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Office of Minerals and Energy Resources South Australia

EARTH Resources
INFORMATION SHEET

GOLD DEPOSITS AND FOSSICKING AREAS IN SOUTH AUSTRALIA

INTRODUCTION

Gold, silver and platinum are known as noble metals because of their superior resistance to oxidation, corrosion and disintegration. Gold is unrivalled for durability, versatility and its lustrous yellow sheen. The chemical symbol for gold (Au) comes from the Latin word 'aurum', meaning shining dawn.

PROPERTIES OF GOLD

Gold is a soft, yellow metal with a specific gravity of 19.3, hardness of 2.5 to 3.0 and melting point of 1 063°C. It crystallises in the isometric (cubic) system, with cubes and octahedrons being the most common habits. Gold in its pure form is malleable, an excellent conductor of both electricity and heat, and is ductile. It has been estimated that one ounce (31.1 g) of gold can be beaten into a sheet with an area of 9 m^2, or drawn into a fine wire 80 km long.

Native gold is rarely pure, frequently being alloyed with silver and sometimes with small amounts of copper, iron, tellurium, bismuth and mercury. The gold content of a gold alloy is defined by its 'carat' rating; pure gold (100%) is 24 carat. Gold purity is described by the term 'fineness'; pure gold is 1 000 fine. Fineness of vein gold ranges from 500 in electrum — an alloy of gold with high silver content — to 800 or 850. Alluvial gold varies in fineness from 500 to 999.

Gold is readily distinguished from other yellow minerals such as pyrite, chalcopyrite, limonite and mica by its specific gravity and malleability.

USES OF GOLD

Gold, because of its rarity, durability, colour and chemical inertness, has been used throughout history as a medium of exchange, a store of wealth and for jewellery and decorative ornaments.

It is portable, and universally accepted in trade between people and nations. The density of gold allows large quantities to be stored in a small space: 1 tonne (t) of gold occupies only 0.05 m^3. Because gold has a high electrical conductivity and is resistant to disintegration, it is used in electronics applications such as computers, radar equipment, satellites and space technology. Chemical inertness makes gold useful in dentistry and medicine.

Jewellery accounts for about 80% of gold consumption per year. Minor uses include coins, electronics and dentistry (13%), and bullion (7%).

GOLD PRODUCTION

Total world production to the end of 1999 was 139 530 t. Annual world production was 2 330 t in 1999.

Nearly 40% of all gold mined in the western world has been produced in South Africa. One-third of the gold produced is held as reserves in central banks, one-third is held in personal reserves and the remaining third is used in jewellery, industry and other fabricated products.

Australia produced 299 t in 2000, making it the world's third largest producer after South Africa with 440 t and USA with 330 t. For comparison, Australia produced 39 t of gold in 1984 and was ranked seventh in the world. In recent times, Australian gold output peaked in 1997 at 314 t.

Overall the increase in output has resulted mainly from new discoveries in old mining areas and increased throughput from established mines, with some contribution from retreatment of old tailings dumps using modern recovery techniques. However, discoveries of gold deposits in 'greenfields' areas (those without significant previously known mineralisation) have also been an important factor. Many of the latter type of discoveries have been in areas where near-surface mineralisation is obscured by soil and sediment cover; examples of this are the Challenger discovery in northwest South Australia and Portia in the northeast. The use of modern geochemical

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and geophysical techniques in such areas is a feature of exploration in Australia today.

Western Australia is the largest producer with about 69% of Australia's total. South Australia has not been a major producer, with records showing a little over 26 t, representing about 0.5% of the Australian total before production began at the Olympic Dam copper-uranium-gold-silver mine (Fig. 1).

HISTORY OF GOLD MINING IN SOUTH AUSTRALIA

The first recorded production of gold in South Australia was in 1846 from the Victoria Mine near Castambul, 18 km northeast of Adelaide (Fig. 2). The discovery of rich specimens caused great excitement but the mine failed to live up to expectations; less than 1 kg of bullion was produced and interest soon waned.

The history of subsequent discoveries is characterised by a series of short periods of high gold production as large numbers of men rushed to, and quickly exhausted, each new find. These gold rushes had a significant effect upon population movements within the State, although not as marked as mineral discoveries elsewhere, such as the Victorian gold rushes of the early 1850s, which drew large numbers of men from South Australia.

In 1851, the South Australian Government offered a £1 000 reward for the discovery of a payable goldfield. The first claim to this reward was by Messrs Chapman, Hardiman and Hampton following the discovery of alluvial gold near Echunga early in 1852; other discoveries in the vicinity followed. Chapmans Gully (the site of the original find) and Donkey Gully saw the most concerted mining efforts, particularly during the period 1852-58. The discovery nearby of the Jupiter Creek alluvial diggings by Messrs Plane and Saunders in 1868 led to another period of intensive activity. Estimated production from the Echunga Goldfield, the State's most productive, is about 6 000 kg.

The Barossa Goldfield was discovered in late 1868 when a prospecting party led by Job Harris found alluvial gold in Spike Gully, south of Sandy Creek. About 3 100 kg were recovered.

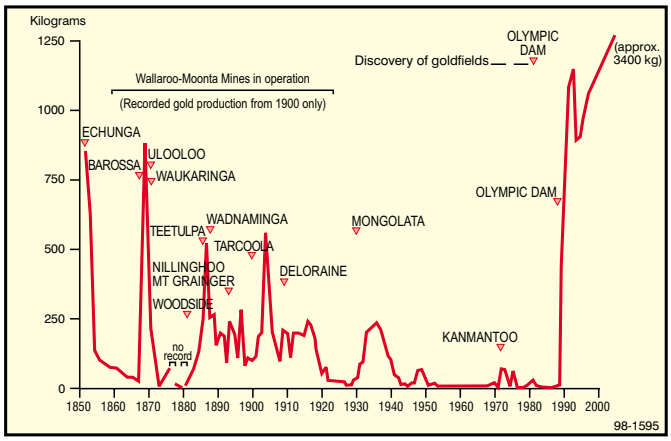

Fig. 1 *South Australian gold production 1852–2000.*

Further discoveries followed at Para Wirra (1869), Birdwood and Ulooloo (1870), Waukaringa (1873) and Woodside (1879). Sporadic prospecting was also centred on the Peake and Denison Inliers following the discovery of alluvial gold at Algebuckina on the Neales River in 1870 (Fig. 3).

The discovery of rich lead-zinc-silver lodes in NSW at Silverton and, subsequently, the massive high-grade Broken Hill orebody, led to completion of the railway from Peterborough to Cockburn in 1887. This aided the efforts of prospectors in the Olary region and contributed to discoveries of gold at Manna Hill (1885), Teetulpa (1886), Kings Bluff (1887), Wadnaminga (1888) and Mount Grainger (1891). The discovery of gold-bearing alluvial deposits at Teetulpa by Messrs Brady and Smith in October 1886 saw 5 000 miners on the field within two months; the field was virtually deserted by 1889 after having produced an estimated 3 100 kg.

Gold was discovered in the Tarcoola area by a shearing-shed hand and prospector named Nichols in October 1893. The attention of other prospectors was drawn to the area and further discoveries were made. The Tarcoola Goldfield was worked from 1900 to 1912 and sporadically thereafter until the present day. Total recorded production is 2 400 kg. The nearby Glenloth Goldfield (1899) produced about 315 kg.

Water sluice at Echunga, erected in 1907 to rework the large Jupiter Creek alluvial goldfield. Alluvial gravel was placed at the top of the sluice and washed over corrugated riffles where gold collected. *(Photo 24062)*

Brady's Claim, discovery site of the Teetulpa Goldfield, in late 1886. *(Photo 32754)*

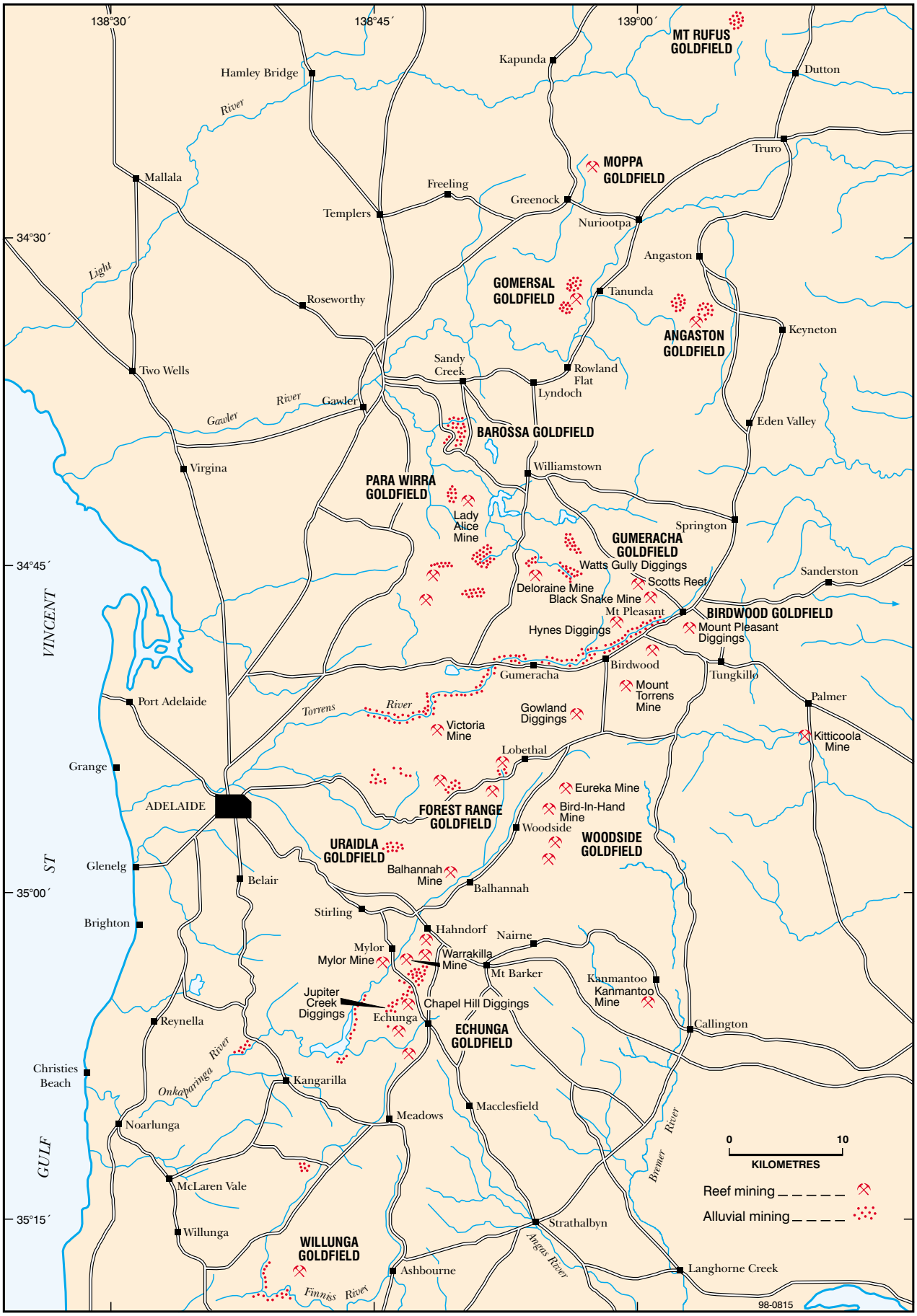

Fig. 2 *Principal gold occurrences near Adelaide.*

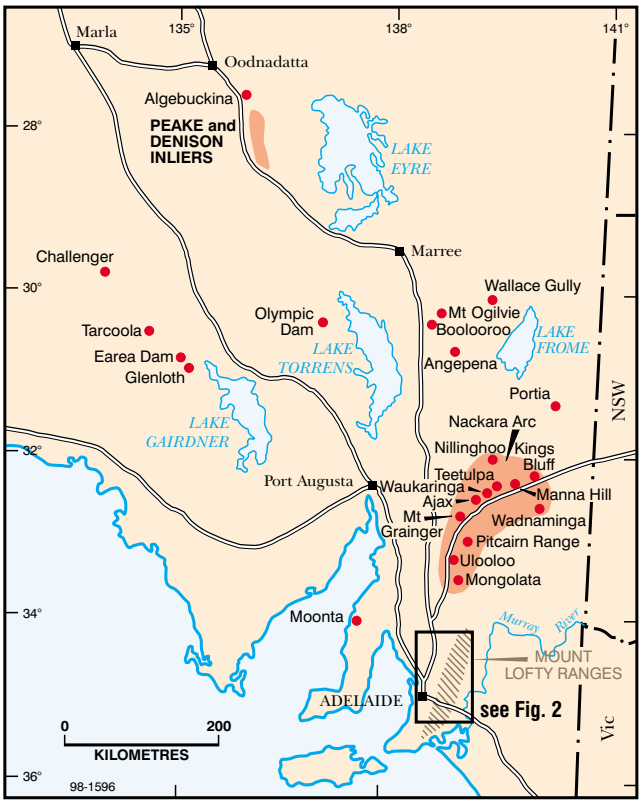

Fig. 3 *Principal gold deposits in South Australia.*

Further discoveries were made at Deloraine, near Kersbrook in the Mount Lofty Ranges, in 1909 and at Mongolata by drover Henry Byles in 1930.

The Moonta-Wallaroo Mines produced an estimated 3 200 kg of gold as a by-product from 9 million tonnes of copper ore between 1860 and 1938. A further 423 kg were recovered by open-cut mining of the Poona and Wheal Hughes copper-gold lodes, part of the Moonta field, between 1988 and 1993.

About 160 kg of gold were recovered as a by-product from the Kanmantoo copper mine between 1969 and 1976.

Significant quantities of gold are produced from the Olympic Dam Mine, 250 km north of Port Augusta. The total resource is 2 320 million tonnes of copper-uranium-gold-silver ore

Low angle aerial view of Olympic Dam Mine and surface plant. *(Photo 47242)*

Gold bullion with mould at Olympic Dam Mine. *(Photo 38688)*

containing an estimated 1 100 t of gold. This is almost equivalent to the total production of the Golden Mile at Kalgoorlie between 1895 and 1975, although the grade is very much lower. Olympic Dam commenced production in November 1988 and had produced 12 t of gold to the end of 2000. Current annual production is 3.4 t.

GEOLOGY OF GOLD IN SA

Past gold production in South Australia has come mainly from quartz veins and alluvial deposits in the Mount Lofty Ranges, Nackara Arc and Tarcoola-Glenloth area (Fig. 3).

In the Mount Lofty Ranges, most gold is hosted by sedimentary rocks of Neoproterozoic (Adelaidean) age or in overlying sediments of Tertiary to Holocene age. Palaeoproterozoic and Cambrian metamorphic rocks and Cambro-Ordovician granite also host some deposits (Fig. 4).

The Nackara Arc, extending from Burra to Olary, also contains gold in Adelaidean rocks and overlying Tertiary to Holocene sediments.

In the Tarcoola-Glenloth area, gold is hosted by metamorphic and granitoid rocks of Archaean, Palaeoproterozoic and Mesoproterozoic age. Hiltaba Suite granite of early Mesoproterozoic age, the suggested source of much of this mineralisation, is equivalent to the granite which hosts the Olympic Dam deposit.

The recent discovery of gold at the Challenger prospect, with an in-ground resource of about 500 000 ounces, and other intersections of gold in Archaean rocks northwest of Tarcoola, indicate potential for this region to be an important gold province.

Primary deposits

Gold in South Australia is obtained from two types of primary deposits — quartz veins (reefs or lodes) and deposits worked mainly for base metals from which gold is obtained as a by-product.

Quartz veins

These generally consist of quartz with carbonate and sulphide minerals, and are commonly localised along faults, shears, joints or bedding planes in the host rock. The vein systems are the result of precipitation of minerals from hydrothermal fluids.

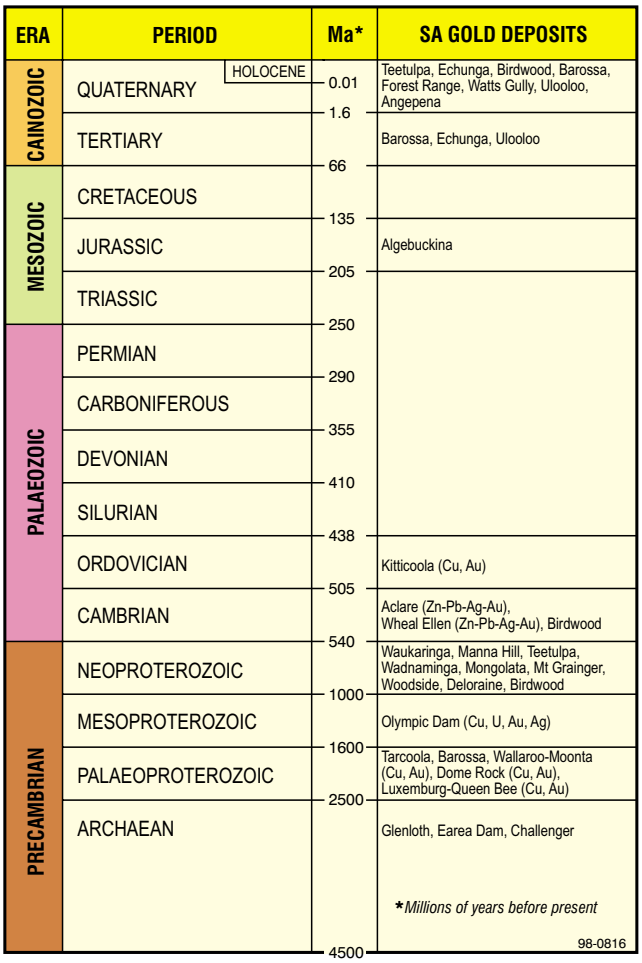

Fig. 4 *Age of South Australian gold deposits.*

In auriferous quartz lodes, gold is most commonly associated with sulphide minerals, particularly pyrite (FeS_2) and pyrrhotite ($Fe_{1-x}S$). Other common sulphides are chalcopyrite ($CuFeS_2$), arsenopyrite (FeAsS), sphalerite (ZnS) and galena (PbS).

Bedded reefs, concordant with the enclosing Adelaidean sedimentary strata, are found at Waukaringa, Ajax and Manna Hill. Structurally controlled reefs are often discordant with the enclosing strata. Quartz reefs in cross-faults or fractures occur at Tarcoola, where north-south striking veins cut across late Palaeoproterozoic slate and quartzite, at Teetulpa where a large number of quartz-ironstone lodes cut across thinly bedded Adelaidean siltstone, and at Wadnaminga Goldfield where auriferous quartz veins cut obliquely across Adelaidean phyllite, dolomite and calcareous siltstone.

Stratabound veins are confined to a particular sandstone or quartzite unit and may consist of both concordant and cross-cutting veins, or veins which intrude the host rock in various directions. Examples are Mount Grainger, Nillinghoo and Kings Bluff, where veins are stratabound within glaciomarine sandstone near the base of the Adelaidean Umberatana Group. At Mongolata, the veins are confined within a sandstone higher in the Umberatana Group.

At Glenloth and Earea Dam Goldfields, auriferous quartz veins are contained within shear zones in Archaean granite and granite gneiss.

At Woodside Goldfield, gold-bearing quartz-sulphide lodes cut across Adelaidean siltstone and sandstone; examples are at New Era, Blackbird, Two-in-the-Bush, Ridge and Bird-in-Hand Mines. Eureka Mine is within calc-silicate rock. Lodes in the western part of the field contain appreciable amounts of chalcopyrite and galena, whereas lodes in the eastern part contain mainly pyrite with the quartz.

Gold in base metal deposits

Gold is often associated with copper mineralisation in South Australia. This is also a common association elsewhere in Australia, particularly in rocks of Proterozoic age.

At Olympic Dam, low-grade gold mineralisation (typically about 0.5 grams/tonne (g/t)) is distributed irregularly through the hydrothermal breccia complex that hosts the copper-uranium mineralisation. Small discrete zones of higher grade (5-8 g/t) gold mineralisation also occur. The Olympic Dam mineralisation, breccia complex and enclosing granite all have a similar early Mesoproterozoic age.

At Wallaroo and Moonta (including Poona and Wheal Hughes), gold is associated with rich copper mineralisation in structurally controlled vein systems within Palaeoproterozoic schist and porphyry. The average grade of gold recovered from the copper ore was about 0.4 g/t and was not of major economic significance at the time, but copper-gold mineralisation in Proterozoic rocks is now a major target of mineral exploration in Australia.

The Kitticoola Mine, in the eastern Mount Lofty Ranges, produced gold and copper from quartz lodes infilling shears and faults within a hydrothermally altered portion of the Cambro-Ordovician Palmer Granite. Gold production was 162.6 kg. Other copper mines with significant gold include Kanmantoo, Dome Rock and Luxemburg-Queen Bee.

At the Deloraine Mine, gold was found associated with pyrite and copper sulphides in quartz veins infilling fissures in Adelaidean quartzite, phyllite and calcareous siltstone.

Gold occurs with lead-silver mineralisation at Eukaby Hill north of the Nackara Arc, Aclare and Wheal Ellen Mines in the eastern Mount Lofty Ranges, and at the Eureka Mine near Woodside.

Secondary (alluvial) deposits

Secondary gold deposits are derived from primary mineralisation (e.g. quartz veins) by physical erosion or solution in groundwater. The gold may be redeposited near the source as eluvial deposits in overlying soil and colluvium, or further from the source as alluvial placer deposits. These deposits are often collectively termed ‘alluvial’ although by no means is all the gold transported by alluvial processes. Gold was once thought to be chemically immobile in the near-surface weathering environment but movement by groundwater is now known to be of considerable importance. Zones of gold depletion and enrichment can form during weathering of primary mineralisation. Gold can be transported in solution by groundwater into overlying sediments. Many near-surface nuggets form by precipitation from groundwater rather than fragmentation from primary veins; bacterial action may play an important role in this process.

In South Australia, the majority of past gold production has come from 'alluvial' deposits. At Echunga, gold was produced from Holocene sediment and soil and Tertiary ferruginous conglomerate. Minor production also came from quartz veins in underlying kaolinised shale, siltstone and sandstone; these veins are probably the source of the gold in the overlying sediments.

Similarly at Teetulpa, most gold was mined from silty gravel of Quaternary age with a much lesser amount produced from the underlying vein mineralisation. At Barossa Goldfield, gold was found in alluvium of present-day creeks and in Tertiary conglomerate and sand. It was particularly concentrated in conglomerate immediately overlying weathered bedrock, and 'deep lead' mining took place where this layer is overlain by a significant depth of sediment. Again gold was also found in much smaller quantities in quartz veins in underlying Palaeoproterozoic schist and gneiss.

Other goldfields with significant alluvial production include Forest Range, Birdwood, Gumeracha (including Watts Gully), Para Wirra, Ulooloo, Uraidla, Angaston, Willunga, Lovely Gully (Waukaringa), Angepena, Boolooroo and Algebuckina.

FOSSICKING AREAS

Fossicking for gold in South Australia has concentrated on alluvial deposits in the Mount Lofty Ranges, and Teetulpa and Ulooloo in the northeast. The fine-grained nature of reef and alluvial gold, and extensive soil and sand cover in some areas, have hampered fossicking activities.

Three areas in the Mount Lofty Ranges near Adelaide have been set aside for fossicking:

Jupiter Creek Diggings — Echunga Goldfield

Up to 1 550 kg of gold were produced from these diggings after discovery in 1868 (Fig. 5). The site is now on an Historic Reserve under the control of PIRSA, and an interpretive walking trail has been established. No permit is required.

Chapel Hill (Old Echunga) Diggings — Echunga Goldfield

The first significant discovery of gold was made nearby in 1852 (Fig. 5). The Chapel Hill area was worked in a series of small rushes between 1853 and 1858. This site is also controlled by PIRSA. Diamonds and small pieces of topaz have been reported in the alluvial gravels. No permit is required.

Mount Crawford Forest Reserve — Gumeracha Goldfield

Gold was discovered at Watts Gully in 1884 (Fig. 6), followed by smaller nearby discoveries in Sailors, Speck, Dead Horse, and Blood and Thunder Gullies. Opal, garnet, beryl, kyanite, tourmaline and other gems have been located in the reserve. Fossicking is permitted but a permit must be obtained from Mount Crawford Forest Headquarters (ph. 8524 6004).

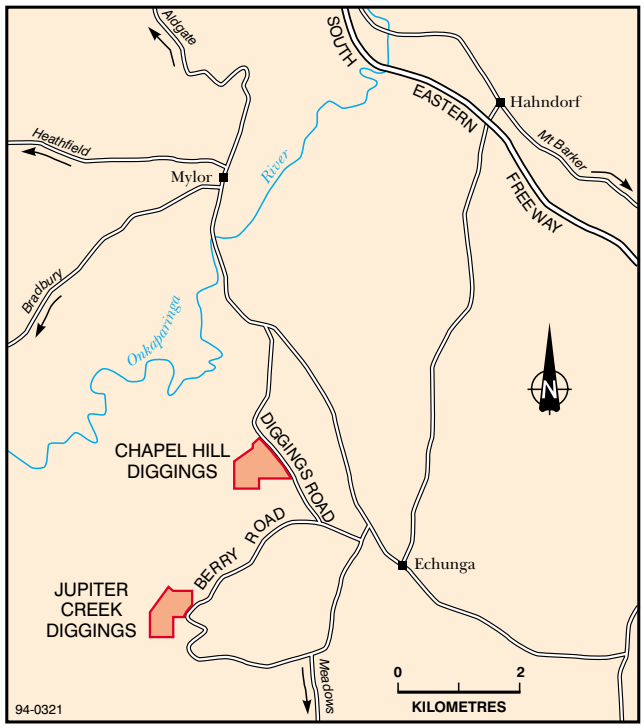

Fig. 5 *Location of Jupiter Creek and Chapel Hill Diggings.*

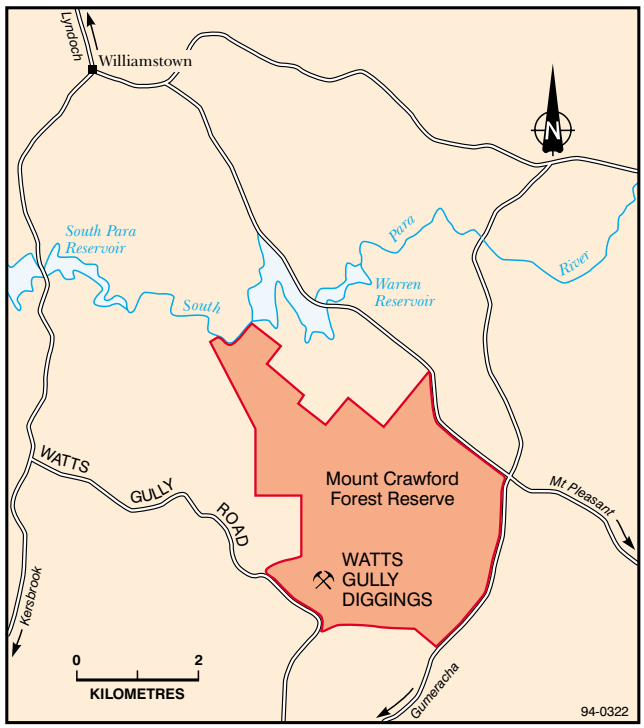

Fig. 6 *Location of Mount Crawford Forest Reserve.*

FURTHER INFORMATION

Brochures *Jupiter Creek Diggings* and *Barossa Goldfields*, and reports *Echunga Goldfield* (RB 83/42), and *Goldfields of South Australia* (RB 92/53), are available from PIRSA.

Copper and gold deposits in South Australia are summarised in RB 95/41. The geology of South Australia is outlined in Bulletin 54 (Volumes 1 and 2).

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