

Corundum in South Australia

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Report Book 2003/3



MINERALS
PETROLEUM
& ENERGY



**PRIMARY INDUSTRIES
AND RESOURCES SA**

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**Geological Survey Branch
Mineral Resources Group**

June 2003

Report book 2003/3



**Government
of South Australia**

**MINERALS
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Preferred way to cite this text

Crooks, A.F. and Abbot, P.J., 2003. Corundum in South Australia. *South Australia. Department of Primary Industries and Resources. Report Book, 2003/3.*

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CORUNDUM

Corundum is a naturally occurring aluminium oxide (Al_2O_3). It is commonly found as hexagonal prisms or tapering hexagonal bipyramids, rounded into barrel shapes with deep horizontal striations. Corundum is generally subopaque and dull blue-grey in colour, but gem-quality varieties are transparent to translucent and finely coloured. Gem varieties include ruby (red), sapphire (blue), oriental emerald (green) oriental amethyst (purple) and oriental topaz (yellow). Rubies and sapphires displaying a stellate opalescence when viewed in the direction of the c crystal axis (the long axis of the prism) are termed star ruby and star sapphire respectively.

Corundum is characterised by its great hardness, being second only to diamond. This characteristic makes it ideally suited to applications as an industrial abrasive. Emery, a term used for black granular corundum intimately associated with the iron oxides hematite and magnetite, is also used as an abrasive.

While gem varieties are still in high demand, world production of natural, industrial-grade corundum is small and declining due to competition from synthetic corundum, manufactured directly by the fusing of bauxite (alumina). Synthetic abrasives are preferred by industry because of their superior physical properties, their more uniform quality, and because they can be tailored to meet specific user needs. Consequently, although manufactured abrasives are more expensive, their superior durability and efficiency commands premium prices over natural alternatives.

Almost half the world's, 1 Mt/y production of fused aluminium oxide for abrasive use originates in China (Olson, 2002). Australia contributes 50 000 t/y, manufactured in Western Australia, principally for export to Japan.

Natural corundum is a common accessory mineral in rocks with high aluminium content, such as clay and limestone, which have undergone extensive metamorphism. Thus, corundum commonly occurs in pelitic schists and gneisses as porphyroblasts (Cornelius, 1971). Corundum may also be found in large masses in a zone separating peridotites and other highly mafic intrusives from adjacent country rocks. Primary corundum may also be found as an original constituent in certain igneous rocks, especially those deficient in silica such as syenites. Pegmatites may also have accessory corundum. The hardness and inertness of corundum means that it will be frequently found as rounded crystals and rolled pebbles in detrital soil and creek gravels adjacent to outcropping corundum-bearing rocks.

CORUNDUM OCCURRENCES

Mount Painter

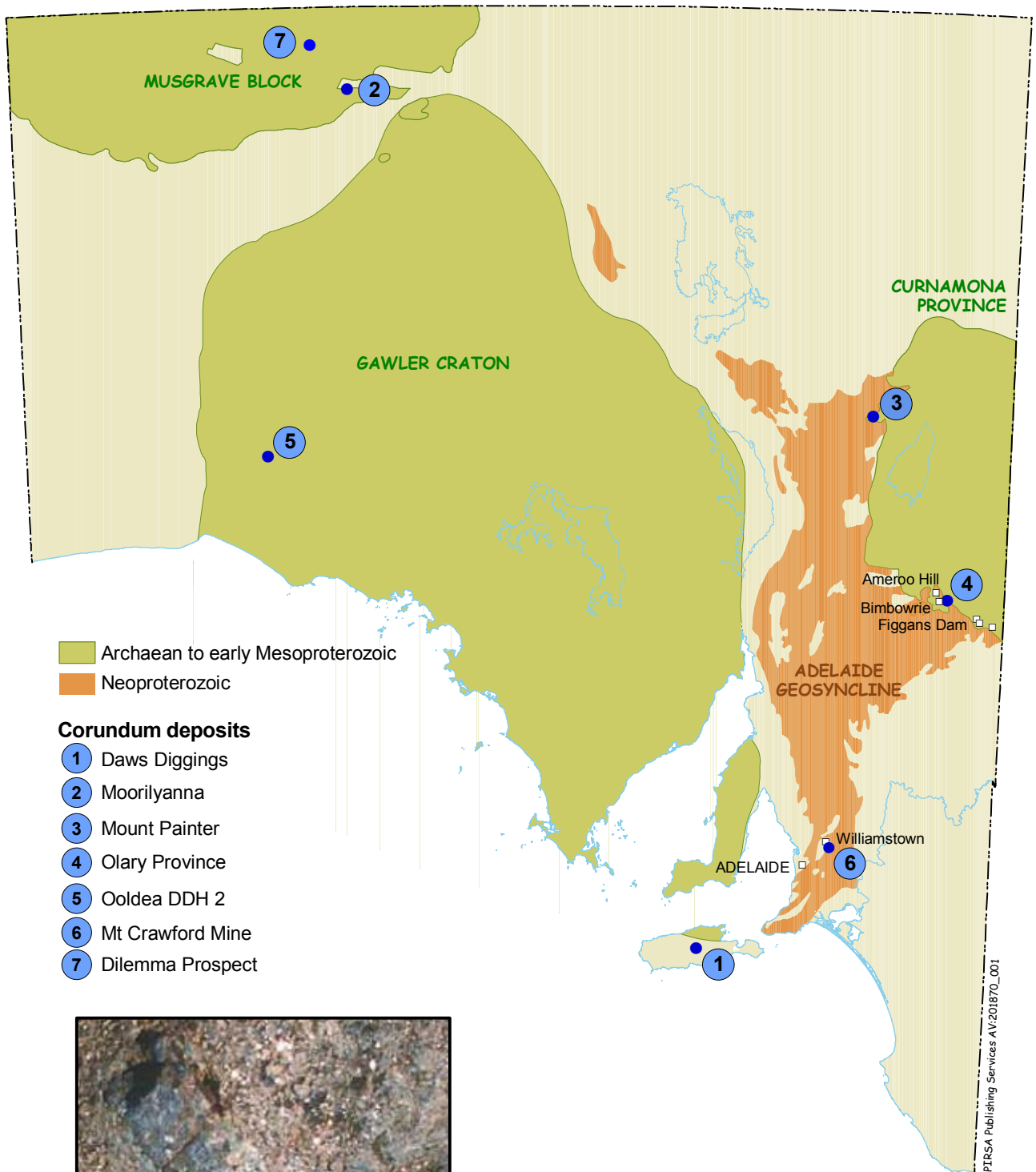
Corundum was discovered by WB Greenwood in 1906 in an unnamed creek, later named Corundum Creek, '4 miles west of Mount Painter and 2 miles east of Mount Pitts' (Brown, 1908; Fig. 1). In 1909 Greenwood revisited the area on behalf of the Mount Painter Corundum and Gem Syndicate of Adelaide, and in the course of prospecting, discovered other corundum-bearing outcrops to the west and SE of Mount Painter. In 1910 a 1 t sample of corundum-bearing material was collected at the original discovery locality via a small adit, subsequently known as the Corundum Mine, for shipment to England for appraisal of its economic potential as a source of abrasives. The area was studied in detail by Ward (1913), who noted that the highest grade corundum deposit occurred at the Corundum Mine with lower grade deposits located on the NE side of Mount Painter and in the valley between Mount Painter and Mount Gee.

The host rocks for the corundum are mica schists forming part of the Corundum Creek Member of Suite 4 of the Radium Creek Metamorphics, metasediments of probable Palaeoproterozoic age (Teale, 1993). The schists trend E–W with southerly dips ranging from 50° to vertical. The corundum was formed in response to high temperature (700°C), low pressure (3–5 kb) regional metamorphism (GS Teale in Giles and Johnson, 1981) of aluminous, silica-deficient, mica schist derived from shale and mudstone. The beds have been intruded by numerous pegmatites of probable Ordovician age which tend to follow the grain of the country rocks (Coats and Blissett, 1971, Blissett, 1973). Dwyer (2000), however, cast doubt on the sedimentary origin corundum bearing schists. She described a corundum schist associated with amphibolite dyke rocks in the East Painter district and, based on detailed geochemistry, suggested a hydrothermally-altered, ultramafic origin for these and other corundum-bearing schists in the district.

The corundum at the Corundum Mine occurs in segregated crystalline lumps, as roughly hexagonal crystals and as small irregularly-shaped pieces disseminated throughout the schist. It is usually blue, mottled white or green, and associated with small crystals of rutile, tourmaline, spinel and cordierite. In places the spinel is abundant and the corundum subordinate. Monazite and apatite have been recorded. Fragments of gem-quality corundum were noted including clear blue sapphire, ruby and oriental emerald.

Brown (1908) stated that the corundum is present over a width of nearly 1 km at creek level and could be traced 50 m up the hill side. In places corundum forms 10–25% of the rock but Ward (1913) concluded that the total amount of schist bearing corundum was not large and doubted whether an appreciable bulk of material averaging 5% corundum could be produced. Difficulty with grade control, lack of water and transport problems contributed to the down-grading of the Corundum Mine's potential as a commercial supply of abrasives (Ward, 1913).

The deposits have been a source of supply for mineral collectors. In 1981 the Corundum Mine was placed on the register of geological monuments by the Geological Society of Australia, SA Division, because of its scientifically interesting mineral assemblage (Giles and Johnson, 1981). Apart from the main Corundum Creek locality, corundum has been identified, and in some cases mapped out, at many locations in the Mount Painter district (GM Teale, Teale and Associates Pty Ltd, pers. comm., 2002; SB Hore, PIRSA, pers. comm., 2002). It also displays a



Archaean to early Mesoproterozoic
 Neoproterozoic

Corundum deposits

- 1 Daws Diggings
- 2 Moorilyanna
- 3 Mount Painter
- 4 Olary Province
- 5 Ooldea DDH 2
- 6 Mt Crawford Mine
- 7 Dilemma Prospect



Corundum var. Sapphire, Mt Painter Region, South Australia

0 100 200 300 Kilometres
 GDA Datum GDA94 - Map projection Equidistant Conic

SOUTH AUSTRALIA
Corundum Localities



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variety of parageneses apart from its formation in meta-pelites as discussed above, from accessory mineralisation in Delamerian pegmatites crosscutting Neoproterozoic sediments, to an association in altered Mesoproterozoic mafics (GM Teale, Teale and Associates Pty Ltd, pers. comm., 2002) as also identified by Dwyer (2000).

Musgrave Block

As indicated above, corundum is commonly formed in an alteration halo around mafic and ultramafic intrusions (Cornelius, 1971). Lawrence et al. (1987) have proposed just such a metasomatic origin in a contact alteration zone surrounding an ultramafic intrusion into anorthosite, for the generation of rubies in the Harts Ranges in central Australia. With significant ultramafic and anorthosite intrusions known in the Giles Complex of the Musgrave Block of northern South Australia, this model has the potential to be applicable in the generation of rubies in this area as well (Tonkin, 1991). Connor (1987) described an unusual aluminous mineral assemblage in a contact aureole around the Dilemma ultramafic body (crudely layered, hornblende–pyroxene peridotite) on Eateringina 1:100 000 map area (AMG Zone 53, 254100mE, 7078500mN) which included up to 10% corundum, but not gem quality.

Aquitaine Petroleum have reported massive blue-grey corundum within ultramafic bodies surrounded by basement gneiss at two localities south of Moorilyanna Dam on Tarcoonyinna Creek, 24 km NW of the Indulkana Creek crossing on the Stuart Highway (Blissett, 1976).

Gawler Craton

Up to 5% corundum occurs as subhedral grains in aluminous granulites of the Moondarah Gneiss in Ooldea DDH2, (Zone 52, 763065mE, 6611372mN) drilled into the Nawa Sub-domain (Daly et al., 1998) of the western Gawler Craton (Teasdale, 1997). The mineral assemblage comprises magnetite–quartz–plagioclase±sillimanite with minor corundum, sapphirine, spinel, sillimanite, garnet, hypersthene and apatite. The paragenesis of quartz + corundum in favour of sillimanite is described as extremely rare and suggests peak metamorphic conditions for the granulites of ~950°C and ~9kb.

Curnamona Province

Corundum occurs in several localities across the Olary region. Localities at the Woman-in-White Mine, 6.5 km SE of the Woman-in-White Mine and 1 km south of Ameroo Hill were recorded by Campana and King (1958). Here the corundum occurs as blue-grey, crude barrel-shaped, non gem-quality prisms coated in pyrophyllite. They occur as porphyroblasts in gneisses and schists.

A further locality on the main road 6.5 km west of 'Bimbowrie', figured in Barnes et al. (1980), contains small crystals described as translucent blue (Office of Minerals and Energy Resources South Australia, 1999).

Rarely corundum prisms occur as an accessory in pegmatites (GM Pitt, South Australian Department of Mines and Energy, pers. comm., 1981).

On the Mingary 1:100 000 map area small chips of clear, blue sapphire have been found in the surface lag at two separate sites during recent mapping by the author. One locality is west of Rocky Dam adjacent to the Tepco fence (Zone 54, 485800mE, 641950mN) and the other is south of Figgans Dam adjacent to the Kyanite Ridge kyanite deposit (Zone 54, 489800mE, 6425300mN). This occurrence is only 2 km

north of Bonython Hill, where Noble et al. (1983) report indigo-blue blebs of corundum in kyanite.

Adelaide Hills

Gem-quality rubies have been reported from wash obtained during gold panning on Section 996, Hundred of Barossa, 2 km south of Williamstown (Duffield, 1909; Noble et al., 1983). A sample submitted to the University of Adelaide led to an investigation by D Mawson who identified significant ruby, sapphire and star sapphire fragments amongst the other gems and rough corundum.

The source of the rubies may be traced to a local source. C Conor (PIRSA, pers. comm., 2002) reports the presence of reddish corundum (ruby) at the Mount Crawford Mine, 4 km SE of Williamstown. The Mount Crawford Mine is a sillimanite, kaolin, mica mine within folded Neoproterozoic sediments and is operated by Unimin Australia Ltd. Hydrothermal fluids, activated during the Ordovician and focused along major fold hinges and shears, have resulted in extensive sillimanite–kyanite–muscovite–kaolin alteration (Conor, 1984). The presence of boehmite and diaspore, together with the minor corundum, also indicate high alumina content. The per-aluminous chemistry is the result of diffusion metasomatism by base-leaching and de-silicification, by aluminous metasomatism, or by a combination of the two.

Kangaroo Island

Daws Diggings (Brown, 1908) is an alluvial goldfield on the Eleanor River about 42 km WSW of Kingscote, Kangaroo Island, in which a variety of gems have been discovered in the washdirt. The gold occurs principally with rutile, zircon and monazite, but also includes ruby, sapphire, amethyst, topaz and cyanite as small crystals and in low abundances. Brown reports that holes sunk into modern alluvium had intersected older Tertiary sediments below and believed these to be the principal media for distribution of the gems. The primary source was considered most likely to be metamorphosed Cambrian sediments, with some corundum-bearing gneisses reported 60 km west of Kingscote (Noble et al, 1983). However, Sprigg et al. (1954) mapped outcropping 'kaolinised, gem-bearing pegmatite' in the Eleanor River suggesting the possibility of an alternative, more local source. Recent mapping on Kangaroo Island has failed to re-locate either the kaolinised, gem-bearing pegmatite outcrop or any corundum-bearing schists and gneisses in the Cambrian, so the source of the gems remains equivocal (AC Burt, PIRSA, pers. comm., 2002).

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