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Argyle Diamond Deposit, Western Australia

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Argyle burst onto the world scene in the early 1980s and has since changed many aspects of diamond exploration and marketing. It is the largest diamond mine in the world, the largest producer of natural industrial diamonds and a significant producer of gem quality diamonds. The mine is in the East Kimberley region, about 2,400 km north-east of Perth, and is virtually one huge pipe with associated alluvial deposits. The Ashton Joint Venture identified diamonds at Smoke Creek in August 1979. Following the stream to its source, 20 kilometres away, geologists discovered the Argyle Pipe in October 1979. Named after nearby Lake Argyle the pipe was referred to as AK1. This pipe subsequently provided extremely rich diamond grades of 7 carats per tonne, 10 times higher than any known deposit. Argyle has proved unique in a number of areas: geological, mineralogical, and commercial.

The geology of the Argyle Pipe did not fit the existing model for diamond exploration and the normal suite of kimberlitic indicator minerals was absent. The main indicator proved to be diamond itself, with some chromite. Previously, kimberlite intrusions in old continental cratons, stable for billions of years, had been considered the primary source of terrestrial diamond. At Argyle, diamonds were found for the first time in an adjoining mobile zone. A further deviation from the accepted model was the olivine-rich lamproite in which the diamonds occurred. This was a new diamond-bearing rock and widened the range of potential diamond hosts. The Argyle Pipe is an olivine lamproite diatreme of Precambrian age with a surface area of 50 hectares. It is an elongated body, 2 km long, that varies in width from 500 m to 150 m. The pipe has been faulted and tilted before erosion. At depth, the diatreme is variable in shape. Like most diamonds, lamproitic diamonds are mantle xenocrysts transported and resorbed by their volcanic host. They come from depths of over 180 km in highly-explosive, rapidly-injected magmas. Diamond emplacement in the larger Kimberley region was sporadic, from Precambrian into Tertiary time (2000 to 20 Ma), but the Proterozoic Argyle pipe (1180 Ma) carried the only economic concentration of diamonds.

The Argyle Joint Venture estimated that the mine would supply more than 25% of the world's diamonds over 20 years. A two-stage mining program was formulated. Stage 1 began in 1983, with the short-term mining of alluvial deposits at Smoke and Limestone Creeks and scree overlying the AK1 pipe. From 1983–1985, 16.8 million carats of diamonds were produced. Stage 2 began in 1986 with the long-term mining of the main orebody. Production jumped to 29.2 million carats. Production reached over 30 million carats annually, about one third of the world's rough diamonds. In 1993, due to expansion and upgrading, a record 40.9 million carats was produced. Figures are still high, with 40.2 million carats produced in 1998.

In spite of its huge production figures, only about 5% of Argyle's total output is gem quality. The vast remainder is about 50% industrial grade and 45% cheap, near-gem quality. The quality of the alluvial diamonds is reputedly higher, with 10% being gem quality. This low gem ratio reduces the output to only 5 per cent, by value, of the world's gem quality diamonds, yet this small percentage generates 50% of the mine's revenue.

The majority of Argyle diamonds (95%) are eclogitic in type. They are dodecahedral or mixed crystal forms and are 1.2 to 1.6 billion years old, formed shortly before eruption. However, peridotitic, octahedral crystals also occur and these have a formation age of 3 billion years. Argyle diamonds provide many contrasts with African and Russian stones. They are typically small, averaging 0.10 carats. To date, the largest stones found have been between 40 and 50 carats. They are characteristically irregular in shape, with heavily etched surfaces attributed to their transport in corrosive potassic melts. Unusual hexagonal etch pits and trigons with truncated corners contrast with the sharply triangular etch features on many African crystals. The colour distribution of gem quality diamonds from the Argyle Mine is unique. They are dominantly brown, with less than 20 % being colourless or yellow shades. Less than 0.001% of total production is pink to red. Occasionally, blue and green stones are found. The pink and brown colours are due to plastic deformation of the crystal lattice. Argyle blue stones are unusual in being coloured by hydrogen, rather than a boron impurity. Argyle provides the world's only reliable supply of rare pink diamonds. A grading system was devised for these stones, which could include a range of colours from purplish pink to mixed shades, like *pink champagne*. Since 1984, Argyle Diamond Sales has held an annual Pink Diamond Tender in Geneva to sell its outstanding pink to red stones. Such stones have sold for $1,000,000 per carat.

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