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PETROGRAPHIC DESCRIPTION OF 21 ROCK SPECIMENS
FROM MUSWELLBROOK, N.S.W.

by

J.E. Glover

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The following report contains descriptions of thin sections and handspecimens of 21 rocks collected from cores in the Muswellbrook area. Rocks numbered 1 to 18 inclusive have previously been described (Records 1953/79) and the following rocks are numbered 19 to 35 inclusive. Locality and depth are also given.

Rocks with ophitic and subophitic texture are called dolerites, whereas porphyritic and amygdaloidal rocks are called basalts. Although these textural terms are used in the normal way, knowledge of relationship of the igneous bodies to overlying rocks is necessary to decide their intrusive or extrusive nature, and hence also their age. Thus basalts could represent margins of dolerites intrusive at shallow depth, and dolerites could represent inner portions of basalt flows. Examination of cores in Muswellbrook may resolve the problem.

Many basalts and dolerites are partly converted to carbonate, and in every such case (except specimen 31 from St. Helier's BMR1 (SC)) ferromagnesian are attacked but plagioclase remains. Origin of the abundant carbonate is not known; if general proximity of cindered coal seams could be demonstrated, it might suggest combination of carbon-dioxide from coal with calcium of ferromagnesian minerals to give calcium carbonate. Some fresh rocks contain serpentine apparently pseudomorphous after olivine, and though no olivine has been identified, the magma may have been of the olivine basalt rather than tholeiitic type. Absence of interstitial quartz and lack of pigeonitic pyroxene supports this. Augite in all samples dealt with in this report is titaniferous.

Descriptions of individual specimens are set out below.

SPECIMEN NO. 19

Mount Arthur, BMR 5(S), 365' - 410'.

Description of handspecimen.

The rock is grey-white, effervesces in cold, 10% HCL, and is difficult to resolve into mineral components with the hand lens. Numerous grey and white, spherical to subspherical amygdales are distributed throughout.

Description of thin section.

Phenocrysts of plagioclase (sodic labradorite) average 1 mm. long and form 5% of the rock. They are set in a groundmass (80%) made up of plagioclase laths (0.05-0.5 mm long), calcite granules and a little iron ore (mainly leucoxene). Dark brown, subhedral carbonate grains of average diameter 1 mm. probably represent former ferromagnesian phenocrysts: these grains form 5% of the slide, and locally contain a little chalcedony.

Amygdales average 2 mm. in diameter, are made up of intermixed brown and clear calcite and spherulitic chalcedony, and form 10% of the rock.

The rock is amygdaloidal basalt, partly replaced by calcite.

SPECIMEN NO. 19A

Mount Arthur, BMR 5(S), 365'-410'.

Description of handspecimen.

The rock is dark grey, amygdaloidal and porphyritic, with small phenocrysts of black augite and white plagioclase set in a dark grey, aphanitic groundmass. Patches of pale green and white minerals, perhaps amygdales, are present.

Description of thin section.

Phenocrysts of titaniferous augite and labradorite are set in a groundmass of minute (0.05 mm. long), randomly oriented, plagioclase, titaniferous augite and black iron ore granules. Phenocrysts, including those replaced by secondary minerals, make up 20% of the rock, amygdales 10% and groundmass 70%. Phenocrysts of titaniferous augite are mostly between 0.5 and 1 mm. in diameter, are pale lavender with strong dispersion ($\rightarrow \vee$) so that basal sections do not extinguish, with $(\div) 2V = 55^\circ$, $ZAC = 49^\circ$. Phenocrysts of a pre-existing ferromagnesian mineral have been completely converted to a mixture of calcite and pale green serpentine. Freshness of augite in the slide suggests, but by no means proves, that the calcite-serpentine mixture is secondary after a ferromagnesian other than augite, perhaps olivine: however no fresh olivine is present. Plagioclase phenocrysts average 0.4 mm. long, are commonly in glomero-porphyritic aggregates, and some are strongly zoned: composition is variable but mainly within the range of calcic labradorite. Locally, plagioclase encloses numerous small carbonate granules.

Pale yellow-green serpentine (antigorite) forms irregular patches, some replacing the groundmass and others appearing in shape somewhat like amygdales. Some patches are composite, with a carbonate core and peripheral band of serpentine.

The rock is basalt.

SPECIMEN NO. 20

Saddler's Creek, BMR 8(S).

Description of handspecimen.

The rock effervesces with cold 10% HCl, is light grey-green with numerous red-brown patches about 1 mm. in diameter throughout. Contact of the light coloured rock with coal can be seen in this specimen, and is outlined by a concentration of red-brown staining.

Description of thin section.

The rock is porphyritic with plagioclase phenocrysts only 0.25 mm. long in a partly felspathic but predominantly glassy groundmass. Plagioclase phenocrysts are somewhat kaolinized and composition is difficult to determine because of smallness: grains seem either to be calcic andesine or sodic labradorite. Irregular veins and patches of calcite are present, and are commonly stained red-brown by iron oxide. A few aggregates, perhaps amygdales, of chalcedony are present. Approximate composition of the rock is

plagioclase 10%, calcite and limonite 35%, glass 50%, chalcedony 5%.

The rock is andesite or basalt partly made over to carbonate.

SPECIMEN NO. 21

Saddler's Creek, BMR 7(S), 60'-96'

Description of handspecimen.

The rock is dark grey and somewhat porphyritic. Dark green phenocrysts of serpentine are set in a dark grey, fine-grained groundmass of white felspar laths and black ferromagnesian minerals. There is very localized effervescence with cold, 10% HCl.

Description of thin section.

Texture is porphyritic with serpentine (xylole) pseudomorphing phenocrysts, in an intergranular to subophitic groundmass. Green xylole forms 13% of the rock, and is present, commonly with minor antigorite cores, as pseudomorphs of a subhedral to euhedral mineral. Shape of the pseudomorphs resembles that of olivine though none of the latter is present, and the contrasting freshness of augite makes it probable that olivine and not augite originally formed the phenocrysts. Interstitial patches of serpentine may be secondary after glass.

Augite (25%) and plagioclase (55%) form the bulk of the rock, and are confined to the groundmass. Augite is mauve and thus probably titaniferous, with the following optic properties: $2V(+)$ = 55° , ZAC 46° , dispersion ($\nabla \nabla$) moderately strong, with basal sections incompletely extinguishing. Augite grains average 0.2 mm. in diameter, and felspar laths (An65) average 0.5 mm. long. Other minerals are black skeletal iron ore grains (5%) and calcite secondary after augite (2%).

The rock is dolerite.

SPECIMEN NO. 22.

Mount Arthur, BMR 3(S), 630'-640'

Description of handspecimen.

The rock is light grey, with pale brown and green clots of serpentine in a light grey aphanitic groundmass that does not effervesce in cold 10% HCl. Pale brown veinlets traverse the rock.

Description of thin section.

About 60% of the rock is brown or colourless carbonate, and about 20% is made up of randomly oriented, plagioclase laths (average length 0.15 mm). The remainder of the thin section is made up of pale brown serpentinous clots, with a few minute veinlets of serpentine are brown from iron staining.

The rock is either dolerite or basalt that has been largely replaced by carbonate.

SPECIMEN NO. 23

Bowmans Hill, BMR 2(3), Approx. 332'

Description of handspecimen.

The rock is dark grey-green, holocrystalline and fine-grained. Dark grey ferromagnesian minerals and light grey felspar laths can be distinguished with the hand lens.

Description of thin section.

Texture is intergranular to ophitic, and the main

constituents are plagioclase 50%, pyroxene 40%, serpentine 8% black iron ore 2%. Plagioclase laths average 0.9 mm. long and are sodic labradorite. Pyroxene is pale brown or mauve, and slightly titaniferous, with the following optic properties: (+) $2V = 55^\circ$, with dispersion $\gamma > \beta$ fairly pronounced so that basal sections do not completely extinguish, and $Z \wedge C = 50^\circ$. Yellow-brown and green brown, pleochroic fibrous serpentine with strong birefringence (xylotile) is present as small patches perhaps secondary after interstitial glass and also commonly as pseudomorphs of subhedral to euhedral grains considerably coarser than most augite found in the slide. It is possible, though by no means certain, that the grains were originally olivine - no fresh olivine is present. Accessory black iron ore is common as skeletal grains and may be ilmenite.

The rock is dolerite.

SPECIMEN NO. 24

Bowman's Hill, BMR. 2(S), 352'-360'

Description of handspecimen.

The handspecimen is light grey: plagioclase laths are visible under a hand lens, and the rest of the rock is light grey carbonate, with here and there blue-grey aggregates of the same mineral. The carbonate effervesces with cold 10% HCl.

Description of thin section.

About 50% of the rock is randomly oriented plagioclase, the remainder being grey calcite granules with occasional larger aggregates. The main group of plagioclase laths vary in length between 0.6 and 0.1 mm: they are ragged and partly replaced by calcite and no reliable determination of composition is possible, though maximum extinction methods suggest andesine-labradorite. Texture and mineralogy indicate the rock to be a dolerite or possibly basalt, replaced by calcite.

SPECIMEN NO. 25

Saddler's Creek, BMR. 11(S), 140'-200'

Description of handspecimen.

The rock is medium grained and dark grey green. Ferromagnesian predominate, a black mineral and its green alteration product being distinguishable. A little felspar can be detected with the hand lens.

Description of thin section.

The specimen examined crumbled easily, and the thin section was thick and otherwise of poor quality. The following minerals were, however, identified: plagioclase (labradorite) as euhedral laths about 1 mm. long making up 20% of the rock: brownish, titaniferous augite, 20%; green chlorite and brown-green serpentine (probably xylotile), 57%; and black iron ore and minor brown biotite, 3%. Texture is ophitic.

The rock is dolerite.

SPECIMEN NO. 26

Bowman's Hill, BMR. 2(S), 269'-271'

Description of handspecimen.

The rock is dark grey-green, holocrystalline and fine-grained. Dark grey ferromagnesian minerals and light grey felspar laths can be distinguished with the hand lens.

Description of thin section.

Texture is ophitic to intergranular, and the main

constituents are plagioclase 50%, pyroxene 40%, serpentine 8% and black iron ore 2%. Plagioclase laths average 0.8 mm. long and are sodic labradorite. Pyroxene is pale mauve and therefore titaniferous, with the following properties: (+) $2V = 55^\circ$, $ZAC = 50^\circ$ with dispersion (✓✓) fairly pronounced so that basal sections do not completely extinguish. Yellow-brown and green-brown, somewhat pleochroic serpentine with strong birefringence is present as small masses perhaps secondary after interstitial glass and commonly also as pseudomorphs considerably coarser than most augite found in the slide. It is possible, though by no means certain, that the grains were originally olivine: no fresh olivine is present. Skeletal grains of accessory black iron ore are common and are probably ilmenite.

The rock is dolerite.

SPECIMEN NO. 26A.

Bowmans Hill, BMR. 2(S), 269'-271'

Description of handspecimen.

The rock is light grey and porphyritic with generally subhedral phenocrysts of a grey mineral, and felspar laths, in a light grey aphanitic groundmass that effervesces slightly in cold 10% HCl.

Description of thin section..

Phenocrysts up to 1.5 mm. diameter, probably originally of ferromagnesian minerals, have been totally replaced by chalcedony and brown calcite. Phenocrysts of plagioclase (calcic labradorite) are common and approach 1 mm. in length. The groundmass consists of minute (.05 mm. long) plagioclase laths, calcite granules and black iron ore (mainly leucoxene) granules. Approximate per cent. composition of the rock is:

Phenocrysts	{	Replaced ferromagnesians	10%
	{	Labradorite	10%
Groundmass	{	Plagioclase	50%
	{	Calcite	35%
	{	Iron ore	5%

The rock is a basalt with ferromagnesians replaced largely by calcite.

SPECIMEN NO. 27.

Saddlers Creek, BMR. 4(S), 100'-140' (?)

Description of handspecimen.

The rock is dark grey and porphyritic, with prominent black phenocrysts up to 4 mm. long, and smaller (up to 1 mm. long) white felspar phenocrysts in a grey, aphanitic groundmass.

Description of thin section.

The black phenocrysts of hand lens classification are serpentinous pseudomorphs after a ferromagnesian mineral: together with sodic labradorite phenocrysts, they are set in a fine grained groundmass of plagioclase, pyroxene, a green micaceous mineral, black iron ore granules and minor, red-brown biotite. Serpentine pseudomorphs comprise 10% of the rock, plagioclase phenocrysts 10%, and the groundmass minerals are plagioclase 30%, pyroxene 25%, green biotite 20%, black iron ore (probably magnetite) and red-brown biotite 5%: A few grains of carbonate are also present.

The green-brown, pleochroic serpentine pseudomorphs are xylotile, but completeness of alteration precludes identification or the original mineral. Similarity of shape of the xylotile pseudomorphs to typical olivine crystals, and lack of serpentiniz-

ation of augite in the rock, suggest but do not prove that olivine was the precursor. No olivine is now present in the rock. The pale mauve colour of augite granules in the groundmass indicates presence of titania. Green, fibrous mica in the groundmass may be secondary after interstitial glass.

The rock is basalt.

SPECIMEN NO. 27A.

Saddlers Creek Area, BMR. 4(S), 100'-140' (?).

Description of handspecimen.

The specimen is fresh and dark grey-green. Minute light grey, randomly oriented feldspar laths, and a dark grey-green ferromagnesian mineral are distinguishable with a hand lens. Grey patches averaging 1 mm. in diameter are common: they effervesce with cold, 10% HCl and are calcite.

Description of thin section.

Texture of the rock is ophitic to subophitic. Main constituents are plagioclase (53%), serpentine (30%), calcite (15%) and accessory iron ore (2%). Plagioclase laths average 0.5 mm. in length, and are sodic labradorite. Serpentine is fibrous, pleochroic from pale green to green, probably secondary after pyroxene, and has, in turn, been partly replaced by calcite. Black iron ore is mainly ilmenite and leucosene: red brown biotite is a rare accessory.

The rock is dolerite, with ferromagnesian minerals partly replaced by calcite.

SPECIMEN NO. 28.

Saddlers Creek, BMR 9(S), 260'

Description of handspecimen.

The rock is light grey, with grey phenocrysts of feldspar in a light grey aphanitic groundmass. Light grey, subspherical carbonate clots, and dark grey, subhedral to euhedral carbonate grains, both averaging 1 mm. in diameter and effervescing in cold, 10% HCl, are present.

Description of thin section.

Plagioclase phenocrysts up to 1 mm. long form 10% of the rock: some are strongly zoned, and the core of one zoned phenocryst was determined as An₆₅ (calcic labradorite). 10% of the slide is brown, euhedral and subhedral calcite that seems to have replaced ferromagnesian phenocrysts. A little black iron ore is associated. Other, lighter coloured calcite, as spherical masses some with rough radial arrangement of crystals, also forms 10% of the rock, and has probably filled former vesicles in it. There are also minute carbonate veins. The remaining 70% is groundmass, evenly divided between calcite granules and minute (about .05 mm. long) plagioclase laths, together with minor pyrite.

The rock is amygdaloidal basalt partly converted to calcite.

SPECIMEN NO. 29.

Saddlers Creek, BMR. 10(S), 40'-44'

Description of handspecimen.

The rock is sedimentary, light grey, somewhat friable and effervesces in cold 10% HCl. Carbonaceous streaks are scattered throughout.

Description of thin section.

Nearly 80% of the rock is brown carbonate in which no

definite organic structure is apparent, though patches of reticulate texture suggest it. Some carbonate, where it has recrystallized, is present as almost colourless, roughly stellate crystal aggregates. Other minerals present are angular quartz 10%, clay secondary after felspar fragments 5%, coal streaks 5%, minor biotite and chlorite and rare plagioclase. Limonite stains are common. Diameter of quartz fragments is usually less than 0.05 mm.

The rock is a silty limestone.

SPECIMEN NO. 30.

Saddlers Creek, BMR. 2(S), 587-597

Description of handspecimen.

Little can be distinguished with a hand lens. The rock is grey-green, faintly mottled, and effervesces readily in cold 10% HCl.

Description of thin section.

The rock is made up about equally of randomly oriented plagioclase (calcic labradorite) laths of the order of 0.15 mm. long, and brown calcite. It is either dolerite or basalt, extensively replaced by calcite.

SPECIMEN NO. 31.

St. Helier's, BMR. 1(SC) 1751'

Description of handspecimen.

Overall colour of the rock is mottled brown, due to presence of iron oxide staining. An apparent shear zone, with concentration of iron oxide and numerous, intersecting, white calcite veins, transects the specimen. The matrix of the rest of the rock varies from mottled brown and very pale green through deeper shades of brown with increasing content of iron oxide. The matrix, which effervesces in cold 10% HCl, contains numerous irregular amygdales of soft, white to very pale green, serpentine. Some amygdales are brown from iron staining.

Description of thin section.

In plane polarized light, texture appears typical of an amygdaloidal basalt. The texture is however relict, for calcite and to a lesser degree antigorite, has replaced plagioclase, preserving its lath-like form. The laths average 0.15 mm. in length and are set in an opaque base of hematite. A number of amygdales are represented by colourless, fibrolamellar serpentine with first order grey interference tints and a mean refractive index 1.561 (antigorite), and some such amygdales have a very narrow outer rim of chrysotile. A few amygdales are calcite and others are composed of a mineral of aggregate texture and very low birefringence that is dark brown to opaque from iron staining: the mineral cannot be scratched with a knife and is probably cryptocrystalline silica. The apparent shear zone is also partly made up of the mineral.

Texture shows the rock to be an amygdaloidal basalt or andesite. It appears to have been sheared and has been highly altered, with replacement by calcite, serpentine and cryptocrystalline silica.

SPECIMEN NO. 32.

Saddlers Creek, BMR 10(S), 562'-572'

Description of handspecimen.

The specimen is fresh, grey-green and fine-grained. Minute, light grey plagioclase laths, a green-grey ferromagnesian mineral, and small patches of light grey calcite that effervesce with cold

10% HCl, can be distinguished.

Description of thin section.

A network of randomly oriented plagioclase laths encloses other minerals of the rock, and approximate composition is plagioclase 35%, calcite 33%, serpentine 30%, black iron ore 2%. Plagioclase laths are sodic labradorite and average 0.4 mm. in length: serpentine is fibrous, pleochroic from pale green to green, with fair birefringence, and is secondary after pyroxene or perhaps glass, and has itself been extensively replaced by calcite. Iron ore is mainly ilmenite and leucoxene with minor pyrite. A few flakes of red-brown biotite are present.

The rock is dolerite partly altered to carbonate.

SPECIMEN NO. 33.

Saddlers Creek, BMR 2(S), 616-630'

Description of handspecimen.

The rock is grey and fine-grained, and minute, white laths of felspar, and grains of a grey ferromagnesian mineral and a white mineral can also be distinguished. The white mineral effervesces in dilute HCl.

Description of thin section.

Texture of the rock is subophitic to intergranular. Augite grains average 0.8 mm. in diameter, are mauve and thus probably titaniferous with the following properties: $2V(\pm) = 55^\circ$, $Z \text{ C} = 49^\circ$, dispersion $(\rightarrow \vee)$ moderately strong, with basal sections of the mineral incompletely extinguishing. Plagioclase laths vary considerably in length (average 0.5 mm) with composition An61 (labradorite). Carbonate grains are present, and seem to have replaced augite. A fair amount of secondary, interstitial, fibrous, olive-brown to green serpentine and a little pale brown biotite are scattered throughout: they may have come partly from ferromagnesian, partly from glass. Iron ore is mainly ilmenite and leucoxene. Per cent. composition of the rock is approximately titaniferous augite 30, plagioclase 35, serpentine 20, carbonate 10, black iron ore and biotite 5.

The rock is dolerite, partly replaced by carbonate.

SPECIMEN NO. 34.

Mount Arthur, BMR. 5(S), 110'-200'

Description of handspecimen.

The rock is grey and porphyritic, with white euhedral phenocrysts and a few black phenocrysts in a grey aphanitic groundmass.

Description of thin section.

Phenocrysts of plagioclase and titaniferous augite, many of the latter completely replaced by carbonate, are set in a finely granular groundmass of unoriented plagioclase laths, titaniferous augite granules and black iron ore. Average diameter or length of groundmass minerals is less than 0.05 mm. Phenocrysts make up about 20%, plagioclase, augite and carbonate pseudomorphs forming 10%, 3% and 7% respectively. Plagioclase phenocrysts of average length 1 mm. are commonly present as glomeroporphyritic aggregates and are calcic labradorite. Augite grains average 2 mm. long, have fairly strong dispersion $(\rightarrow \vee)$ so that basal sections extinguish incompletely, with $(\pm) 2V = 55^\circ$, $Z \text{ C} = 50^\circ$, and are locally altered to pale green, fibrous amphibole.

The rock is basalt.

SPECIMEN NO. 34A.

Mount Arthur, BMR 5(S). 110'-200'

Description of handspecimen.

The rock is light grey, porphyritic and amygdaloidal, with pale brown phenocrysts and amygdales averaging 2 mm. in diameter, occasional black phenocrysts and numerous smaller, white felspar laths, in a light grey, fine grained to aphanitic groundmass. The pale brown phenocrysts and amygdales, and much of the groundmass, effervesce in dilute HCl.

Description of thin section.

Pale mauve phenocrysts of titaniferous augite, averaging 2 mm. in diameter once represented 10% of the rock: however, about 90% of them have been converted to euhedral brown calcite. Calcite is also present as irregular clots that are probably infillings of vesicles, and these form 5% of the rock. Plagioclase laths about 0.75 mm. long, commonly strongly zoned and therefore not of uniform composition, are arranged mainly in glomeroporphyritic aggregates: a good determination on one grain was An₈₀. The groundmass, which constitutes 80% of the rock, is made up of carbonate (60%), unoriented felspar laths averaging 0.08 mm. long (25%), and black iron ore granules (mainly leucoxene) (15%).

The rock is a basalt whose ferromagnesian minerals have been almost completely replaced by calcite.

SPECIMEN NO. 35.

Mount Arthur, BMR 5(S), 434'-437'6"

Description of handspecimen.

The rock is grey, porphyritic and amygdaloidal, with grey calcite phenocrysts and amygdales, and rare black phenocrysts of augite in a grey aphanitic groundmass. Amygdales and phenocrysts average 2 mm. diameter: all carbonate effervesces with dilute HCl.

Description of thin section.

Phenocrysts of very pale mauve, probably titaniferous augite are comparatively rare, but many granular aggregates of brown calcite are clearly secondary after such phenocrysts. Optics of the augite are: (+) $2V = 55^\circ$, $Z \wedge C = 50^\circ$, and dispersion ($\rightarrow \vee$) fairly strong with incomplete extinction in basal sections. Plagioclase phenocrysts attain 0.5 mm. in length, and some are strongly zoned: the core of one phenocryst has the composition An₅₆.

Calcite amygdales are colourless, contrasting with the light brown of calcite secondary after augite. Calcite shares infilled vesicles with two minerals, one colourless and isotropic with low relief and the other, its alteration product, colourless to very pale yellow, with low but slightly higher relief, second order birefringence and (-) uniaxial interference figure. The colourless mineral is a zeolite (perhaps analcime) and its alteration product is cancrinite. A little anhedral analcime is also present in the groundmass.

The groundmass consists of randomly oriented plagioclase laths (average length 0.15 mm), iron ore granules (mainly leucoxene), calcite, and a very pale green, secondary, finely fibrous, sericite-like mineral of moderately high birefringence. A little anhedral analcime and some minor cancrinite are also present. The groundmass forms about 75% of the rock, amygdales 10%, augite phenocrysts 3%, calcite secondary after augite phenocrysts 10%, and felspar phenocrysts 2%.

The rock is amygdaloidal basalt that has had most ferromagnesian constituents replaced by calcite.