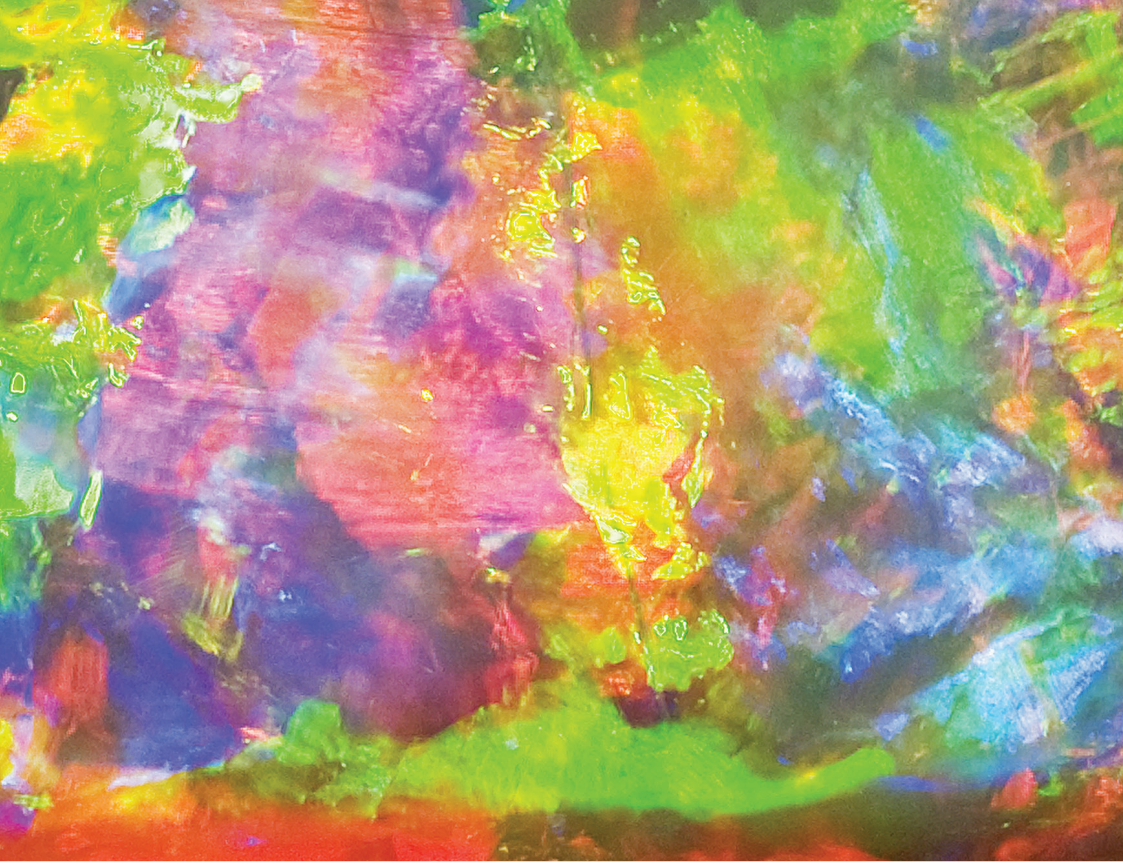
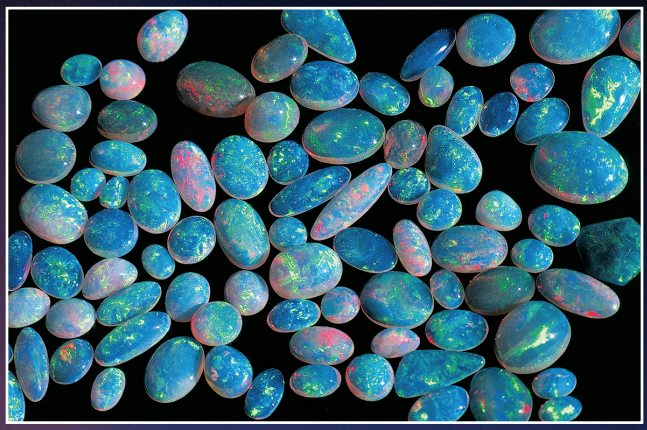


Opal

in South Australia

HPRM 2018D035927

BROCH 074



HISTORY OF OPAL

Opal has a long history of use, both as a treasured possession and for personal adornment. Opal artefacts several thousand years old have been discovered in East Africa.

The Romans established opal as a gemstone, obtaining their supplies from traders in the Middle East. They believed that the gem came from India, and the Roman name *opalus* is based on an ancient Indian word *upala* meaning precious stone. The Romans valued opal above all other gems, believing it to combine the beauty of all precious stones.

The gems so eagerly sought by Rome probably came from open-cut mines in Hungary. These remained the only source of European opal until the Spaniards returned from the New World with many fine examples of Aztec opal.

In the late 18th and early 19th centuries, opal fell out of favour in Europe. It was associated with pestilence, famine, and the fall of monarchs. Underground mining had also begun in the Hungarian deposits and much of this opal was allowed to dry out too quickly and became crazed. The demand for opal diminished and the Hungarian mines closed for a period of time.

When Australian opal appeared on the market in the 1890s, the Hungarian mines promoted the idea that it was not genuine, probably because gems with such brilliant fire had not been seen before.

The first discovery of common opal in Australia was made near Angaston (SA) by the German geologist Johannes Menge in 1849. Production of precious opal began at White Cliffs (NSW) in 1890, Opalton (Qld) in 1896, and Lightning Ridge (NSW) in 1905.

Opal was discovered at Coober Pedy in 1915, where mining became established after the First World War, and at Andamooka in 1930. The industry declined during the depression of the 1930s when few people could afford luxuries, but major new finds in 1946 stimulated mining and there has since been a spectacular increase in production. More than 95% of the world's opal now comes from Australia, with South Australian fields estimated to produce over 50% of the Australian production.

***Left** Blower operating at sunset near Andamooka. (Photo T023091)*

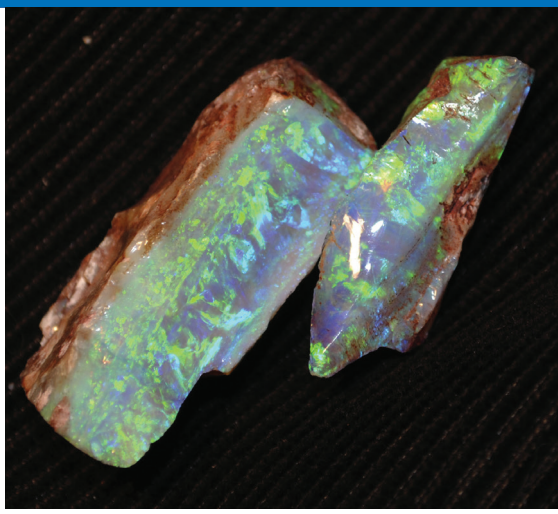
***Inset** Crystal opals from Andamooka. (Photo 036351*

WHAT IS OPAL?

Opal is a form of silica, chemically similar to quartz, but containing water within the mineral structure. Precious opal generally contains 6–10% water and consists of small silica spheres arranged in a regular pattern.

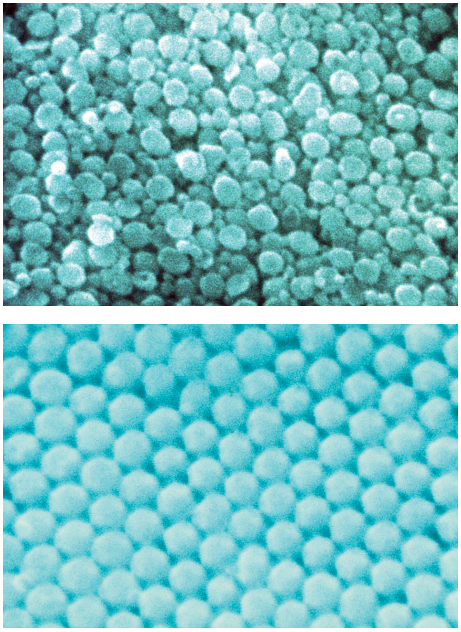
Opal occurs in many varieties, two of which are precious opal and potch.

Colour in precious opal is caused by the regular array of silica spheres and voids diffracting white light, and breaking it up into the colours of the spectrum (see figure below). The diameter and spacing of the spheres controls the colour range of an opal.



Precious opal from Donna's Rush, Coober Pedy. *(Photo 409705)*

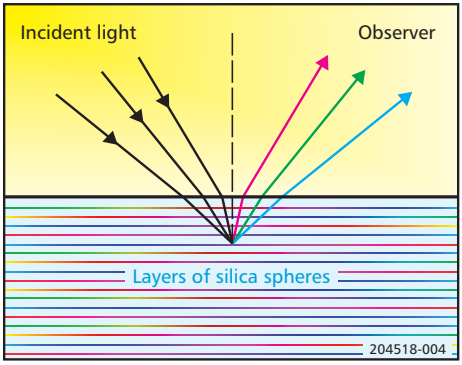
Scanning electron micrographs (x 40 000) of potch (top) and precious opal (bottom). *(Photos T015001 and T014999)*



Small spheres (~150–200 nm; 1 nm = 10-9 m) produce opal of blue colour only, whereas larger spheres (350 nm) produce red colour. Opal with red colour can display the entire spectrum.

Opal colours also depend on the angle of light incidence and can change or disappear when the gem is rotated.

In potch opal, the silica spheres may be absent or too small or irregularly arranged to produce colour.



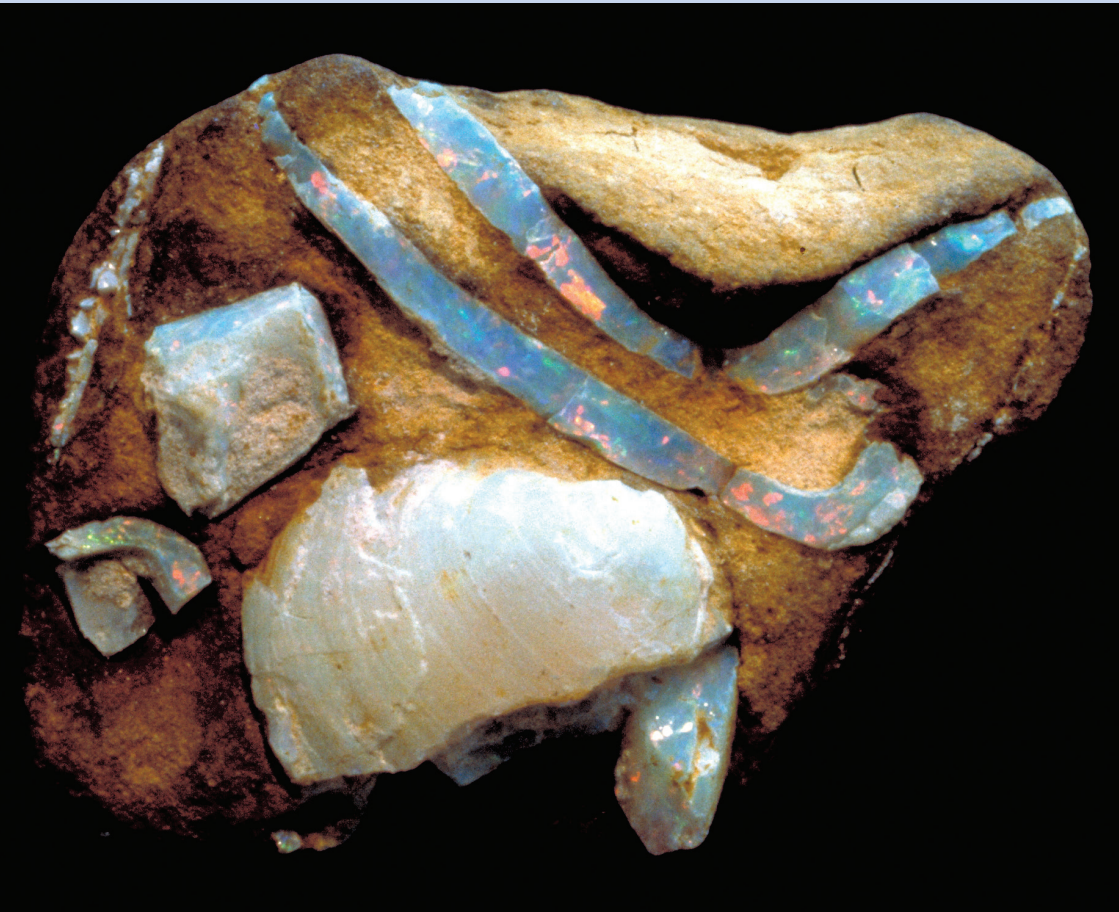
GEOLOGY OF OPAL

Precious and potch opal in South Australia occurs in rocks of a variety of ages but most commonly those of Cretaceous age (deposited as sediments 140–66.5 million years ago). The opal probably formed as a result of weathering processes in the Tertiary Period, and most probably in the range of 20–18 million years ago.

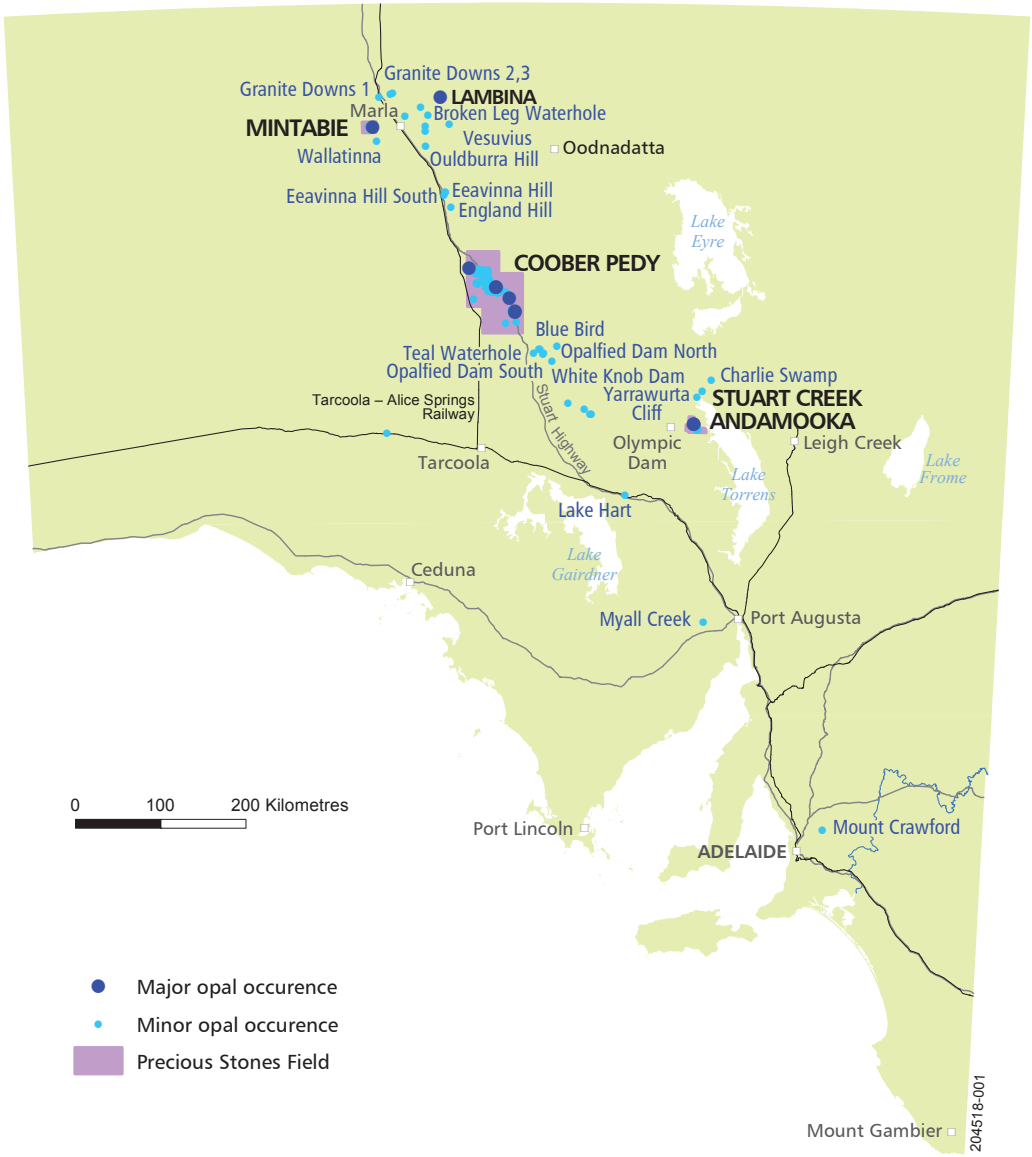
The weathering process broke down minerals of the country rock to produce kaolin (a clay) and soluble silica. It also created cavities in the rock by dissolving soluble minerals and fossil shells. These cavities, together with faults and fractures in the rock, provided pathways for underground water containing the soluble silica.

Periodic lowering of the watertable, possibly caused by changes in climate, carried silica-rich solutions downwards to deposit opal in the rock cavities.

Opalised fossil shells from Coober Pedy. *(Photo 035141)*



OPAL OCCURRENCES IN SA



COOBER PEDY

Opal triplets from Coober Pedy. *(Photo 039406)*

Coober Pedy opal field lies in the Stuart Range, 750 km north of Adelaide, from where it may be reached by regular air and coach services, or by driving via the Stuart Highway. The township has shops, hotels, motels, and caravan and camping areas. Many of the locals prefer to live underground in dugouts where it is cool in summer and warm in winter; several dugouts and mines are open for inspection. One of the main motels has also been constructed underground.

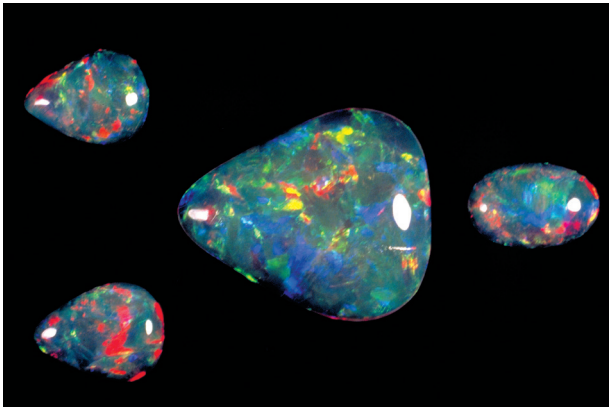
Opal was discovered there in 1915 by a 14-year old boy who was camping with his father's gold prospecting party and, by 1916, Big Flat was established as the principal field. After the First World War, an influx of miners caused a major increase in production. The dugout style of living introduced by these ex-soldiers gave the field its name which is derived from the Aboriginal kupa piti, meaning 'white man's burrow'.

Opal workings now extend for nearly 30 km north and 45 km south of the township, and local tours are available. Once off the bitumen, roads are rough and dusty, becoming impassable after heavy rain.

Opal at Coober Pedy is found in deeply weathered white to mauve Bulldog Shale of Cretaceous age. Miners call the light, porous host rock 'sandstone'. Within the sandstone, opal may be found as veins in horizontal 'levels' or in steeply dipping 'verticals' down to 25 m below the surface.

Distribution is unpredictable and opal may not persist from one claim to the next.

Coober Pedy is generally the largest producer of precious opal in South Australia, and has been superseded only by Mintabie for a few years in the mid-1980s.



Opal solids from Coober Pedy. *(Photo 039405)*

134°30´
To Mount Clarence
Dingo
Shell Patch
To Marla
32
31
30
Vino
John Deere
Seventeen Mile
Fourteen Mile
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
Breakaways
Dora Gully
Greek Gully
STUART
Hans Peak
Dead Man's Gully
Piping Lane
Halleys Comet
Diggers Gully
Kenda Flat
Hellenic Hill
Russos Folly
Larkins Folly
Turkey Ridge
Zorba
Jupiter
Geraghty Hill
South Pacific
East Pacific
Southern Cross
Olympic
Kimba
Browns Folly
28°50´
29°00´
To Manguri and Mabel Creek
0
5
KILOMETRES
Access point
20
134°30´

134°45′

Breakaways Scenic Lookout

28°50′

METRES

Schematic geological section

0
20
40
60
80
100

OPAL BEARING ZONE

Level with opal

Slide (or slip)

Surficial deposits with silcrete rock

MESOZOIC (Bulldog Shale)

Bleached white to light mauve claystone ('sandstone')

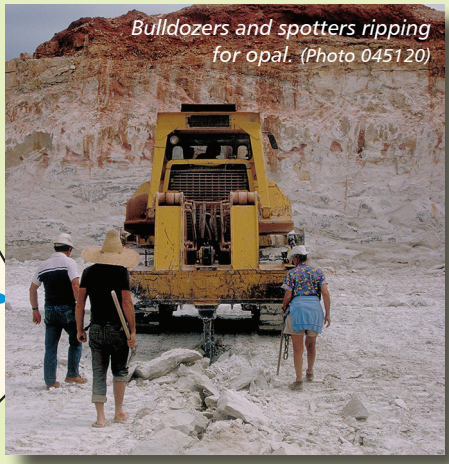
Partly weathered mauve, grey, brown or yellow-brown claystone

Unweathered dark grey claystone

204518-005

To Oodnadatta

Underground mining. *(Photo 035142)*



Bulldozers and spotters ripping for opal. *(Photo 045120)*

29°00′

MAJOR WORKING AREA

Old Four Mile

Hopeful Hills

Crowder Gully

Jewellers Shop

Black Point

Potch Gully

German Gully

Saddle

German Valley

Jungle Company

Deadmans Dugout

Big Flat

Ryans Hill

COOBER PEDY

Peretto

Pluto

Venus

Prospect

Willow

Lennon

Black Flag

AIRSTRIP

Emu

Bonitos Folly

Five Mile

HIGHWAY

Crater

To Adelaide

1 2 3 4 5 6 7 8 9 10 11

134°45′

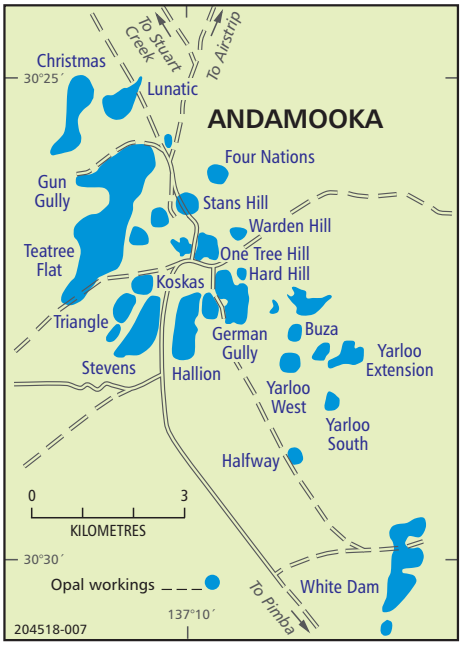
204518-006

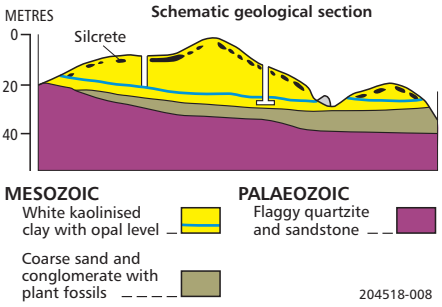
ANDAMOOKA

Situated 520 km north of Adelaide, the Andamooka opal field is reached by travelling 30 km east along a sealed road from Roxby Downs.

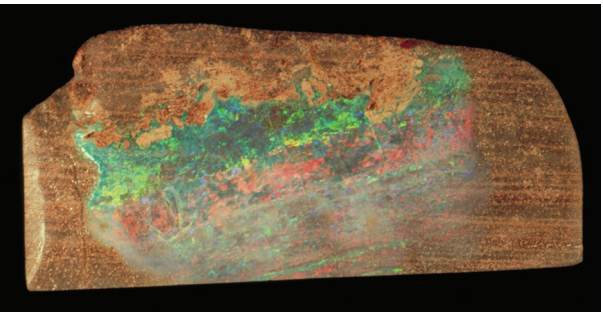
A regular coach service operates from Adelaide and the township has a motel, a guest house, restaurant, caravan and camping area, general store and a post office. Mining and fossicking areas are open to visitors; tours to local places of interest are available.

Host rock for opal is highly weathered claystone of Cretaceous age, called 'kopi' by miners, at the base of which is a band of pebbles and boulders. The opal level lies at the contact between this band and the underlying grey-brown claystone, known as 'mud'. Opal is randomly distributed within the level, infilling voids and cracks, and its presence cannot be predicted. Occasionally opal infills cracks of an erratic boulder as a thin veneer, creating a 'painted lady'. In places it also infills the pore spaces of calcareous boulders forming matrix opal and thin sandstone bands (opalised sandstone). Both of these can be treated to enhance the colour by soaking in a sugar solution and either heating or boiling in sulphuric acid to produce a dark body colour.

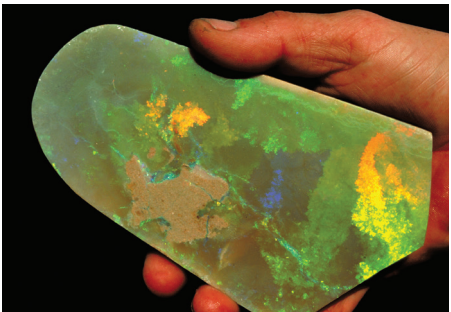




Painted Lady, Andamooka. *(Photo 039417)*



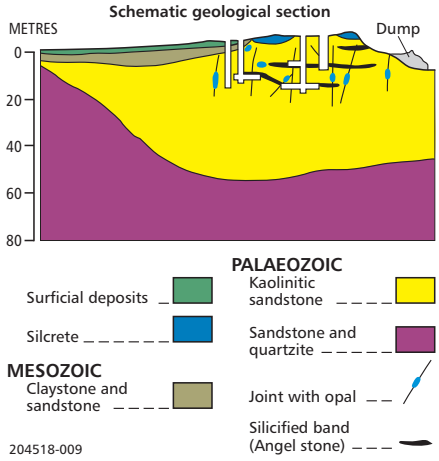
Untreated matrix opal. *(Photo 035143)*



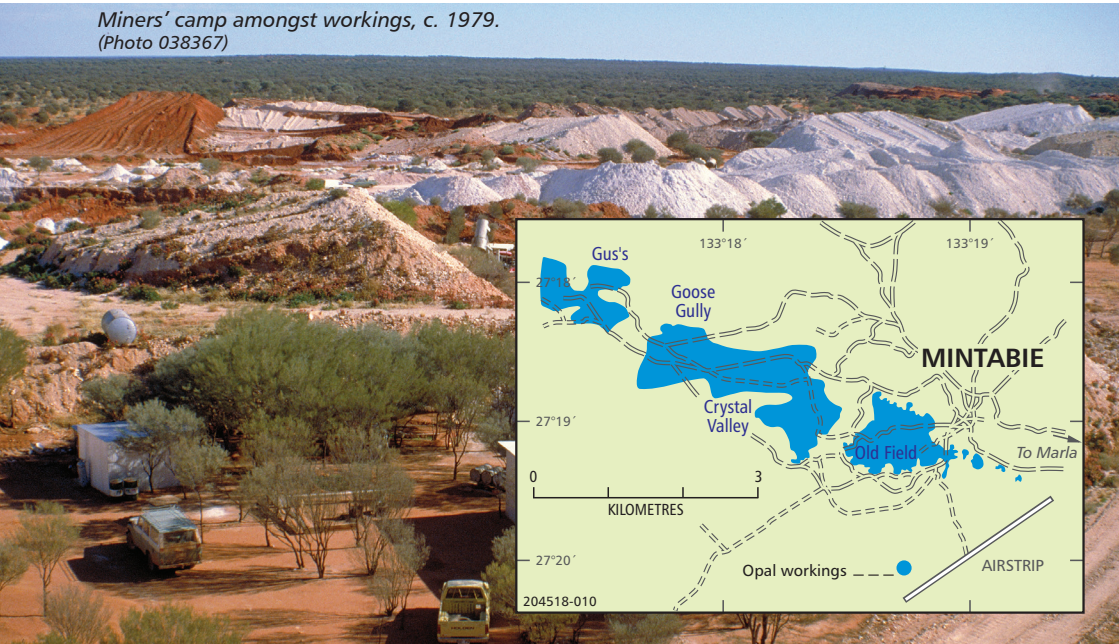
During the First World War, Aboriginals sold black opal at Coober Pedy which probably came from Mintabie, 350 km to the northwest. White opal miners discovered the field in the 1920s, but it was worked only on a very small scale or remained deserted for many years. In 1976, heavy earth-moving machinery moved in and since then there have been many large finds. From 1985 to 1993, Mintabie was the largest producer of precious opal in South Australia and probably Australia. Over 500 miners lived and worked on the field.

Host rock is a kaolinitic sandstone of probable Ordovician age, with the opal found as seams in horizontal or arcuate levels, or infilling steeply dipping verticals down to depths of 25 m. The sandstone is strongly silicified near the surface and has to be drilled and blasted before bulldozing or sinking a shaft.

Opal Miners holding a current Precious Stones Prospecting Permit which has been endorsed for Mining at Mintabie may enter the field. Under the *Anangu Pitjantjatjara Yankunytjatjara Land Rights Act 1981* visitor permits must be obtained by tourists and visitors prior to entry. These can be obtained from the Marla police station.



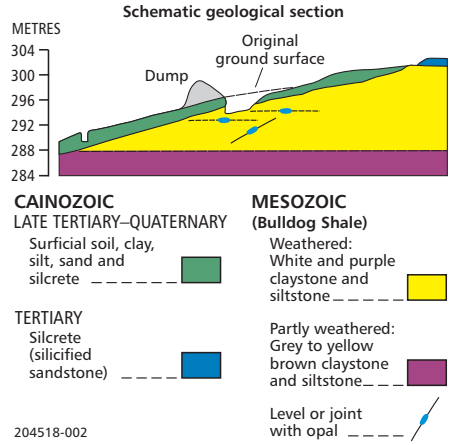
Miners' camp amongst workings, c. 1979.
(Photo 038367)

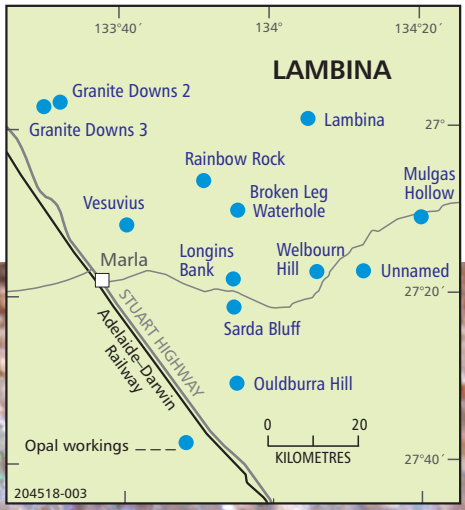


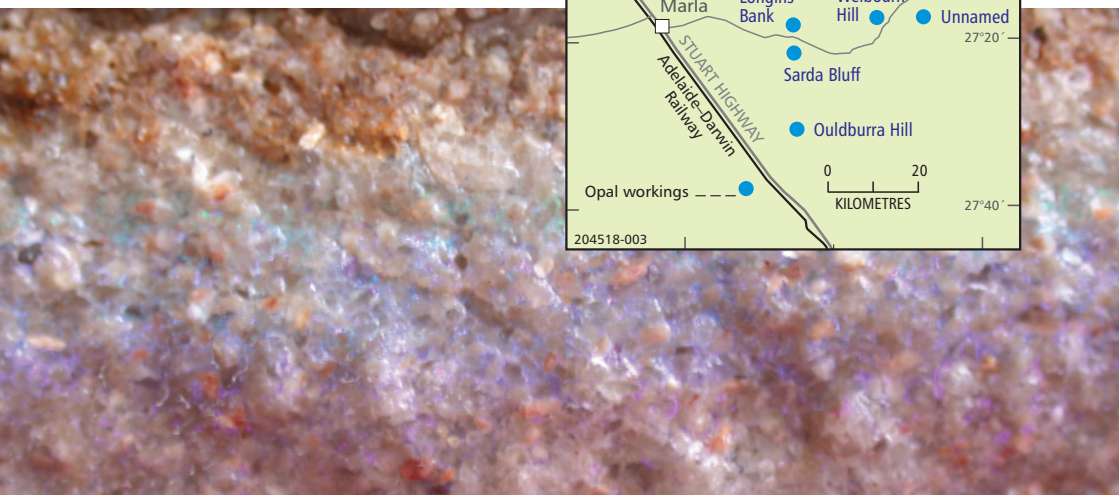
LAMBINA

Lambina opal field, 100 km south of the Northern Territory border and 90 km northeast of Mintabie, is Australia's most recently worked source of precious opal. Although worked for at least 30 years, it has only been in the last decade that production has become significant. Probably discovered in the 1930s, it was visited and worked intermittently in the 1950s, 1964 and 1978, and then worked seriously from 1989 to the mid-1990s. Lambina became more accessible to opal mining in 1998 following the signing of a native title agreement with the Antakirinja and Yunkuntjatjara people.

Opal at Lambina is associated with weathered sediments of the Great Artesian Basin, and is hosted mainly in rocks of Cretaceous age. It is hard by opal standards, and occurs as seams and infilling cracks around nodules, and by filling moulds or replacing fossils; opalised sandstone also occurs. The high-quality gems include white (light) and crystal opal displaying a good play of colour. Up to 50% of Lambina opal does not fluoresce under long-wave ultraviolet light. However, much of the opal is covered by clay and soil, which tends to dull the fluorescence.







Opal is one of the few minerals that can still be extracted economically by a miner working alone. The simplest form of mining is by shaft sinking with a pick and shovel. Driving along the level is then carried out with picks and explosives. A handpick or screwdriver is used to extract any opal found.

Most shafts are now sunk by Calweld-type drills which are used to sink vertical holes about 1 m in diameter using an auger bucket. This rig is also used for prospecting and the opal fields are pitted with abandoned Calweld drillholes. Large auger drills are also used for opal prospecting. The Coober Pedy Miners Association use an auger rig, funded by the South Australian Government, for ongoing opal exploration.

Waste material, or mullock, from the shafts and drives was originally lifted in buckets by hand windlass, but power winches (Yorke hoists) or automatic bucket tippers (self unloaders) are now used. Truck-mounted blowers, which operate like vacuum cleaners, are also used for lifting mullock.

***Left** Opalised sandstone from Rainbow Rock, southeast of Lambina. Note that opal fills the porosity in between quartz grains in Cretaceous or Tertiary Sandstone. (Photo 049384)*

There has been a rapid increase in the use of mining machines since the 1970s. Tunnelling machines with revolving cutting heads and small underground front-end loaders (boggers and bobcats) have been introduced. Recently, excavators have been used to excavate large drives allowing access to several levels at once.

Bulldozers are employed to remove overburden and expose the level where it is shallow. Spotters follow behind watching for traces of opal; any seam found is then worked over by handpick.

Noodling

Many locals make a living out of searching through heaps of discarded mullock for pieces of precious opal, a pastime popular with tourists. The most productive heaps are those excavated by bulldozers where opal may have been crushed or overlooked by miners. Noodling machines, in which mullock is passed by conveyor under an ultraviolet light in a darkened enclosure, are also used. The ultraviolet light causes the opal to fluoresce a bright white, enabling it to be sorted by hand.

***Above left** Coober Pedy in 1920. (Photo N000238)*

***Above right** Windlass hauling a bucketful of kopi to the surface. (Photo T013754)*

Clockwise from top left *Calweld drill; Excavating a large drive; Driving along the level at Andamooka; Government funded auger with blower in back; Tunnelling machine.*
(Photos T024083, 414070, T013772, 414071 and T015015)

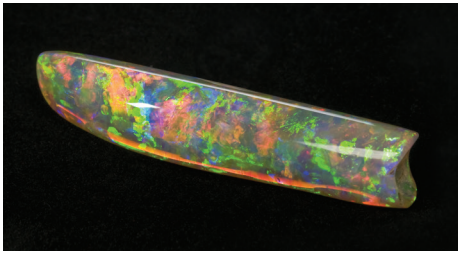
Attempts have been made to establish guidelines for determining opal prices but they have been largely unsuccessful because of the gem's infinite variation in colour pattern.

The main factors influencing the price paid for opal are:

- Background colour — black opal (a gem with a dark background) is more valuable than clear opal (crystal opal) which in turn is generally more valuable than white or milky opal.
- Dominant fire colour — red-fire opal is generally more valuable than a predominantly green opal, which in turn is more valuable than a stone showing only blue colour.
- Colour pattern — harlequin opal, where the colour occurs in patches, is generally more valuable than pinfire opal where the colour is in small specks.

There is a marked difference between the value of uncut opal and that of a cut and polished stone.

Opals may be cut and polished in a number of ways, depending on the nature and thickness of the colour band. Under the Trade Standards Act, all opal sold in South Australia must be clearly labelled to show the type of opal and how it is presented.



Rainbow Opal. Crystal opalised belemnite guard fossil procured by the South Australian Museum and valued at $1 million. (Courtesy South Australian Museum; photo 414065)

Solid (cabochon)

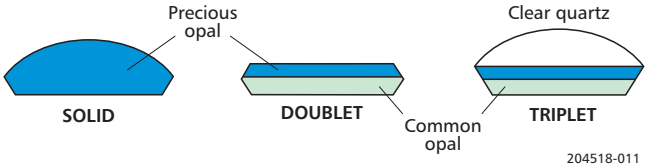
Most cutters prefer to produce the opal as a solid cut *en cabochon* if the gem is sufficiently thick.

Doublet

A thin veneer of opal may show enhanced colour with a dark backing. This can be achieved by cementing either black or grey silica material or a thin slice of common opal to the back of the opal with epoxy resin.

Triplet

A slice of quartz may be used to cap the thin opal veneer to protect it from abrasion. This produces a three-tiered gemstone known as a triplet, which can often display brilliant colours. It is a cheaper method of presentation and can enhance the appearance of the opal.



Clockwise from top left: Solid opal cabochon; Solid crystal opal; Treated Andamooka matrix opal; Opalised fossil shell pendant; Solid black opal; Opal triplets before final shaping. *(Photos T024097, T024093, 035144, T024092, T024091 and T024096)*

Matrix opal

Matrix comprises precious opaline silica as an infilling of pore spaces in silty claystone; it generally shows fine pinfire colour in the natural state. The colour may be enhanced by soaking the specimen in a sugar solution and then boiling in acid to deposit carbon in the available pore spaces, resulting in a dark background. Matrix opal is only found at Andamooka and is generally cut and sold en cabochon.

Synthetic opal

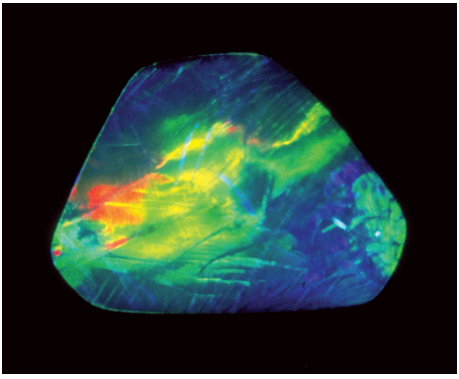
Synthetic opal, such as Gilson, is opaline silica produced in the laboratory and having a similar structure to that of precious opal. The following observations can help to differentiate between natural and synthetic opal:

- synthetic stones generally show brighter colours, and colour patches are often larger than in natural opal
- colour grain boundaries are generally highly irregular in synthetic opal
- within each colour grain in synthetic opal there are numerous sub-grains that produce a distinctive snakeskin pattern
- synthetic material generally shows a more ordered array of colours since artificial material does not duplicate the intricate pattern of natural opal.

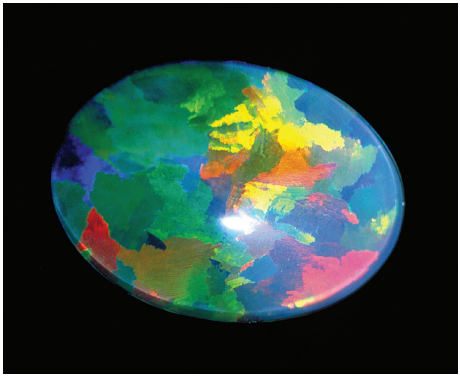
Imitation opal

This is non-opaline material, such as coloured tinsel, set in clear plastic or epoxy resin.

Precious solid opal. *(Photo T024095)*



Gilson synthetic opal. *(Photo T015007)*



OPAL MINING AND THE LAW

The *Opal Mining Act 1995*, brought into operation on 21 April 1997, contains a number of new provisions including larger claims and Opal Exploration Licences. Anyone wanting to prospect within a proclaimed Precious Stones Field (PSF) must have a current Precious Stones Prospecting Permit (PSPP). Tenements under the Act are:

- small claim (50 x 50 m)
- large claim (100 x 50 m)
- extra large claim (100 x 200 m) — can be pegged outside the Coober Pedy Major working area on all Precious Stones fields and registered Native title mining areas e.g. Lambina and Welbourn Hill
- Opal Development Lease (200 x 200 m) — this size claim cannot be pegged within 500 m of an existing tenement or within the Major Working Area of Coober Pedy. It is for a period of three months and cannot be renewed.

Outside a PSF, an Opal Exploration Licence may be applied for and exploration can be carried out under similar conditions to other minerals under the Mining Act including a native title agreement on native title land.

The Opal Mining Act does not affect the fossicker who searches for minerals as a recreation and has no intention of selling any gems found. Casual noodling by tourists is permitted although permission must be obtained from the miner on active claims. A fence now lines the Stuart Highway for the full extent of the Coober Pedy workings to discourage tourists from wandering into mining areas which can be dangerous, particularly to children and the unwary photographer. Some access points to the workings are provided (see Coober Pedy map).

Tours are available from Coober Pedy to safe mines, and this option is encouraged for safety reasons.

Further reading

Opal, South Australia's gemstone. Handbook No. 5 published by the Geological Survey of South Australia, Department of Mines and Energy.

Geology of the Coober Pedy Precious Stones Field. Report of Investigations 56 published by the Geological Survey of South Australia, Department of Mines and Energy.

Andamooka Opalfields. Geology of the precious stones field and the results of the subsidised mining program. Report of Investigations 51 published by the Geological Survey of South Australia, Department of Mines and Energy.

Prospecting and mining for opal within proclaimed precious stones fields. Earth Resources Information Sheet M07 published by the Geological Survey of South Australia, Department of State Development.

Prospecting and mining for opal outside proclaimed precious stones fields. Earth Resources Information Sheet M08 published by the Geological Survey of South Australia, Department of State Development.

Coober Pedy Database 2007 CD contains detailed GIS data on Coober Pedy Opalfield.

Hardcopies can be purchased from the Resource Information Centre, Level 7, 101 Grenfell Street Adelaide.
IS M07, IS M08 and the Database CD are also available from the regional office at Coober Pedy and district offices at Marla and Andamooka.

Glossary of mining terms

Driving	excavating horizontally underground.
Fossicking	searching for minerals as a recreation.
Level	a near-horizontal layer associated with opal formation.
Mullock	waste rock.
Noodling	searching through heaps of rejected material for precious opal.
Painted lady	a boulder split along a fracture to reveal a coating of opal.
Potch	opaline material, generally milky white in colour, that does not show any play of colours.
Slide (or slip)	a near-vertical fault displacing the level.
Solid shell	a fossil shell filled with precious opal.
Spotter	a person engaged to follow behind a bulldozer and search for precious opal.
Traces	small pieces of precious opal found during prospecting or mining that encourage further exploration.

Opal mining and fossicking information

Resource Information Centre
Level 7, 101 Grenfell Street
ADELAIDE SA 5000
Phone (08) 8463 3000
Fax (08) 8463 6518
www.minerals.statedevelopment.sa.gov.au

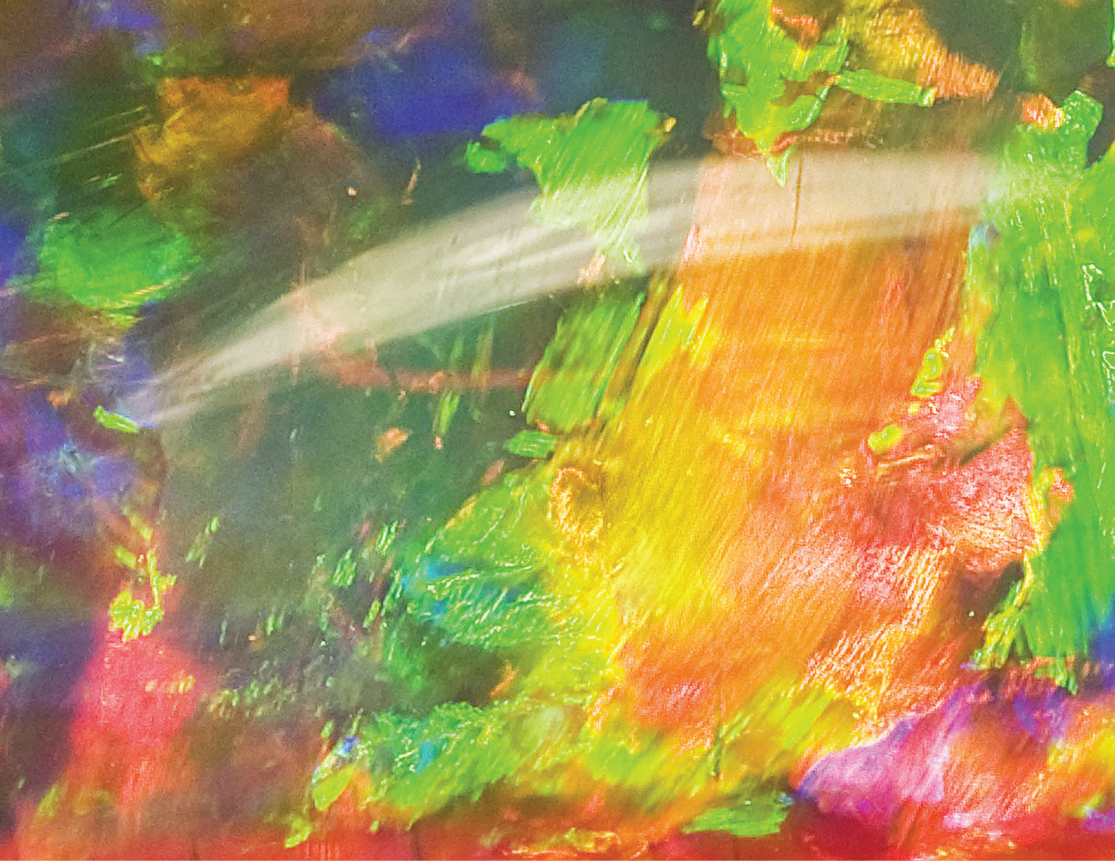
Travelling to the opal fields

Information on air flights, coach services and accommodation bookings for Coober Pedy can be obtained from the contacts below or most travel agents:

RAA Travel Agency
41 Hindmarsh Square
ADELAIDE SA 5000
Phone (08) 8202 4346
Email info@raa.com.au
ww.raa.com.au/Travel

South Australian Visitor Information Centre
Phone 1300 764 227
Email enquiries@southaustralia.com
www.southaustralia.com

July 2014
Job number 204518



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