# THE GEOLOGY AND VOLCANOLOGY OF THE ARGYLE (AK1) LAMPROITE DIATREME

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The diamondiferous Argyle (AK1) olivine lamproite diatreme is located in the East Kimberley region of Western Australia, at latitude 16° 14' S and longitude 128° 23' E. The diatreme is located near the eastern margin of the north north east trending Halls Creek Mobile Zone. This Mobile Zone contains Archaean (?) and Lower Proterozoic sediments and volcanics metamorphosed and strongly deformed at ca 1920 Ma, intruded by mafic plutons and late stage granites at ca 1800 Ma (Bofinger, 1967; Hancock and Rutland, 1984). Later movements on structures wihin this Mobile Zone produced deposition of sediments in fault controlled basins during the Middle and Upper Proterozoic and Phanerozoic. In addition sinistral wrench faulting continued from the Proterozoic to at least past Upper Devonian. the country trocks immediately surrounding the AK1 diatreme are predominantly quartzites and silstones of Lower to Middle Proterozoic age belonging to the Revolver Creek Formation and Carr Boyd Group. Dating by whole rock Rb-Sr and mica Rb-Sr and K-Ar methods (Pidgeon et al this volume) give Argyle an intrusion age of 1200 $\pm$50 Ma, which is contemporaneous with the Middle Proterozoic dates obtained by Bofinger (1967) for the adjacent Carr Boyd Group country rock sediments.

The diatreme has an elongate shape in plan (Fig. 1), with a length of 2 km and a width varying from 150 to 500 m. The surface area is ca. 50 ha. The body was emplaced along a pre-existing fault, but the present shape results from post-intrusion faulting plus regional tilting of 30° to the north. As a result of the tilting the northern end of the diatreme represents a shallower erosion level than the southern. The form of the diatreme is variable in cross section (Fig. 1), bowl-shaped in the north but essentially steep dipping in the south.

The main rock type in the diatreme is a quartzose tuff, with a lesser amount of younger quartz-free tuff and minor late-stage intrusive dykes of olivine lamproite. Accidental inclusions of quartz grains comprise a significant proportion of the quartzose tuffs. The main tuff type is a lapilli ash tuff with lesser amounts of coarse ash and fine ash tuffs. The olivine lamproite dykes intrude all areas of the diatreme and lamproite flows may possibly be present. Epiclastic rocks (now quartzites) occur interbedded and locally intermixed with the pyroclastic rocks. The predominant juvenile clast type is altered, glassy and microcrystalline, lacks vesicles, has a blocky and equant shape and contains quartz xenocrysts. These clasts have probably formed by rapid chilling caused by magma contact with water. The presence of accretionary and armoured lapilli indicate wet eruption conditions. Bedding is either absent, or poorly developed in the tuffs, although plane parallel bedding and low-angle cross-bedding suggestive of base surge eruptions are present in the central and northern areas of the diatreme. The massive units, lacking bedding, result from enlargement of the crater by collapse and consequent mass flows (lahars) of unconsolidated material down the sides of the crater onto the crater floor. Such debris flow units constitute the dominant rock type.

Syn-sedimentary deformation and water escape structures indicate that abundant water was enclosed in the deposits and subsequently driven out by subsidence and compaction under the load of superincumbent tuffs. The accidental quartz grains in the quartzose tuffs have been derived from the surrounding country rocks, likely to have been poorly cemented at the time of the volcanicity. Groundwater would have been present in the pore spaces of these sands an sandstones, and in fractures in the fault zone into which the diatreme was emplaced. All the above eivdence favours a phreatomagmatic eruption process, caused by interaction of rising lamproite magma with groundwater. Removal and eruption of country rock bu this process from levels below the vent led to subsidence downward slumping of the crater deposits and creation of a deepening diatreme as the phreatomagmatic eruptions progressed. The downturning and downfaulting of the country rock adjacent to the diatreme contacts (Fig. 2) and the presence of bedded tuff, often with steep dips, at deep levels of the diatreme, support this subsidence hypothesis.

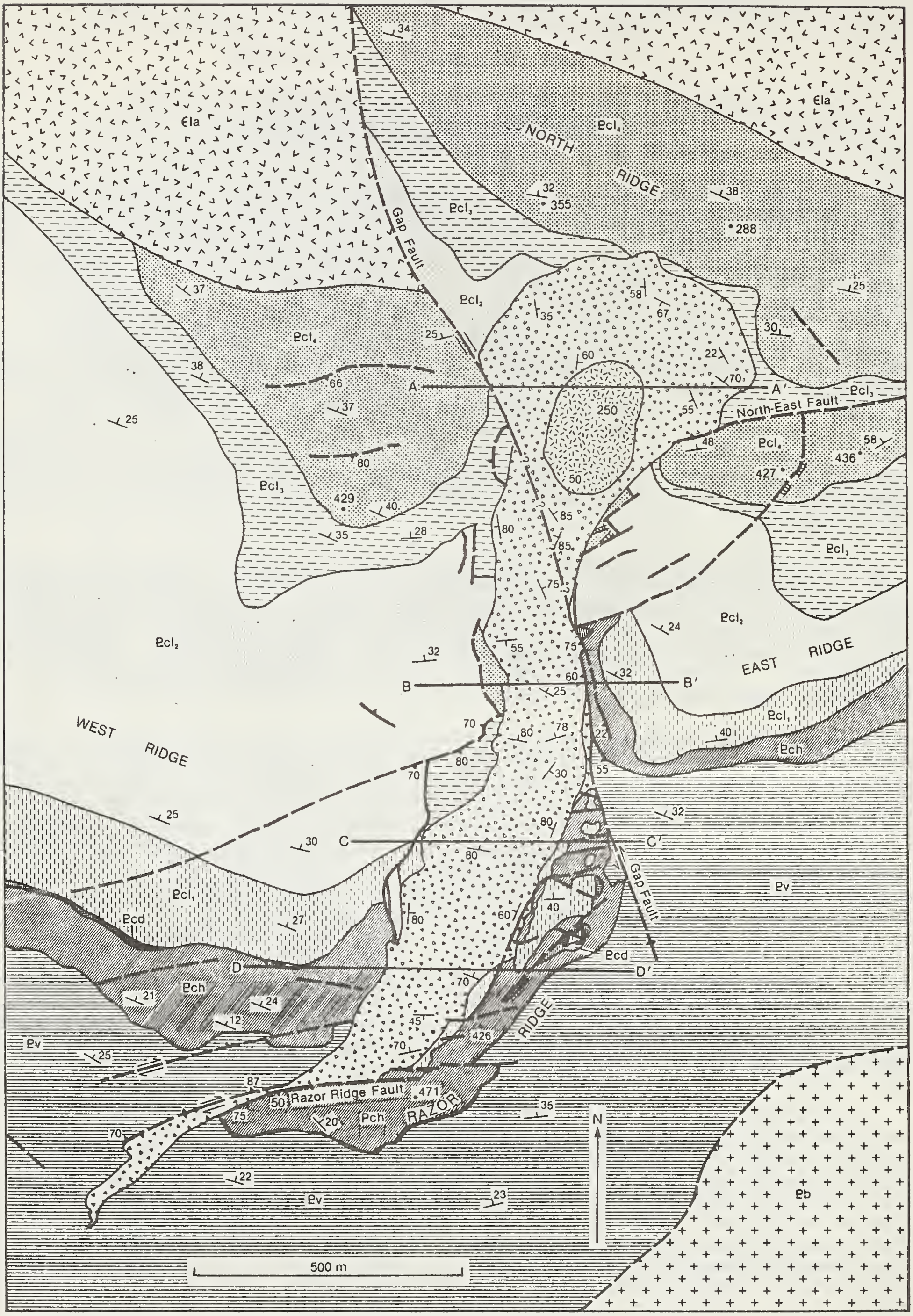


Fig. 1 Geological map of the Argyle Pipe.
For legend see Fig. 2

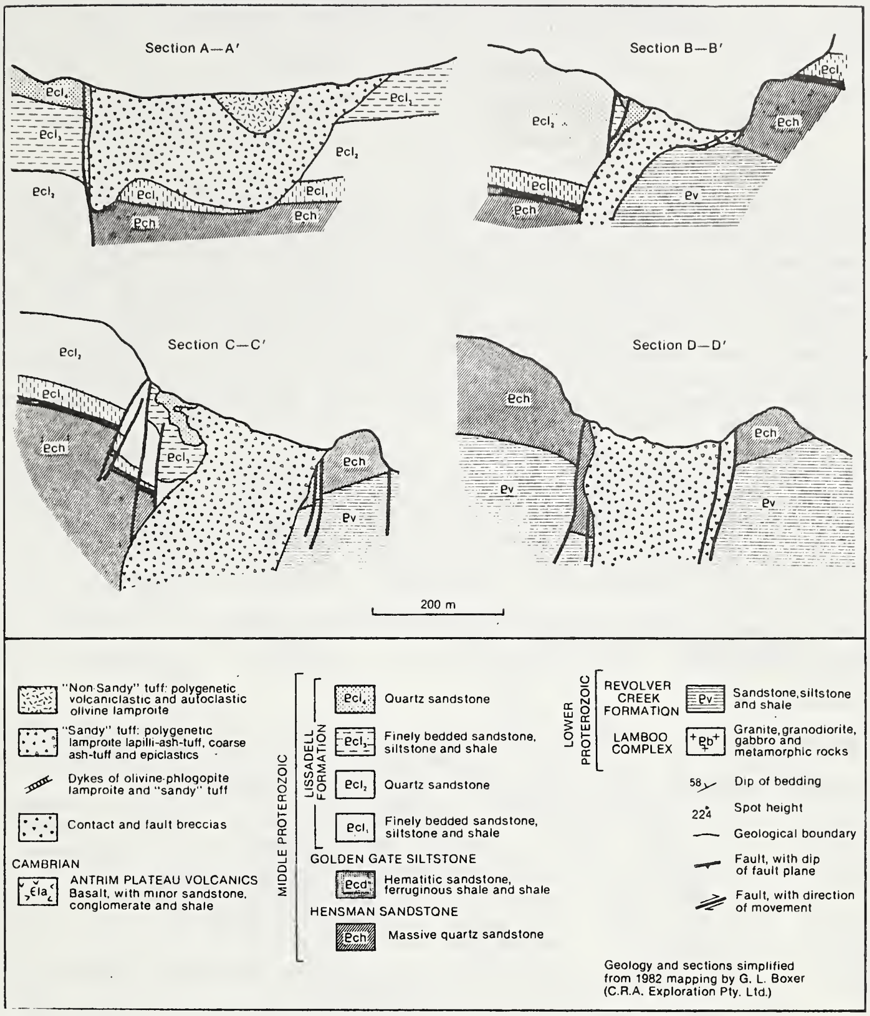


Fig. 2 Cross sections through the Argyle Pipe

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