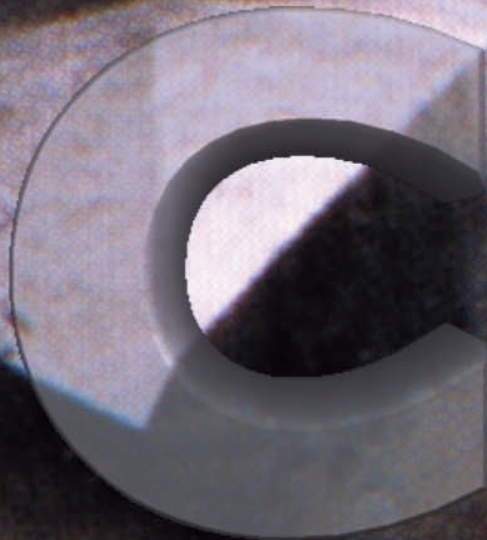
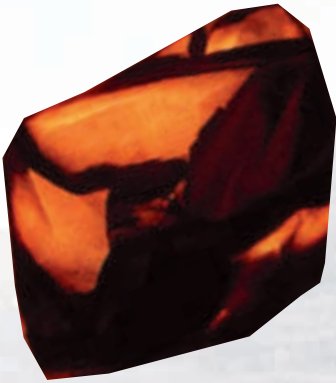


DIAMONDS



FORMATION a



- Diamonds are a hard, compact crystalline form of carbon. Most of Earth's carbon is in the atmosphere (as CO₂, CO, CH₄), in the biosphere (as plants and animals) or in the rocks near the surface (as carbonate minerals or graphite).
- Carbon is usually associated with biological processes on the surface of our Earth, but diamond crystals grow at pressures that are 30,000 times atmospheric pressure. These conditions are found naturally deep within the Earth, in excess of 200km, with temperatures greater than 1,000°C.
- Millions of years after crystallising, diamonds were carried rapidly towards the surface, along paths of weakness in the crust, within gas charged magma (molten rock) which burst out at the surface as an explosive volcano.
- The magma must have travelled very quickly (greater than 70 km/hour) otherwise the diamonds would have either burned or converted to graphite (the low temperature and pressure crystalline form of carbon). The rocks that remain in the Kimberley indicate that the volcanic eruption must have been very explosive.
- When the diamond-bearing magma broke through the surface, some debris fell back clogging the vent or throat of the volcano. Over time, the cone and uppermost section of this volcano has rapidly eroded, exposing the deeper rocks within the throat of the extinct volcano. This remnant is called a 'pipe'.

MINING

- In most economic mines the amount of diamond ranges from one part per million in the highest grade deposits, to one part per 100 million for the lowest.
- Once exploration has revealed a pipe with an economically feasible concentration of diamonds, the site is pegged and a mine established.
- Diamond mining usually commences as an open cut operation. The ore is drilled and blasted. The blasted ore is then loaded by front end loader into on-highway trucks and hauled to the processing plant stockpile.
- From the stockpile the gravel is loaded into the processing plant where the feed is split into fractions of size and cleaned.
- Around the Argyle Diamond mine site, silt traps stop the loosened soil escaping into Lake Argyle. The trapped material is removed and spread over the recontoured areas and revegetated with native plants propagated at the on-site nursery. Environmental officers are continuously monitoring the progress of this ongoing environmental program.
- The life of Argyle's open pit operation presently extends to 2007.

The Argyle Diamond



400 BC

Diamonds were first recognised in India – the magic of their fire and brilliance has captivated the human race ever since.



1725

Diamonds were found in Brazil by alluvial gold prospectors – this dramatically increased the supply of diamonds.



1866

The first diamond found in South Africa weighed 21 carats.



1869

The 83ct 'Star of South Africa' diamond was discovered at Kimberley, South Africa causing the first large 'diamond rush'.



Mid 1880's

In Australia, diamonds were first discovered in alluvial gravels in NSW. Between 1850 and 1870, a number of small deposits were mined at Copeton, near Inverell.

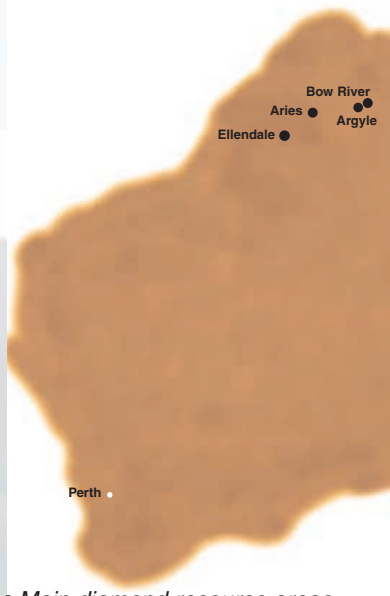


1895

Alluvial diamonds were found near Nullagine in the Pilbara Region of WA.

nd LOCATION

- The magma solidified to form rocks that have an unusual composition due to originating as magma deep in the mantle of the Earth. There are two main types of diamond-bearing rocks – kimberlite and lamproite. They differ in chemical composition and also in the shape of the volcanic pipe they form. In WA, diamonds are found in lamproite – a magnesium-rich rock type with significant amounts of titanium, potassium and zirconium.
- Western Australia's diamond fields are located in the Kimberley region. The AK1 pipe at Argyle was the only commercial production site for two decades before Ellendale Mining Lease came on-line in 2002.
- Downstream from the massive AK1 Pipe, the gravels of the creek system have concentrated diamonds eroded from the pipe. An alluvial strip-mining operation at Bow River was in place until late 1995. Further exploration is in progress to extend this resource.
- Diamond deposits in WA vary in age. The West Kimberley deposits, around Ellendale, formed only 20 million years ago. In contrast the Aries Pipe in the Phillips Range is about 800 million years old, whereas the AK1 Pipe at Argyle is about 1,200 million years old.



● Main diamond resource areas in Western Australia

PROCESSING

- After the ore has been mined, it is crushed, washed then sieved, with the size fraction of 18mm to 3mm continuing to the next stage. Any diamonds larger than 18mm will be broken, but statistical sampling indicates that this size is very rare and mostly are of poor quality.
- The material is now mixed with ferrosilicon and passed through a gravity separating process which separates the diamonds and other heavy minerals from the lighter waste minerals.
- The diamonds are separated from the heavy mineral mixture by an ingenious machine that uses the X-ray fluorescence properties of minerals. The concentrate passes through an X-ray beam, causing the diamonds to fluoresce (glow). A photo electric cell detects this fluorescence and triggers off an air jet, blowing the diamonds into a bin for collection. This method is very fast and 99% effective.
- The Argyle processing plant is one of the most efficient in the world. It was recently expanded to process up to 10 million tonnes of ore per year – a significant increase from the mine's first full year production of 3.3 million tonnes.
- The diamonds are cleaned in an acid solution which dissolves any other minerals which are stuck to the diamonds, then transported to Perth.
- In Perth, the diamonds are sorted according to size, shape, colour and quality, before being offered for sale on the world markets. The three main classes are industrial grade, low quality gems and high quality gems. The large, clear gem stones are categorised according to colour, clarity and size.
- Very small and poor quality stones (very dark coloured or containing numerous inclusions of other minerals) are classed as industrial diamonds. These are used as the abrasive material on cutting wheels and drill bits used for mineral and oil exploration. Other uses include machine bearings, glass cutting implements, and as grinding and polishing powder.
- Gem quality diamonds are cut into a variety of shapes and polished to reveal their true brilliance. Usually 50%, sometimes as much as 80%, of a rough diamond is lost during cutting and polishing.
- Western Australia is the world's foremost producer of the rare pink diamond. There is also a growing market for 'champagne', 'cognac' and other coloured stones produced at the Argyle mine.

nd mine



1953	1972	1976	1979	1985	1996
A Swedish company succeeded in making synthetic diamonds. These were very small, but suitable for industrial purposes.	Modern scientific diamond exploration began in the Kimberley Region of WA.	Discovery of the first diamond-bearing pipe at Big Spring near Fitzroy Crossing.	Diamonds recovered from Smoke Creek, near Lake Argyle. The upstream trail led to the discovery of the Argyle Pipe, a bonanza pipe, with grades up to 10 times that of many South African mines.	The main processing plant at Argyle was commissioned – it produced 29.2 million carats of diamonds in its first full year.	Argyle supplied almost 40% of the total diamond production world-wide.

DIAMOND STATISTICS

Total Quantity of Diamonds Mined in Western Australia

2003 - 35,486,604 carats - (\$663,071,954)

2002 - 34,367,807 carats - (\$652,459,470)

Western Australia supplies 99.6% of Australia's diamonds and 29% of the world's production.

Royalty Receipts

Royalties are payments made by mining companies to the government for the right to develop a resource. Royalties paid by the diamond sector were:

2003 - \$72,794,517

2002 - \$77,106,520

Employment

During 2003, the diamond industry in Western Australia directly employed 1,094 people.

Primary Diamond Producers in WA

ARGYLE DIAMOND MINES PTY LTD
Argyle Diamond Pipe.

KIMBERLEY DIAMOND COMPANY NL
Ellendale Mining Lease.

Current statistics are available from the Statistics Digest on the Department of Industry and Resources website at www.doir.wa.gov.au

DIAMOND PROPERTIES

The word 'diamond' is derived from the Greek adamas, meaning unconquerable.

Diamond is one of two common naturally occurring crystalline forms of the element **carbon**, the other being graphite.

Diamond is the **hardest natural** substance on Earth, while graphite is one of the softest. The difference lies in their crystal structure and relates to where they crystallised – diamond is the high-pressure form whereas graphite is the low-pressure form of carbon.

On **Moh's hardness scale** of 1 to 10, diamond is 10 whereas graphite has a hardness of about 1.

Although extremely hard, a diamond has planes of weakness within the crystal structure that make it **brittle**, hence a diamond may shatter if struck with a hammer.

Diamonds have the highest **thermal conductivity** (ability to dissipate heat) of any known substance, this makes them very useful for cutting and polishing.

The very **high refractive index** and power to disperse light gives diamond the brilliance or 'fire' that is so valued. A well cut diamond returns a greater amount of light to the observer than a gem of lesser refractive power.

A **gem-quality** diamond is any clear diamond, free of inclusions, cracks and other flaws. Its hardness and rarity makes a diamond unsurpassed as a precious gem.

The Argyle production consists of 5% gem and 70% near gem with the remaining 25% of volume being industrial diamonds. Their hardness makes them very useful as abrasives for cutting and polishing.

Colouration in diamonds is usually due to impurities within the crystal lattice. Today colours such as pale blue, yellow and even brown, are promoted as gem specialities.

Pink diamonds are the rarest of coloured diamonds. The 'Argyle Pinks' are even more special because of their depth of colour, ranging from delicate pastel rose to full-bodied purple.

Diamonds are measured in the old units known as **carats** – one carat = 0.2 grams. Note, a carat to measure diamonds is very different to the 'carat' used to describe gold purity.



MORE INFORMATION

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● Minerals Council of Australia
and Bureau of Resource Sciences

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