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OPAL

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Opal is Australia's national gemstone. Over 95 per cent of the world's precious opal comes from Australia.

CHARACTERISATION

Opal has the chemical composition $SiO_2.nH_2O$ and consists of silica with chemically bonded water which varies from 1 to 21 per cent, but is about 6to 10 per cent in precious opal.

While several different types of opal are present in nature, there are two main varieties - precious opal and common opal or potch. Precious opal exhibits the characteristic play-of-colour, and is comparatively rare. Common opal and potch does not exhibit a play-of-colour. When common opal is found in association with precious opal, it is known as potch.

CLASSIFICATION

Precious opal is classified on the background or *body colour* of the stone, the *play-of-colour* of the spectrum, and the *patterns* of the play-of-colour.

The variety of natural precious opal is determined by the characteristics of *body tone* and *transparency*. The *body tone* refers to the relative darkness or lightness of the opal. Varieties include black opal, dark opal and light opal. The diaphaneity of opal ranges from transparent to opaque.

The phenomenon known as the *play-of-colour* is the brilliant range of the full spectrum of colours caused by the diffraction of white light by the internal structure of orderly arrayed spheres of silica.

Pattern of colours is the variable mosaic of colours seen as the stone is viewed from different angles. Classic patterns include **harlequin**, with a chequered pattern of coloured patches, and **pin fire**, composed of closely spaced specks of brilliant colour. Other common patterns are **fire, flame** and **flash.**

TYPES

While volcanic-hosted and other types of precious opal are found in Australia, virtually all economic production comes from sediment-hosted deposits associated with the Great Australian Basin. Australia has three major varieties of natural sediment-hosted precious opal – black opal from Lightning Ridge in New South Wales, white opal from South Australia, and Queensland boulder and matrix opal.

The term 'boulder opal' describes precious opal, which occurs in deposits within weathered sedimentary rocks of Cretaceous age in western Queensland. This type of precious opal is in fact unique to Queensland. The opal is found within siliceous ironstone concretions or boulders, which range in size from less than a few centimetres to a boulder size of greater than 20 centimetres. The smaller ironstone concretions up to 5 centimetres across are known as 'nuts', and these may host a kernel of solid opal or contain a network of thin veins of opal through the ironstone. The best development of this variety of opal is at Yowah where the concretions form distinct nut bands and the nuts are known as 'Yowah-nuts'. Only a small proportion of boulders contains precious opal. Boulder 'matrix opal' is where the opal occurs as an infilling of pores or holes or between grains of the host rock (ironstone). Like other precious opal, there are many varieties of boulder opals defined on body tone, play-of-colour and transparency. These mainly include black boulder opal, dark or light boulder opal.

OPAL FIELDS

Queensland's opal fields located in the west and southwest of the State, include **Yowah field** (the southernmost field centred on the small town of Yowah and includes *Black Gate*), **Koroit field** (northeast of Yowah), **Toompine field** (east and southeast of Toompine and includes *Lushingtons, Coparella, Duck Creek, Sheep Station Creek* and *Emu Creek*), **Quilpie field** (west and north northwest of the town of Quilpie and includes some of the more productive mines in recent times - *Pinkilla, Bull Creek, Harlequin,* and probably the most famous mine of all, the *Hayricks*), **Kyabra-Eromanga field** (west and northwest of Eromanga), **Bulgroo field** (north of Quilpie field in the Cheviot Range and includes the *Bulgroo*, or *German's* and to the north, *Budgerigar*), **Yaraka field** (includes the mines in the Macedon Range, such as *Mount Tighe*), **Jundah field** (west of the town of Jundah over the Thompson River and includes the *Jundah* and *Opalville* mines), **Opalton-Mayneside field** (centred on the old abandoned township of Opalton and to the south in the Horse Creek - Mount Vergemont area), and **Kynuna field** (south of the town of Kynuna, the furthest field to the north).

These opal fields lie within a 300 kilometre wide belt of deeply weathered Cretaceous sedimentary rocks known as the Winton Formation, which extends in a north northwesterly direction from Hungerford on the New

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South Wales border, west of the townships of Cunnamulla, Quilpie, Longreach and Winton, to Kynuna, a distance of about 1000 kilometres (Fig. 1).

In addition to the traditional opal fields, exploration for opal has been undertaken in the Hebel - Dirranbandi area near the Queensland - New South Wales border where there is a 70 kilometre northern extension of the Cretaceous Griman Creek Formation, which hosts the Lightning Ridge opal field (Fig. 2). Detailed exploration has found gem quality black opal and prospective conditions in the area.

GEOLOGY

Almost all Queensland opal occurs within the Cretaceous sedimentary Winton Formation. Other Cretaceous sedimentary units, which are known to contain opal, include the Griman Creek Formation and the Doncaster Member. These units generally crop out to the east of the Winton Formation.

Opal is thought to have formed by remobilisation of silica following deep chemical weathering. Silica was mobilised and precipitated as opal within voids in ironstone boulders in basal ferruginous zones. Ferruginous zones at the base of old palaeo-channels are considered prime sites for opal deposition. Opal is also found associated with faults or “slides”. Altered Winton and Griman Creek Formations shown on Figures 1 and 2 are considered the most prospective host rocks for opal.

MINING

The majority of mines worked in recent years are large open-cut operations. Overburden is stripped from zones of ironstone boulder concretions. Boulders are carefully removed from the ground for processing. Heavy equipment has been used to open up most areas of old workings. At Yowah, underground methods are still applied with success. Shafts are sunk until a prospective layer is intersected. The layer is then explored by the driving of tunnels. Usually at least two shafts are sunk and connected by drives to allow circulation of air. In areas of underground mining, miners utilise 'light' electrical machinery driven by portable generators.

PROCESSING AND PRODUCTION

Processing of rough opal is carried out mainly on the field. If the boulders show any evidence of opalisation, they are carefully removed from the ground for sawing and dressing to provide gemstones.

Opal is mainly cut and polished into cabochons. These may be solid stones, doublets with a dark coloured backing, or triplets where a thin slice of opal has a quartz or glass capping fixed to the top as well as the backing material. For boulder opal, some of the ironstone is left attached as a natural backing, producing natural doublets.

Queensland production of opal in 1998-99 was recorded as $653 939 compared with $660 690 in 1997-98 and $1.04 million in 1996-97. Currently, Australia produces almost all of the world's opal for use in the jewellery industry. The Australian export market for opals in 1998-99 was estimated at $60 million compared with $69 million in 1997-98 and $85 million in 1996-97. These figures should only be used as relative indicators of the state of the Australian opal industry as there is currently no way to accurately gauge the amount of opal being produced in Australia.

VALUES & PRICES

Opal is mainly used for jewellery. The value of an opal is subjective and depends on many factors. These include the size and carat weight of the cut stone, the perfection of the cut and polish, the body tone and the play-of-colour.

Generally opals with a black or dark body tone are more valuable than those with a white or light body tone. The play-of–colour of the opal is important and includes factors such as its brightness, actual colours present, saturation of colours, pattern, consistency of colours and pattern when viewed from different directions. The clarity and soundness of the stone is also important, as the presence of inclusions or flaws will effect the value of the opal. Prices depend on these value-based considerations. Black opal is the most prized opal and may realise prices over $10,000 a carat.

RESOURCES

Due to the nature of prospecting and mining activities, both past and present, and because of the lack of data available, previous attempts to quantify resources of opal in Queensland have been limited.

EXPLORATION AND NEW DEVELOPMENTS

There has been little systematic exploration for opal in Queensland and only a very low percentage of potential opal-bearing country has been rigorously explored. However, exploration to find new prospects is continuing over potential opal-bearing country. In addition to the traditional opal fields, exploration for opal has been undertaken in the Hebel - Dirranbandi area near the Queensland-New South Wales border.

Restricted Areas (Development of opal areas) have been gazetted over most of the known opal producing areas and various restrictions may be applied to facilitate the equitable administration of prospecting, exploration and mining activities. Tenure restrictions also apply within these areas to further assist explorers and miners.

Geophysical prospecting methods using magnetic and resistivity measurements or ground penetrating radar have been used to locate zones of ironstone concretions. These techniques have met with limited success.

Studies using aerial photographs or satellite imagery have identified lineaments as a guide to prospectivity for opal. Areas which have a high lineament density, and in particular a high density of lineament intersections are considered most prospective.

The Queensland Department of Mines and Energy is about to release a promotional opal information package for western Queensland on CD. In addition to general information about opals and opal mining, the CD will also contain a large number of Geographical Information System (GIS) datasets that can be used in exploration. These datasets include base data such as roads, towns, drainages, etc; tenure data, including current and historical exploration permits, mining leases, mining claims and mineral development licences, opal occurrences, and geology. Several geo-referenced images, including topography, satellite imagery and geophysics are also included.

MARKETS AND WORLD DEMAND

Australia exports most of its opal to Hong Kong, Japan, USA and Europe. Currently it produces almost all of the world's opal for use in the jewellery industry. The Asian recession has mainly contributed to the lower demand with Australian opal export values decreasing in recent years.

POTENTIAL AND OUTLOOK

At present most opal is processed into jewellery overseas. Queensland has the potential to further develop the processing of boulder opal, as it is the sole supplier of this material. Opportunities exist for expansion of the export market.

FURTHER READING

COOPER, W. & KROSCH, N.J., 1993: *Queensland opal*. Department of Minerals and Energy, Brisbane. This opal kit contains a commentary with colour photographs, as well as maps of the western Queensland opal areas. It is available from the Southern Region office of the Department of Mines and Energy.

QUEENSLAND DEPARTMENT OF MINES & ENERGY. 2000: *Western Queensland Opals.* Promotional Information Package, Version 1.0.

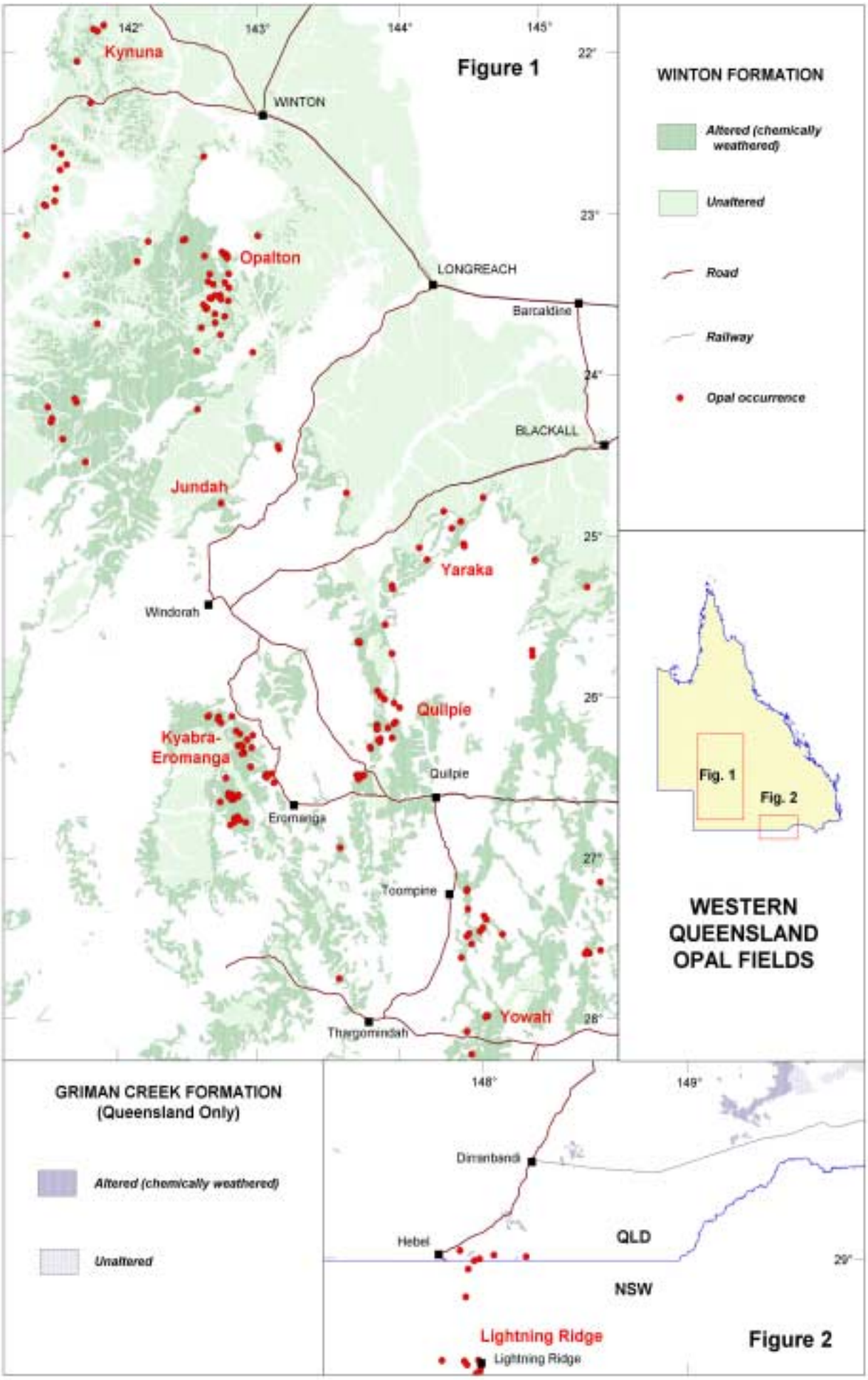
Figure 1
142°
143°
144°
145°
22°
23°
24°
25°
26°
27°
28°
Kynuna
WINTON
Opalton
LONGREACH
Barcaldine
BLACKALL
Jundah
Yaraka
Windorah
Quilpie
Kyabra-
Eromanga
Quilpie
Eromanga
Toompine
Yowah
Thargomindah
WINTON FORMATION
Altered (chemically weathered)
Unaltered
Road
Railway
Opal occurrence
Fig. 1
Fig. 2
WESTERN
QUEENSLAND
OPAL FIELDS
GRIMAN CREEK FORMATION
(Queensland Only)
Altered (chemically weathered)
Unaltered
148°
149°
Dirranbandi
Hebel
QLD
29°
NSW
Lightning Ridge
Lightning Ridge
Figure 2