THE UNIVERSITY OF ADELAIDE
DEPARTMENT OF ECONOMIC GEOLOGY

GEOLOGY OF PART OF THE SPRINGTON-CAMBRAI AREA

S. Kaewbaidhoon,
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SUMMARY

The report deals with the general geology of part of the East Mount Lofty Ranges on lower part of Cambrai sheet and upper part of Mannum Sheet, which is the result of geological mapping during 1951.

The rocks of the area are mainly, schists, quartzites, and marbles of Kanmantoo Series and Palmer granite. The structure of Kanmantoo Series is pitching north synclinal fold, of which, the east limb was cut off by big fault separating the Mount Lofty Ranges from the Murray Plains. The Palmer granite intruded the Series about the middle of the area.

GEOLOGY OF PART OF THE SPRINGTON-CAMBRAI AREA

Introduction

The geology of 40 square mile area, covering the lowest part of Cambrai and upper part of Mannum one-mile military sheet has been mapped with the aid of aerial photographs, during 1951. The two runs of 4 inches to 1 mile scale photographs cover the area of 15 miles from east to west and 3 miles from north to south.

The area is part of the East Mount Lofty Ranges, 35 miles east northeast of Adelaide. The three adjoined similar areas were also mapped to the north by Messrs. J.E. Harms, R.C. Rowley and N.L. Markham.

The interpretation of the stratigraphical geology has been done, referring to results of those works in the upper area, especially the division of Kanmantoo Series which cannot be done only from the mapping of the southern area.

Previous Geological Work

1. In 1926 P.S. Hossfeld had done geological mapping over the wide area including the area in this report. He put out the paper entitled "The Geology of Part of the North Mount Lofty Ranges" in the form of reconnaissance survey report with geological sketch map covering the area of 180 square miles. Hossfeld's work has been used as main reference for interpretation in this report.

2. The age of Kanmantoo Series of the area has been interpreted before by R.C. Sprigg of the S.A. Mines Department.

Topography

The Mount Lofty Ranges were separated from the Murray Plains by the series of faults on the eastern part of the area. Close to the fault scarp, in the plains, are small hills of boulders and gravels carried out and deposited by the creeks. All the creeks run down from the ranges into the plains, cutting deep gorges and valleys on the east. The biggest creek of the area is Saunder's Creek whose bottom is as low as 500' level.

The hilly side on the east is steep and rugged. The peaks and the ridges of the hills are mainly hard rocks as quartzites, sandstones, and marbles. Most trends are nearly north south, parallel to the main fault scarp. The highest peak on the eastern part is 1250', where the Cooke's Hill Trig. is 1013'. On the west of the area the slope of the hills is much gentler than that on the east. The highest peak on this side is 1648', at the Burn's Trig. The topography of the western part does not follow the ridge or strike line of the rocks as found on the east.

The rock outcrops are well exposed on the east but not on the west. The geological control of topography is that - the Saunder's Creek and Keynes Gap Beds form the rugged and long ridges and the Eden Valley Bed forms the gentle slopes.

Rock Types and Stratigraphy

The rocks found in this area have been divided into horizons according to the work of the upper area where the rocks are more definite in character and more beds have been found.

Tertiary and Recent
- Alluvium
- Boulders and gravels deposit
- The deposit in the Murray Plains

Kanmantoo Series
- Pine Hut Quartzites
- Somme River Micaceous Quartzites
- Saunder's Creek Marbles and Schists
- Keynes Gap Sandstones
- Eden Valley Mica Schists (including granitised sediments and Springton quartzites)

Igneous Activity
- Palmer granite
- Granites
- Pegmatite
- Dolerite - Hornblendite
- Quartz blows.

Tertiary and Recent

The consolidated rocks of young ages have not been found in the area, except small patches formed by the calcareous cementation of boulders and gravels, close to the marbles. The travertine limestone is only found as slightly capping on the marbles. Small area of shallow alluvium has been deposited about the middle of the area. The material is obviously pure sand. The deposition of clay has not been located.

The boulders and gravels were transported and deposited at the mounts of the creeks in the form of small hills along the fault scarp. The boulders are quartzite, granite, schist and marble of sub angular shapes.

The Murray Plains are believed to be The area of Tertiary and Recent deposition. The sediments are sandy clay, sands, gravels, and travertine limestone.

Kanmantoo Series

Pine Hut Quartzites and Somme River Micaceous Quartzites

The rocks of these two beds are found in the upper area, as overlying the Saunder's Creek Marbles and schists. They are not found extending down south in this area. Pine Hut Quartzites, the upper bed, is distinguished from Somme River Micaceous Quartzites by their constituents. Both rocks are densed and banded, but the upper one consists essentially of quartz with some micaceous mineral and the Somme River micaceous quartzites consist essentially of micaceous mineral (biotite) with quartz, feldspar, and some apatite and scapolite.

Saunder's Creek Marbles and Schists

The rocks of this bed have been used as the key to interpret the structural feature of the area. The bed consists of marbles interbedded with schists, micaceous quartzites, and in certain place sandstone reefs. Many thin bands, about 15' as maximum thickness of scapolite diopside rock are also found interbedded with schists.

Marbles of Saunder's Creek are lenticular and continued beds in some places. The greatest thickness of the bed is 700'. The rocks are coarse grained, pure to very impure marbles. The minerals of these marbles are calcite, scapolite, diopside, horblende in varying quantities. The colours are from white to dark. The siliceous bands are numerous.

The schists are composed mainly of biotite with quartz on the west. On the east the rocks are more knotted with andalusite as the main composition instead of quartz. Many pegmatite and granite bodies intruded into the rock of this bed. The rocks were intensely metamorphosed to form quartzites, granitised quartzite and coarse grained schists. The sandstone and quartzite reefs are found as long ridges on the north of the area, close to arbles. These are fine grained, massive and very slightly micaceous.

The thin bands of scapolite diopside rocks are found composed of quartz, scapolite, diopside, calcite and horblende. As they are tough and well standing to the weathering, they obviously maintain the strikes and dips of the formation.

The rocks of Saunder's Creek are highly metamorphosed and granitised. The thickness of the bed is about 4000'.

Keynes Gap Sandstones

The rocks, underlying Saunder's Creek Marbles and Schists, are the Keynes Gap Sandstones. The rocks are mainly massive sandstones and quartzites with quartz as essential constituents. The rocks were metamorphosed to form very tough quartzite in some places. The micaceous quartzites or mica schists are not uncommon. On the southern part, the rocks were intruded by a number of granite bodies which are very hard to be distinguished from granitised sandstones of the area. The rocks are richer in biotite as approaching south. The quartz blows are plenty in this bed.

The Keynes Gap Sandstones form mainly long ridges running from north to south. The thickness of the bed is about 3000'.

Eden Valley Mica Schists

(including Granitised sediments and Springton Quartzites)

The Eden Valley Mica Schists are in the lowest horizon of the Kammantoo Series found in the area. This includes granitised sedimehts and Springton quartzites. The rocks are mainly mica schists consisting of biotite, muscovite, quartz and plagioclase. The rocks are rich in quartz in form of sandy mica schists in many places. The metamorphism is very intense in the rocks of this bed. They are all well recrystalline rocks. Many small granite bodies as well as Palmer granite intruded into these rocks, developing widely granitisation.

The rock so called granitised sediments are found as continued bed running along the certain axis of anticline in the Eden Valley Mica Schists. The outcrop is about 3000' wide from east to west. This can be followed from the north to the south of the area. The rocks are very tough and fine to medium grained, consisting of essentially feldspar and quartz with some epidote and green minerals. The structure of the rocks is gneissic, without any definite bedding plane. These granitised rocks are associated closely to green and very grained quartzite. It is believed to be altered from purer siliceous bed of the Eden Valley mica Schists.

Springton quartzites are exposed in many quarries around Springton. The rocks are light coloured, fine grained, intensely folded and sheared. They conformably underly the mica schists and sandy schist of the Eden Valley. The interesting feature is that the intensely shearing nature is not observed in the mica schists.

Springton quartzites might be an origin of mentioned granitised sediments. As it is hardly seen as exposed outcrop in the country except in quarries, the thickness of this rock cannot be estimated. It can be, probably, believed that many of the soil covered hills in the area are quartzite hills. The exposed outcrops of quartzite around Springton where the dips of mica schists are generally the same, suggests that the thickness of the

overlying mica schists is not very great, but it is the repetition of folding that makes the schists cover more than a half, on the west, of total area.
The thickness of Eden Valley Bed is not known.

Iron Capping Hills of Eden Valley Mica Schists.

Many places in the area, Eden Valley Mica Schists are found weathered to form iron rich capping. The leached parts consist of red ironstained mica, and in some places, only white fine grained mica. The gossan character has been observed on the west of the area where a trace of cavities suggesting pre-existing sulphide. The thickness of the capping is about 10 feet. These zones are on the tops of the hills at about 1600 foot level. One of these leached cappings can be seen at the Burn's Trig. point.

Igneous Activity

Palmer Granite

The rock covering the lower middle part of the area is a reddish, massive, fine to medium grained granite. The rock is called Palmer Granite, as it occurs in a big area to the west of Palmer. It consists mainly of quartz, pink felspar and biotite. The structure of the rock is gneissic, with uniform gneissicity of about north west direction.

Palmer granite is said to be granitised sediments. The bedding planes of the sedimentary rocks still remain in some places near to Palmer. In this area the Palmer granite intruded Eden Valley Mica Schists. The direction of gneissicity of this rock is about north west, where the direction of strikes or schistosity of the mica schists is about north south. The difference of gneissic Palmer granite and schists can be observed distinctively along the contact. The bedding planes are not seen in the Palmer granite of this area. The outcrop is about 1½ miles wide and about 3 miles long The rock extends downward to the south east. On the north east of the outcrop are very fine grained aplite lining along the contact. The Palmer granite is well exposed on the east and mostly covered by the soil on the west. The weathered concentric shape helps to tell Palmer granite from the ordinary schists and quartzites in the field.

It is believed that many small granite bodies intruded in the area are branches of this big massive Palmer granite.

GRANITES

As the rocks are granitised in most parts over the area, it is hard to distinguish between granitised and intrusive granites. But in many places the rocks are certain to be true granite. The character of these rocks are equigranular, fine to medium grained, with clear quartz and, in cases, completely decomposed felspar to form white kaolin. On the other hand, the granitised rocks are not

seen chemically decomposed, but can be traced back to micaceous quartzite and coarse grained quartzite. In addition granitised rocks look more vitreous and denser, as they may lack of volatiles during recrystallisation. Many small bodies of biotite granite of true igneous origin are found in the area from west to east.

Aplite

Fine grained aplite is found lining along east contact of Palmer Granite and Eden Valley Mica Schists. In many places the aplitic rocks are associated with white, fine grained quartzite, where both of them are strongly sheared.

Pegmatite

There are many granite pegmatite bodies intruding the Saunder's Creek Bed. The pinkish pegmatite carrying tourmaline is mainly in the sand schists of this bed. Small bodies of pegmatite are also found in the Eden Valley schists as intrusion along the strike of the schist on the south west of the area.

The pegmatite containing clear quartz and fresh pinkish feldspar with small amount of biotite is found close to Kanappa Copper Mine. This pegmatite is believed to be the mineralizer of the copper and gold of the region.

Dolerite-Amphibolite

The basic igneous intrusives are found as two small bodies close together on the west of Palmer granite, south of the area. The rocks are dark in colour, with very small amount of felspar as constituent. In Saunder's Creek Bed the rocks are found to be more porphyry texture. The feldspars are more and developed in bigger grains.

The rocks socalled amphibolite are found generally close to marbles of Saunder's Creek. The rocks are dark, heavy, composed mainly of fine to very coarse grains of amphibole, sometimes, with feldspar. The shape of the intrusion is not definite.

This may be formed by means of metamorphism, As the small amount of the rocks of the same feature are found produced along the contact of marbles and siliceous rocks as quartzites.

Quartz blows

Quartz blows are found intruded mainly in the Keynes Gap Sandstones, especially on the southern part. Cooke's Hill peak is covered by milky to clear quartz. The form and dimension of the blows are notdefinite. In many places they are found as aggregate of clear crystals carrying haematite.

Metamorphism

The rocks of Kanmantoo Series are highly metamorphosed. The rocks are high grade metamorphic, such as quartzites, schists and marbles. The most intense metamorphism took place on the east of Saunder's Creeks Marbles and Schists. The minerals of high grade metamorphism as garnet and andalusite are well developed all over the schists on this part. The influence of regional metamorphism destroyed the sigg of bedding plane of sandstones to form massive sandstone and quartzites reefs inmany places. The sheared minerals as talc are developed among quartzites in the middle part of Saunder's Creek bed. Scapolitization developed in most of marbles and calcareous beds especially the bands of scapolite-diopside rocks interbeided in the Saunder's Creek rocks. Horbblende is developed in marbles and along the contact of marbles and siliceous rocks. From the study of impure marbles, they are found to be holo recrystalline, containing calcite, scapolite, diopside, hornblende and quartz. The minerals arrange themselves in manner of banded structure. These scapolitization and hornblendisation are developed all over the rocks of Kanmantoo Series. The very coarse grained rocks of scapolite, hornblende and diopside are found around the Kanappa Copper Mine.

The granitisation took place widely over the area. The strong regional metamorphism also took place after granitisation. This developed the crush in some pegmatite, aplite and quartzite. The epidolisation developed along the shearing zones as well as in the granitised rocks themselves.

Granitisation

The biggest area of granitisation is that in Eden Valley Schists, known as Palmer Granite. This rock has been proved in place of Palmer as maintaining sign of bedding plane which is the character of sedimentary rock. As it occurs in this area, no sign of bedding plane can be observed but the physical properties of the rocks are more like that of granitised ore. This rock is believed to be intrusion and to be sources of many small granite intrusions in the area.

The rocks so called granitised sediments forming continued belt along anticline axis in the Eden Valley Schists, are of obvious sedimentary origin.

The rocks are believed to be altered from siliceous bands in the Eden Valley Bed. The minerals developed are quartz, feldspar with residue of sediment material. The rocks are strongly epidotised. Epidotes are found as composition as well as the filling along the shearing zones of the rocks. They lack in sign of bedding plane, but their structures are gneissic, with direction of gneissicity conforming to the bedding plane of surrounding schists.

The granitisation took place intensely in the southern part of the area, in both Keyne's Gap Sandstones and Saunder's Creek Marbles and Schists. Quartzites are turned into micaceous quartzite, recrystallised rock and granite like rocks. The rocks are recognised to be granitised as they can be traced back to the sedimentary origins which are not very far away. Most granitised rocks have gneissic structure grading into schistose structure of enclosing schists.

In Saunder's Creek bed, the granitisation took place mainly in micaceous quartzite along the shearing plane and contact with marbles. In Keynes Gap Sandstones, where granitic intrusions are plenty, the granitisation developed all over the bed especially close to the intrusions.

Mineralization

1. The only important mineralized area is that of Kanappa Copper Mine. The mineralizer is believed to be pegmatite found as small body close to the deposit. The minerals occurring in this deposit are pyrite, chalcopyrite and pyrrhotite.

2. At South Kanappa mine 1 mile south of Kanappa Copper Mine, the mineralizer is in form of indefinite quartz vein carrying gold and silver.

3. The mineralizing aplite is found on the east of Palmer Granite body. The mineral is pyrite of small crystals in the hard part of fine grained rock. The mineral is, in part, leached out to form gossan. The mineralization is negligible.

4. Quartz blows which are numerous in Keynes Gap Sandstones, carry small amount of haematite as ore mineral.

The sources of mineralization are obviously not many in the area. The igneous activity is mainly granitised rocks which are not favorable sources of mineralization.

STRUCTURAL GEOLOGY

Major Structure

The Kanmantoo Series were folded to form major syncline with north pitch on the east of the area. The east limb of the fold was cut off by big faults separating the ranges from the Murray Plains. The axis of major fold runs N 20° W along the Saunder's Creek Marbles and Schists of which the part of east limb is left. The general direction of axis of fold is north westerly. On the west of the area, the Eden Valley Mica Schists were folded back to form anticline and synclines with axes of nearly the same direction as the major fold.

The direction of big fault separating the ranges from the plains is about N 25°E. The evidence of faulting is very poor. Only small piece of breccia has been found near to the fault scarp. The throw of this big fault is not known.

Minor Structure

1. Saunder's Creek Marbles and Schists forming central core of major syncline are intensely folded and sheared. The shearing faults developed on east limb in form of en echelon faults having direction of N 10° W to the north and N 10°E to the south. The rocks on east limb of this bed were also intensely folded to form series of minor folds. The marbles are squeezed and flowed all over the bed. The true bedding plane of marbles were all destroyed, but many small drag folds can be still observed from the siliceous bands in the rocks. There is no evidence of tension fault except drag movement. The creek pattern does not suggest any fault. The uncontinuity of marble beds are believed to be due to lenticular shape of the bed, not to the fault.

The shearing fault in Saunder's Creek bed is not related to the big fault. The development of folds and faults of these rocks are believed to occur the same time as granitisation which caused the plasticity of the rocks.

The dips of Saunder's Creek bed on the west limb vary from 30° to 70°. On the east limb, most of marble dip nearly vertical.

2. Keynes Gap Sandstones are found only on the west limb of major syncline. The rocks dip uniformly about 50° to 65° to the east, in the northern part of the area. In the southern part of the area, the rock were intensely granitised and lack of bedding plane.

3. In the middle part of the area Eden Valley Mica Schists were folded to form anticline and syncline. The granitised sediments form a continued core of the anticline axis where the synclinal fold has Palmer Granite as the core.

On the west of the area, south of Springton, the rocks were folded in a complex system. The series of anticlinal folds pitch about 20° to the south and south east. On the lower part of the area they form a syncline pitching south east.

Springton quartzites as seen in many quarries around Springton were intensely sheared and folded. This is not observed in the

mica schists or sandy schists which overly on the top of these quartzites. However, the Eden Valley Mica Schists are believed to fold repeatedly to cover the big area rather than to have a great thickness. That the intense folding cannot be observed as well in mica schists as in quartzites, might be the plastic nature of the schists formed during the time of earth movement.

ECONOMIC GEOLOGY

1. Kanappa Copper Mine

The Kanappa Mine is situated in the north eastern part of the area. The mine was discovered in 1867 and was worked for copper. About 400 tons of ore was raised from the mine. The ore contains copper, gold and silver. The geology of the region is that the garnet schists contact marbles with intrusions of pegmatite and granite veins. The general strike of the country rocks is N20°W and dip is 60°W. Many veins of clear quartz of 3 inches as maximum width are found in the schists whic are the main working area. The minerals in the stope are all leached by the recent ground water to form blue and green carbonates. A fine grained biotite granite of 1" wide has been found intruding along the bedding plane of the country rocks. The stopes from which the ore was carried out is conformed in direction to this granite vein. The big stope was connected to the surface by inclined shaft of 50 feet depth.

The mineralization of the deposit is believed to be the pegmatite found on the opposite bank of the creek. This pegmatite is composed of clear quartz, pinkish feldspar and small amount of biotite. The rock intruded limestone and change the impure limestone into scapolite, diopside and hornblende bearing marbles. The very coarse grained scapolite diopside and hornblende rocks are found in many places associated to the schists. This coarse grained rock carries a fair amount of pyrite, chalcopyrite and pyrrhotite. The marbles and schists are both mineralized, but the later is much more favorable. Along the contact of schists and marbles is a siliceous band which is believed to be the wall protecting the marbles from intense mineralisation.

2. South Kanappa Mine

This mine is situated on the slope of west side of the Ranges, 1 mile south of Kanappa Copper Mine. The country rocks are mainly fine grained quartzites, small amount of schists and gossan or ironstone. Only one short and undefinite quartz vein of 3 feet wide, striking N 60°W, dipping 60° to the east follows the dip and strike of quartzite. Both quartz vein and country rocks are crushed and sheared. Many shallow shafts had been sunk and short tunnels had been driven to follow quartz veins and ironstone. This mine had been worked for gold, yielding 3 ozs, 7 dwts and 11 grs. of metal.

3. Springton Quartzites

Many quarries had been carried around Springton for quartzites which were mainly used as road metal. The rocks are fine grained and intensely sheared and folded.

Historical Geology

1. Deposition of Kanmantoo Series

The age of Kanmantoo Series cannot be certain because no fossil has been found in the rocks of the series. The rocks are highly metamorphosed, composed mainly of schists, quartzites and marbles. In the south eastern part of the area they are intencely granitised and were intruded by numbers of granite and pegmatite. On the northern part of upper area, Proterozoic tillite was reported by P.S. Hossfeld, to be found and this tillite when traced further south become part of the Kanmantoo Series. This evidence suggests Proterozic as the age of Kanmantoo Series.

But Kanmantoo Series has been considered by R.C. Sprigg of the S.A. Mines Department as Ordovician in age and that they are separated from Adelaide system on the western side of the ranges by a fault unconformity. The Interpretation on age of Kanmantoo Series requires some more evidence. This should be reserved for the later workers in this area.

2. Intrusion of Palmer Granite
3. Granitisation in conjunction with folds and faults of Kanmantoo Series.
4. Basic igneous intrusion
5. Granite and pegmatite intrusion
6. Mineralisation of Kanappa mine
7. Scapolitization
8. Formation of peneplain during Tertiary
9. Big Fault separating the ranges from the Murray Plains
10. Erosion of Kanmantoo Series and deposition of the Murray River in the Plains.

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