THE GEOLOGY OF THE M1 KIMBERLITE, SOUTHERN BOTSWANA.

*Daniels, *L.R.M.; Jennings, **C.M.H.; Lee, J.E.; Blaine, J.L.; Billington F.R.; and Cumming B.C.*

Falconbridge Explorations (Botswana) (Pty) Limited, P.O. Box 1463, Gaberone, Botswana.

**Present address: Dept. of Geochemistry, University of Cape Town, Rondebosch 7700, South Africa.*

***Present address: Repadre Capital Corportation, Suite 1900, 120 Adelaide Street West, Toronto MSH 1T1, Canada.*

The M1 kimberlite, 40 km southwest of Tshabong in southern Botswana, is the largest in a field of 37 kimberlites. With a surface area of 180 hectares it may be the largest kimberlite discovered to date. It has a U-Pb zircon age of 77.5 My which was determined from several fragments of a single zircon.

The kimberlite is covered by approximately 80 m of Kalahari sediments and was initially detected from an aeromagnetic survey with 500 m line spacing. The aeromagnetic anomaly produced by the kimberlite is a broad feature approximately 2000 x 1000 m in plan with an amplitude of 70 nTesla. A gravity survey over the aeromagnetic target produced a gravity low anomaly which flattened across the centre, suggesting the presence of crater-fill epiclastics.

Seven different lithologies were identified in the M1 kimberlite:

g) Ablation Facies
f) Epiclastic Mudstone Facies
e) Gravel-Grit-Mudstone Facies
d) Mudstone-Phlogopite Siltstone Facies
c) Breccia-Mudstone Facies
b) Tuffaceous Facies
a) Intrusive Facies

A model for the geological history of the kimberlite has been reconstructed from an interpretation of the different facies, their igneous or sedimentary features and their distribution within the pipe. The model is summarised as follows:

1) No root zone material was intersected. The features of this zone are therefore unknown.

2) The crater was formed by explosive breakthrough from a depth in excess of 500 m. Repeated intrusive/eruptive cycles continued for an unspecified period of time giving rise to a thick pile of tuffisitic kimberlite breccias and the building of an extensive tuff cone on the perimeter of the crater.

3) A late stage kimberlite sill, characterised by abundant olivine, calcite and ilmenite with minor perovskite was emplaced within the tuff beds in the southeast of the crater after the cessation of the main igneous activities.

4) The crater gradually filled with water. Destabilisation of the tuff cone together with slope failure occurred resulting in gravity slumps of tuff cone material into the water-filled basin which gave rise to debris flows and turbidite-like deposits.

5) The tuff cone was eventually eroded into stabilised tuff hills surrounding the crater. In a generally moist climate, as indicated by the fern and podocarp pollen spores in the mudstone-phlogopite siltstone facies, small streams removed the fine and the light fractions form the tuff hill, leaving behind the coarser and heavier fration of material. The fine sediment was deposited in the lake as varved mudstone-phlogopite siltstone couplets.

6) A shallowing of the basin and a change in the climate to a more arid period, probably characterised by thunderstorms and flash floods, occurred. The resultant high energy streams deposited the coarser and heavier material from the remaining tuff hills in alluvial fan-type deposits characterised by poorly-sorted immature gravels and grits showing moderately developed stratification. The crater sediments in the upper 40 m exhibit a facies change from an alluvial fan association to a proximal association and finally to a distal association from the southeast to the northwest of the crater.

7) A continued change in climate to a dry environment occurred. Fine mudstones were deposited in a few shallow, localised pans.

8) With the onset of a very dry climate the wind winnowed out light material from the surface while heavy material was deposited as an eluvial concentration on the ablation surface.

9) The Kalahari Formation covers the kimberlite crater and associated sediments.

10) Bioturbation transports kimberlite indicator minerals to the surface.