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PRELIMINARY GEOLOGICAL INVESTIGATION OF BELCONNEN AREAS 5, 6, 7, 8 AND 9, AUSTRALIAN CAPITAL TERRITORY

by

E.G. Wilson

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CONTENTS

	Page
SUMMARY	1
INTRODUCTION	1
GEOLOGY	1
GENERAL GEOLOGY	1
Ordovician	2
Silurian	2
Intrusions	3
Quaternary	3
STRUCTURE	3
METAMORPHISM	4
GEOMORPHOLOGY	4
ENGINEERING GEOLOGY	4
BELCONNEN AREA 5	4
BELCONNEN AREA 6	5
BELCONNEN AREA 7	5
BELCONNEN AREA 8	6
BELCONNEN AREA 9	6
DRAINAGE OF GROUNDWATER	7
CONSTRUCTION MATERIALS	7
FOUNDATIONS AND EXCAVATIONS	7
REFERENCES	8
APPENDIX I - LIST OF THIN SECTIONS	8
PLATE I - GEOLOGY OF PART OF THE BELCONNEN AREA, A.C.T. SCALE, 1 INCH: 400 FEET	8

SUMMARY

The district of Belconnen is to be developed as a residential area of Canberra; this report deals with the geology of the first part of the proposed development area and the influence of the geology on the installation of hydraulic and other engineering services.

The area is divided meridionally by the Deakin Fault into two sections. Hills to the east of the fault consist of quartzite, chert, slate and meta-greywacke of Ordovician age; the gentler land surface to the west is underlain by meta-rhyodacitic lavas and tuffs of Silurian age, which have been intruded by a porphyritic microgranodiorite. Another intrusion, a granodiorite, crops out in the north of the development area.

Ease of excavation for hydraulic services depends on the thickness of soil and alluvium, and the thickness and mechanical properties of the weathered bedrock. Isopachs in Plate 1 show the thickness of unconsolidated material in the main areas of soil and alluvium. The thickness of weathered bedrock depends not only on the original depth to which weathering penetrated, but also on later erosion which has removed some of the weathered mantle: in the Belconnen area thick soil accumulated on top of weathered bedrock at some time in the past; rejuvenation of streams resulted in partial to complete removal of soil, and in the partial removal of weathered bedrock. Benches of soil on some slopes are remnants of earlier, more extensive, soils.

The main factor determining the ease of excavation of bedrock is the susceptibility of the bedrock to weathering. The siliceous rocks such as quartzite, chert, slate and shale are resistant to weathering, consequently little mechanical excavation of these rocks in the areas east of the Deakin Fault will be possible. The igneous rocks to the west of the fault are more susceptible to weathering, but boulders in the weathered rock will hinder mechanical excavation. Test augering, and probably seismic traverses, will be required to assess the cost of excavation with reasonable accuracy.

Several groundwater drainage problems exist in Areas 6, 7 and A but are amenable to treatment. No important deposits of construction materials occur in the development area.

INTRODUCTION

The district of Belconnen lies immediately to the north-west of the City District of Canberra and is to be developed as a satellite area to cope with the future expansion of Canberra. This report deals with, Areas 5, 6, 7, 8 and 9, which cover approximately four square miles (Plate 1). The geology is described briefly and is followed by notes on the effect of the geology on the provision of engineering services.

Three other so far unnumbered areas which are not part of the present investigation, were mapped but are only described where necessary in reporting on the Areas 5-9: the unnumbered areas have been shown on Plate 1 as Areas A, B and C.

GEOLOGY

GENERAL GEOLOGY (Plate 1)

The Belconnen Development Area is underlain by metasediments (slightly metamorphosed sedimentary rocks) of Ordovician age and metavolcanics (slightly metamorphosed volcanic rocks) of Silurian age which have been intruded by the Mount Painter Porphyry, and by an unnamed coarse-grained granodiorite.

The Ordovician metasediments occupy the eastern part of the area and are separated from the Silurian volcanic rocks to the west by the Deakin Fault. The Mount Painter Porphyry crops out mainly in the west where it intrudes the Silurian rocks. The granodiroite in the north intrudes Ordovician and Silurian strata and the Mount Painter Porphyry.

Ordovician

The rocks of Ordovician age crop out in Areas 5 and 6 and adjoining areas. They have been subdivided as follows:-

Siliceous metasediments (Ou)

Acton shale (Oua)

Pittman Formation (Omp)

The Pittman Formation consists of quartz-rich metasediments - quartzite, meta-greywacke, chert and slate. The rocks are resistant to weathering and residual soils are thin. The metasediments were deposited as silt and mud; they contain graptolites and radiolaria. The formation is mainly Middle Ordovician in age, but it persists into the Upper Ordovician. A full description of the formation and lists of fossils may be found in "The Geology of the Canberra City District" (Opik, 1958).

The Pittman Formation in Canberra crops out to the north-east of the intersection of Dryandra Street and Weetangera Road, O'Connor. The Pittman Formation in the Belconnen area is similar to that in O'Connor; interbeds of quartzite will require special attention in excavating.

The Acton Shale is a siliceous black and grey slate; it contains graptolites of Upper Ordovician age (Opik, 1958). The term shale is a misnomer from an engineering point of view because shale is usually regarded as a relatively soft rock; the Acton Shale is hard slate and where fresh should be regarded as hard rock for excavation purposes. The formation crops out over a considerable portion of Area 6; the rocks are resistant to weathering and generally form rises with little or no soil cover. The Acton Shale at Belconnen is similar to that found at Southwell's Quarry, to the west of Lyneham; slate from this quarry was used for road metal in the early development of Canberra.

The siliceous metasediments consist of quartzite, slate and chert (Appendix I, Thin sections 13176, 13177, 13788); they are folded into a shallow syncline north of Weetangera Road and appear to overlie the Acton Shale conformably.* Chert predominates in about 100 feet of the succession and has been mapped separately south-east of Area 5.

Large areas of quartzite and silicified chert have not previously been encountered during the development of Canberra; they will provide some difficulty in excavation.

Silurian

The Silurian sedimentary and volcanic rocks are of two ages; Lower Silurian State Circle Shale (?) which overlies Ordovician rocks unconformably and is intruded by granodiorite, and Middle to Upper Silurian volcanic rocks in the west which are faulted against Ordovician rocks to the east along the Deakin Fault.

The State Circle Shale (?) crops out in a creek bed to the west of Area 5; the shale is intruded by quartz veins and small dykes from the nearby granite. The rock, which is a sheared and jointed mudstone that has been hardened by the nearby intrusion, disintegrates on weathering to small angular fragments.

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* Opik (1958) regarded the siliceous metasediments as part of the Pittman Formation and he regarded the Acton Shale as occupying the cores of synclines within the Pittman Formation; however, he suggested that the relationship between the two formations may have been unconformable.

The State Circle Shale was named by Opik (1958) in Canberra City, where it contains Monograptus exiguus. Fossils were not recovered from the outcrop shown on Plate 1 but they were collected from outcrops a half-mile farther north (Wilson, 1961).

The Silurian metavolcanic rocks were initially rhyodacitic lavas and tuffs. The rocks are massive and jointed but do not crop out extensively at the surface. They form low rounded hills that retain a thin soil cover. The original volcanic rock has been metamorphosed to "greenschist" grade and has the following mineral assemblage: quartz-albite (?), actinolite and chlorite (Thin Sections: 13784, 13785, 13174). Similar volcanic rocks are at present (November, 1964) being excavated in the course of development of Woden Areas 8 and 9.

Intrusions

The Mount Painter Porphyry, a microgranodiorite, has intruded Silurian rocks to the west of the Deakin Fault and Ordovician and Silurian rocks to the east of the fault. It was subsequently faulted and metamorphosed to a quartz-albite-actinolite-chlorite-white mica schist. The microgranodiorite texture remains, but considerable mineralogical changes have occurred. Phenocrysts of quartz are embayed and sub-hedral plagioclase phenocrysts have been altered to white mica, chlorite, albite and quartz. The original ferromagnesian minerals are now represented by aggregates of opaque mineral and actinolite, and chlorite dominates the groundmass (Thin Sections 13175, 13786).

Granodiorite crops out poorly in the north of the area; it is deeply weathered and will give little trouble in excavation. Large boulders crop out to the north, on the C.S.I.R.O. farm, where the granodiorite may be harder to excavate. A small outcrop of granodiorite farther east may indicate that granodiorite extends below the soils in Area 5.

Quaternary

Soil, alluvium and gravel comprise the Quaternary deposits in the area. The soils and alluvium range in thickness from a few inches to many feet and consist of clayey sand, talus and clay soil (van Dijk, 1964, 1965). A maximum thickness of 20 feet of soil is found in the north of Area 6, and in Area B.

Soil cover is probably less than three feet thick in the areas that have been mapped as Ordovician and Silurian rocks. Isopachs showing the thickness of superficial material have been drawn for most of the areas mapped as soil and alluvium. The isopachs incorporate the results of some augering (van Dijk, 1964), but they were mainly derived from air-photo interpretation and field inspection of erosion gullies. The soils are similar to the clay soils found in the Canberra valley.

Deposits of angular to sub-rounded gravel that consist mainly of quartzite are found in Area A, near the Deakin Fault south of "Emu Bank". This material may provide a suitable road base; the thickness of the material is probably less than 10 feet.

STRUCTURE

The area west of the Deakin Fault consists of gently folded metavolcanic rocks. The average dip is from 15 to 20 degrees to the south-west. East of the Deakin Fault the Ordovician rocks are more deformed: the main structure is a syncline that plunges gently to the north-east. Minor folding on the limbs of the syncline is common.

The western block has been displaced downwards by the Deakin Fault. Near "Emu Bank" Lower Silurian rocks are faulted against Middle (?) Silurian rocks; downthrow to the west at this point is possibly thousands of feet.

METAMORPHISM

The rocks of the area have undergone low-grade regional metamorphism: they display the greenschist facies of metamorphism. The quartzite, meta-greywacke and slate have the mineral assemblage quartz-(albite)-brownish green biotite-chlorite; the metavolcanic rocks and meta-microgranodiorite are quartzo-feldspathic schists with the mineral assemblage quartz-albite-actinolite-chlorite-white mica, and opaque mineral. Basic schists are not present in the area.

Contact metamorphism around the margin of the granodiorite has baked the Lower Silurian mudstone, but has had little effect on the quartz rich Ordovician rocks.

A ferruginous gossan lies on top of the hill in area A; minor excavations along the gossan reveal that the unweathered rock is a schistose fault breccia. The breccia contains a fibrous green amphibole that is pale yellow in thin section and slightly pleochroic; it has parallel extinction and low second-order interference colours. An exact determination of this mineral was not made (Thin section 13787).

GEOMORPHOLOGY

The land surface falls into two broad divisions: the gently rolling hills of metavolcanic and intrusive rocks that lie to the west of the Deakin Fault, and the more rugged area of quartz-rich meta-sediments that lie to the east of the fault. The southern limit of the presently proposed development in Areas 6 and 7 is the divide between the valleys of the Molonglo River and Ginninderra Creek.

Deeply weathered rock belonging to a relatively old land surface is preserved under thick soil cover near the headwaters of tributaries of Ginninderra Creek. This land surface was more extensive in the past but it has since been partly eroded by Ginninderra Creek and its tributaries.

West of the Deakin Fault. Thin soil covers the weathered bedrock of metavolcanic rock and Mount Painter Porphyry; rounded boulders crop out on rises, but rock outcrops are few. In the lower valley of Area 9 the rocks below the thin soil are hard and tough, but farther south, above the 2,000-foot contour in Area 7, deeply weathered rock underlies a thick accumulation of soil in depressions.

East of the Deakin Fault. The rocks are more resistant to weathering than farther west and crop out extensively on the hills. Thick soils have accumulated to the north-west of Area 6, but farther north, in Area 5, soil and rock debris that once mantled the old land surface have been eroded and only remnants of this material remain as benches on the slopes above the 2,000-foot contour.

The siliceous metasediments are resistant to weathering and to erosion, and easy excavation will generally be limited to the soil profile. The finer-grained meta-siltstones are more susceptible to weathering and may be readily excavated where they are deeply weathered. Excavation by mechanical means should be possible in weathered bedrock of sandstone or siltstone, but not in quartzite. Unweathered sandstone and siltstone will not be amenable to mechanical excavation.

ENGINEERING GEOLOGY

BELCONNEN AREA 5

The rocks in Area 5 are siliceous metasediments of Ordovician age - chert, quartzite and siliceous slate (Ou of Plate 1). The rocks are folded about axes that plunge gently to the north-east.

Very thin soils are found on the metasediments: it is doubtful if any of the soil and alluvium is more than 5 feet thick. Mechanical excavators will not be very successful in the siliceous metasediments, but will be adequate for the soil and alluvium; blocky fragments in the lower part of the soil profile will be a nuisance. Some granodiorite may be found below the soil in the southern part of the area; if present it will be partly weathered and, except for fresh boulders, will be excavated readily.

The natural point of entry of the service mains is through the north-west corner. The provision of services in this area is expected to be costly because the use of mechanical equipment will be limited. Test holes should be sunk in the area to ascertain what material lies below the soil in the southern part of the area, and to assess the cost of services.

BELCONNEN AREA 6

The rocks in this area are siliceous metasediments (Ou) and Acton Shale (Oua), both of Ordovician age; the rocks lie close to the surface over three-quarters of the area.

The siliceous metasediments consist of folded and metamorphosed sandstone and siltstone, with some quartzite. Mechanical excavation will only be possible in deeply weathered siltstone and sandstone; the only deeply weathered rock lies below the soil on the lower slopes in the north of the area. Partly weathered rock will be encountered at the surface elsewhere but mechanical excavation may be limited to about two feet into the bedrock over much of the area. It will not be possible to excavate massive sandstone, quartzite or slightly weathered slate by mechanical trenchers.

The Acton Shale is a hard, grey and black slate. The use of the term "Shale" in the formation name is, for engineering purposes, misleading as shale is generally regarded as a soft and easily-worked rock. The slates of this formation will only be excavated mechanically to very shallow depths. Their resistant nature is emphasized by the fact that they occupy the crests of rises wherever they are found.

Soil, rock debris, and alluvium mantle the northern part of the area to an estimated maximum thickness of 20 feet. The isopachs showing the thickness of overburden (Plate 1) should be regarded as approximate only; if precise information is required it should be obtained by augering and seismic traverses.

The main sewer and stormwater lines should, for ease of excavation, enter Area 6 at the north-west corner. Test auger holes should only be required along the main service lines after the hydraulic services have been planned; however, estimation of the cost of servicing may require additional test holes.

Springs are found in the north-west corner of Area 6 adjacent to Area A and indicate poor underground drainage of the soils to the south-east of this point. Suitable open jointing of stormwater drains in the alluvium of Area 6 and Area A should improve subsurface drainage.

BELCONNEN AREA 7

The northern part of Area 7 occupies the lower northern slope of Mount Painter. The rock in the area is mainly Mount Painter Porphyry, an intrusion of microgranodiorite, that crops out on the northern slope of Mount Painter. Metavolcanic rocks have been mapped but they are regarded as pendants resting on top of the Mount Painter Porphyry. The granodiroite and volcanic rocks generally have a thin soil cover but a considerable thickness of alluvium and soil is evident in the erosion gullies.

The Mount Painter Porphyry crops out as boulders, and similar boulders will be encountered in excavations in the area. At the present southern limit of planned development of Area 7 the ground slopes to the north and consists of fairly fresh rock with small amounts of weathered material.

The metavolcanics are mainly flows, but some fine-grained tuffs are present. The metavolcanics dip gently to the west-south- west and are more resistant to weathering than the Mount Painter Porphyry.

Soils on the porphyry and metavolcanics are thin; excavation of these rocks by mechanical means may be successful, but the finer-grained volcanics have resisted weathering and are probably too tough for mechanical excavation.

Soil and alluvium attain a maximum thickness of 15 feet in the erosion gully at the northern margin of the area, and a thickness of 10 feet in the gully that lies farther east. The thickness of soil is reliably indicated by the depth of the erosion gullies. Springs break out at the surface in the areas of thick alluvium and drains should be suitably open-jointed in these areas.

Services to this area will probably be by two subsidiary mains along the two erosion gullies. Test auger holes may be required along the routes of the services mains after planning of the hydraulic services.

BELCONNEN AREA 8

Belconnen Area 8 consists of metavolcanics with small areas of Mount Painter Porphyry to the west of "Springvale" and to the north of "Baringa". Outcrops are few, but the soil on the areas mapped as porphyry and metavolcanics is expected to be less than 3 feet thick and to be generally underlain by weathered rock.

The Mount Painter Porphyry is deeply weathered in this area and it may be possible for mechanical excavators to dig to a depth of 5 feet for minor service lines; however, hard boulders will be encountered.

The metavolcanics are expected to be more resistant to mechanical excavation; they vary in the texture, and amenability to excavation cannot be readily assessed because they do not crop out. Test-holes should be sunk on the hill in the centre of Area 8 to assess the ease of excavation.

Soil and alluvium attain a maximum thickness of 15 feet at the boundary between Areas 7 and 8. The soil isopachs indicate the approximate thickness of overburden only; if precise information is required, the soil and alluvium should be augered. The 10-foot isopach on the eastern slope of the hill below the 2000-foot contour indicates a bench of superficial material which was once part of a more extensive deposit in the valley. The north-flowing creek has eroded its present valley out of the old extensive deposit, leaving remnants as benches on the slopes. The benches contain patches of hard pisolitic ironstone, which is not expected to hinder mechanical excavation greatly.

Services into this area will probably follow the gully north of "Baringa" and the gully north-east of "Springvale". If they follow these depressions, test holes may be required where thin soil overlies volcanic rock above the 2000-foot contour in the northern gully and above the 1975-foot contour in the southern gully.

BELCONNEN AREA 9

The rocks of Area 9 consist of Mount Painter Porphyry and meta-volcanics. The Mount Painter Porphyry crops out as boulders on rises, but is generally obscured by a thin covering of soil. The volcanics crop out poorly, but also have only a thin soil cover.

The Mount Painter Porphyry is weathered on the top of rises, but the success of mechanical excavators in this material will depend on the incidence of boulders in the weathered rock; mechanical excavation will probably prove more difficult in this area than in Area 8. The volcanics have a thin soil cover; mechanical excavation will be less successful to the north of Dam A in Area 9, where hard rock lies very close to the surface.

The thickness of soil and alluvium is generally less than 3 feet, but along the banks of the main stream, alluvium attains a thickness of 7 feet. Some small benches of superficial material remain to the west of the stream, but they do not provide significantly thicker soil.

The main service line will probably enter the area from the north along the stream bed on the eastern side of Area 9. Offshoots from the main will probably extend in a south-westerly direction along the depression. Test holes should be sunk along the proposed lines in Area 9 before plans for the hydraulic services are finalised.

DRAINAGE OF GROUNDWATER

Significant drainage problems are present in the Quaternary areas of the northern part of Area 6 and in the adjoining Area A, and in the northern part of Area 7. Drainage would be greatly improved in these areas by suitable open-jointing and, or by perforating the stormwater drains (gravel-packed where necessary). Numerous minor seepages are indicated on the soil map of Belconnen (van Dijk, 1965), and suitable open-jointing or perforating of stormwater drains (gravel packed where necessary) in the seepage areas will control this problem. All housing in poorly drained areas should be provided with additional foundation ventilation, and the foundation specifications should be considered carefully. Major building sites in Area A will require foundation testing, and provision should be made for the drainage and waterproofing of basements.

CONSTRUCTION MATERIALS

No deposits of brick shale or sand are present in the development area. Gravel in Area A could be used for road base material. A pit has been worked for salamander in deeply weathered granodiorite to the south of Area 17 which is outside the area of this study: similar material will be found in the deeply weathered zones of granodiorite within the area. Good aggregate could probably be obtained by crushing unweathered granodiorite but as adequate resources of aggregate are available outside the proposed development area there should be no need for quarrying within the area mapped.

FOUNDATIONS AND EXCAVATION

There should be little difficulty in excavation for foundations except where quartzite crops out at the surface in Areas 5 and 6. Deep trenches in alluvium will require drainage and adequate support. The foundations for the main north-south road will prove adequate and will only require standard testing.

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APPENDIX I

LIST OF THIN SECTIONS

Field No.	Registd. No.	Thin Sect. No.	Location	Description (and rock unit)
Bel 1	R17439	13174	C080453	Meta-rhyolite
Bel 2	R17440	13175	C080453	Meta-granodiorite (Mount Painter Porphyry)
Bel 3	R17441	13176	C081450	Quartzite (siliceous metasediments)
Bel 4	R17442	13177	C082455	Meta-greywacke (siliceous metasediments)
Bel 5	R17489	13784	H076475	Meta-rhyodacite (Deakin Volcanics)
Bel 6	R17490	13785	H073481	Tuffaceous sandstone (Deakin Volcanics)
Bel 7	R17491	13786	H072469	Meta-granodiorite (Mount Painter Porphyry)
Bel 8	R17492	13787	H091469	Schistose breccia
Bel 9	R17493	13788	H087467	Quartzite (siliceous metasediments)

* Military Grid Reference; C prefix denotes Canberra 1:50,000 Sheet and H denotes Hall 1:50,000 Sheet.

GEOLOGY OF PART OF THE BELCONNEN AREA AUSTRALIAN CAPITAL TERRITORY

PLATE I

SCALE

400 0 400 800 1200 1600 2000 FEET

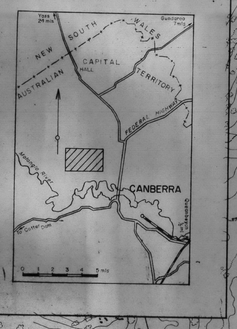
MN

QUATERNARY		Q	Clay soil and scree, sandy soil, alluvium, gravel Gravel Sandy soil
SILURIAN		Sg	Granodiorite
	Mount Painter Porphyry	Sup	Porphyritic microgranodiorite
		Sv	Meta-rhyodacite lavas and tuff
	State Circle Shale (?)	Sls	Mudstone
ORDOVICIAN		Ou	Siliceous metasediments - quartzite, slate, chert
	Acton Shale	Ouq	Siliceous grey and black slate
	Pittman Formation	Omp	Quartzite, meta-greywacke, slate, chert

Topographic base by the Lands and Survey Branch, Dept of the Interior, Canberra – grid co-ordinates refer to the Canberra City grid; origin Mt Stromlo, A.C.T.

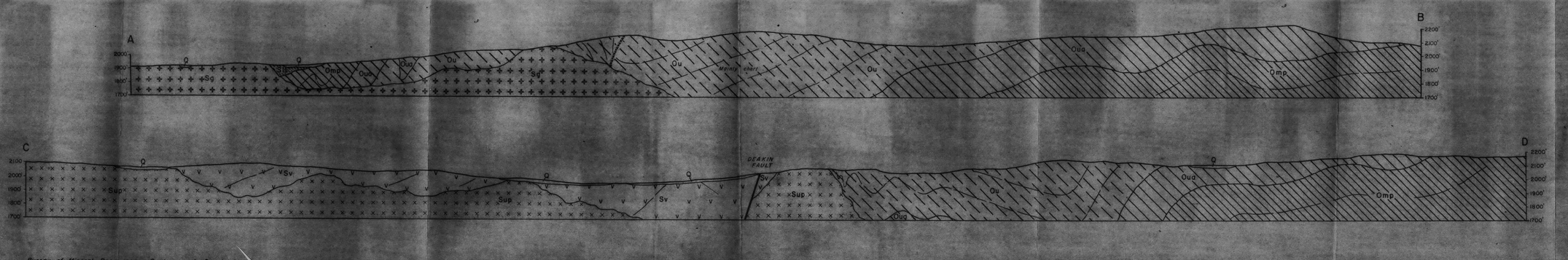
Geology, 1964, by E.G. Wilson

- Geological boundary
- Anticline
- Syncline
- Fault, probable where dashed, concealed where dotted
- Strike and dip of strata
- Plunge of fold
- Trend of bedding
- Breccia
- R17490 Rock specimen locality and registered number
- 4 Soil thickness in feet
- Isopach showing thickness of soil in feet
- Boundaries of areas referred to in text
- Quartz vein
- Tree
- Topographic contours in feet



SECTIONS

Scale : V/H = 1



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