Geological Survey of South Australia

Mineral Systems Drilling Program

Rock Shack

Outcrop sample collection for the Mineral Systems Drilling Program, Southern Gawler Ranges Margin

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Government of South Australia
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SOUTH AUSTRALIA

Government of South Australia
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Mineral Systems Drilling Program (MSDP) Rock Shack collection exhibited with MSDP drillcore at South Australian Drill Core Reference Library, Tonsley Precinct.

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Introduction

Between July 2015 and April 2016 the Geological Survey of South Australia, in collaboration with the Deep Exploration Technologies Cooperative Research Centre (DET CRC), Minotaur Exploration and Kingston Resources, carried out a Mineral Systems Drilling Program (MSDP) along the southern margin of the Gawler Ranges.

Working alongside the MSDP, a detailed geological mapping program was carried out at each of the three drilling areas, namely Six Mile Hill, Peltabinna and Mount Double (Fig. 1) in order to provide a regional geological context in which the stratigraphy and potentially the alteration and mineralisation of the drillholes can be interpreted. The geological mapping program comprised detailed basement, structural and regolith mapping, as well as petrological, whole rock geochemical, isotopic and geochronological studies, with a particular focus on the stratigraphy of the lower Gawler Range Volcanics.

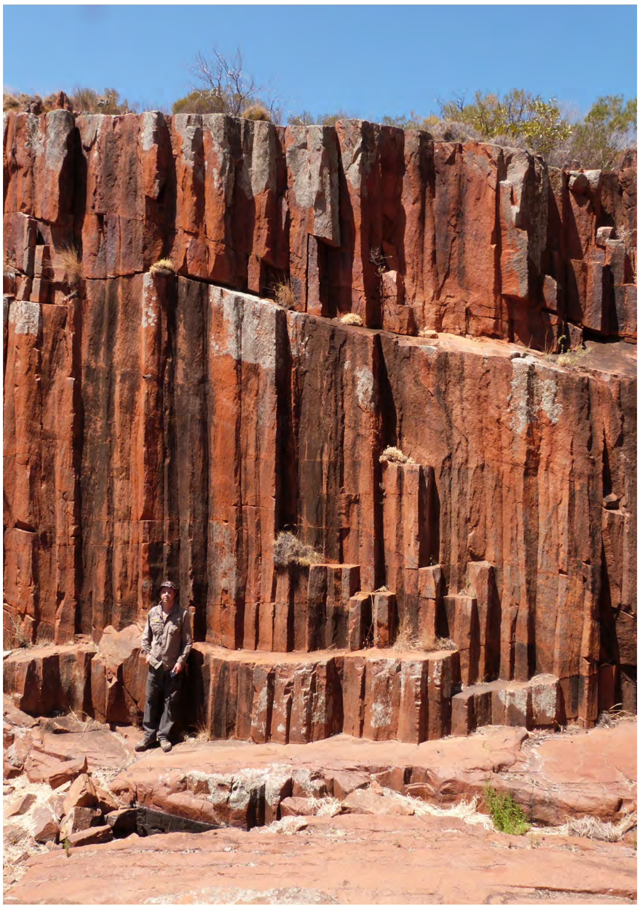
During the mapping program rock samples were collected for petrology, geochemistry and geochronology as well as hand specimen, to compare with the lithologies intersected in the MSDP drill holes. This report comprises a photographic collection of nearly 100 selected rock samples collected during the geological mapping program as displayed during the MSDP Open Day on 11 August 2016 as well as during Discovery Day on 1 December 2016, both hosted by the Geological Survey of South Australia (GSSA) and the Department of State Development (DSD).

Acknowledgements

Thanks to Adrian Fabris for collaboration during the MSDP drilling program, Ben Nicolson, Claire Wade and Tom Wise for joint field mapping and David Groom and staff at the Core Library for sample transport and storage. Ben Nicolson is thanked for reviewing this report book.

Location

The majority of the rock samples have been collected in each of the three MSDP drilling areas along the southern margin of the Gawler Range Volcanic Province, including the Six Mile Hill 1:75 000 map sheet (subsequently referred to as SIX MILE HILL), Peltabinna 1:75 000 geological map sheet (subsequently referred to as PELTABINNA), and Mount Double 1:75 000 geological map sheet (subsequently referred to as MOUNT DOUBLE) as well as in adjacent areas (Fig. 1, Appendix 1).



Columnar jointing in Pondanna Dacite Member (upper GRV), Gawler Range National Park.

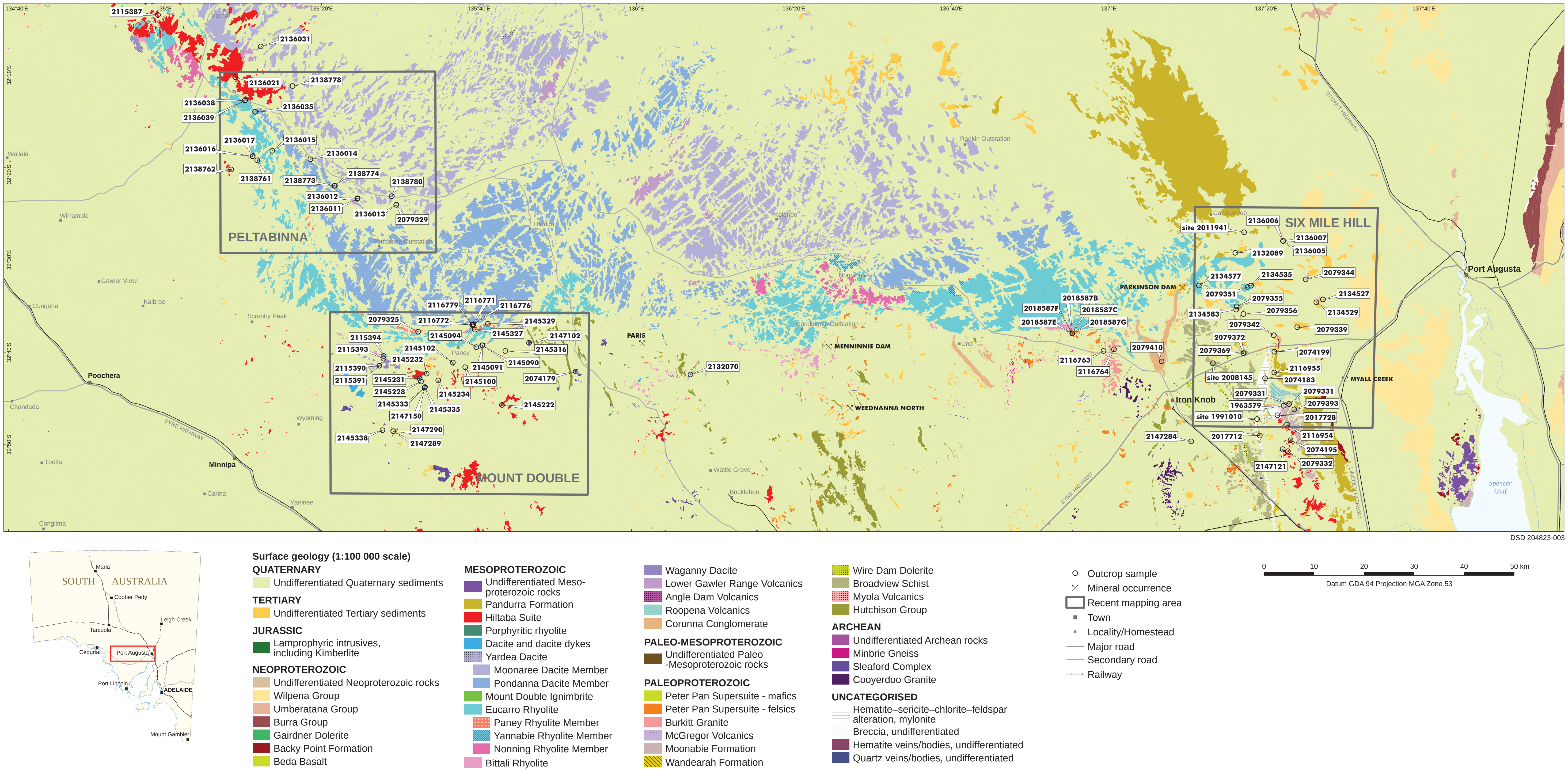


Figure 1 Locality map of the three MSDP project areas SIX MILE HILL, MOUNT DOUBLE and PELTABINNA with rock sample location.

Basement to the Gawler Range Volcanics in the MSDP drilling and mapping areas

Basement rocks of various type and age underlie the southern margin of the Gawler Range Volcanics. They include rocks of the Neoarchean to Palaeoproterozoic Sleaford Complex and Peter Pan Supersuite, the Broadview Schist and Wire Dam Dolerite, the Moonabie Fromation and the Corunna Conglomerate.

Sleaford Complex (ALs)

The late Archaean to earliest Palaeoproterozoic (2550–2440Ma) was a period of basin development in the Gawler Craton, represented by the Sleaford Complex in the south and the Mulgathing Complex in the north. The Sleaford Complex comprises granitic gneiss, arenaceous and aluminous metasediments, banded iron formation, mafic granulite and calc-alkaline felsic volcanics (Hall Bay Volcanics) which were deformed and intruded by felsic to intermediate magmas (Dutton Suite) during the Sleafordian Orogeny (2480–2420 Ma) (*Swain et al., 2005; Wade and McAvaney, 2016a)*. On the northern Eyre Peninsula the Sleaford Complex is dominated by gneissic granite, quartzofeldspathic gneiss and migmatite. The complex was metamorphosed to amphibolite to granulite facies during the Kimban Orogeny (~1730–1690 Ma) (*Dutch et al., 2010*).

(?)Sleaford Complex, Peter Pan syncline
(2147102)

Fine- to medium-grained and seriate-textured to sparsely porphyritic foliated metagranite.

MOUNT DOUBLE

(?)Sleaford Complex, Peter Pan syncline
(2147102 – wet)

Fine- to medium-grained and seriate-textured to sparsely porphyritic foliated metagranite.

MOUNT DOUBLE

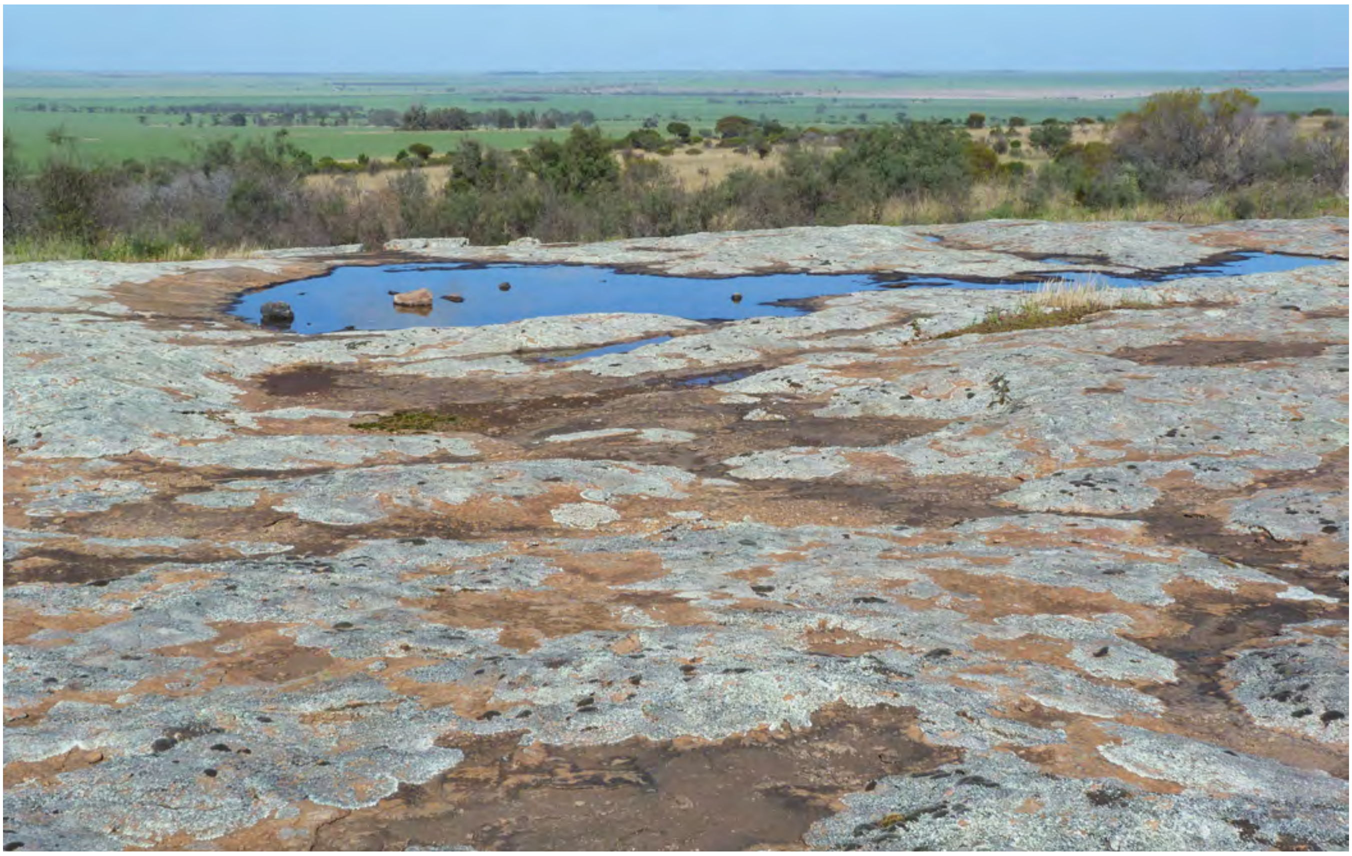
Peter Pan Supersuite (Lz)

The Peter Pan Supersuite comprises felsic and mafic intrusive rocks associated with the Kimban Orogeny, and includes the Moola Suite (1750–1735 Ma), the Pinbong Suite (1740–1700 Ma) and the Moody Suite (1710–1700 Ma). The term Peter Pan Supersuite has been introduced to replace the now obsolete term Lincoln Complex, and extends over the whole of the Gawler Craton (*Wade and McAvaney, 2016b*). The Peter Pan Supersuite intrudes Sleaford Complex, Minbrie Gneiss and Hutchison Group as plutons and fabric-parallel sills, and ranges from undeformed to migmatitic.

Sleaford Complex & Peter Pan Supersuite
(2145333 – wet)

Intrusive contact between fine-grained felsic gneiss (top) and medium-grained granodiorite (bottom).

MOUNT DOUBLE



Peter Pan Supersuite intruding Mitali Gneiss at Bascombe Rocks lookout, 20 km north of Kimba.

Moola Suite (Lzm)

The Moola Suite (1750–1735 Ma) comprises felsic and mafic rocks intruded during the early stages of the Kimban Orogeny (Wade and McAvaney, 2016b & c). It is part of the Peter Pan Supersuite. The suite is lithologically variable and includes undeformed to foliated, equigranular to megacrystic granite, diorite and amphibolite. The Moola Suite is largely restricted to north-eastern and northern Eyre Peninsula, and includes the Burkitt Granite, Wortham Granite, Glue Pot Granite and Deuter Diorite.

Gluepot Granite (Lzmg)

The Gluepot Granite is a coarse-grained porphyritic to medium-grained equigranular K-feldspar-quartz-biotite granite with a magmatic crystallisation age of ~1740 Ma which intrudes the Moonabie Formation, and is part of the Moola Suite (McAvaney et al., 2016).

Gluepot Granite
(2074195)

Coarse-grained, porphyritic potassium feldspar-quartz-biotite granite.

ROOPENA

Gluepot Granite
(2079332)

Deformed, medium-grained quartz-feldspar biotite granite.

ROOPENA

Gluepot Granite
(2147121)

Quartz-hematite-altered granite.

ROOPENA

Wortham Granite (Lzmw)

The Wortham Granite is a pink medium-grained equigranular K-feldspar-plagioclase-quartz-biotite granite and is part of the Moola Suite (1755–1735 Ma) (McAvaney et al., 2016). It has a magmatic crystallisation age of ~1745 Ma (Jagodzinski and McAvaney, 2016), and is inferred to intrude the Broadview Schist.

Wortham Granite
(2017712)

Medium-grained, equigranular potassium feldspar-quartz-plagioclase-biotite-tourmaline granite.

ROOPENA

Pinbong Suite (Lzp)

The Pinbong Suite (1735–1700 Ma) comprises felsic and mafic rocks intruded during the mid- to late Kimban Orogeny (Wade and McAvaney, 2016b). It is part of the Peter Pan Supersuite. The Pinbong Suite is lithologically variable, and contains foliated to gneissic quartz-feldspar-biotite granite, quartzofeldspathic migmatite, gabbro, metagabbro and dolerite. It intrudes the Sleaford Complex, Minbrie Gneiss and Hutchison Group. The Pinbong Suite is largely restricted to the Cleve and Coulta domains of central Eyre Peninsula, and includes the Middlecamp Granite and Carappee Granite.

Pinbong Suite, Peter Pan Platforms
(2074179 – wet)

Fine-grained equigranular quartz-feldspar-biotite gneissic granite.

MOUNT DOUBLE

Broadview Schist (Lyb)

The Broadview Schist is a variably deformed package of interbedded quartzites and shales that have a maximum depositional age of 1809–1790 Ma (A. Reid pers. com., Fraser and Neumann, 2010). The sedimentological features preserved in the Broadview Schist suggest that the sediments were deposited in a lower-middle marine shoreface environment. The sediments were deposited in a north-south trending, fault bounded basin, with the detritus apparently derived from the north and south. There is an observed decrease in strain from south to north (McAvaney et al., 2016).

Broadview Schist
(site – 2008145)

Fine-grained, equigranular quartzite with locally preserved fine bedding (cm-scale), which is sub parallel to the East SE-striking solid-state foliation.

SIX MILE HILL

Broadview Schist
(Site 1991010)

Quartz-rich sedimentary rock with mm-scale laminations folded into tight, cm-scale folds.

SIX MILE HILL

Broadview Schist
(2074183)

Mylonitic quartzite within Roopena Shear Zone.

SIX MILE HILL

Hydrothermal breccia in Broadview Schist
(2079356)

Multi-phase hydrothermal breccia vein with angular milky quartz clasts set in fine-grained quartz-tourmaline matrix.

SIX MILE HILL

Vein quartz breccia in Broadview Schist
(2134583)

Multi-phase quartz vein containing angular fragments of sandstone derived from Broadview Schist.

SIX MILE HILL

Vein quartz breccia in Broadview Schist
(2134583 - wet)

Multi-phase quartz vein containing angular fragments of sandstone derived from Broadview Schist.

SIX MILE HILL

Weathered quartzite with trough cross-beds of the Broadview Schist near Wire Dam, SIX MILE HILL.

Wire Dam Dolerite (Lyw)

The Wire Dam Dolerite was previously included as a sub-unit (Lyb2) within the Broadview Schist (Lyb). However, based on the unlikely petrogenetic relationship between the mafic intrusive rock and the hosting meta-sedimentary rocks, it has been defined as a new stratigraphic unit (McAvaney et al., 2016). The mafic rocks of the Wire Dam Dolerite are generally fine- to coarse-grained, equigranular, dark green amphibolites that often have a speckled appearance, due to the green amphiboles and white feldspars. The Wire Dam Dolerite forms a series of sills in the Broadview Schist. Its age is constrained between c. 1809–1790 Ma and c. 1775 Ma (McAvaney et al., 2016).

Wire Dam Dolerite
(2079369 – wet)

Medium- to coarse-grained and inequigranular gabbro, with large equant mafic minerals in a medium-grained groundmass of feldspar and elongate mafic minerals. Sample is from core of a thick differentiated sill of Wire Dam Dolerite.

SIX MILE HILL

Wire Dam Dolerite
(2079372)

Massive, medium-grained and relatively equigranular dolerite with interlocking texture of tabular feldspars and prismatic amphiboles. Dolerite represents finer-grained margin of a thick mafic intrusion, with the gabbro (sample 2079369) representing core of sill.

SIX MILE HILL

Moonabie Formation (Lmm)

The Moonabie Formation is composed of massive pebbly sandstones and well-bedded sandstones (Drexel, 1976; Nixon, 1975) with a dominantly c. 1750 Ma felsic volcanic source. It was intruded and locally hydrothermally altered by the c. 1740 Ma Gluepot Granite and was folded during either the Kimban Orogeny (1740–1690 Ma; Parker, 1993) or the Kararan Orogeny (1610-1590 Ma; McAvaney et al., 2015b). The Moonabie Formation is unconformably overlain by the Fresh Well Formation, Angle Dam Volcanics, Roopena Basalt and Pandurra Formation. At its type locality in the Moonabie Range the Moonabie Formation overlies and inter-tongues with the McGregor Volcanics, which have been dated at 1754 ±5 Ma (Fraser and Neumann, 2010). The Moonabie Formation contains tourmaline-quartz, jasper and goethite breccias, presumed to be associated with the intrusion of the Gluepot Granite.

Moonabie Formation
(2079411)

Poorly sorted volcanogenic conglomerate.

WHYALLA/Middleback

Moonabie Formation
(2147284)

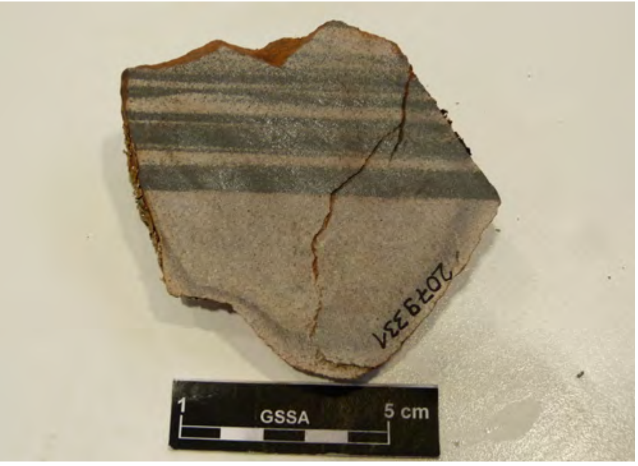
Poorly sorted volcanogenic sandstone-conglomerate.

WHYALLA/Middleback

Moonabie Formation
(2079393)

Laminated, well-sorted, heavy mineral-rich medium-grained sandstone.

SIX MILE HILL



Moonabie Formation
(2079331)

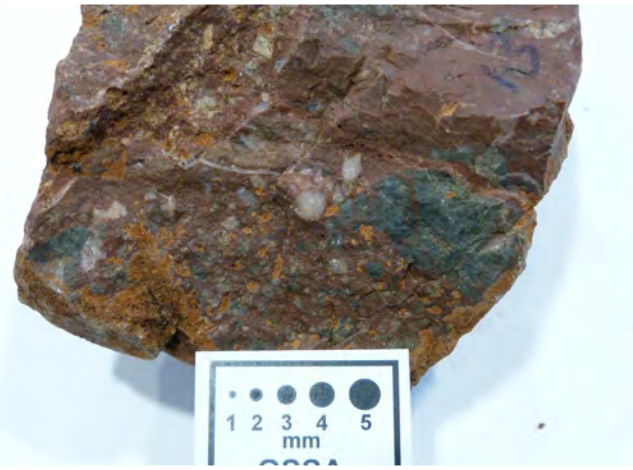
Well-sorted, medium-grained sandstone with heavy mineral layers.

SIX MILE HILL

Jigsaw breccia in Moonabie Formation
(1963579)

Matrix-supported jigsaw breccia composed of angular to subrounded quartzite clasts in a goethite-quartz-muscovite matrix.

SIX MILE HILL



Clast-supported breccia in Moonabie Formation
(2116954)

Clast-supported breccia composed of subrounded-rounded quartz and tourmaline clasts in a brown siliceous matrix.

SIX MILE HILL

Tourmaline breccia in Moonabie Formation
(2017728)

Tourmaline breccia composed of subangular to subrounded quartz clasts in a tourmaline matrix.

SIX MILE HILL

Corunna Conglomerate (Mcc)

The Corunna Conglomerate is a sequence of fluvial to shallow marine sediments comprising conglomerates, sandstones and siltstones, which were deposited in active fault grabens in the eastern Gawler Craton. In the Corunna and Uno ranges the Corunna Conglomerate has been deformed by open to tight folding about a NNW-trending axis (Lemon, 1972; Morgan, 2007). At Mt Allalone a N-trending tectonic foliation is locally observed. The Corunna Conglomerate was deposited after the Kimban Orogeny (maximum depositional age 1659 ±7 Ma; Fraser and Neumann, 2010), suggesting that deformation of the Corunna Conglomerate may be Kararan in age (~1610–1590 Ma; McAvaney et al. 2015b).

Corunna Conglomerate
(2145234)

Poorly sorted conglomeratic sandstone containing tectonic foliation defined by strained quartz and clast alignment.

MOUNT DOUBLE

Mount Allalone entirely composed of Corunna Conglomerate, Gawler Ranges National Park.

Gawler Range Volcanics (Ma)

The Gawler Range Volcanics (GRV) comprise a sequence of Mesoproterozoic (~1590 Ma) A-type bimodal volcanics which cover much of the central-eastern Gawler Craton (Allen et al. 2003; Allen et al. 2008), and are comagmatic with felsic and mafic intrusions of the Hiltaba Suite (1590–1575 Ma). The GRV consists of two main packages: the lower GRV and the upper GRV (Fig. 2). The lower GRV includes dacites to rhyolites, ignimbrites and tuffs with minor basalt erupted from discrete volcanic centres (Allen et al., 2003; Blisset et al., 1993; Fricke, 2005; Creaser, 1995; Stewart, 1994; Giles, 1988). In comparison, the upper GRV consists of three regionally extensive thick (200–300 m) high temperature (900–1100 °C) felsic lava flows.

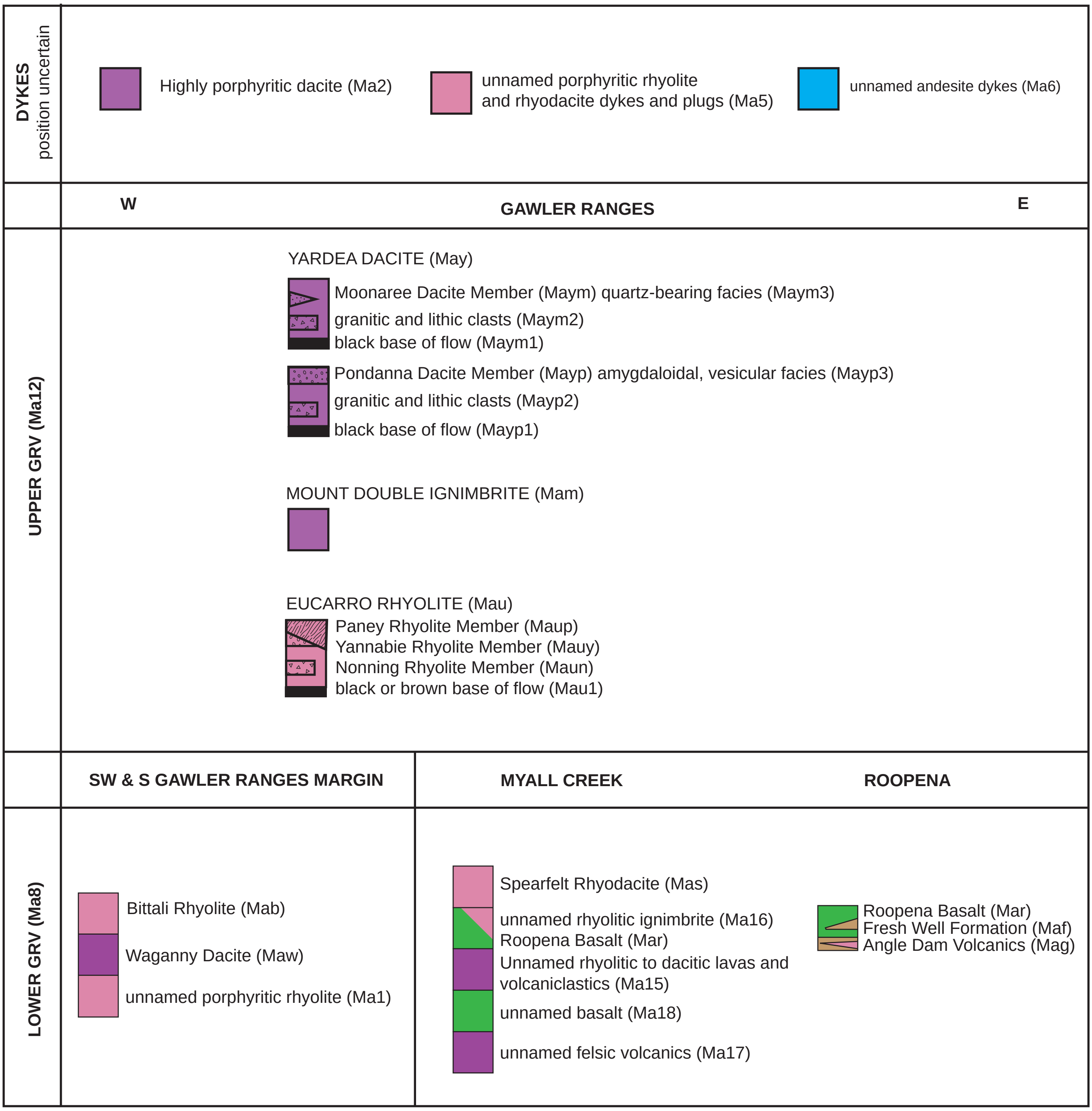


Figure 2 *Stratigraphic units within the Gawler Range Volcanics.*
Adapted from Blissett (1993), Allen et al. (2003) and Allen et al. (2008); modified after: McAvaney and Wade (2015a & b).

Lower Gawler Range Volcanics

The lower Gawler Range Volcanics comprise felsic and mafic lavas, ignimbrites and tuffs erupted from discrete volcanic centres (Allen et al., 2003; Blisset et al., 1993; Fricke, 2005; Creaser, 1995; Stewart, 1994; Giles, 1988). The lower GRV along the southern margin of the Gawler Ranges comprise three main sequences: (i) the Waganny Dacite and Bittali Rhyolite; (ii) the Roopena Basalt, Fresh Well Formation and Angle Dam Volcanics; and (iii) unnamed felsic volcanics and the Spearfelt Rhyodacite in the Myall Creek area identified from recent field mapping (Fig. 2; McAvaney et al., 2016). There are also a number of occurrences of mafic, intermediate and felsic volcanic dykes intruding the basement along the southern Gawler Ranges margin, which may be part of the lower GRV or feeders to the upper GRV (Parker and Flint, 2005) (Fig. 2).

Ma_1 unnamed quartz-phyric rhyolite

Map symbol Ma_1 is a quartz-phyric and feldspar-phyric rhyolite lava which underlies the Waganny Dacite northeast of Mt Sturt. It is the oldest unit of the lower GRV along the southern Gawler Ranges magin (Parker and Flint, 2005).

Lower GRV – Ma_1
(2115390 – wet)

Quartz-phyric rhyolite lava composed of round quartz phenocrysts in a fine-grained groundmass.

MOUNT DOUBLE

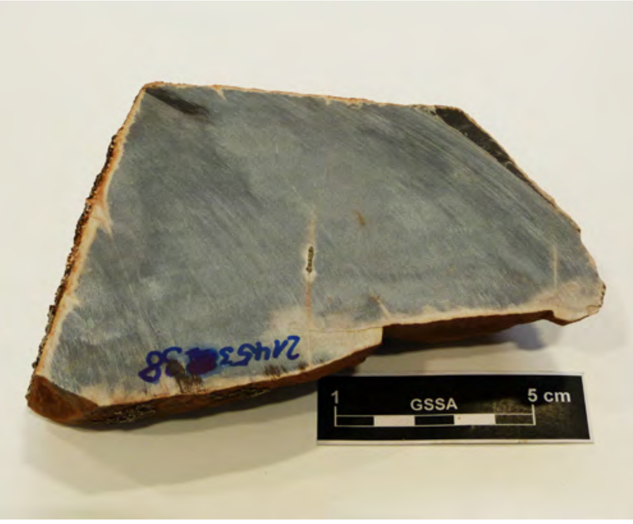
Ma_2 unnamed porphyritic dacite

Map symbol Ma_2 is a porphyritic dacite dyke containing plagioclase megacrysts, mafic volcanic and basement clasts intruding the Bittali Rhyolite near Peterlumbo Hill (Parker and Flint, 2005).

Lower GRV – Ma_2
(2132070 – wet)

Porphyritic dacite composed of tabular to rounded plagioclase phenocrysts, pyroxene crystals and fine-grained mafic xenoliths in a fine-grained groundmass.

YARDEA 250K



Lower GRV – Ma$_2$
(2145338)

Aphyric rhyolite dyke with pyrite in alteration vein (intruding augen gneiss of ?Sleaford Complex).

MOUNT DOUBLE

Lower GRV – Ma$_2$
(2136031)

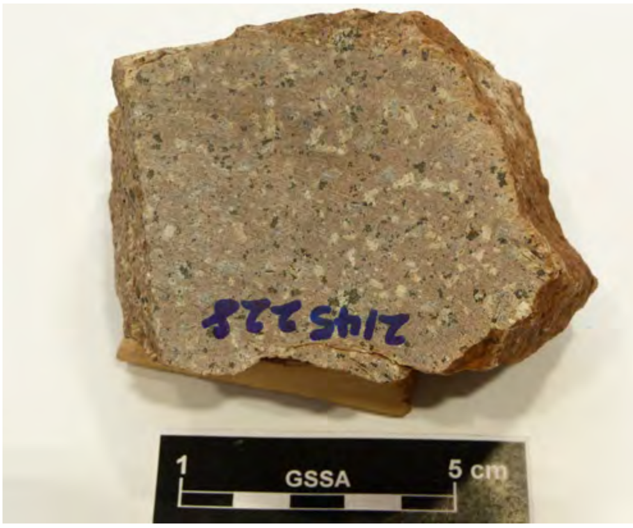
Dacitic feldspar-quartz-pyroxene-magnetite intrusive volcanic rock.

PELTABINNA

Lower GRV – Ma$_2$
(2147150 wet)

Feldspar-phyric dacite dyke (intruding Peter Pan Supersuite granodiorite).

MOUNT DOUBLE



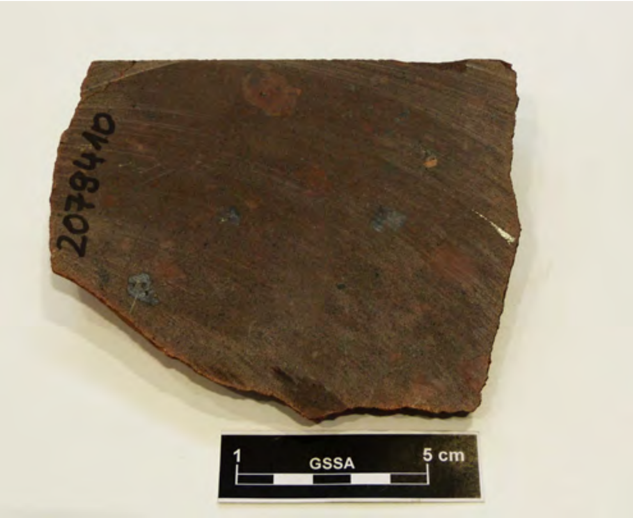
Lower GRV – Ma$_2$
(2145228 wet)

Porphyritic dacite intrusive composed of feldspar and pyroxene phenocrysts in a granular groundmass.

MOUNT DOUBLE

Ma_6 unnamed andesite to dacite dykes

Map unit Ma_6 are unnamed andesite to dacite dykes which intrude basement and lower GRV along the southern Gawler Ranges margin.



Ma_6 – andesite dyke
(2079410)

Feldspar-phyric andesite dyke (intruding Corunna Conglomerate).

ROOPENA

Ma_6 – andesite dyke
(2078410 – wet)

Feldspar-phyric andesite dyke (intruding Corunna Conglomerate).

ROOPENA

Ma_6 – andesite dyke
(2145335)

Andesite dyke – intruding Peter Pan Supersuite granodiorite.

MOUNT DOUBLE

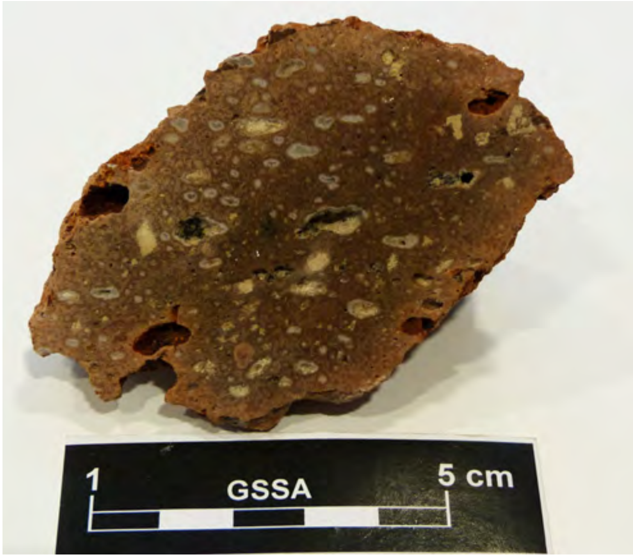
Ma_{15} unnamed felsic volcanics in the Myall Creek area

Map symbol Ma_{15} is used to collectively describe a number of felsic volcanic units of the lower GRV, comprising lavas, pyroclastic rocks and minor tuffaceous sedimentary rocks, underlying the Spearfelt Rhyodacite and the Roopena Basalt in the Myall Creek area. Ma_{15} has also been intersected in drillholes RC1 (McAvaney and Wade, 2015a), MSDP01 & MSDP04 (McAvaney et al., 2016).

Lower GRV – Ma_{15}
(2018587)

Felsic volcanic rock with agate-filled lithophysae.

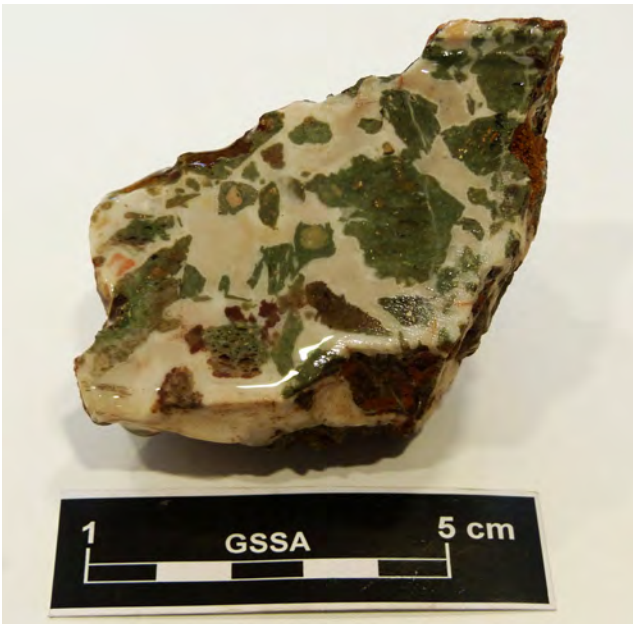
SIX MILE HILL



Lower GRV – Ma_{15}
(2018587B)

Felsic (?)ignimbrite composed of lithic clasts and concentrically zoned quartz amygdales aligned with flow foliation.

SIX MILE HILL



Lower GRV – Ma_{15}
(2018587C – wet)

Volcanic breccia composed of irregularly shaped fragments of altered volcanic (possibly pumiceous) felsic volcanic in a quartz groundmass.

SIX MILE HILL

Lower GRV – Ma$_{15}$
(2018587F)

Lithophysae composed of quartz epimorphs after ?carbonate calcite.

SIX MILE HILL

Lower GRV – Ma$_{15}$
(2079342)

Agate-amethyst-chlorite nodule (?lithophysae) weathered out from felsic volcanic rock.

SIX MILE HILL

Lower GRV – Ma$_{15}$
(2018587G)

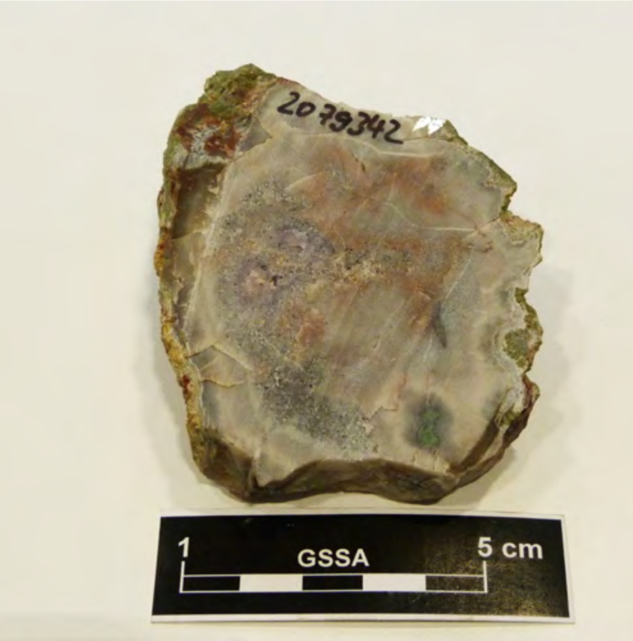
Banded agate lithophysae.

SIX MILE HILL

Lower GRV – Ma$_{15}$
(2136007)

Clay-mineral altered, flow-banded felsic volcanic rock.

SIX MILE HILL



Lower GRV – Ma$_{15}$
(2079342B)

Agate-amethyst-chlorite nodule (?lithophysae) weathered out from felsic volcanic rock.

SIX MILE HILL

Ma$_{15}$
(2074199)

Felsic ?ignimbrite composed of angular and irregular feldspar and lithic fragments in a fine-grained groundmass.

SIX MILE HILL

Lower GRV – Ma$_{15}$
(2136005)

Clay-mineral altered, shard-rich fine ash tuff.

SIX MILE HILL

Ma_{16} quartz-phyric rhyolitic ignimbrite

Ma_{16} is an unnamed quartz-phyric rhyolitic ignimbrite composed of feldspar and quartz phenocrysts with an evenly porphyritic texture in a fine-grained vitric groundmass. Underlies Spearfelt Rhyodacite between Myall Creek and Parkinson Dam (McAvaney et al., 2016).

Ma_{16}
(2134577)

Quartz- and feldspar-phyric rhyolitic ignimbrite.

SIX MILE HILL

Bittali Rhyolite (Mab)

The Bittali Rhyolite is a composite unit of quartz-phyric rhyolite to rhyodacite lava flows, ignimbrites, lava domes, feeder dykes and crystal-rich and pumiceous tuffs (Blissett, 1986). It has a lateral extent of ~200 km along the southern margin of the Gawler Ranges, from Toondulya Bluff in the west to Wartaka in the east, and is likely to comprise multiple volcanic sequences from different volcanic centers. In the west the Bittali Rhyolite overlies the Waganny Dacite.

Bittali Rhyolite
(2145090)

Flow-banded and spherulitic, quartz- and feldspar-phyric rhyolite.

MOUNT DOUBLE

Bittali Rhyolite
(2136016)

Feldspar-phyric and very sparsely quartz-phyric rhyolite with flattened, quartz- and chlorite-filled amygdales.

PELTABINNA

Bittali Rhyolite
(2115394)

Rhyolitic (?)autobreccia composed of lenticular quartz-phyric rhyolite clasts defining a preferred orientation in a quartz- and feldspar-phyric groundmass.

MOUNT DOUBLE

Bittali Rhyolite
(2145091)

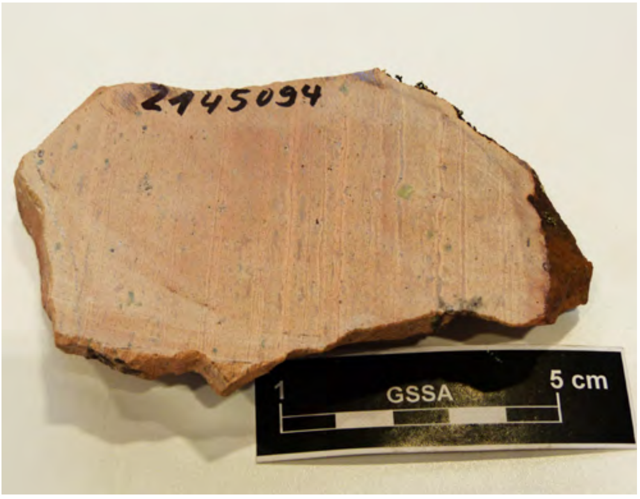
Altered, strongly quartz-phyric and sparsely feldspar-phyric, massive to vaguely flow-banded rhyolite.

MOUNT DOUBLE

Bittali Rhyolite
(2115393)

Porphyritic rhyolite composed of quartz and feldspar phenocrysts and orange-pink lenses and discontinuous bands in a fine-grained groundmass.

MOUNT DOUBLE



Bittali Rhyolite
(2145094)

Very sparsely quartz- and feldspar-phyric rhyolite with extremely fine flow foliation.

MOUNT DOUBLE

Waganny Dacite (Maw)

The Waganny Dacite is a composite unit of porphyritic rhyodacitic to dacitic autobrecciated lavas interlayered with crystal-rich volcaniclastic facies and intruded by polymict volcanic breccia dykes. It has a lateral extent of ~100 km along the southern margin of the Gawler Ranges, from Toondulya Bluff in the west to Thurlga in the east. The Waganny Dacite overlies Ma_1 and is overlain by the Bittali Rhyolite.

Waganny Dacite
(2145102)

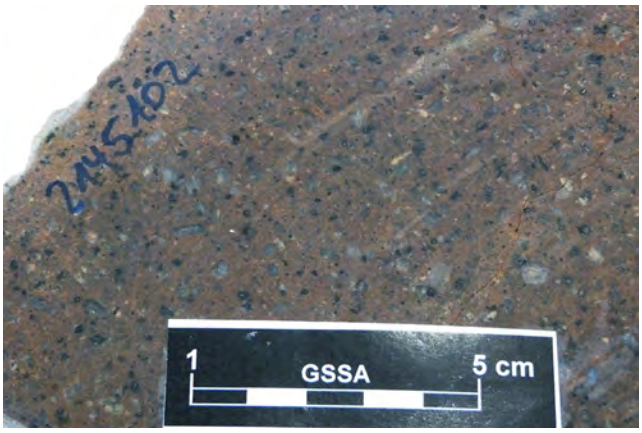
Feldspar-phyric dacite.

MOUNT DOUBLE

Waganny Dacite
(2115391)

Porphyritic dacite lava composed of feldspar and pyroxene phenocrysts in a fine-grained groundmass.

MOUNT DOUBLE



Waganny Dacite
(2145102 - detail)

Feldspar-phyric dacite.

MOUNT DOUBLE

Roopena Basalt (Mar)

The Roopena Basalt is a flat-lying sequence of basaltic lavas conformably interlayered with volcaniclastic lacustrine sediments of the Fresh Well Formation, and is part of the lower Gawler Range Volcanics. It comprises basaltic lavas with amygdaloidal or autobrecciated flow tops, with local hyaloclastite and peperite flow bases, indicating that the lavas came into contact with standing water and wet substrate (McAvaney and Wade, 2015b). The Roopena Basalt overlies the Moonabie Formation, Wandearah Formation or Angle Dam Volcanics. The age of the Roopena Basalt can be inferred from a SHRIMP U-Pb zircon age of 1587 ±15 Ma for a tuff within the upper Fresh Well Formation (Johnson, 1993).

Roopena Basalt
(2132089 – uncut surface sample)

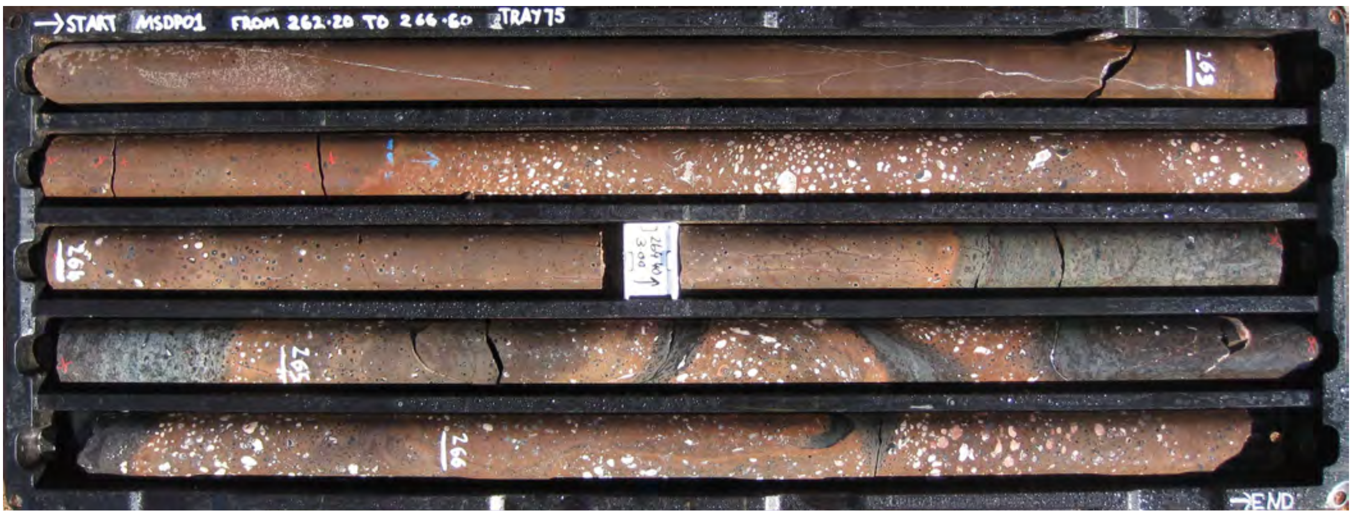
Basalt containing amygdales filled with quartz and clay.

SIX MILE HILL

Roopena Basalt
(2132089 – cut sample)

Basalt containing amygdales filled with quartz and clay.

SIX MILE HILL



Coherent facies of the Roopena Basalt in MSDP01 drillhole showing amygdaloidal basaltic lavas with hyaloclastite margins composed of angular glassy basalt fragments (MSDP01 262.20–266.60 m).

Spearfelt Rhyodacite (Mas)

The Spearfelt Rhyodacite is a newly recognised unit of the lower Gawler Range Volcanics forming the stratigraphically highest preserved part of the lower GRV succession in the Myall Creek area. It is predominantly a reddish-brown, massive, feldspar-phyric rhyolitic to dacitic volcanic rock overlying the Roopena Basalt. Outcrops of the porphyritic felsic volcanics in the Myall Creek area were originally mapped as Nonning Rhyodacite (Blisset, 1987; Weste, 1996) but later renamed Eucarro Rhyolite following the correlation of the Nonning Rhyodacite with the Eucarro Rhyolite by Allen et al. (2003). However, recent TIMS dating has shown that the outcropping felsic porphyritic volcanics at Myall Creek have a lower GRV age incompatible with the younger age of the TIMS-dated Eucarro Rhyolite or Nonning Rhyodacite sample from the Siam area farther west (Jagodzinski and McAvaney, 2016). Major and trace element geochemistry classification plots show that samples of the Spearfelt Rhyodacite from *Six Mile Hill* range in composition from rhyolite to dacite.

Spearfelt Rhyodacite
(2079351)

Feldspar-phyric rhyolite with lithic clasts of flow-foliated, aphyric rhyodacite.

SIX MILE HILL

Spearfelt Rhyodacite
(2079351)

Feldspar-phyric rhyolite with lithic clasts of flow-foliated, aphyric rhyodacite.

SIX MILE HILL

Spearfelt Rhyodacite
(2079355 – fresh broken surface)

Massive, feldspar- and hornblende-phyric rhyodacite.

SIX MILE HILL

Spearfelt Rhyodacite
(2079355 – cut sample)

Massive, feldspar- and hornblende-phyric rhyodacite.

SIX MILE HILL

Upper Gawler Range Volcanics

The upper Gawler Range Volcanics consist of three regionally extensive, thick (200–300 m, volatile-rich, high temperature (900–1100°C) felsic lava flows comprising the Eucarro Rhyolite, and the Pondanna Dacite and Moonaree Dacite members of the Yardea Dacite (Allen et al., 2003) (Fig. 3). These three lava flows are isotopically homogenous and define a single fractionation trend, suggesting that they were derived from the periodic tapping of a single stratified magma reservoir (Stewart, 1994). The lava flows comprise black, crystal-poor bases, homogenous spherulitic to granophyric middle parts and flow-banded and amygdaloidal flow tops. At Mt Double, the Mount Double Ignimbrite occurs locally between the Eucarro Rhyolite and the Yardea Dacite, representing a discrete episode of explosive volcanic activity. The hand specimens are a selection from different units within the upper Gawler Range Volcanics, and different volcanic facies within the lavas flows.

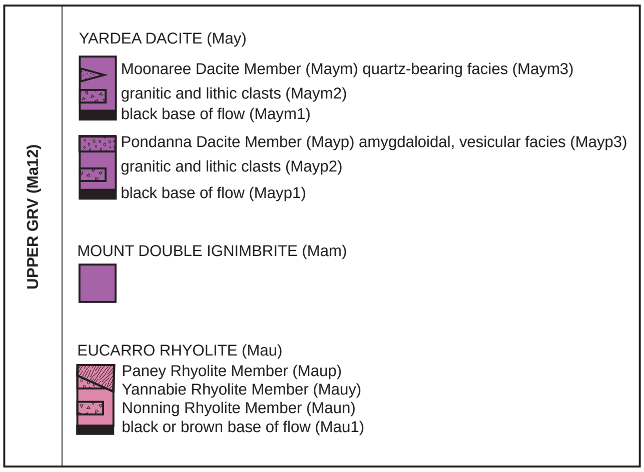


Figure 3 *Stratigraphic units within the Upper Gawler Range Volcanics. Adapted from Blissett (1993), Allen et al. (2003) and Allen et al. (2008); modified after: McAvaney and Wade (2015a & b).*

Eucarro Rhyolite (Mau)

The Eucarro Rhyolite represents a compositionally heterogeneous single lava flow unit. It is dominated by a ~300 m thick plagioclase-phyric rhyolite composed of plagioclase feldspar phenocrysts in a red-brown granophyric to spherulitic groundmass (Allen et al., 2003). The plagioclase-phyric rhyolite has an amygdaloidal flow top and a black crystal-poor base. Along its upper margin the plagioclase-phyric rhyolite is intricately mingled with a ~50 m thick quartz-phyric rhyolite (Paney Rhyolite Member).

Basal Eucarro Rhyolite (2136017)

Flow-banded, feldspar-phyric rhyolite.

PELTABINNA

Eucarro Rhyolite
(2136039)

Feldspar-phyric, spherulitic and microamygdaloidal rhyolite.

PELTABINNA

Eucarro Rhyolite
(2136015)

Massive, feldspar-phyric rhyolite.

PELTABINNA

Paney Rhyolite Member (Maup)

The Paney Rhyolite member is a quartz-phyric, typically flow-banded rhyolite ~50 m thick, occurring along the upper margin of the Eucarro Rhyolite. Flow bands are generally steeply dipping and are either planar or highly contorted. The Paney Rhyolite Member is more heterogeneous than the rest of the Eucarro Rhyolite in terms of its phenocryst abundance (11–21%) and texture (Allen et al., 2003). Rare volcaniclastic facies ($Maup_1$) locally overlie the coherent lava facies of the Paney Rhyolite Member near Mt Hiltaba, and thus serve as a useful stratigraphic marker within the upper GRV (Werner et al., 2016).

Paney Rhyolite Member
(2136035)

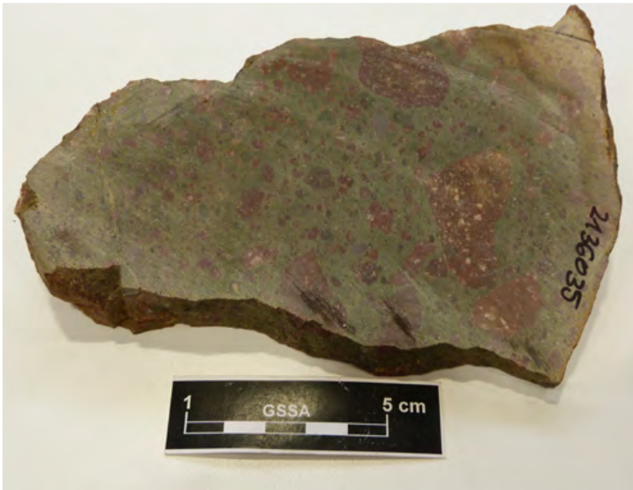
Matrix-rich, volcanogenic debris/mud-flow deposit with dispersed rhyolite lithic clasts.

PELTABINNA

Paney Rhyolite Member
(2145327)

Mingled porphyritic rhyolite with pseudo-fiamme texture (red = Eucarro Rhyolite; yellow = Paney Rhyolite Member.)

MOUNT DOUBLE



Paney Rhyolite Member
(2136035)

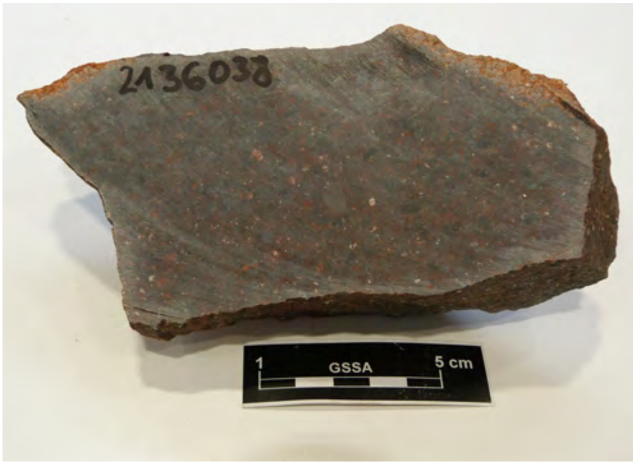
Volcanogenic breccia with lithic clasts of flow-banded rhyolite in sericite-chlorite altered matrix (reworked rhyolitic autobreccia).

PELTABINNA

Paney Rhyolite Member
(2079325)

Rhyolite with flow banding defined by buff sparsely quartz-phyric rhyolite and red plagioclase-phyric rhyolite.

MOUNT DOUBLE



Paney Rhyolite Member
(2136038)

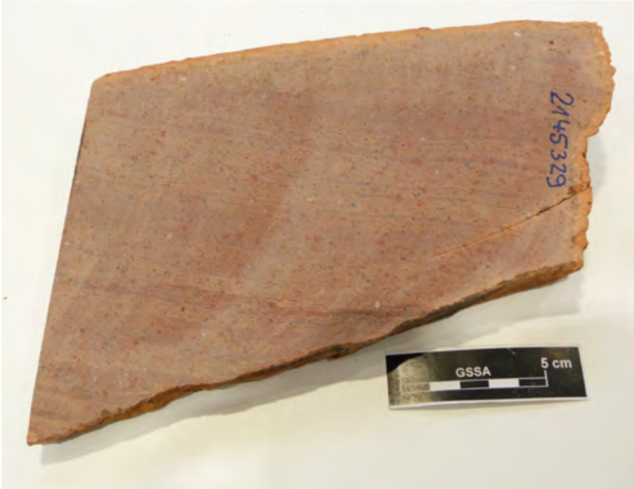
Volcanogenic rhyolite granule conglomerate.

PELTABINNA

Paney Rhyolite Member
(2145329)

Quartz- and feldspar-phyric, flow-banded rhyolite.

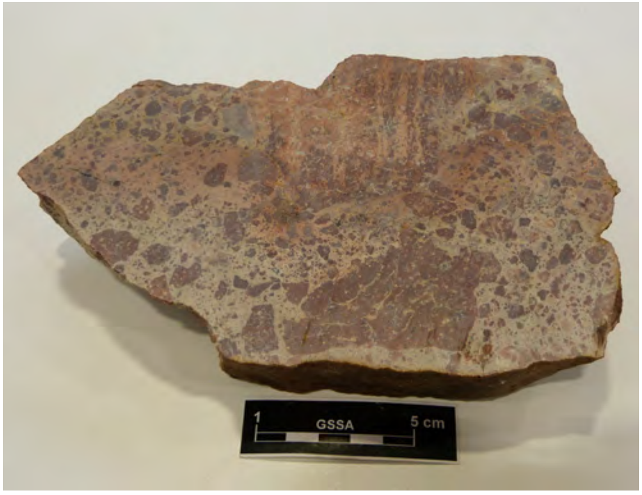
MOUNT DOUBLE



Paney Rhyolite Member
(2145329 – cut surface)

Quartz- and feldspar-phyric, flow-banded rhyolite.

MOUNT DOUBLE



Paney Rhyolite Member
(2136035)

Volcanogenic breccia with lithic clasts of flow-banded rhyolite and kaolinitic matrix (reworked rhyolitic autobreccia).

PELTABINNA

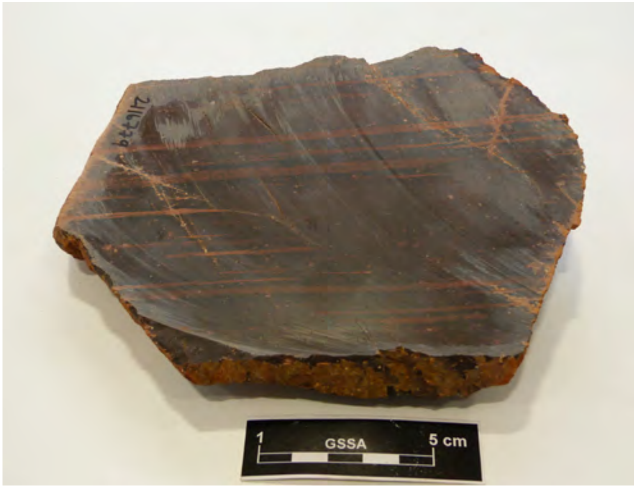
Mount Double Ignimbrite (Mam)

The Mount Double Ignimbrite is a dark, poorly sorted, fiamme-bearing unit about 20 m thick that occurs between the Eucarro Rhyolite and the Yardea Dacite at Mt Double (Allen et al., 2003). It is texturally heterogeneous, comprising irregularly distributed, angular, cm-sized lithic clasts and feldspar and sparse quartz crystal fragments (1–2 mm) in a matrix that contains strongly attenuated, bedding-parallel fiamme. The fiamme have ragged edges, and are deformed around lithic and crystal fragments. Plastically deformed and flattened relic shards are evident in thin-section, hence this unit is interpreted to be a small-volume, welded ignimbrite.

Mount Double Ignimbrite
(2116772)

Thinly planar bedded to laminated, alternating crystal-rich and crystal-poor, rhyolitic ash tuffs.

MOUNT DOUBLE



Mount Double Ignimbrite
(2116779)

Crystal-poor, flow-banded, rhyolitic rheoignimbrite.

MOUNT DOUBLE

Mount Double Ignimbrite
(2116771)

Welded rhyolitic ignimbrite with deformed and flattened pumice clasts.

MOUNT DOUBLE

Mount Double Ignimbrite
(2116776 - wet)

Welded ignimbrite rich in rhyolite lithic clasts.

MOUNT DOUBLE

Yardea Dacite (May)

The Yardea Dacite occupies a large area of the central and northern Gawler Ranges. It comprises two members, the Pondanna and the Moonaree Dacite members, each of which represents a single volcanic flow unit (Allen et al., 2003). The Yardea Dacite overlies the Mount Double Ignimbrite and the Eucarro Rhyolite along its southern margin, and directly overlies the lower GRV to the north.

Pondanna Dacite Member (Mayp)

The Pondanna Dacite represents a single lava flow unit. It is a porphyritic dacite with 68.5–70.3 wt% SiO_2, dominated by red massive to columnar jointed dacite composed of plagioclase, potassium feldspar and ferromagnesian phenocrysts in a sperulitic groundmass (Allen et al. 2003). It contains rare mafic igneous clasts up to 5 cm scattered throughout. The base of the Pondanna Dacite is a black flow banded dacite which is slightly finer and less crystal-rich (20–25%) than the red dacite (23–37%) (Allen et al., 2003).

Pondanna Dacite Member
(2138774)

Dacite lava containing flow banding defined by bands of red aphyric and brown feldspar-phyric dacite.

PELTABINNA

Pondanna Dacite Member
(2136014)

Feldspar-phyric rhyolite with calcite- and celadonite-filled amygdales.

PELTABINNA

Pondanna Dacite Member
(2136013)

Massive, feldspar-phyric dacite with inclusion of fine-grained volcanic clast.

PELTABINNA

Pondanna Dacite Member
(2138773)

Dacite lava containing flow banding defined by bands of red aphyric and brown feldspar-phyric dacite.

PELTABINNA

Pondanna Dacite Member
(2079331)

Partially melted granitoid with spherulitic to granophyric groundmass.

PELTABINNA

Pondanna Dacite Member
(2079329)

Porphyritic granite clast in dacite.

PELTABINNA

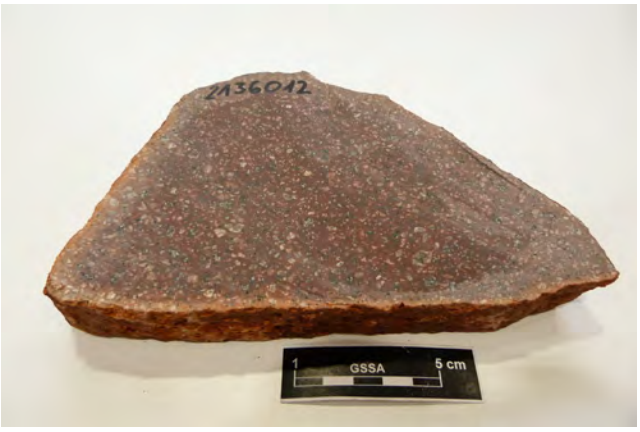
Moonaree Dacite Member (Maym)

The Moonaree Dacite represents a single lava flow unit. It comprises two facies: a red dacite and a brown quartz-bearing dacite. They occupy separate large areas as well as occurring complexly intermingled (Allen et al., 2003). The exposed thickness is ~250m. The red dacite is composed of plagioclase, potassium feldspar and ferromagnesian phenocrysts in a granophyric groundmass (66.8–68.3 wt% SiO_2), and the brown dacite is more silica-rich (68.3–69.2 wt% SiO_2) and contains free quartz (Allen et al., 2003). Both are columnar jointed. The Moonaree Dacite locally contains a black base.

Basal Moonaree Dacite Member
(2136011)

Massive, feldspar-phyric dacite.

PELTABINNA



Moonaree Dacite Member
(2136012)

Massive, feldspar-phyric dacite.

PELTABINNA

Moonaree Dacite Member
(2138780)

Porphyritic dacite lava containing fine-grained mafic clasts.

PELTABINNA

Moonaree Dacite Member
(2138778)

Porphyritic dacite lava composed of euhedral feldspar phenocrysts and subequant ferromagnesian phenocrysts in a fine-grained groundmass.

PELTABINNA

Hiltaba Suite (Mh)

The Hiltaba Suite is a bimodal intrusive suite which occurs as widely distributed plutons in the central and southern Gawler Craton (Flint, 1993; Stewart and Foden, 2003). It is dominated by high-T, fractionated granite to granodiorite and is accompanied by coeval mafic magmatism (Hand et al., 2007). Hiltaba Suite granites are lithologically and geochemically variable, ranging from megacrystic varieties to fine-grained subvolcanic varieties and are mostly fractionated, enriched in high field strength elements, (including U and Th) and K, and with SiO_2 contents generally >70%. The broad range of lithologies and wide variations in REE and isotopic compositions in the Hiltaba Suite suggest that its source region is heterogeneous. Its age is ~1595–1575 Ma.

Hiltaba Suite
(2145100)

Equigranular quartz-feldspar leucogranite.

MOUNT DOUBLE

Hiltaba Suite – Tin Hut
(2145222 – wet)

Equigranular coarse-grained potassium feldspar-plagioclase-quartz granite containing aplite dyke.

MOUNT DOUBLE

Hiltaba Suite - Koondoolka Batholith
(2115387)

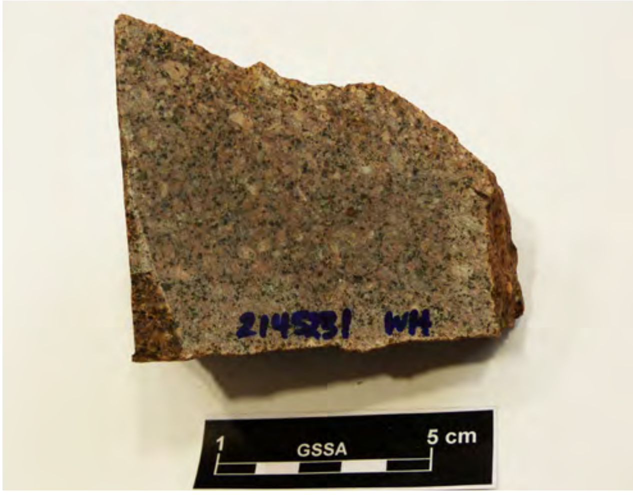
Equigranular medium-grained feldspar-quartz-biotite granite containing graphic intergrowths and miarolitic cavities.

STREAKY BAY 250K

Hiltaba Suite - Waulkinna Hill
(2145232 – wet)

Coarse-grained granodiorite composed of feldspar phenocrysts in a groundmass of feldspar, amphibole and minor quartz.

MOUNT DOUBLE



Hiltaba Suite - Waulkinna Hill
(2145231)

Fine-grained monzonite composed of euhedral feldspar phenocrysts in a fine-grained groundmass of feldspar-amphibole and minor quartz.

MOUNT DOUBLE

Hiltaba Suite - Narlaby Well
(2138762)

Equigranular feldspar-quartz-biotite granite containing miarolitic cavities.

PELTABINNA

Hiltaba Suite - Narlaby Well
(2138761)

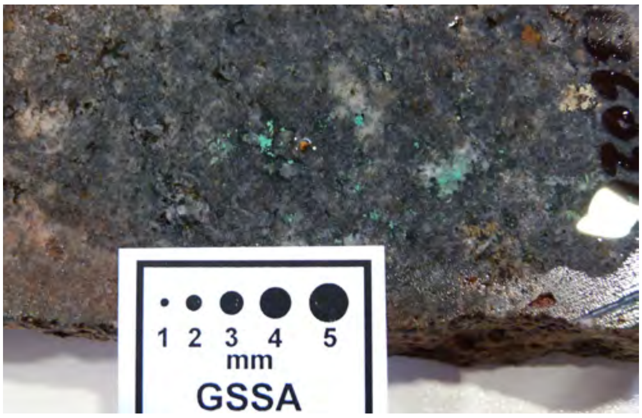
Equigranular medium-grained feldspar-quartz granite containing vughs filled with quartz and hematite and feldspar.

PELTABINNA

Hiltaba Suite
(2136021 - dry)

Muscovite-quartz-fluorite altered granite (greisen) with Sn-Cu-Pb-Zn-As-Bi-Sb mineralisation.

PELTABINNA



Hiltaba Suite
(2136021 detail – wet)

Muscovite-quartz-fluorite altered granite (greisen) with Sn-Cu-Pb-Zn-As-Bi-Sb mineralisation.

PELTABINNA

Outcrop of Hiltaba Granite in Pinkawillinie Conservation Park, PELTABINNA.

Cover to the GRV in the MSDP drilling and mapping areas

Pandurra Formation (M-p)

The Pandurra Formation is a relatively flat-lying sequence of quartz and lithic sandstone with lesser conglomerate and siltstone deposited in a fluvial environment in the Cariewerloo Basin (Cowley, 1991). The age of the Pandurra Formation is poorly constrained, with a Rb-Sr maximum depositional age of 1424 ± 51 Ma (Fanning et al., 2007). In many locations the Pandurra Formation directly overlies the Gawler Range Volcanics, and has incorporated locally derived clasts within basal grit and conglomerate beds (McAvaney et al., 2016).

Basal Pandurra Formation
(2116955)

Very poorly sorted, angular to moderately rounded medium-grained sandstone to granule conglomerate containing clasts of reworked

Roopena Basalt up to 1 cm in diameter, and minor quartz clasts.

SIX MILE HILL

Basal Pandurra Formation
(site 2011941)

Very poorly sorted, angular to moderately rounded conglomerate with subangular to subrounded vein quartz and porphyritic rhyolite clasts.

SIX MILE HILL

Pandurra Formation at Red Rock, Roopena Station, SIX MILE HILL.

Gairdner Dolerite (N-g)

The Gairdner Dolerite forms part of the Willouran Basic Province and the dykes were emplaced during a major NE-SW extensional event and accompanied by continental rifting in the early Neoproterozoic (c. 825 Ma) (Crawford and Hilyard, 1990). Outcrop of the fresh dolerite is very rare and most dykes are inferred from prominent linear positive magnetic anomalies that represent NW-trending dyke swarms.

Gairdner Dolerite
(2116764)
Plagiclase-clinopyroxene-titanomagnetite ± olivine dolerite.

ROOPENA

Neoproterozoic – Stuart Shelf sediments

Whyalla Sandstone (Neh)

The Whyalla Sandstone is generally a massive to thinly-bedded fine- to medium-grained sandstone that can contain low to moderate angle cross-bedding, normal and inverse grading, lenticular beds, scours and low angle truncations (McAvaney et al., 2016). It unconformably overlies the Tapley Hill Formation (Williams, 1998). In the Six Mile Hill area the Whyalla Sandstone is interpreted as a fluvio-deltaic to shallow-marine sandstone and therefore could be the equivalent to any of the marine sandstones within the Yerelina Subgroup. The Pandurra Formation is a primary source for the sediments of the Whyalla Sandstone.

Whyalla Sandstone
(2134529)

Cross-bedded, moderately to well-sorted, fine- to coarse-grained, kaolinitic sandstone.

SIX MILE HILL

Whyalla Sandstone
(2079344)

Poorly sorted, medium- to coarse-grained, conglomeratic, kaolinitic sandstone with subrounded quartz grains and quartzite clasts, and white mudstone clasts.

SIX MILE HILL

Tapley Hill Formation (Nnt)

The Tapley Hill Formation comprises a transgressive-regressive sequence of dark grey dolomitic siltstone and shale with dolomite and minor calcarenite laminations (Mason, 1979). The Tapley Hill Formation unconformably overlies the Backy Point Formation, Beda Basalt or Pandurra Formation (McAvaney et al., 2016). The deposition of the Tapley Hill Formation was initiated during transgression following the melting of the icesheets at the end of the Sturtian glaciation, and represents the first significant onlap of the sea onto the Gawler Craton since its cratonisation. Copper mineralisation occurs within the Tapley Hill Formation (Lambert et al., 1987).

Tapley Hill Formation
(2079339)

Finely laminated, kaolinitic claystone.

SIX MILE HILL

Regolith

Silcrete (T_{Si})

Silcrete is a secondary cementation feature imposed on both existing sediments and/or on weathered rocks (Sheard 2014). Silcretes mostly developed within the quartz-rich arenaceous zone of highly weathered lithotypes of different stratigraphic units. Typically silicified horizons range from less than 0.3 to more than 3 metres thick and may have an underlying incipient silicified zone of less than 0.1 to more than 1 metre thick. Accessory minerals and lithic inclusions present in varying amounts can include: fine-grained anatase ± relict zircons ± opaque heavy minerals ± entrapped quartz vein fragments and remnant quartz grit ± colluvial and/or alluvial quartz (Sheard et al., 2012). Silcretes commonly exhibit features that potentially can reveal information concerning palaeo-climates, palaeosols and paleo-groundwaters (Sheard, 2012; Ullyott et al., 1998).

Silcrete
(2134535)

Silcrete conglomerate composed of glaebules, which typically have multiple silica- and titania-rich cutans of variable thickness.

SIX MILE HILL

Silcrete
(2134527 - varnished

Silcrete conglomerate composed of glaebules, which typically have multiple silica- and titania-rich cutans of variable thickness.

SIX MILE HILL

Silcrete
(2134527)

Silcrete column grown on pebble, occur loose as surface lags associated with underlying weathered conglomerates and conglomeratic sandstones (Krapf and Werner, 2016).

SIX MILE HILL

Silcrete
(2116763)

Silcrete skinned vein quartz clast.

ROOPENA

Ferruginous Duricrust (T_{fe})

Ferricrete or ferruginous duricrust is formed by the *in situ* cementation of regolith by iron oxyhydroxides, mainly goethite and/or haematite (Eggleton, 2001). The fabric, mineralogy and composition of the cemented materials may reflect those of the parent material. The ferricrete and associated ferruginous regolith represents an episode of significant deep chemical weathering in an environment where iron was dissolved, redistributed by lateral migration and then precipitated as ferruginous accumulations. During that time intense chemical weathering and leaching of exposed surfaces occurred. Where abundant silica and iron was released into solution it reprecipitated either locally or distally as duricrusts, megamottles or coatings and secondary cements.

Ferruginous Silcrete
(2145316)

Partly ferruginized silcrete developed in pedolith of undifferentiated weathered basement.

MOUNT DOUBLE

Ferruginous duricrust
(2147290)

Pisolithic ferricrete.

MOUNT DOUBLE

Ferruginous duricrust
(2147289)

Ferruginous swamp or marsh deposit (bog iron) ~1m thick developed on megamottled saprolite.

MOUNT DOUBLE

Appendix 1.

Sample number or site number	LONG	LAT	EASTING	NORTHING	ZONE
1963579	137.3890935	-32.7408516	723856.45	6374916.62	53
2017712	137.3395150	-32.7956228	719075.57	6368946.55	53
2017728	137.3762561	-32.7581432	722610.25	6373026.13	53
2074179	135.8779051	-32.6989913	582288.93	6381741.52	53
2074183	137.3483312	-32.6920611	720156.07	6380412.66	53
2074195	137.4054961	-32.8027256	725237.71	6368020.18	53
2074199	137.3667014	-32.6439386	721997.73	6385710.85	53
2079325	135.5413924	-32.6289293	550785.58	6389719.40	53
2079329	135.4935546	-32.4002357	546415.47	6415092.68	53
2079331	137.4004345	-32.7374380	724927.93	6375271.13	53
2079331	137.4004345	-32.7374380	724927.93	6375271.13	53
2079332	137.4001488	-32.8225839	724686.87	6365829.33	53
2079339	137.4143210	-32.5987291	726579.53	6390623.74	53
2079342	137.3649109	-32.6140759	721903.49	6389026.17	53
2079344	137.4298689	-32.5122694	728257.98	6400178.39	53
2079351	137.3066519	-32.5281565	716642.29	6398674.03	53
2079355	137.2843166	-32.5633770	714460.26	6394813.67	53
2079356	137.2990299	-32.5770377	715809.17	6393269.07	53
2079369	137.3015483	-32.6480437	715875.07	6385390.03	53
2079372	137.3005876	-32.6475648	715786.09	6385445.09	53
2079393	137.4119157	-32.7470446	725979.75	6374181.34	53
2079410	137.1268056	-32.6654614	699442.97	6383800.59	53
2079411	137.1941465	-33.2721294	704356.53	6316396.78	53
2115387	134.9869957	-32.0587696	498772.46	6453050.04	53
2115390	135.4591717	-32.6904224	543043.27	6382938.86	53
2115391	135.4591717	-32.6904224	543043.27	6382938.86	53
2115393	135.4677339	-32.6777764	543852.09	6384337.24	53
2115394	135.4678677	-32.6728978	543867.02	6384878.00	53
2116763	137.0025887	-32.6487874	687827.26	6385876.15	53
2116764	137.0250419	-32.6453678	689940.79	6386215.37	53
2116771	135.6580276	-32.6163727	561735.41	6391049.62	53
2116772	135.6583433	-32.6157115	561765.48	6391122.74	53
2116776	135.6593762	-32.6147780	561863.03	6391225.62	53
2116779	135.6566495	-32.6160905	561606.31	6391081.71	53
2116954	137.3975661	-32.7746263	724565.00	6371153.00	53
2116955	137.3674671	-32.6812926	721977.15	6381566.90	53
2132070	136.1228300	-32.7021300	605243.96	6381176.98	53
2132089	137.2788894	-32.4670656	714179.07	6405504.46	53
2134527	137.4676285	-32.5476277	731715.12	6396175.76	53
2134527	137.4676285	-32.5476277	731715.12	6396175.76	53
2134529	137.4535829	-32.5531148	730381.84	6395597.77	53
2134535	137.3139883	-32.5255283	717337.83	6398950.52	53
2134577	137.2029389	-32.5274943	706900.93	6398953.73	53
2134583	137.2834222	-32.5694046	714361.93	6394147.08	53
2136005	137.3801110	-32.4439767	723751.68	6407857.02	53
2136006	137.3801110	-32.4439767	723751.68	6407857.02	53
2136007	137.3802802	-32.4438346	723767.94	6407872.42	53

Sample number or site number	LONG	LAT	EASTING	NORTHING	ZONE
2136011	135.4104824	-32.3898067	538607.47	6416281.76	53
2136012	135.4111849	-32.3886060	538674.05	6416414.61	53
2136013	135.4935538	-32.4002106	546415.41	6415095.46	53
2136014	135.3105898	-32.3185647	529235.04	6424210.56	53
2136015	135.2297542	-32.3035203	521629.74	6425897.39	53
2136016	135.1877022	-32.3136200	517668.88	6424785.57	53
2136017	135.1881116	-32.3128637	517707.56	6424869.33	53
2136021	135.1507676	-32.1708404	514214.34	6440617.73	53
2136031	135.2045545	-32.1153226	519297.06	6446763.24	53
2136035	135.1931609	-32.2333047	518198.74	6433687.41	53
2136035	135.1931609	-32.2333047	518198.74	6433687.41	53
2136035	135.1931609	-32.2333047	518198.74	6433687.41	53
2136038	135.1714469	-32.2123918	516156.64	6436009.00	53
2136039	135.1712682	-32.2132420	516139.65	6435914.79	53
2138761	135.1976754	-32.3207053	518606.23	6423998.49	53
2138762	135.1421340	-32.3372745	513375.94	6422170.11	53
2138773	135.3627669	-32.3661990	534128.48	6418914.90	53
2138774	135.3618165	-32.3663240	534039.02	6418901.35	53
2138778	135.2724395	-32.1865228	525681.18	6438856.84	53
2138780	135.4838354	-32.3847117	545509.22	6416817.71	53
2145090	135.6780012	-32.6527147	563583.64	6387009.09	53
2145091	135.6789702	-32.6528085	563674.44	6386998.11	53
2145094	135.6655433	-32.6561556	562412.91	6386635.03	53
2145100	135.6422374	-32.6925637	560202.88	6382612.39	53
2145102	135.6156278	-32.6840661	557713.94	6383569.20	53
2145222	135.7210841	-32.7602326	567543.02	6375063.19	53
2145228	135.5481272	-32.7188028	551365.89	6379753.10	53
2145231	135.5446641	-32.7132682	551044.51	6380368.32	53
2145232	135.5598599	-32.7044284	552473.81	6381340.86	53
2145234	135.5847324	-32.7165315	554797.67	6379986.56	53
2145316	135.7274770	-32.6626846	568216.05	6385873.14	53
2145327	135.6620072	-32.6245811	562103.11	6390137.35	53
2145329	135.6899697	-32.6138783	564734.04	6391307.14	53
2145333	135.5557031	-32.7297347	552069.50	6378537.52	53
2145335	135.5563941	-32.7287800	552134.80	6378643.02	53
2145338	135.4662020	-32.8068557	543645.49	6370028.52	53
2147102	135.7779944	-32.6476630	572965.43	6387504.82	53
2147121	137.3890266	-32.8191731	723653.98	6366231.19	53
2147150	135.5557147	-32.7296849	552070.62	6378543.04	53
2147284	137.1934180	-33.2716580	705362.10	6367799.00	53
2147289	135.4894197	-32.8086170	545818.20	6369823.40	53
2147290	135.4894197	-32.8086170	545818.20	6369823.40	53
2018587 (B)	136.9354079	-32.6182474	681586.90	6389379.32	53
2018587 (C)	136.9354079	-32.6182474	681586.90	6389379.32	53
2018587 (E)	136.9354079	-32.6182474	681586.90	6389379.32	53
2018587 (F)	136.9354079	-32.6182474	681586.90	6389379.32	53
2018587 (G)	136.9354079	-32.6182474	681586.90	6389379.32	53
1991010 (site)	137.3329560	-32.7659462	718533.83	6372251.10	53
2011941 (site)	137.2967776	-32.4296891	715949.85	6409613.01	53
2008145 (site)	137.2363311	-32.6671065	709712.11	6383406.95	53

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Bittali Rhyolite at Black Eagle Rock, MOUNT DOUBLE.

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