A GEOLOGICAL REPORT OF
PART OF THE PARA FAULT BLOCK

by P.J. Darragh.

Honours thesis 1946
Supervisor: Sir Douglas Mawson

THE PARA FAULT BLOCK

A geological outline of the Para Fault Block from a little south of Modbury to the Little Para River.

The author wishes to acknowledge the help and encouragement given by Professor Sir Douglas Mawson and other members of the staff of the Geology Department.

The area investigated is situated a few miles north-east of Adelaide. Its eastern and western limits are marked by two well defined fault scarps which are sub parallel. The western fault is known as the Para and the eastern as the Eden Fault. The southern boundary has been taken as the Grand Junction Road owing to absence of outcrops south of this line. The northern boundary has been fixed at the Little Para River owing to pressure of time There is some suggestion that the geology north of this boundary is essentially similar to the area under discussion.

Some investigation was carried out east of the Eden Fault . This was made as an attempt to determine the position of the Block in the generally accepted sequence known as the Adelaide System. No very detailed mapping was carried out. Little more than a log of beds above the schists of the Barossian Complex was prepared.

These investigations proved of little benefit as fautling has greatly disturbed the sequence. As yet no displacement can be measured as location of marker beds is not definite.

Owing to relatively flat topography of the block there is little removal of eroded material and hence rock exposures are poor except adjacent to the creeks.

Investigation has been confined to field mapping. Air photos proved useful only as a means of location. The photos showed no geology except for some trend lines adjacent to the Little Para River.

SUMMARY

The area investigated consists of 7000 (±) feet of sediments of Lower Adelaide Series. There is no evidence of other than sedime tary rocks. No mineralisation is evident even adjacent to faults except for injection of milky quartz along cleavage planes.

The sediments have a low dip. (25°) to the east i.e. they dip towards the older Barossian Complex. Super imposed on this low dip are numerous drag folds inclined so that the axial planes dip to the east and are parallel to the cleavage. Although the boundary faults are apparently of great displacement little evidence of brecciation was seen.

It is more likely that numerous small faults have been overloc looked. Exact correlation is open to discussion as outlined in the text.

GEOGRAPHY

The Para Fault Block is the central of three well defined fault blocks of the western escarpment of the Mt. Lofty Ranges in this area.

The first consists of the Adelaide Plains while next above this and approximate to it is the Para Block, a still higher block is situated between the Eden and Kitchener Faults.
The most obvious geomorphological features are the two scarp faces. The western scarp of the scarp of Para Fault is approximately 500 feet n the northern section decreasing more or less uniformly to 250' in southern section.

Numerous streams have cut into this scarp but in few cases do the head waters extend far beyond the scarp. Owing to their restricted catchment areas the majority of them are purely seasonal Cobbler's Creek in the orthern section although its head waters are much more extensive is mainly seasonal in flow. Dry Creek in central and southern sections and Little Para in the north are relatively permanent. No detailed stream analysis was attempted. The Little Para River has cut a considerable Gorge practically to base level.

It will be noted from the map that the greater part of the drainage is across the general geological trend i.e. Drainage is generally east to west while fold axes, strikes, and faults trend north and south. Hence drainage control is not definitely related to these features. It is however related to elevation and tilting of the block.

Mr. Hossfeld suggests that the major were before the uplift and were only displaced somewhat by the rejuvenation of topography.

The eastern boundary, the Eden Fault is more sharply defined as the scarp is formed mainly of a hard resistent quartzite. The scarp is known as Anstey Hi;; and further north as the Tea Tree Gully Hill. The scarp is approximately 600 feet at Anstey's Hill and becomes less well defined further north.

The general topography is probably still related to the pre-Pliocene peneplain, although a certain amount of tilting may have taken place. This has allowed the preservation of a considerable amount of Tertiary sands against the Eden Fault. At present the topography is relatively level or gently undulating. The greater part of the Tertiary sands have been removed from the western side of the block only a few isolated outcrops remaining.

The sands have been utilised as building material, being river (?) sands they are relatively "sharp" and hence suitable for concrete aggregate. They also provide a suitable soil for vineyeards. These vineyards with some small mixed farm holdings represent the sole efforts at agriculture in the area. The soil is in most cases fairly siliceous and it would seem that large numbers of quartzite "floaters" and surface travetine would make agriculture difficult.

Adjacent to the Little Para River some citrus fruit is grown. This appears dependent on the river for irrigation. As the block has a fair average rain fall it is thought greater use could be made of this area, especially by application of science to beneficiation of the soil. Even the poorest parts, where soil is little more than semi fixed sand dunes would appear to warrant improvement. The relative nearness to markets, hence low transport costs would help to offset higher production costs. The area should at least be capable of producing timber if suitable trees could be planted. It seems a pity that in a state of low rainfall any of the areas of fair rainfall should be neglected.

GEOLOGY

There are present, sediments of two distinct types. The older slates quartzites and dolomites of the Adelaide System and the uch younger sands and gravels which overlie them.

Beds found are:-

Adelaide System.

Quartzite
Shales, slates, and phyllites. These may be somewhat calcareous in places.
Dolomites, Buff and blue grey

Tertiary

Sands and gravels.
Surface limestone.

There is no evidence of any type of rocks other than sedimentary. Hard quartzite has been formed, cleavage developed in shales, some of which rather suggest phyllites. This may be explained by load metamorphism.

Even adjacent to the faults there is no mineralisation except for injection of large amounts of milky quartz. This has apparently spurred some optimist to drive a 150 feet into the hillside on the north bank of Cobbler's Creek.

On the southern bank of the same creek the old ordinance map shows a hill marked as Copper Hill - No justification has been found for this name.

QUARTZITE

For individual measurements and relation of these see the accompanying table P

The quartzites are generally fairly thin - the majority are of the order of 10 - 20', but are fairly prominent owing to their resistance to weathering. They range from almost pure quartzite t through various percentages of feldspar to arkose. Fine to medium grained, grains are generally well rounded. In most cases the feldspar is now represented by white kaolin. In only a few cases is jointing developed in the quartzite, they are generally massive Some variation in grain size and composition occurs within the narrow beds but actuall bedding was usually hard to distinguish. One of the most outstanding variations is the presence of rounded blue white opalescent quartz grains up to 5 mms in diameter. This is shown in band in quarry at 677017.

The underlying band is a uniform fine grained quartzite then there is a sudden break to the coarse phase which may be 2 - 3 cms wide then a return to normal phase. The band appears as a very minor diastem.

Also some bands exposed on quarry faces developed a peculiar honeycomb type of weathering. This was related to bedding as it could be traced parallel to the bedding and is probably due to some variation in original composition.

It was noticed particularly with these bands that the exposed surface was light coloured. This extends about 1 inch below the surface, then rock become distinctly yellow brown & tended to become a ferruginous sandstone rather than a quartzite This extended some distance into the rock but eventually returns to normal quartzite. Hence rock may be regarded as an outer shell of well leached material, then a concentration of iron towards the weathering surface (in this case the quarry face) then a gradual return to normal quartzite.

The contact between the outer leached zone and iron rich zone seemed quite sharp and depth of leached zone comparatively constant. The normal quartzite is taken to be white to pale grey in colour. Some reddish vitreous quartzites were found but these are only minor beds.

Owing to the relative competency of the quartzite they provide the outstanding examples of dray folds in this area. The shales and to a less extent the dolomites do not show these features so well.

In some few instances poor current bedding is shown.

1. West side of road leading to the Snake Gully Bridge (see specimen)
2. Approach to quarry 671009

   Although rather indistinct both cases suggest that they are concave upwards and truncated at top. i.e. It would appear that beds have not been overturned as the two specimens are from opposite sides of the block.

SHALES

Owing to difficulty in distinguishing bedding in these rocks they are referred to as shales. It is however more than probable that both shales and slates are present. Slate being applied to a rock with cleava ge appreciably inclined to the bedding.
Some of these rocks have the definite surface sheen of phyllites but for convenience all are referred to as shales.
The shales vary from the brilliant yellow brown shales similar to the Glen Osmond shales, to hard, siliceous olive green rocks. The yellow shales show fairly definite bedding as exposed in quarry 656985, in which a small syncline is exposed. The most common are light grey green to dark green rocks with a well developed cleavage. The phyllites are generally light grey to greenish grey in colour.

The majority of the shales have been injected with quartz, almost always the quartz appears to have moved in along the cleavage.
In some cases quartz is so plentiful that it constitutes more than

50% of the rock e.g. upper part of Cobbler's Creek.

In some cases the shales carry a fair percentage of CO_3 radicle either as calcite or perhaps as dolomite. Where cleavage is not quite so prominent these calcareous bands are difficult to distinguish from the dolomites. In the case of the central dolomite which outcrops near gaol and also near Snake Gully Bridge and along Dry Creek, the whole has been shown as dolomite although actually consists of bands of varying composition from dolomite, shaly dolomite, dolomitic shale.

These calcareous or dolomitic shales have given rise to fairly extensive kunkur deposits.

Adjacent to quartz injections the shale has been converted to a richly chloritic rock other than this no minerals were determinable in the hand specimen.

Because in most cases bedding is difficult to find it is almost impossible to follow the folding in these beds. However the cleavage developed in the shales which has a remarkably constant easterly dip bears a direct relation to the axial planes of the folds as shown by the quartzites. The shale outcropping just beyond the gaol fence and west of Snake Gully Bridge appear to be the same; the wider outcrops being due to low folds in northern exposure.

DOLOMITES

These range from buff coloured to dark blue grey in colour. As all the thicker bands of dolomite are blue grey, although surface layer may have developed a buff, it is thought that buff colour may be due largely to weathering. The majority of the dolomites are only of few inches wide and have some tendency to lens out. There are present two groups of much thicker dolomites associated with calcareous or dolomitic shales.

Unfortunately no analyses were made of these dolomites except a rough check to prove they were dolomites. The small bands are at times difficult to recognise except for their typical weathering surface. This is practically always of light brownish colour.

with typical channel ways of a weathered limestone surface. The dolomites are usually massive, some have an easterly dipping jointing developed in them. These rocks are extremely fine grained, - crypto - crystalline and break with a concloidal fracture. The colour is usually very uniform below weathered zone. No particular structures were noted except for some cherty material.

STRUCTURE

The area is apparently a part of Hossfeld's Para Series. Shepherd referred to the area as "Blue Metal Series" Neither of these investigators did any detailed work on the area. Shepherd covered a small section in the vicinity of the Snake Gully Bridge.

Investigations early in the year were hampered by failure to recognise the significance of the considerable amount of drag folding.

The structure appears to be a relatively simple sequence of beds which have a fairly shallow dip to the east. Regional strike is approximately 20° (i.e. N 20 E) and dip is approximately 25° to the east. Cleavage is well developed and has a strike about 20° and dips about 40° to the east i.e. cleavage is steeper than bedding. This fact and the occurences of poor current bedding suggest that the beds have not been overturned. Some minor examples of graded bedding tended to confirm this idea, although the low dip caused a certain amount of suspicion.

Superimposed on the dip slopes are numerous drag folds. These are fairly small, usually less than 500 ' between successive crests. In some cases these folds have smaller folds imposed on their limbs. These grade right down until hand speciments if dra g folds may be obtained. see specimen 22 which is an orientated specimen of one of these minor drag folds. The drag folds owing to better exposures are well shown on the western border of the fault block.

As the area under consideration shows no major folding it is assumed that these drag folds are related to major structures of the Mt. Lofty Ranges.

The drag folds are remarkably constant in their properties, The axial planes dip towards the east at approximately 40°(parallel to the cleavage). The steeper western limbs are in some minor instances overturned.
A typical example of dips of the limbs is 65° to the west and 35° to the east. This is the anticline exposed in quarry 670007.
The majority of the folds are south pitching, although pitch is usually very slight and fairly difficult to determine. Two adjacent examples gave readings of 10° to the south.

In the northern section of the area near the Snake Gully Bridge, the minor folds appear to be north pitching. These were not mapped in detail but were investigated while trying to establish a genera l picture of the area.

On the northern bank of the Little Para River a small quartzite fold showing pitch reversal was noted. This was represented as a small dome structure with central axis horizontal and then developed a downward pitch of 5° both to north and south. Unfortunately this structure was too small to map on final scale.
This was the only case of change of pitch that was noted.

Generally the relative constancy of drag folds and fact that the cleavage is parallel to the axes of the folds suggests that there has been only one period of dolding or if more than one that the stresses came from the same direction. Note that these beds dip towards the older Barossian rock.

FAULTING

Faulting has had a considerable effect on the geomorphology of the area. The exact location of faults, particularly, the major ones is open to some doubt as in extremely few instances was there evidence of fault outcrops.
Major Faults

PARA FAULT

This is a fairly long fault - it extends from little south of Adelaide to at least as far north as Gawler.

Here although the actual fault is probably obscuredly out wash material there is more likelihood of observing associated structures Very little evidence however was actually seen. The scarp indicates a fault of considerable dimensions but little drag and practically no brecciation was found. In no instance was this fault actually located but it is thought its location is approximately correct. The fault has been sketched in bearing in mind the contours and the most westerly of the outcrops. It is believed that the Mines Department intend to use geophysical methods to accurately locate these faults.

EDEN FAULT

Here much the same applies although location is perhaps a little more accurate. This was helped by the teeper fault scarp, brecciation in the quartzite, and occasional springs.

The fault scarp owes its comparative steepness to the resistant nature of the quartzite. Both these faults are included in Sprigg's High Angle faults of Major Meridional Series, and are considered to be of Kosciuskan Age. These are probably Palaeozoic Faults which were reopened during the Kosciuskan epoch.

Owing to lack of evidence no attempt has been made to determine amounr or exact direction of movement of these faults. It will be noticed that the major faults are approximately parallel and trend north east.

Several small faults were mapped, but these were considered to be of minor importance. They also have a north easterly trend and are therefore probably related to the major faults, The fault just east of Golden Grove may be of greater importance. This was located and mapped accurately for only a short distance but was extended hypothetically on topographic evidence.

It is more than likely that other minor faults occur but as they are usually sub parallel to the strike they are difficult to recognise, particularly in the shale bands.

The depth of Tertiary sands preserved on the eastern section of the fault and to some extent the drainage pattern suggests that the block suffered not only elevation but also a slight tilt towards the east.

CORRELATION

Sequence is undoubtedly part of the Adelaide System.

As stated previously Hossfeld included this area in his Para Series which he considered to be Lower Adelaide Series. Shepherd applied the term Blue Metal Series to the same area.

Owing to the unsympathetic attitude of the Gaol authorities the quartzite exposed in the gaol quarries has not been examined. A brief verbal description was given by Mr. Whittle The exact determination of the sequence appears to depend on recognition of dolomites and the above mentioned quartzite. There appear to be three possibilities.

1. The soft yellow shales on western border appeared similar to the Glen Osmond Shales and the central broad dolomitec series seemed in some respects similar to the Beaumont dolomite. Correlation on these assumptions had two very serious disadvantages.
   (1) The great statigraphical distance between them.
   (2) This assumption would involve overturning of the block and all evidence is against this.
2. Similaritywas noted between sequence in Mr. Spriggs type section and this area.

Type Section	Para Section
10 Glen Osmond slates	1 Shales & qtzite
9 Beaumont Dolomite	2 Shales & dolomite
8 Upper Phyllites	3 Shale
7 Thick Quartzite	4 Gaol quartzite
8 Lower phyllites (& qtzites)	5 shales
5 Upper Torrens Dolomite	6 Dolomite.
Type	Para
4 Phyllite with quartzite bands	7 Shales & quartzites.

(Numbers 10 - 4 refer Mr. Sprigg's Series)
This also involves overturning and is therefore considered untenable.

3.

Type Area	Para Area
4 Phyllite with qtzite bands	1 Shales & qtzites
5 Upper Torrens Dolomite	2 Shales & blue dolomites
6 Lower phyllite (qtzite)	3 shales
7 Thick quartzite	4 Gaol Quartzite
8 Upper phyllite	5 Shales
9 Beaumont Dolomite	6 Dolomitic series
10 Glen Osmond Shales	7 Shales & quartzites.

This appears to be the most logical conclusion but some doubt is still held regarding it. The lack of evidence of Gaol quartzite in unfortunate and the extreme drag folding of beds only a short distance above such a competent bed add to this doubt.

If this is the Thick quartzite it seems somewhat surprising that no outcrops could be found the only evidence being that of the quarries.

If the shales near the gaol and the Snake Gully Bridge are taken to be the same; they bear the same relation to the dolomites, why does not the quartzite outcrop along the Little Para ?

TERTIARY DEPOSITS

No attempt has been made to give exact age of these beds as no evidence of fossils was found in the numerous shallow exposures. Bore records show lignite beds at far depths and a total thickness of over 250' at its greatest depth. This is the east section. No detail work was done on these sediments as it is believed that the Mines Department is working on them.

The sediments vary from course gravels to fine semi-consolidated sands.

The gravels are usually well bedded and consist of well rounded milky quartz grains up to 1 inch in diameter embedded in an iron rich clayey matrix.

There are present all gradations from these coarse gravels to very fine white semi consolidated sands.

There is some suggestion of gentle structures in these sands which appear more regular than slumping or torrential bedding etc.

However, sands may generally be regarded as horizontal sedime nts, or perhaps with a very shallow dip to the east(?)

The approximate limits of these deposits have been shown as a large continuous area with smaller outlines. It is quite possible that the large mass is itself a large number of these residuals.

They all suggest that they were once continuous over the whole area. The large eastern mass has been protected by the Eden Fault scarp and here it attains its greatest depth.

ECONOMIC GEOLOGY

There is little of economic importance in the area.

Spasmodic work is carried out on the washing of Tertiary sands, and occasionally local lateritic gravels are used as road metal.

Numerous quarries have been opened up along the western border, These supplied road metal (quartzite and dolomite) and building stone (shale). The majority of these have not been worked for some years. The Gaol quarries are now the only one producing road metal.

REFERENCES

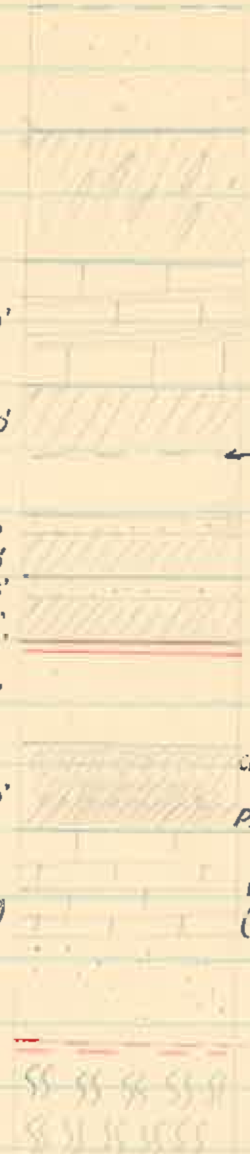
"The Geology of Part of the North Mount Lofty Ranges" by Paul S. Hossfeld. Trans Roy. Soc. 1935.

"Geology & Physiology of Part of the Mt. Lofty Ranges North of the River Torrens". by J. Shepherd.

"Reconnaissance Geological Survey of Portion of the Western Escarpment of the Mount Lofty Ranges". by R.G. Sprigg. Trans. Roy. Soc. 1946.

analyses?
plates?

Log of Strata



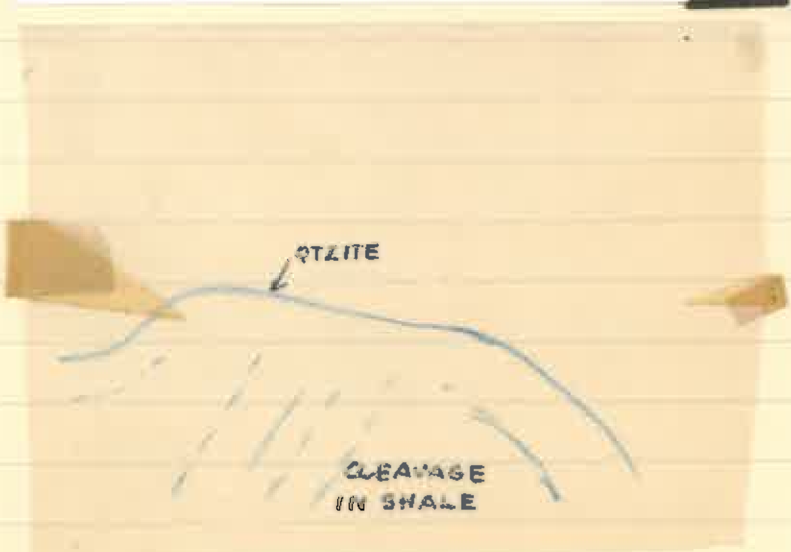
* In area in which sections were run no trace of Lower Torrens Dolomite was found, nor did the sandstone appear to contain dolomite.

Photographs to accompany Report of part of Pora Fault Block.

Mature topography with Eden fault scarp.

Para Fault Scarp looking SW.

Drag fold in thin quartzite.



Drag fold exposed on hillside showing cleavage in shale parallel to axis of fold.

Drag fold in thin quartzite. 670001.

Series of Drag folds 670 995.

Anticline in quarry 670075 looking N.

Same anticline looking S.
Fold pitches S about 10°

Liesegang Rings in shale

Tertiary Sandsin sand pit. 715 982.

Looking S E across block towards Tea Tree Gully.
Showing level block and fault scarp in background.

Banded outwash material East of B Parafield 655003.

Damagh 1946

1947

Traverse along the South Para from the Devil's Nose to near Gawler.

The traverse was undertaken as additional field work for the Honours degree.

SUMMARY

The work was commenced at the eastern limit. This was the known unconformity between the older schists (Barossian) and sediments of the Adelaide System.

In running a traverse to determine position in sequence it was found impossible to determine exact location of contact. The attitude of the beds suggested a fault contact at this locality. (Vacinity of Upper Hermitage)

At the Devil's Nose a definite uncomformity was noticed. The older schists have a cleavage and probably a bedding dipping 30° to the east and over lain by quartzite dipping steeply to the west. Faulting has interrupted the sequence but as far as Gawler beds are probably only lower Adelaide Series.

Field investigations were confined to a traverse along the South Para River. It is obvious that a considerable amount of field work would be needed to completely map the area.

No more than a small strip map was prepared and this is meant to show only the main features.

Rocks investigated were

Barossian Complex

overlain by

Adelaide Series.

Barossian Complex.

These rocks were not examined except adjacent to the unconformity.

In the hand specimen the schists had a somewhat greasy lustre which suggested cordierite. Adjacent to the unconformity some shafts have been sunk. Judging by the size of the ruins which were apparently a treatment or concentration plant these mines must have been fairly productive.

In the quartz on the dumps geothite type iron ore was noted, this occurred in columnar and fibrous radiating structures. (Form suggests open space filling type ore deposits.

Adelaide Series.

This overlay the schists. The contact appeared to be very steep but of varying angle 70 - 90^{0}. It may even be overthrust in places.

The basal bed consisted of a medium grained arkose. Ilmenite was present in fine bands. This was not as plentiful as was expected, as compared with basal beds in other areas.
In fact it seemed that in the very lowest part the ilmenite was less evident than further up in thebeds.

The arkose gradually grades into a feldspathic quartzite.
The beds then were alternating quartzites shales and blue crypto crystalline dolomites. The upper section shows a wide outcrop of clacareous shales with a few interbedded blue dolomites.

Structure.

Little definite effort was made to unravel the structure as it was obvious that this would take a considerable amount of time and experience to fully unravel this area.

All that has been attempted is the interpretation of the data collected. It is obvious that data collected is not the complete and hence minor points may have been elaborated at the expensive of what are really major points.

Briefly sequence suggests a faulted syncline then a faulted anticline and then a gently folded series of shales.
The idea of faulted syncline in the lower or basal bed means. Basal bed in repeated - This is supported by the idea of Mr. Hossfeld who some years ago made a brief investigation of this area.

If this is the case it suggests that the structure is actually decollement folding. The upper section of calcareous shales show no structure as bedding is very difficult to find. A great deal of quartz has been injected along the bedding and in some cases the quartz shows some evidence of folding. Also the extent of the outcrop would also support the idea of shallow folding. As no definite evidence was found it has been shown on section as a more or less uniformly dipping sequence.

The topography is fairly mature but steep valley and gorges and retained these provide fairly extensive outcrops.

It is thought that detailed work in this area would be well worth while as it may through more light either for against theories advanced by Mr. Hossfeld.

There are minor areas of kunkar and some lateritic material is found in the higher levels - adjacent to Gawler Town Hill.