DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT BK NO 91/70

# ROCKS FROM TRURO-FRANKTON LAMPROITE PROVINCE

GEOLOGICAL SURVEY

BY

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# Rocks From Truro-Frankton Lamproite Province

## ABSTRACT

Specimens from the southwestern part of the lamproite province are similar to those in the rest of the province except that an alkali amphibole with anomalous optical properties occurs in both lamproite blocks from the diatreme and outcrop near a crocidolite quarry which includes both lamproite and country rock. The nature and extent of metasomatism may be significant in mapping and understanding the lamproite province. Both greisenisation and magnesium metasomatism have taken place.

## INTRODUCTION

Specimens of outcrop in the Truro-Frankton area were received for examination from Brian Morris of the Mineral Resources Branch. The specimens were the subjects of Mineralogical Reports 5707, 5722 and 5764 from Pontifex and Associates Pty Ltd with descriptions and comments by Alan Purvis.

# PETROGRAPHY

6729 RS 3342

Locality No. 12, diatreme 2.5 km N of Truro

Rock Name Phlogopite lamproite with amphibole

Hand specimen

The rock is grey with a yellow-green tint. It has a high specific gravity despite a relatively high degree of alteration. The surface is talcose to the touch. Textures are patchy and exhibit a preferred orientation in places. The sample was impregnated with resin before sectioning.

Thin section

Most of the rock consists of a closely packed mass of pale, yellow brown mica. Where fresh the mica flakes are about 0.5 mm across but fine-grained alteration affects large patches. An amphibole of the same order of grain size is frequent but not as abundant as the mica. Opaque grains, apatite and a fragmented mineral which may be rutile or priderite are accessories.

The mica is a typical phlogopite of the Truro-Frankton province, pale and weakly pleochroic but with bands of a darker mica within and marginal to some crystals. It is not markedly macrocrystalline but the overall grain size distribution is affected by alteration. It is subhedral to anhedral due to close intergrowth.

The amphibole exhibits the pleochroism of a pale riebeckite but birefringence is anomalous with bright blue, brown, purple and grey colours. It is closely integrown with the mica and of similar grain size. The crystals are fractured and in places

replaced by fine grained phlogopite. The mineral may be a type of richterite.

Scattered opaque grains are subhedral to anhedral and are probably ilmenite.

Apatite occurs as broken, thick prisms up to 0.5 mm long.

Highly fragmented, amber coloured grains are optically similar to rutile but in the lamproite environment may be priderite.

Comment

The section did not display any preferred orientation such as is seen in hand specimen and underlines the variability of the rock. Identification of the amphibole and possible priderite by optical means should be supplemented by probe analysis. This would also identify compositional variation in the mica.

Amphibole-bearing lamproite has been identified previously in the blocks of the diatreme but so far has not been noted as a dyke or other individual intrusion. It may occur at a lower crustal level than the present erosion surface.

6729 RS 3252

Locality 2 km SE of Frankton

Rock name Albitite

Hand specimen

White, ovoid crystals up to 4 mm long with a preferred orientation are contained in a fine grained grey groundmass.

Thin section

The rock consists of albite, opaque minerals and various alteration products.

Albite occurs as phenocrysts of euhedral to subhedral shape, usually altered to various extents to sericite, as anhedral subhedral grains in mosaics and radiating arrays filling vesicles and as irregular laths with preferred orientation forming the main groundmass of the rock. The foliation is due to magma flow and deviates around phenocrysts. This type of albite is closely intergrown with fine grained opaque minerals. Recrystallised albite fills discordant veins.

Fragments of finer grain size with a higher content of opaque material appear to be xenolithic in the vein system.

Composition of the opaque material may not be homogeneous. Grain size varies from coarse to fine.

In addition to sericitic alteration, a cloudy, indeterminate material is common as an alteration product. It is probably leucoxene which suggests that the opaque material is at least partly ilmenite.

A few rhombic outlines with little or no mineral contents suggest the possible former presence of a soluble carbonate with euhedral form.

Comment

Albitite volcanics have been found elsewhere in the basement of the Murray Basin. They may be genetically related to the lamproite suite.

6730 RS 47

Locality No 24. Blue hole crocidolite quarry

Rock name Muscovite-tourmaline greisen with retrograde alteration.

Hand specimen

The specimen is soft and incoherent with a talcose texture. Abundant mica flakes are evident.

Thin section

Altered mica is the main component and forms a close packed mass of anhedral flakes about 1 mm across. Brown tourmaline is a minor constituent.

Mica flakes are almost completely altered to a mineral of low birefringence with biaxial optics and a very low 2V. Crystals are anhedral. Sericitic alteration occurs in patches.

Tourmaline crystals are anhedral to subhedral and often skeletal. Pleochroism is mainly brown to pink to yellow but some grains and patches are open rather than brown. Grains tend to be clustered in patches, often with opaque minerals and fragmentary rutile.

Comment

Mica-tourmaline greisens are present elsewhere in the area. Hydrous alteration may be due to weathering.

6730 RS 48

Locality No 24. Blue hole crocidolite quarry

Rock name Greisenised syenite with hydrous alteration.

Hand specimen

Clusters of fine grained mica are contained in a mosaic of coarse grained feldspar crystals. Patchy clusters of pink and brown minerals are present.

Thin section

A mosaic of coarse grained plagioclase and indeterminate feldspar has been partly replaced by fine grained mica and scattered rutile. A second platy mineral, probably talc, has replaced both feldspar and mica. The pink mineral noted in hand specimen is seen as a pinkish brown tourmaline in thin section. Opaque minerals are either ilmenite or haematite.

Most of the feldspar is cloudy plagioclase with poorly developed twinning. It consists of interlocking, subhedral laths up to 1 mm long and is partially replaced by mica. A few crystals exhibit an irregular twin pattern which may indicate microcline or possibly anorthoclase. Many grains are not visibly twinned.

Fine grained mica with weak yellow-brown pleochroism occurs as individual flakes and clusters of flakes between and within the feldspar grains. Birefringence is moderate for a mica and the mineral is either phlogopitic or poorly crystalline.

A few larger flakes of a colourless, highly birefringent mineral are probably talc.

Fragmentary, anhedral grains of probable rutile are widespread as individual grains, in clusters of grains and in close association with tourmaline and opaque minerals.

Tourmaline occurs as pinkish brown, strongly pleochroic crystals, alone or associated with rutile and opaque minerals.

The opaque minerals occasionally exhibit prismatic sections and hexagonal cross sections and hence may be ilmenite or haematite.

Comment

Evidence of alkali magmatism and greisenisation has been encountered elsewhere in the Truro area. Probe analysis of the mica would augment the optical data and provide an identification of both mica and talc. It is possible that magnesium was involved in pneumatolytic processes or subsequently in hydrothermal alteration. The apparent abundance of rutile, if confirmed, may be of economic significance.

6730 RS 49

Locality No 24. Blue Hole crocidolite quarry.

Rock name Greisenised syenite

Hand specimen

The rock is coarse grained with patches of black, white and brown minerals. Yellow stain from sodium cobaltinitrite indicates the presence of potash feldspar. The potash content by analysis is 6.53% $K_2O$.

Thin section

Feldspars, both plagioclase and potash feldspar, are mainly present as relict crystals the major part of which has been replaced by tourmaline, phlogopite, muscovite, talc and an alkali amphibole.

Indistinct and absent twinning prevents the definitive identification of many feldspars. Staining by sodium cobaltinitrite indicates a high content of alkali feldspar but plagioclase is also present on the evidence of twinning in some grains.

Tourmaline is present in fragmented grains and masses up to 8 mm across. It is pinkish brown in colour and strongly pleochroic. It is abundant enough to produce a boron assay of 1%.

Pale, weakly pleochroic mica which is probably phlogopite is present in scattered fine grains and clusters similar to those in specimen RS 48. Larger, though rather diffuse, colourless platy minerals probably include muscovite but some appear to be fibrous rather than platy and may be talc. The potash assay is 6.53% $K_2O$ which suggests a high mica content in addition to the potash feldspar.

A prismatic to fibrous amphibole occurs in dispersed patches which often exhibit a radiating structure. The amphibole is low in refractive index but exhibits dramatic pleochroism and birefringence. Pleochroism is from violet through aquamarine to very pale yellow. Birefringence is anomalous from purple through brown, blue, blue green, green to yellow green. It is similar to glaucophane but may be a richterite.

Rutile and a prismatic opaque mineral are moderately abundant.

Comment

Tourmalisation is a more significant part of the greisenising process than the development of mica in this specimen. The fibrous amphibole is closer to glaucophane than to riebeckite and it is doubtful whether the designation of crocidolite is mineralogically exact. It is possibly a richterite similar to that seen in the lamproite.

6730 RS 50

Locality No 24. Blue hole crocidolite quarry.

Rock name Greisenised syenite.

Hand specimen

The rock is finer grained than RS 49 and black patches are not present. It is otherwise similar to RS 49 and has taken a strong yellow stain from sodium cobaltinitrite. The potash assay is 12.21% $K_2O$.

Thin section

As is apparent from the hand specimen, grain size, of the feldspar in particular, is somewhat lower than that of RS 49. The same minerals are present but in different proportions.

Plagioclase is abundant despite the indications of the staining technique but much of the feldspar is optically indeterminate.

Phlogopite is abundant although particularly finer grained. Tourmaline is a minor constituent.

Rutile is abundant and the content of titania is 2.23% $TiO_2$.

The fibrous sodic amphibole is much more abundant than in the other specimens from the Blue Hole quarry and is probably a true crocidolite. Strong pleochroic colours are close to those of riebeckite and birefringence is less anomalous.

The opaque minerals are irregular in outline rather than prismatic or hexagonal.

Comment

The rock is another example of alkaline magmatism and pneumatolytic alteration.

6730 RS 51

Locality No 25. Asbestos prospects northeast of Blue Hole crocidolite quarry.

Rock name Altered ?lamproite.

Hand specimen

The rock is crumbly and micaceous. Occasional flakes are as much as 3 mm across but most flakes are considerably smaller than that. The groundmass is brown and structureless.

Thin section

The main constituents of the rock are a pale, phlogopitic mica, fibrous amphibole and a groundmass of poorly crystalline talc.

Mica flakes are almost 0.5 mm to 1 mm across. Orientation is consistent locally but a single preferred orientation does not extend throughout the section. The mica is pale brown and weakly pleochroic. Bands of darker colour are typical of lamproitic phlogopite in the Truro-Frankton area. Most mica flakes have been wedged apart along cleavage planes and replaced

to varied extents by talc. Pseudomorphs of whole mica flakes are distinguishable within formless patches of talc. Felsic minerals are absent, suggesting that talc has preferentially replaced the groundmass of the rock.

Scattered crystals of fibrous amphibole have also been partially replaced by talc. The amphibole is more of the glaucophane than riebeckite type and displays a brightly coloured, anomalous birefringence.

Comment

On the evidence of the type of mica the rock is probably an altered lamproite similar to that represented by blocks in the Truro diatreme. However, replacement by talc is advanced enough to make identification uncertain.

6729 RS 3742

Locality No 8. S side of Sturt Highway 250 m W of Truro.

Rock name Phlogopite lamproite.

Hand specimen

The specimen is somewhat decomposed but abundant bronze coloured mica phenocrysts up to 8 mm across are prominent. A preferred orientation is apparent but not exclusive.

Thin section

Mica flakes vary from 5 mm across to a few microns. Groundmass minerals are identifiably feldspathic in places but are otherwise indeterminate. Pseudomorphs after apatite prisms up to 1 mm across are frequent. Potash content is 9.1% $K_2O$.

Mica varies from the type of phlogopite typical of the Truro-Frankton lamproites to what appears to be a normal biotite. In the larger flakes compositions vary zonally and limonitic alteration is also frequently zonal. Biotite flakes are finer grained components of the groundmass and tend to be less strongly altered.

The minerals identifiable as feldspars are mainly prismatic to fibrous but most feldspathic material is poorly crystalline and without identifiable optical properties or crystal form. The felsic groundmass is possibly the product of devitrification.

Pseudomorphs after broad prisms of apatite are clearly identifiable although the replacement mineral is isotropic and not identifiable. In many places the mineral has plucked out or been dissolved away.

Individual grains and mosaic patches of quartz are present but may be a late introduction.

Extremely fine grained acicular minerals of high refractive index are abundant. They appear to have developed along cleavages and grain boundaries of groundmass minerals. They may be rutile or priderite.

Comment

The lamproite is of the type encountered in DDH Frankton 2 with pale phlogopite as the dominant mica and apatite of relatively coarse (although not strictly phenocrystal) grain size. Initially glassy groundmasses are typical of the Frankton 2 lamproites.

6729 RS 3743

Locality No 8. S side of Sturt Highway 250 m W of Truro.

Rock name Felsic lamproite

Hand specimen

The specimen is crumbly, porous and limonite stained. Mica phenocrysts are visible but are much less abundant than in RS 3742.

Thin section

The major part of the rock consists of a fine grained mesh of sericite flakes with fine granules of opaque minerals and possible rutile. Mica flakes are scattered, corroded and either colourless, weakly tinted or completely replaced by limonite. Apatite prisms are abundant and up to 1.5 mm long. Quartz and plagioclase are present.

A much lower potash content (3.63% $K_2O$) than in RS 3742 suggests that the abundant flakes of highly birefringent minerals may include talc. The low content of magnesia (1.15% MgO) suggests that talc is not abundant. Some of the mica may retain magnesian.

The porphyritic mica has been partially altered to muscovite which is colourless or weakly tinted green. Weakly yellow-brown mica may retain some phlogopitic character. Some mica has been replaced by a yellow brown, amorphous mixture of limonite and leucoxene.

Apatite crystals are thick prisms and are not only more abundant but also better preserved than in RS 3742. The crystals are fractured and somewhat imperfect structurally but have not been replaced or plucked out of the section. The assay of $P_2O_5$ is 2.711%.

Quartz is present as individual grains and as mosaic clusters of grains. It may have been introduced late in the history of the intrusion.

Plagioclase is not abundant but has escaped sericitisation and is therefore prominent.

Finely granular opaque minerals (probably ilmenite) and rutile or priderite in coarser grains than in RS 3742 are probably the source of 2.13% $TiO_2$. They may have exsolved from the groundmass during devitrification or sericitisation.

Comment

The rock appears to be complementary to RS 3742 in containing abundant groundmass and few phenocrysts. It may be a felsic differentiate of the other dyke at the same site.

6729 RS 3744

Locality Not available.

Rock name Spotted metasandstone.

Hand specimen

A pale grey, fine grained sandstone without apparent bedding or cleavage is marked by brown spots 2-5 mm across and by cavities which are rhombic and irregular in outline. A weak effervescence occurs from some cavities when 10% HCl is applied.

Thin section

Fine grained quartz and feldspar are closely interlocked through authigenic overgrowth but the recrystallisation has not imposed a directional fabric.

Flakes of biotite are distributed irregularly without any preferred orientation.

Rhombic cavities mark the former presence of soluble carbonate.

The brown spots consist of irregular, discontinuous masses of yellow-brown amorphous, translucent material. This is probably limonite but may have originally been discrete grains and clusters of pyrite. The nucleus of many patches is a cavity which may mark the former presence of the organic matter responsible for stabilising pyrite.

Comment

The metasediment is probably a hornfels in which moderate recrystallisation was not associated with directed stress.

6729 RS 3745

Locality No 9. N side of Sturt Highway 250 m W of Truro.

Rock name Phlogopite lamproite

Hand specimen

The specimen is crumbly and decomposed to the extent that no bright reflections are produced by the abundant mica. Relatively coarse grain sizes are apparent but the main appearance is earthy and brown with limonite staining.

Thin section

The most abundant mineral is mica in flakes up to 2 mm across. A weak flow-orientation is apparent but does not amount to a strict preferred orientation. A fine grained groundmass consists mainly of quartz and feldspar but may include felspathoids and zeolites. Epidote is quite abundant and may be replacing the mica.

The mica is not as decomposed as it appears in hand specimen but does appear to have been leached of iron and magnesium in places. The absence of reflection from mica flakes in hand specimen may be due to a coating of limonite. Iron has been mobile, possibly during weathering and has been reprecipitated as patches of limonite. Prior to leaching the mica was typical of Truro lamproites in a zoning of phlogopite in the centre and darker mica at the rim. Individual flakes and patches of muscovite are not abundant and may be the product of leaching at an earlier stage than weathering.

Groundmass is not as abundant as phenocrysts and consists largely of untwinned feldspar, probably orthoclase. Feldspar with multiple twinning is not uncommon and appears to include both anorthoclase and plagioclase. Octagonal cavities may have originated as a leucite. Zeolites appear to include biaxial types and isotopic grains which may be analcite.

An epidote with pale yellow green pleochroism is an abundant interstitial mineral which has clearly embayed and replaced mica with which it is in contact. It may have replaced completely groundmass minerals.

Accessory minerals include sphene and an acicular mineral of high refractive index and birefringence which may be eudialyte.

Comment

The lamproite is like RS 3742 from across the road in its mica-rich composition. It is possibly part of the same intrusion. However, it has undergone epidotisation which may be linked to leaching of the micas which was not noted in RS 3742. This underlies the local variability of these rocks. Weathering has resulted in further mobility of iron.

6729 RS 3746

Locality No 9. N side of Sturt Highway 250 m W of Truro.

Rock name Phlogopite lamproite

Hand specimen

Brightly reflecting bronze mica flakes up to 15 mm across are scattered within a grey and brown groundmass.

The groundmass consists of spherical clusters of grey minerals about 4 mm across with brown, limonitic material between them.

Thin section

Mica flakes include phenocrysts up to 4 mm across and groundmass components a few microns across. Both display a preferred but not exclusive orientation almost certainly due to magma flow. The grey spheroidal areas consists of poorly defined to fibrous minerals of low birefringence, probably feldspathic but not well enough crystallised to be identified. Interstitial material includes mosaic quartz and amorphous limonite. Apatite is a common accessory.

Phenocrystal mica is typical of the phlogopites in the Truro-Frankton lamproites with darker mica as rims and internal patches. Groundmass mica is of more biotitic appearance.

Spheroidal forms within the groundmass are probably the product of devitrification and individual grains are not distinguishable let alone identifiable. The relatively high silica assay of 57.3% $SiO_2$ suggests that quartz may be present as well as feldspars. Similar forms have been described in the Frankton lamproites and are only diagnostic of a rapidly chilled, glassy groundmass.

Quartz occurs as meandering veins and as patches of mosaic with relatively coarse grain size. Small layers and patches of colloidal silica are present.

Apatite occurs as thick prisms up to about 1 mm long. It is probably phenocrystal in the sense of being present in crystal form before intrusion although not comparable to the mica in grain size.

Fine granules of opaque oxide are ubiquitous in the groundmass. Opaque masses of limonite are probably the product of lateritisation and replace glass which was not devitrified.

Comment

The specimen may correlate with the groundmass-rich lamproite south of the road (RS 3743) but local variation is so strong that correlation is uncertain.

6729 RS 1510

Locality No 16. Frankton prospect

Rock name Phlogopite lamproite

Hand specimen

The rock is fine grained, dark grey lamproite with phenocrysts only 1 mm long.

Thin section

The lamproite has already been described in Report Book 90/41. Fine grained, weakly oriented phlogopite phenocrysts are contained in a groundmass of even finer grain. Radiating aggregates of feldspar are present within a more randomly oriented feldspar. Crystals of rhombic outline, very low birefringence and 2V may be nepheline. Fine granules of opaque minerals are abundant.

Comment

The specimen was sectioned to examine a suggested xenolith. This was not included in the section.

## DISCUSSION

The main point of interest arising from these specimens is the presence of an alkali amphibole in both blocks of lamproite in the Truro diatreme and in non-lamprophyric rocks in the vicinity of the Blue Hole crocidolite quarry and adjacent asbestos prospects. Whether the mineral is crocidolite or a glaucophane is less significant than whether it originates as a primary lamproite mineral, a product of metasomatic alteration or both.

The extent and origin of such processes of alteration as greisenisation, epidotisation and amphibolitisation may be significant in delineating an area of metasomatic activity which may have been associated with the lamproite suite in general and the diatreme in particular. In view of the small area determined for the outcropping part of the diatreme (B Morris pers. comm.) the possibilities that the ejecta pile is a detached part of a much larger feature and that this may be mapped geochemically by determining the metasomatic aureole, if such exists, are worth considering.