

Mineral Occurrences in the Olary Domain, South Australia

P.M. ASHLEY

The Olary Domain forms part of the Curnamona Province, a large nucleus of Proterozoic rocks located in eastern South Australia and western New South Wales. The Olary Domain is contiguous to the Broken Hill Domain to the east and is dominated by metamorphic rocks of the Palaeoproterozoic Willyama Supergroup, together with significant amounts of Palaeoproterozoic and Mesoproterozoic intrusive rocks. Although large mineral deposits analogous to Broken Hill have not been discovered to date in the Olary Domain, there exists, nevertheless, a diverse range of mineralisation types, as well as metamorphic and metasomatic rocks, from which a wide variety of minerals, both common and unusual, may be obtained.

The Willyama Supergroup sequence in the Olary Domain displays regional correlations with that in the Broken Hill Domain, although there are numerous differences in detail. The lower part of the Olary Domain sequence is dominated by composite gneiss and migmatite. These rocks grade into the Quartzfeldspathic Suite. This contains the "Lower Albite" unit, dominated by ~1715–1700 Ma A-type metagranitoids and felsic metavolcanic rocks (Ashley *et al.*, 1996), the "Middle Schist", dominated by psammopelitic schist and composite gneiss, and the "Upper Albite", dominated by finely laminated albitite, as well as minor amounts of iron formation. The Quartzfeldspathic Suite grades up-sequence into the Calcsilicate Suite, dominated by laminated calcalbitites and minor calcsilicate and Mn-rich rocks. In turn, there is an up-sequence transition into the Bimba Suite, dominated

by calcsilicate rocks and marble, locally with abundant Fe–Cu–Zn sulfides, and minor pelite and albitite. The Bimba Suite is overlain by a regionally sharp contact with the Pelite Suite, composed of pelite and psammopelite, psammite, tourmalinite and manganese iron formation (Page *et al.*, 1998).

Several intrusive suites occur in the Olary Domain and there have been at least five deformation and metamorphic events (Flint and Parker, 1993; Ashley *et al.*, 1997a). A-type granitoids were emplaced at ~1715–1700 Ma and co-magmatic rhyolitic volcanic rocks were erupted. Several small I-type granitoid bodies were emplaced into the central part of the Olary Domain at ~1640–1630 Ma. A major episode of deformation and amphibolite grade metamorphism occurred in the Olarian Orogeny at ~1600 ± 20 Ma, with subsequent emplacement of voluminous S-type granitoids and associated pegmatite bodies. Regional-scale retrograde metamorphism and alteration may have followed episodically between ~1580 Ma and ~1500 Ma, and there were further thermal perturbations during the Musgravian Orogeny at ~1200–1100 Ma. Mafic dyke emplacement at ~820 Ma was a precursor to development of the Adelaide Geosyncline and at least two episodes of low grade metamorphism and deformation occurred between ~500–450 Ma during the Delamerian Orogeny.

Regional-scale hydrothermal alteration has affected much of the sequence, as well as some intrusives, within the Olary Domain. Fluids have been high-temperature (~450°–600°C), commonly oxidizing and saline. They may have been derived by

metamorphism of the host sequence, although there is a possibility of some magmatic fluid. Widespread metasomatism of the Willyama Supergroup, and some of the intrusives, has occurred episodically between ~1630 Ma and ~1500 Ma, with development of Na-Fe assemblages (mainly albite $\pm$ Fe oxides, pyrite), with local strong Fe-metasomatism of iron formations and albitites and Ca-Fe(-Mn)-metasomatism of calcsilicate rocks (commonly in association with spectacular breccias), marble and quartzofeldspathic rocks.

Several styles of mineral deposits are recognised in the Olary Domain, including early syn-sedimentary or diagenetic types, various hydrothermal deposits related to intrusives, to metamorphic and alteration events, and to later weathering and redox-controlled processes (Ashley *et al.*, 1997b). Syngenetic and/or diagenetic deposit styles are represented by Fe-Zn-Pb sulfides in the Bimba Suite, iron formations and barite in the Quartzofeldspathic Suite and Mn-enrichments in the Calcsilicate and Pelite Suites. Manganiferous iron formations in the Pelite Suite are closely analogous to iron formations associated with the Broken Hill ore bodies. In the Bimba Suite, stratiform laminated to massive and disseminated sulfides are common in calcsilicate, marble and pelitic rocks and have given rise, in part, to extensive, base metal-anomalous gossans. Epigenetic mineral deposits are represented by various types of hydrothermal replacements, vein/stockwork systems, and rare metal pegmatites and U-Th-REE deposits related to the ~1600 Ma S-type granitoids. Supergene oxidation and diagenetic processes from the Mesozoic to Recent has led

to Cu-Co-Au enrichment deposits and redox-controlled U and Au deposits, especially to the north of the outcropping Olary Domain.

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