs as euhedra and subhedra up to 3.0 mm. in diameter. Phenocrysts are commonly extensively resorbed, leaving only a shadowy relic. Laths have been chloritized and sericitized to various degrees. The composition approximates to An 50.

Quartz phenocrysts, up to 5.0 mm., are normally subhedral to anhedral. Many are strongly resorbed and deeply embayed.

Biotite, which occurs in subhedral flakes up to 3 mm. in length, has been almost completely replaced by white mica, chlorite and leucoxene. Other patches of chlorite up to 5 mm. diameter appear to be pseudomorphs after pyroxene or amphibole. The chlorite is the grass green, slightly pleochroic, penninite. It is notably vermiculate and is commonly intergrown with white mica, leucoxene and sphene. A few chlorite pseudomorphs are riddled with blebs of secondary silica.

The groundmass consists of a fine mosaic of feldspar, quartz and chlorite, sprinkled with ilmenite and granular epidote. Apatite is quite abundant.

The specimen is a porphyritic dacitic rock. No indication can be given by thin section examination as to whether it is intrusive or extrusive.

8. Specimen No. : B.M.R. Museum R6574
Locality : Brindabella 957354
Formation : Paddy's River Volcanics
Rock Name : Porphyritic dacite.

This rock resembles No. 267 very closely but the groundmass is slightly coarser-grained and the rock contains microscopic quartz veins.

9. Specimen No. : B.M.R. Museum R6576
Locality : Brindabella 957355
Formation : Paddy's River Volcanics
Rock Name : Porphyritic dacite.

It resembles Nos. 267 and 2882 very closely mineralogically and texturally. However it has been sheared, resulting in elongation and granulation of some of the phenocrysts.

The effect of shearing is not as obvious in thin section as in hand specimen.

10. Specimen No. : B.M.R. Museum R6573
Locality : Brindabella 957354
Formation : Paddy's River Volcanics
Rock Name : Tuff.

The rock is a fine, fairly even grained tuff with angular to subangular fragments of quartz, plagioclase, chlorite and other minor minerals up to 0.5 mm. in diameter.

The quartz grains generally show very light marginal corrosion and pronounced undulose extintion. The feldspar grains are generally less angular than the quartz and are profoundly altered, being almost completely turbid owing to kaolinization, minor sericitization and chloritization. Chlorite pseudomorphs commonly include granular iron oxide minerals and some epidote.

The grains are set in a fine matrix of quartz, feldspar, chlorite, iron oxide, and sericite. A few grains of apatite and zircon are present in the section.

The rock is a fine-grained tuff of dacitic composition.

11. Specimen No. : B.M.R. Museum R6575
Locality : Brindabella 957358
Formation : Paddy's River Volcanics
Rock Name : Tuff.

The specimen is of a fairly even, and fine, grained tuff consisting mainly of quartz, plagioclase, chlorite-serpentine pseudomorphs, and rock fragments, in a fine chloritic matrix. Grains are normally angular to subangular though euhedral feldspar is fairly common.

Quartz grains, which rarely exceed 1 mm. in diameter, show slight marginal fretting. The feldspar has been almost completely altered to chlorite-sericite and minor albite. The few rock fragments present consist mainly of fine-grained, somewhat trachytic, feldspathic lavas. The matrix consists of very fine-grained quartz, altered feldspar and chlorite.

The rock is a fine-grained tuff.

12. Specimen No. : B.M.R. Museum R6570
Locality : Brindabella 956364
Formation : Paddy's River Volcanics
Rock Name : Trachyte.

In thin section the rock consists essentially of phenocrysts of plagioclase, quartz, biotite and pyroxene in a groundmass of pilotaxitic plagioclase laths.

Plagioclase phenocrysts, normally subhedral, measure up to 4 x 3 mm; most have been slightly kaolinized. Many phenocrysts have been almost completely replaced by epidote; replacement has proceeded from the core outwards. The composition of the unaltered phenocrysts is near to An.40-An.45.

Quartz phenocrysts occur sporadically. They are typically fractured, with embayed and resorbed margins.

Both the ferromagnesian minerals have been almost completely replaced - the biotite by chlorite and skeletal ilmenite and the pyroxene by chlorite.

The groundmass consists of partly trachytic, partly pilotaxitic feldspar laths up to 0.2 mm. long. Quartz constitutes only a minor proportion of the groundmass. Fine-grained granular epidote is very abundant and primary accessory minerals include minor iron oxide and apatite.

The rock is a trachyte.

13. Specimen No. : B.M.R. Museum R6571
Locality : Brindabella 958351
Formation : Paddy's River Volcanics
Rock Name : Trachyte.

Essentially this rock very closely resembles R6570 though quartz phenocrysts are slightly more abundant. The composition of the plagioclase in the groundmass is about An.35. Apatite is fairly abundant and forms subhedral prisms up to 0.4 x 0.2 mm. The rock is intersected by numerous quartz veins.

14. Specimen No. : B.M.R. Museum R6592
Locality : Canberra 016364
Formation : Deakin Volcanics
Rock Name : Tuff. (hematized).

In thin section the rock consists essentially of grains of orthoclase, plagioclase and quartz in a very fine feldspathic matrix.

Orthoclase makes up about half of the coarser grains. Euhedra and subhedra are up to 3 mm. in diameter and are commonly twinned. Incipient kaolinization is widespread in most grains. The cleavage is particularly prominent, being emphasized by parting. Most grains show slight staining by hematite around the margin and along cleavages.

The quartz occurs in anhedral grains up to 4 mm. across and many grains are rounded by resorption and deeply embayed. Hematite staining is widespread. Plagioclase is much subordinate in quantity to the other minerals. It is typically corroded and embayed and kaolinization precludes identification by normal means.

The fine-grained groundmass, which formerly consisted essentially of quartz and feldspar, has been almost entirely replaced by radiating, fibrous hematite.

The rock is a hematized tuff.

15. Specimen No. : B.M.R. Museum R6590
Locality : Canberra 018362
Formation : Deakin Volcanics
Rock Name : Tuff.

In thin section the rock consists essentially of fragments of quartz and minor feldspar set in a very fine iron-stained matrix.

Quartz makes up roughly 75% of the coarser fragments. The grains are angular to subangular and many are shardlike in form. Grainsize is normally less than 0.75 mm. The feldspar has been completely altered and the original composition cannot be determined. It is now mainly kaolin, chlorite and/or sericite. Hematite staining is common. A few ragged shreds of biotite, up to 0.5 mm.long, have been almost completely replaced by iron oxide, chlorite and sericite.

The extremely fine-grained matrix consists dominantly of kaolinized feldspar, sericite, minor quartz, chlorite and iron oxide. It is stained yellow-brown by iron oxide.

The rock is <u>fine grained tuff</u>.

16. Specimen No. : B.M.R. Museum R6618
Locality : Brindabella 936399
Formation : Uriarra Volcanics (Swamp Creek Member)
Rock Name : Dacite.

In thin section the rock is porphyritic, with phenocrysts of quartz and plagioclase and chlorite pseudomorphs in a fine-grained matrix of quartz, feldspar, and chlorite.

The quartz occurs as anhedral phenocrysts up to 5 mm. in diameter. Some crystals are angular giving a superficial tuffaceous appearance to the rock. Others are well rounded with resorbed margins and deep embayments. Some phenocrysts are crowded with trains of very fine-grained inclusions.

Phenocrysts of plagioclase are subhedral and anhedral, up to 3 mm. across,and are turbid owing to kaolinization. Hematite stains in the kaolin impart a pronounced reddish-pink colour to the feldspar when seen in hand specimen. The degree of alteration of most of the plagioclase precludes determination of the composition by normal methos. Some crystals show alteration to chlorite and sericite in addition to the kaolin noted above.

The rock contains abundant chlorite in lenticular patches up to 1 cm. long. This chlorite is commonly crowded with granular leucoxene, after ilmenite.

The groundmass appears to consist essentially of microcrystalline quartz, [illegible] feldspar and abundant chlorite. Epidote abounds; it occurs in clusters in the groundmass. Fine-grained granular ilmenite, much of it part-altered to leucoxene, is also very common. Both apatite and zircon occur as primary accessory minerals.

The rock is a <u>dacite</u>.

17 Specimen No. : B.M.R. Museum R6621
Locality : Brindabella 940407
Formation : Uriarra Volcanics (Swamp Creek Member)
Rock Name : Dacitic tuff (pink feldspar).

This rock consists essentially of angular and subangular fragments of quartz and plagioclase, with shreds of chloritized

biotite, in a very fine-grained matrix of quartz, feldspar, chlorite and granular iron oxide minerals.

Quartz occurs as angular and subangular fragments up to 2 mm. across. The feldspar appears to consist entirely of plagioclase in all stages of alteration. Some grains are unaltered, while others show partial alteraltion to chlorite, sericite and carbonate. Most widespread mode of alteration is kaolinization combined with staining by iron oxide to give the feldspar a pink appearance in hand specimen. No orthoclase was identified in the section.

Biotite shreds,up to 2 mm. long, are partly chloritized and charged with granular iron oxide. Large irregular patches of chlorite, with secondary quartz, carbonate, sericite and other minerals,are apparently pseudomorphs after amphibole or pyroxene. Iron oxide grains are up to 0.5 mm. across and are very numerous. Most are associated with the chlorite and are evidently of secondary origin.

The matrix is a fine-grained aggregate of quartz, chloritized feldspar, sericite, carbonate and iron oxide. A few grains of zircon and apatite are present.

The rock is a dacitic tuff, the pyroclastic equivalent of the preceding dacite (58).

18. Specimen : B.M.R. Museum R6617
Locality : Brindabella 940365
Formation : Uriarra Volcanics (Tarpaulin Member)
Rock Name : Tuff.

The rock is a fine-grained tuff consisting of very angular fragments of quartz, plagioclase and orthoclase in a microcrystalline, almost cryptocrystalline, matrix.

All grains are very angular and some possess a characteristic shard-like form. Internal fracturing of grains is very prominent. The average grainsize is about 0.75 mm.

The feldspar consists dominantly of partly altered plagioclase. Orthoclase is much subordinate and normally is highly kaolinized. Irregular chlorite pseudomorphs, with included iron oxide, measure up to 1 mm. in diameter.

The matrix appears to consist of quartz feldspar, commonly with appreciable carbonate. Fine-grained leucoxene is very abundant.

The rock is a fine-grained tuff.

19. Specimen No. : B.M.R. Museum R6594
Locality : Brindabella 976386
Formation : Uriarra Volcanics (Walker Member)
Rock Name : Dacite.

In thin section the rock consists of phenocrysts of plagioclase, quartz, biotite, and chlorite pseudomorphs in a fine-grained groundmass of quartz and feldspar.

Plagioclase makes up about 75% of the phenocrystic minerals in the form of euhedral to subhedral laths. Most phenocrysts show varied alteration to chlorite, albite or sericite. The composition of the unaltered feldspar is An 40 - An 45.

Quartz occurs as anhedral phenocrysts up to 4mm. across. Most are rounded, with resorbed margins and deep embayments, but a few are very angular. Euhedral biotite flakes up to 1 mm. long have been almost completely replaced by aggregates of chlorite, iron oxide, sericite and quartz. Sporadic aggregates of chlorite appear to be pseudomorphs after pyroxene.

The fine-grained groundmass consists of a mosaic of quartz and partly chloritized feldspar. Epidote and granular iron oxide are minor constituents. Primary accessory minerals include apatite, zircon and iron oxide (now altered to hematite).

The rock is a dacite or dacite porphyry.

20. Specimen No. : B.M.R. Museum R6601
Locality : Brindabella 975390
Formation : Uriarra Volcanics (Walker Member)
Rock Name : Dacite.

In thin section this rock very closely resembles No. 197. The main difference is in the respective amounts of phenocrystic quartz and feldspar. In this specimen (352) these minerals are present in approximately equal amounts.

The rock is a dacite or dacite porphyry.

21. Specimen No. : B.M.R. Museum R6595
Locality : Brindabella 981397
Formation : Uriarra Volcanics (Walker Member)
Rock Name : Dacite.

In thin section the rock is seen to consist essentially of phenocrysts of quartz, plagioclase, chlorite pseudomorphs after biotite and pyroxene, and microphenocrysts of apatite, in a very fine-grained equidimensional groundmass of quartz, plagioclase, iron oxide, chlorite, and other minor minerals.

The quartz occurs as subhedral phenocrysts up to 1 cm. across. Many are resorbed and embayed and cataclastic effects such as fracturing of phenocrysts are evident. Undulose extinction is very common. Inclusions are fairly common in many phenocrysts and include apatite, zircon, chlorite and iron oxide minerals.

The feldspar phenocrysts are extensively altered. Alteration includes albitization, chloritization, sericitization and kaolinization. Though difficult to determine, it appears as if most if not all of the feldspar remaining is plagioclase.

Euhedral pyroxene phenocrysts up to 5 mm. in diameter have been completely pseudomorphed by chlorite (penninite), granular leucoxene and secondary quartz.

The biotite occurs as flakes up to 3 mm. long. It has been completely altered to vermiculite, chlorite (penninite), leucoxene, sphene and minor sericite. Alteration appears to proceed in the following manner:

Biotite

Vermiculite + sphene +/or ilmenite

Penninite + sericite + leucoxene

Subhedral microphenocrysts of apatite measuring up to 0.5 x 0.3 mm. are common.

The groundmass is a microcrystalline mosaic of quartz and feldspar (albitized and chloritized).

The rock is a dacite or dacite porphyry.

22. Specimen No. : B.M.R. Museum R6611.
Locality : Brindabella 955367.
Formation : Uriarra Volcanics (Walker Member).
Rock Name : Tuff.

The rock is a medium-grained crystal tuff composed of angular and subangular fragments of quartz and plagioclase, set in a fine-grained matrix of the same composition. Chlorite is very abundant, as pseudomorphs after ferromagnesian minerals and also as a replacement of phenocrystic and groundmass feldspar.

A few rock fragments, apparently chert or acid volcanic, occur in the section.

The rock is a tuff of dacitic composition.

GEOLOGY OF THE COTTER-URIARRA AREA

SCALE OF MILES
1 ½ 0 1 2

148°50' 148°55'

Reference

Gossan (Fe, Cu, Pb)

LATE MID DEVONIAN	*CONDOR GRANITE	Dgc — Hornblende microgranite
LOWER DEVONIAN	MOUNTAIN CK VOLCANICS	Dℓm — Rhyolite and rhyolite breccia
	*MCDONALD GRANITE	Sgd — Granite porphyry
	MURRUMBIDGEE GRANITE	Sgm — Granite
UPPER SILURIAN	*URIARRA VOLCANICS	Sμv — Lavas and tuffs (*kanily member)
		Sμs — Dacitic lavas and tuffs (*Swamp Ck. member)
		Sμt — Fine-grained tuff (*Tinpaulin member)
		Sμw — Pyroxene dacite with lenses of shale and tuff (*Walker member)
	DEAKIN VOLCANICS	Sμd — Lavas and tuff
MID SILURIAN	*PADDYS RIVER VOLCANICS	Smp — Volcanics with lenses of shale and limestone
ORDOVICIAN	*FRANKLIN FORMATION	Of — Phyllite, sandstone and quartzite

Geological Boundaries –
- Established boundary position accurate
- Established boundary position approximate
- ?– Probable boundary

40° Strike and dip - inclined
Strike and dip - vertical
Overturned anticline

Faults –
- Position accurate
- Position approximate

Ls Limestone
Sh Shale and siltstone

* Name not published. See text of Record 1954/71

TRUE NORTH
GRID NORTH
MAGNETIC NORTH

LOCALITY MAP

ACT 10-32

Bureau of Mineral Resources, Geology and Geophysics

Folding diagrammatic