

NORTH TERRACE, ADELAIDE

Geological trail

Introduction

South Australia is rich in building stone.

Given the State's historic lack of timber for construction, and even for fuelling brick kilns, building stone has been used more extensively here than in any other Australian State. From 1856–1923, South Australian legislation explicitly discouraged the use of inflammable building material in construction, thus encouraging stone use.

A short walk along North Terrace reveals the rich diversity of South Australian building stone, and natural stone use generally, in numerous applications, historic and modern.

In addition, important aspects of South Australia's heritage are revealed.

The diverse types of rocks that have been used in construction over the past 150 years also provide the student of geology with a valuable teaching laboratory.

During this walk you will see the three common rock types: igneous, sedimentary and metamorphic.

You will see granite and sandstone of different colours, as well as basalt, gabbro/norite, limestone and phyllite. The granite, basalt and gabbro/norite are igneous rocks that formed from the cooling of molten material, whilst the other stones formed as sedimentary rocks, with a few being further transformed by heat and pressure into metamorphic rocks as exemplified by marble, slate and phyllite.

This city excursion commences at the State Parliament House and involves walking eastwards on the northern side of North Terrace, with diversions along Kintore Avenue and into the Art Gallery of South Australia, until the Mawson Monument is reached opposite the Pulteney Street / North Terrace intersection.

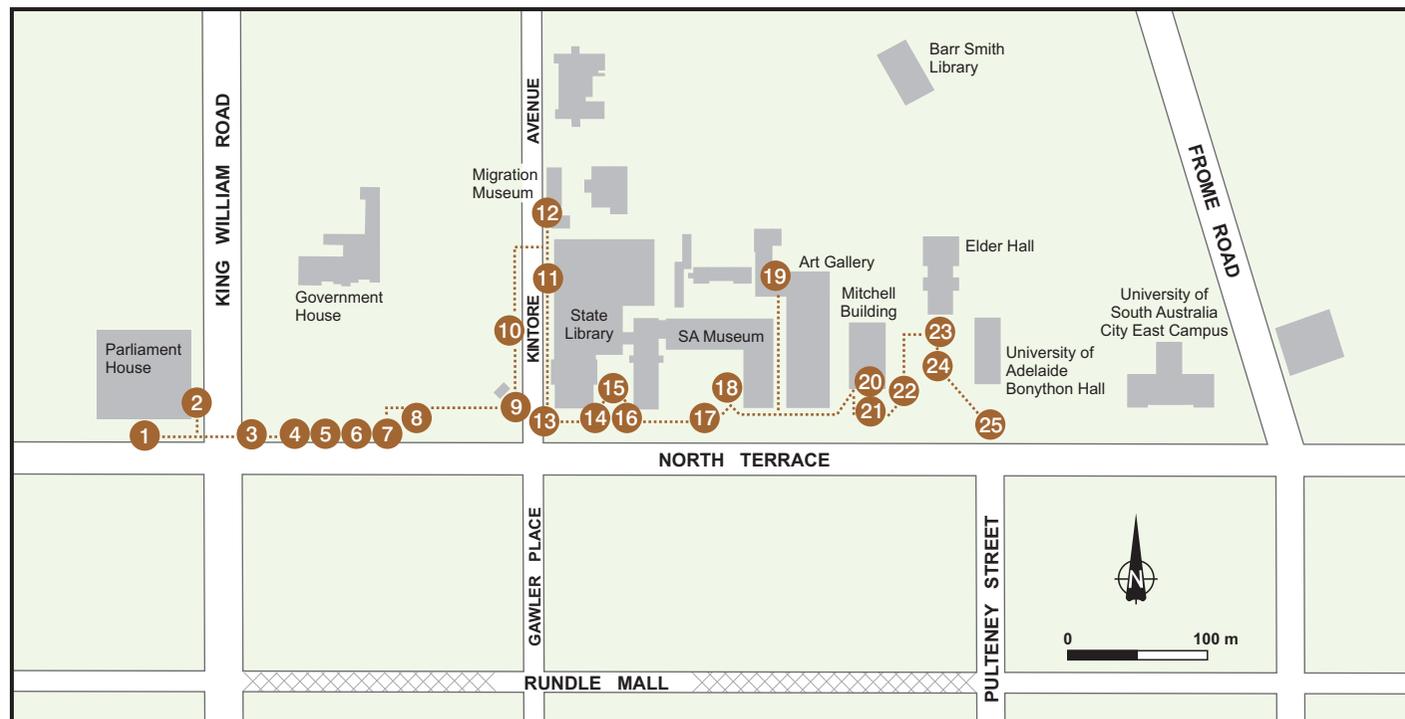
The map below shows the walking route with numbered points giving the location of the stops discussed.

The stops on this excursion do not include every example of natural stone utilised in this city precinct. However they do provide an excellent representative sample of South Australian building stone, coupled with examples of stones that have been imported from interstate and overseas.

A city walk observing geology, building stones and building stone use



South Australian Division



1 Parliament House of South Australia (constructed 1883–89, 1936–39)

South Australia's Parliament House is constructed of grey marble sourced near Kapunda, 90 km north from Adelaide, on a plinth (base) of grey granite sourced from West Island, an island off the south coast near Victor Harbor.

Note the particularly large crystals of feldspar in the "West Island Granite", many of which are concentrically zoned. Other characteristic minerals in this and most other granites are glassy quartz and a black-coloured mica (biotite).

The variation in colour and banding in the marble, as well as cross-cutting veins, have been thought to be unattractive characteristics, so this stone has rarely been used for other building projects, despite its ongoing availability.



2 Granite block seating adjacent Parliament House

The lack of accessibility of granite from West Island, due to it being proclaimed a Conservation Park, has meant that alternative granite was sourced during the 1970s from Kingston SE for block seating next to Parliament House along King William Road.

This "Kingston Blue Granite" has large bluish-coloured feldspar crystals, also with concentric banding. There are also dark pieces of altered sedimentary rock that have been incorporated into this granite. These are termed xenoliths. This stone has been used spectacularly in a sculpture park located at Maria Creek in rural Kingston SE.

The term "Kingston Blue Granite" is used by stonemasons and marketers. Other stone names in inverted commas in this guide are also stonemason terms.



Near this point, cross King William Road at the traffic signals

3 South African War Monument (erected 1904)

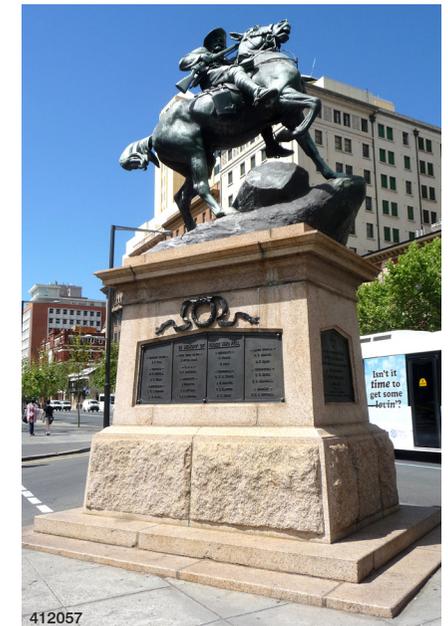
This is Adelaide's first war memorial, commemorating involvement in the South African (or Boer) War, 1899–1902.

The bronze statue, by English sculptor Adrian Jones, of an Australian bushman soldier is placed on a base of orange coloured Murray Bridge Granite having both a sawn or rock faced finish. This stone was sourced near Murray Bridge and was the first granite to be used widely in South Australia in the late 19th and early 20th centuries.

The unusual orange colour of this granite is due to minor impurities in the mineral feldspar in this rock. On this walk, South Australian granites of many different colours — orange, red, green, blue and grey — will be observed. The colour difference in each instance is mostly due to different impurities in the constituent mineral feldspar.

The main quarry for this granite at Murray Bridge was located at the position where Highway 1 (SE Freeway) crosses the Murray River and remaining evidence of the quarry can still be seen near the northwest corner of the Swanport Bridge.

Other examples of Murray Bridge Granite can be seen on this excursion and around Adelaide.



Proceed to walk on the outside pathway closest to North Terrace

4 Granite walkways starting King William Road extending east

The surface of the footpath along the north side of North Terrace has been progressively converted to granite paving in recent years. Such granite paving has become fashionable in cities around the world in the past 50 years.

Here a green-coloured granite is used, commonly called "Balmoral Green Granite" or "Tatiara Green Granite". It has been sourced from Padthaway, 300 km southeast of Adelaide. The stone has been sawn and provided with a bush-hammered finish in order to reduce slippage.

This section of North Terrace paving also includes the Jubilee 150 walkway with bronze plaques commemorating famous South Australians, first placed in 1986.

The rare green colour of this granite is again caused by impurities in the constituent feldspar. Quarrying of "Balmoral Green Granite" commenced in 1991 and the stone has since been exported. It can be seen in Singapore International Airport and in the cladding of high rise buildings in Thailand and China.

5 Dame Roma Mitchell Memorial (1999)

This is one of Adelaide's more recent monuments. The basal block is "Calca Red Granite" sourced near Streaky Bay, Eyre Peninsula, almost 700 km west of Adelaide.

"Calca Red Granite" is also widely used as a monumental stone in Australia as well as for paving around the Sydney Opera House and Australia's Federal Parliament building in Canberra.

The chequered top of the granite block utilises polished "Adelaide Black Granite" from Black Hill, near Mannum, set with small contrasting pieces of "Yellow Venice Granite" from Brazil. Better examples of "black granite" will be seen at later sites.



6 Venere di Canova Statue (1892)

This was the first public statue in the City of Adelaide.

The principal stone used in the sculpture is statuary marble from Carrara, in Tuscany, northeast Italy, where this rock has been quarried for more than 2000 years. The public expression of a naked body caused a great outcry in conservative 19th century Adelaide.

Whilst Carrara marble has many natural variations, it is still available from what are probably the largest stone quarries in the world. Carrara marble with its pure white colour and sugary texture, sets a standard against which all other marbles are judged.

Carrara marble has been used around the world and can be found as monuments (especially from the 19th century) in most Australian cemeteries, even in the remote outback.

Carrara marble has also been used in the main facade of Australia's Federal Parliament building in Canberra, completed in 1988.

The base of the monument consists of Carrara veined marble. The basal slab is either white Angaston or Kapunda marble like that used in the construction of Parliament House (Stop 1).

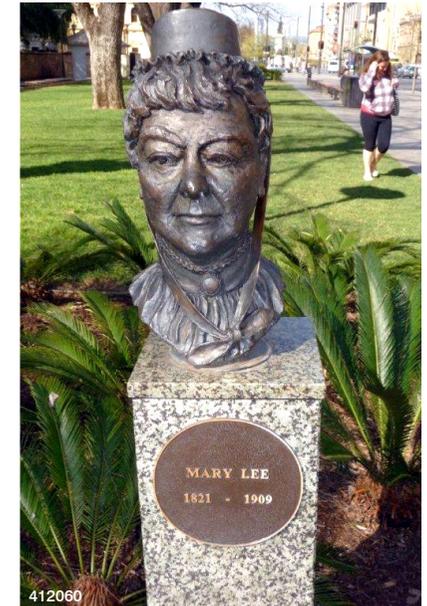
Walk away from North Terrace along the honour avenue towards the stone wall



7 Honour avenue of bronze busts on granite pedestals (1969, 1970, 1978, 1994)

These four bronze busts commemorating Lord Florey (1969), Sir Mellis Napier (1970), Sir Mark Oliphant (1978) and Mary Lee (1994) all have granite pedestals. Harcourt Granodiorite, from central Victoria, is the principal stone used. It will be better seen at the War Memorial and King Edward VII statue (Stops 9 and 13).

The pedestal supporting the Mary Lee memorial is a green granite that is similar to that used in the nearby paving. However, here it is revealed in tiles with a bright, polished finish.



8 Government House wall (1849-50)

The original southern perimeter wall of Government House, between King William Road and Kintore Avenue, is constructed primarily of white limestone that was obtained close to this site by quarrying in the Adelaide Parklands. This quarrying ceased in 1855.

The limestone is in the form of calcrete, formed in relatively recent geological time within the soil profile from chemical weathering of a pre-existing source of calcium carbonate, in this case an underlying limestone. It is variable in character often being powdery, nodular or distinctively banded.

Such surface limestone (commonly called paddock stone in rural areas) remains widespread across South Australia and is still widely used as a local building material in regions such as Eyre Peninsula.

The paving stone next to the wall is "Balmoral Green Granite".



Continue walking easterly

9 State War Memorial (1927–31)

The base and steps are constructed of grey granodiorite quarried from Harcourt, central Victoria. This stone has been quarried for 150 years and utilised around Australia.

Granodiorite is a granite-like rock, both in its crystalline texture and intrusive origin. The feldspar mineral, which differentiates the rock from granite, is a form in which the element sodium is an important constituent.

Fragments or xenoliths of pre-existing intruded rocks can be seen in



various stages of assimilation into the igneous mass of the granodiorite.

The pedestal, pool surround and rock-faced arch are grey marble from Macclesfield in the Mt Lofty Ranges. This rock is no longer quarried. The central relief carving was prepared from white marble from Angaston in the Barossa Valley, which will be discussed at Stop 11.

10 ANZAC Centenary Memorial Walk, west side Kintore Avenue (2016)

Extending from the State War Memorial down Kintore Avenue is a spectacular wall with associated granite paving labelled the "ANZAC Centenary Memorial Walk".

Most of the paving utilises "Balmoral Green Granite" as also seen along North Terrace. In addition selected pavers made from Calca Red Granite, as previously seen at Stop 5, have been selectively used here both around the base of the War Memorial itself as well as in lines across the paving. Details of Australian theatres of war are inscribed and commemorated on the Calca Red Granite paving.

The Memorial Walk, with respect to the prominent wall and decorative boxes, has been constructed of a polished, dark coloured rock (known geologically as gabbro or norite). Although the minerals comprising this very attractive rock are different from those of a true granite, because it has a coarsely crystalline texture, stone masons commonly describe this gabbro/norite as "black granite". Unlike granite, gabbro/norite contains no quartz and is characterised by dark minerals such as pyroxenes and calcium feldspar.

The rock is actively quarried at Black Hill, about 80 km east of Adelaide, where there are some of Australia's largest building stone quarries. The Black Hill stone is commonly known by the

names "Adelaide Black Granite", "Imperial Black Granite" or "Austral Black Granite".

Since the establishment of the Black Hill quarries in 1946, "Adelaide Black Granite" has become a very popular monumental and commercial building stone in Adelaide, around Australia and internationally. It has become the preferred paving stone in the city of Sydney and has also been used for paving in Leigh Street, Adelaide.

In the ANZAC Centenary Wall, "Adelaide Black Granite" has been cut, polished and then hand engraved with images depicting Australian war time experiences. This engraving reveals what is arguably one of the most spectacular



modern uses of stone. The wall is beautifully illuminated at night. More examples of the use of “Adelaide Black granite” will be seen on this excursion.

Now cross Kintore Avenue in order to examine two obvious sites of stone use

11 Marble and “granite” cladding, Library Building, Kintore Avenue (1964)

This is an example of the modern use of stone as thin cladding in construction.

The dark stone at the base is “Adelaide Black Granite”, also seen at the last stop.

The white stone above the gabbro is Angaston marble also seen in the State War Memorial.

Angaston marble has been quarried in the Barossa Valley since the 1850s. It became a common monumental stone in South Australian cemeteries in the 1920s.

The use of Angaston marble illustrates the aesthetic challenge that stonemasons have — using large slabs of cut stone. Ideally the internal structure of the stone should link from one slab to another in order to preserve aesthetic appearance. Here this is only partly the case. To achieve such continuity requires careful monitoring of quarrying and cutting as well as slab placement.



12 Migration Museum, Kintore Avenue (1857–59)

This heritage building, with brick quoins, was constructed of a shale modified by low grade metamorphism. It is commonly known as “Glen Osmond Bluestone”.

The stone was sourced from a quarry located near the entrance to the SE Freeway at Glen Osmond in metropolitan Adelaide. The quarry site is now a housing estate.

During the period 1850–1920, “Glen Osmond Bluestone” was the most common building material in Adelaide and surrounding villages, being especially used for domestic housing.

Ironically “Glen Osmond Bluestone”, as typically represented here, is brown/black rather than blue in colour. In Victoria, the term “bluestone” is used for an entirely different stone. See Stop 14.

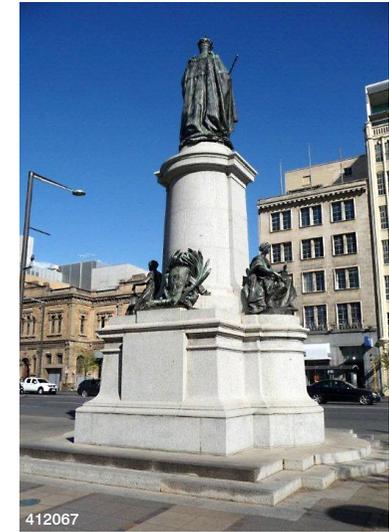
This rock was originally a siltstone that has experienced low-grade metamorphism. Subsequently weathering products, such as rust-coloured iron oxides, have concentrated along bedding and cleavage planes to produce characteristic brown colours. Many of the flat faces exposed in the wall are a consequence of natural splitting parallel to rock cleavage. In its unweathered state the rock is green or bluish in colour.

Return now to North Terrace and continue walking east along inner pathway



13 King Edward VII statue (1920)

The pedestal of this large statue is Harcourt granodiorite from central Victoria, as previously seen over the road at the State War Memorial.



14 Bill’s Fountain and associated landscape features in front of the State Library of South Australia

Decorative boxes around this fountain, as well as associated paving, are constructed from basalt of volcanic origin. Some of the basalt is polished, some is clean sawn by diamond saw.

This basalt contains internal structures indicating that, at the time of extrusion, parts of the lava contained gaseous bubbles, which remained in the solidified rock.

The stone originates from the volcanic plains in western Victoria, from basalt quarries at Deer Park on the western fringe of Melbourne.

In Victoria, stonemasons and stone merchants called this stone “bluestone”, even though it is totally different in character to the South Australian stones that are labelled bluestone.

“Victorian Bluestone” has been widely used in Victoria for historic buildings both in Melbourne and throughout the western districts, being utilised in such prominent Melbourne landmark buildings as St Patrick’s Catholic Cathedral.

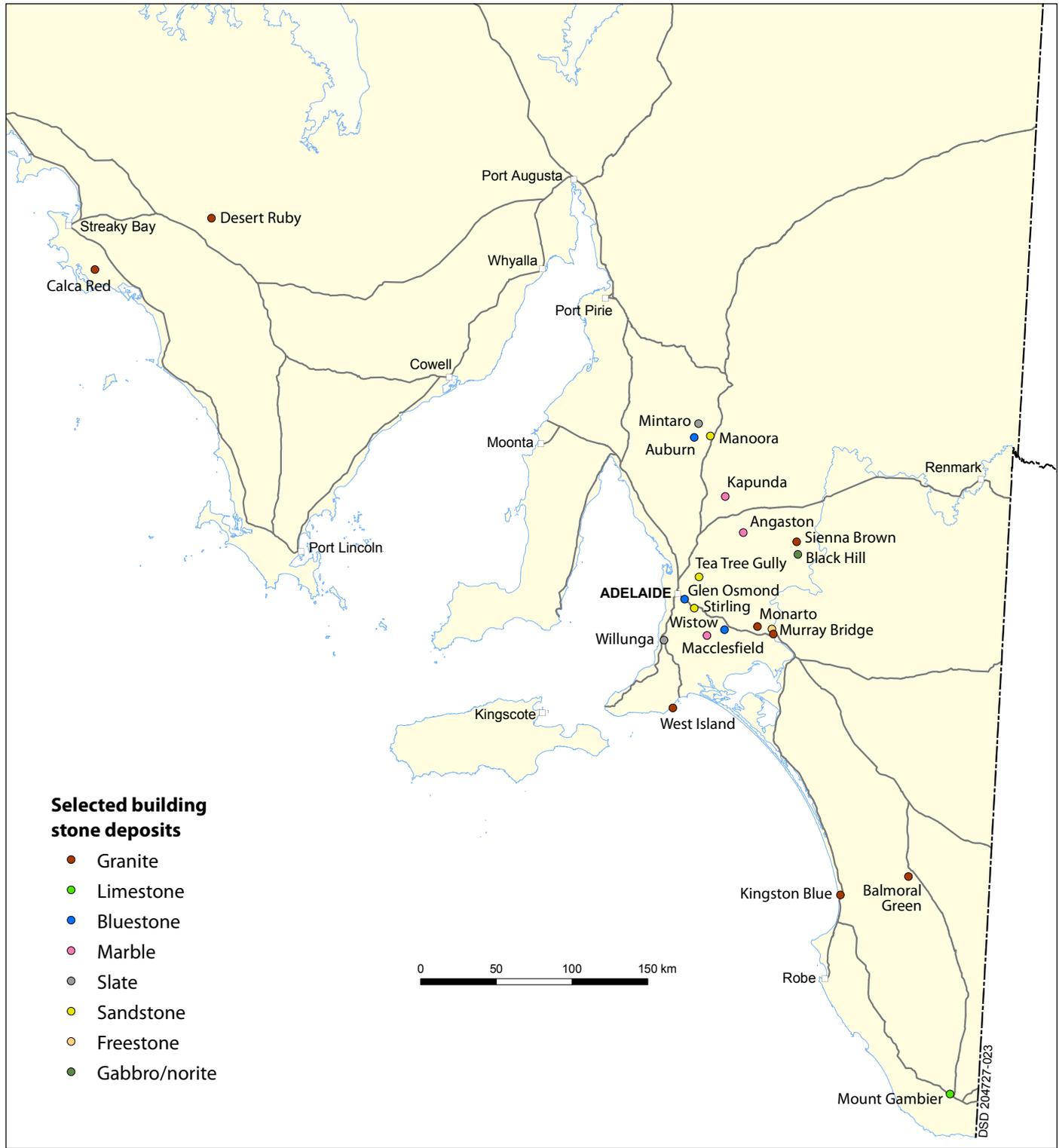


Over the past decades, this basalt has also been used for pedestrian paving in the city of Melbourne. A small section of "Victorian Bluestone" paving has been placed here at the entrance to the State Library around the Burns statue.

15 Robert Burns statue (1894)

This early Adelaide statue commemorating the famous Scottish poet was sculpted by Adelaide-based, yet Scottish-born, William Maxwell. Constructed from white Angaston marble, this stone is also seen at the War Memorial and in the Library wall on Kintore Avenue. It demonstrates that local marble can also be used for fine sculpture.

The pedestal utilises the grey Monarto granite from the Murray Bridge/Palmer area. Cararra marble from Italy is used for the unveiling stone near the base.



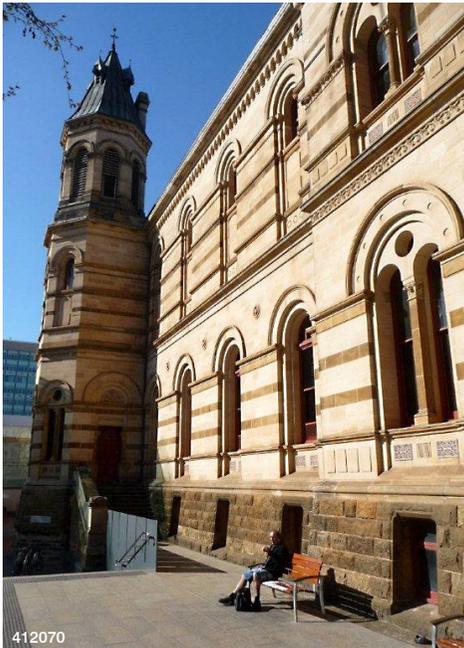
16 Jervois Wing (Mortlock Library) (1879–84)

Towards the base is mottled brown-yellow, rock-faced sandstone that was quarried at Tea Tree Gully from 1856–1929. The quarry site is now part of suburban Adelaide. Competing land use pressures from housing and urbanisation has resulted in the sterilisation of many building stone resources within the state.

This sterilisation, which has been exemplified on this excursion with “West Island Granite”, “Glen Osmond Bluestone” and now “Tea Tree Gully Sandstone”, has become an issue of national and international significance. Safe guarding and preservation of stone resources for restoration works on heritage buildings has become an important issue.

When demolition of the old Hindmarsh Bridge on Port Road, northeast of the city, took place, the “Tea Tree Gully Sandstone”, that had been used, was retained for potential future use in restoration work. In Adelaide, “Tea Tree Gully Sandstone” has been used in several prominent buildings, including the Town Hall and Post Office.

Here “Tea Tree Gully Sandstone” is used with a rock-faced dressing near the base of the building as well as with a smooth, rubbed finish in small columns and decorative bands higher in the superstructure.



In the small columns and decorative bands, it is possible to recognise circular patterns resulting from weathering. Geologists call these weathering bands “liesegang rings”.

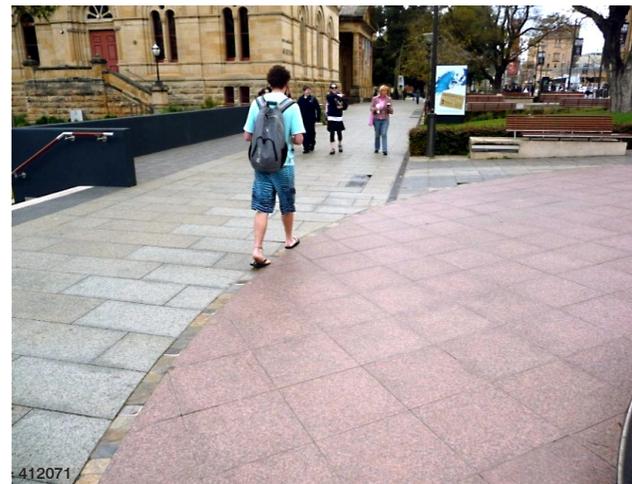
The main superstructure of this building is sandstone from Sydney. The city of Sydney is built on this especially durable sandstone that has been widely used in the city and exported internationally. As a consequence, Sydney has sometimes been labelled “the Sandstone City”.

Following use of “Sydney Sandstone” in this Government building, there was an outcry against the use of “imported” stone. As a consequence, “Murray Bridge Freestone” was used in the construction of the matching Museum Wing built 25 years later (See Stop 18).

17 Paving in front of South Australian Museum

Here several types of stone paving can be seen in contrast. In addition there is manufactured concrete paving.

Extending along North Terrace is “Balmoral Green Granite” on which you have been walking since crossing King William Road. Here “Balmoral Green Granite” is seen in juxtaposition with paving using “Calca Red Granite”, which was also seen at the Dame Roma Mitchell Memorial (Stop 5). By examining these two granites together it is possible to appreciate that the colour of granite is produced mostly by the colour of the mineral feldspar constituents.



Also you can see specialty concrete pavers interspersed with a metamorphic phyllite rock from Wistow in the Adelaide Hills. This stone was once a mudstone that has been transformed under heat and pressure to phyllite, a metamorphic rock similar to slate. Today it is quarried under the name “Wistow Bluestone”.

The adjacent “14 Pieces” water sculpture, created in 2005, also contains large blocks of “Adelaide Black Granite” which has been described previously at Stops 10 and 11.

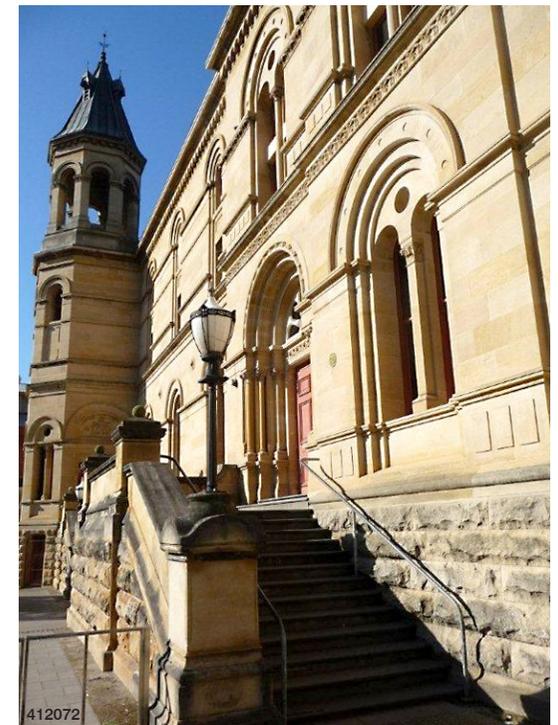
18 South Australian Museum, Eastern Wing

The main construction is of smooth-finished ashlar (blocks) of sandy limestone from Murray Bridge on a rock-faced base or plinth of the same rock.

This rock is fossiliferous and numerous fossil sea urchins are exposed. Fossil burrows can also be seen.

Stonemasons have commonly called this rock a “freestone” as it is relatively easy to cut into blocks.

The steps and paving are constructed of slate slabs or flagstones quarried at Mintaro, 130 km north of Adelaide.





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19 Art Gallery of South Australia — interior floor and stairs of west wing (1996)

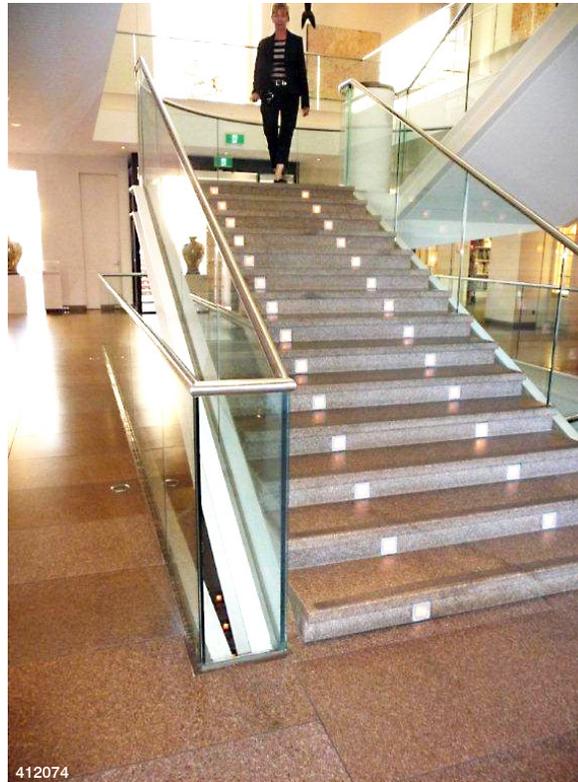
Granite is often used today for paving and stairs in the foyers of major public and commercial buildings where it is especially resistant to wear. Here is an excellent example of such use.

Fine grained “Sienna Brown Granite” from Sedan in the Murray Mallee, about 100 km northwest of Adelaide, has been used with a semi-polished finish. Usage extends outside on the northern side of the west wing, where it is associated with Mintaro Slate paving. Here “Sienna Brown Granite” is also used for bench tops and even table tops in the associated restaurant.

The brown colour of the granite, as in other South Australian granite, is due to minor impurities in the mineral feldspar.

This section of The Art Gallery of South Australia is open to the public, free of charge, from 10 am to 5 pm every day except Christmas Day.

Return to North Terrace and continue walking east



412074

Mintaro Slate is a particularly interesting stone product that has been utilised throughout Australia. It has been quarried for more than 150 years at Mintaro and is one of the oldest continuous mining operations in Australia.

The success of Mintaro Slate has resulted from the product’s capacity to occupy a unique market niche for steps, paving and window sills that no other stone product in Australia can emulate. Currently Mintaro Slate is being utilised for pedestrian paving on the south side of North Terrace as well as along King William Street. In the past it has been used to manufacture billiard tables.

If the Art Gallery of South Australia is open (10 am to 5 pm daily), leave North Terrace here and walk down lane between the museum and art gallery, enter art gallery via the west wing (schools entrance) directly in front of you.

On the left hand side as you walk down the lane is the wall of the South Australian Museum which reveals a base course of rock-faced banded “bluestone” quarried from Auburn in South Australia’s mid north. Both the South Australian Museum and the Art Gallery of South Australia (on the opposite side of the lane) utilise “Murray Bridge Freestone” as the principal building stone.

20 Mitchell Building, University of Adelaide (1879–82)

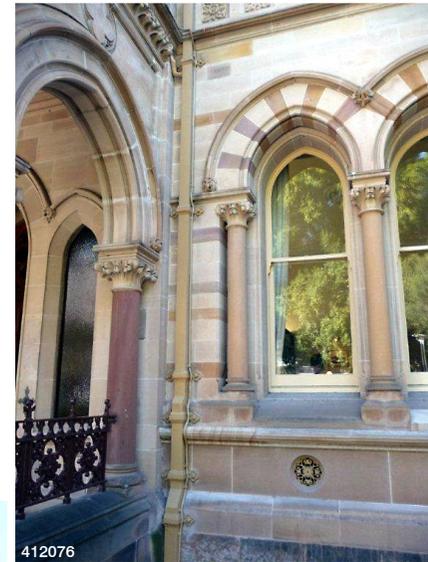
The Mitchell Building is the oldest building of the University of Adelaide. Its front wall uses four different varieties of sandstone with different dressings.

The base or plinth uses rock-faced brown “Tea Tree Gully Sandstone” whilst the main part of the frontage or superstructure is rubbed white “Sydney Sandstone” blocks. Both stones are also seen at Stop 16.

Within the superstructure are bands of rubbed brown “Manoora Sandstone” sourced from the mid north of South Australia, approximately 120 km north of Adelaide. The columns of ground floor windows are also “Manoora Sandstone”. This stone is still available today though rarely used.

The columns in the main porch and upper floor windows are a red sandstone from Dumfries, Scotland.

“Desert Ruby Granite” from Minippa in central Eyre Peninsula, 600 km northwest of Adelaide, has been used for the front steps of this building with one piece being replaced by “Sienna Brown Granite” that was seen in the Art Gallery.



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This replacement presumably occurred due to the unavailability of "Desert Ruby Granite" at the time of replacement.

21 Sir Walter Watson Hughes statue (1906)

In front of the Mitchell Building is the prominent statue of Sir Walter Watson Hughes (1803–87), a major benefactor of the University of Adelaide who made his fortune through substantial ownership of the Moonta/Wallaroo copper mines.

The pedestal and the base of this monument are constructed of orange-coloured granite quarried from Murray Bridge. This stone type has been seen previously in the South African War Memorial (Stop 3).

The monument is instructive because the same granite has been processed and presented here in four different ways. The basal layer is presented as rock faced ashlars (blocks). The overlying layer has a rough hammered finish, which is overlain in turn by a layer of rough sawn granite. The main pedestal and its mount are sawn and polished granite. This granite, particularly in its polished state, reveals a deep orange colour.



22 Reconciliation Touchstone sculpture (2007)

The material of this modern sculpture can be perceived as "sophisticated concrete", a terrazzo, or a "reconstituted stone".

Today reconstituted stone is widely used in building and paving and the material here could possibly be confused with genuine granite.

Upon close examination, it can be seen that this sculpture has been manufactured by mixing a crushed red granite aggregate, probably "Calca Red Granite", in a mortar coloured with a pastel red pigment.

Adelaide-based companies have highly sophisticated operations to produce these materials and have a large selection of "durable" reconstituted stones that can be readily manufactured.



23 Elder Hall, University of Adelaide (1898–1900)

Grey sandstone from Stirling in the Mount Lofty Ranges, less than 20 km southeast of Adelaide, is the dominant stone utilised in this building.

It is used in three finishes. Rock-faced stonework forms the base with pick-dressed and smooth-finished stone work in the major part of the construction. The smooth-finished stone of the porch clearly shows thin dark bands of heavy minerals, a characteristic of this material.

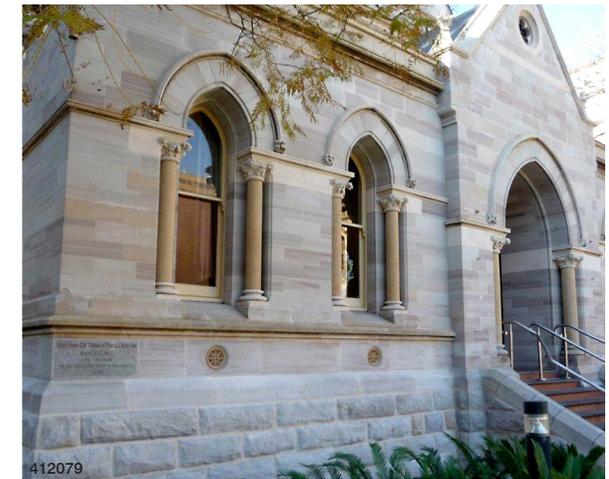
Sandstone from the Stirling area has been widely used for domestic housing in Adelaide, especially frontages, during the first half of the 20th century.

Buff coloured string courses, mouldings and columns within the main structure have utilised "Murray Bridge Freestone" (see Stop 18).

White capitals at the top of the columns as well as adjacent stone courses have utilised "Mount Gambier Limestone". This is a very small and limited example of "Mount Gambier Limestone", which remains one of South Australia's major building stones today. "Mount Gambier Limestone" has been widely used for building domestic housing in Adelaide especially in the 1950s as well as in the southeast. In recent years, it has also been used for luxury housing in the eastern states.

The steps are Mintaro Slate which was examined at Stop 18.

The foundation stone is a light-grey granite, sourced from Monarto, near Murray Bridge.



24 Bonython Hall, University of Adelaide (1933–36).

Stand back near the Sir Thomas Elder

Monument to see slate roof.

“Murray Bridge Freestone” predominates in this heritage building, principally in rock-faced dressing (see Stop 18).

Most notably, Bonython Hall has a roof cladding of slate which was sourced from Willunga in the Southern Vales area south of Adelaide. A glance back at the roof of the University’s Mitchell Building also reveals a slate roof.

Since European colonisation, Willunga has provided the most widely used roofing slate produced in Australia.

The resource was discovered in 1840 soon after European settlement and, as early as 1841, slate was being shipped to Melbourne, Sydney and Perth.

Willunga Slate continues to be produced today. However the slate is primarily utilised for walling and facing of local domestic housing, as well as for paving. Like Mintaro Slate, Willunga Slate is also one of the oldest mining operations in Australia.

The Elder Monument adjacent to Bonython and Elder Halls is on a plinth of granite that was imported from Aberdeen, Scotland.



25 Memorial to Sir Douglas Mawson (1982)

This monument commemorates the life of one of Australia’s greatest geologists, Sir Douglas Mawson (1882–1958), who was associated with the University of Adelaide from 1906 until his death. It was put in place in 1982, the centenary of Mawson’s birth.

The pedestal is polished gabbro or, as termed by stonemasons, “Adelaide Black Granite”. It has been seen previously in an unpolished form at Stops 10 and 11. “Adelaide Black Granite” has been used as a building and ornamental stone extensively around Australia.

“Calca Red Granite” sourced near Streaky Bay is used as basal slabs for the central sculpture and the two boulders. It has also been seen at Stops 5 and 17.

The two boulders on either side of the monument symbolise Mawson’s contribution to the geological exploration of South Australia and Antarctica. One originates from Mawson Valley near Arkaroola in South Australia, the other from Antarctica near Australia’s Mawson base.



Acknowledgement

Original text prepared by B. Cooper of the Geological Society of Australia (South Australian Division) and the Field Guide Subcommittee.



Overview looking west along North Terrace with Stop 14 in the foreground, Stop 13 in the left middle distance and Stops 9 and 10 in the right background. (Photo 400020)



Overview looking east along North Terrace showing Stop 17, with examples of different granite paving and large granite blocks in the ‘14 Pieces’ water sculpture. Stop 18 is in the background. (Photo 412088)