

Goodbye from the Argyle diamond deposit

M.J. Rayner¹, A.L. Jaques², G.L. Boxer³, C.B. Smith⁴ and V. Lorenz⁵

1. MAusIMM, Argyle Diamonds, Rio Tinto, Perth WA; 2. Research School of Earth Sciences, Australian National University, Canberra ACT; 3. Consultant geologist, Maylands WA; 4. Department of Earth Sciences, University of Bristol, Wills Memorial Building, Queen's Road, Bristol BS8 1RJ, United Kingdom; 5. Physical Volcanological Laboratory, Department of Geography and Geology, University of Würzburg, Pleicherwall 1, D-97070 Würzburg, Germany.

Correspondence: murray.rayner@riotinto.com

The Argyle (AK1) pipe in the Kimberley region of Western Australia is the world's largest source of natural diamonds. The ore body was discovered in 1979 and mining of associated alluvial diamonds commenced in 1983 and the AK1 pipe in late 1985. Over the life of the mine to its closure in November 2020 Argyle produced more than 900 million carats of diamonds. Argyle diamonds are distinctive in having a predominance of brown colours and rare highly-prized pink diamonds, which are a signature of the deposit.

The ~1.2 Ga Argyle pipe lies southeast of the town of Kununurra within the Paleoproterozoic Halls Creek orogen at the southeastern margin of the Kimberley craton. The 3D geological model developed from mining and deep drilling shows that Argyle is a composite pipe formed by the coalescence of several steep-sided diatremes, each with their own feeder zones at depth, that were erupted along a NNE-trending fault. Post-emplacement deformation has tilted the ore body 30° to the north and regional strike-slip faulting has offset, segmented and elongated the ore body.

Recent significant modifications of the geological model have resulted following the commencement of underground block cave operations, producing several critical lessons learnt. Diamond grade and quality reconciliation issues warranted a geological investigation which resulted in numerous new volcanoclastic olivine lamproite domains being discovered with a broad range of low to very high-grade units being recognised. The new lamproite domains had a significant effect on the block cave mining and resultant recovery of diamonds. The result of the study was a more coherent and detailed geological understanding of the volcanic emplacement and paragenetic sequence of the Argyle AK1 pipe. Structural

modelling of the deposit also played a major role in the block cave mining tonnage recoveries and daily operations.