Morphology of the Juína Maars

Teixeira, N. A.[1], Gaspar, J.C.[2], Oliveira, A. L. A. M.[3], Bitencourt, R.M.[1] and Yeda, B.[4]

1. Rio Tinto Desenvolvimentos Minerais Ltda. SCS Ed. Morro Vermelho, 10 andar – Brasília – DF, Brazil.
2. Instituto de Geociências, Universidade de Brasília, 70910-900 Brasília, DF, Brazil.
3. R. Marechal Rondon, 246 – B. Ipazé – 78110-070 – Várzea Grande - MT, Brazil.
4. Petrobras / Cenpes / Siger. Cid. Universitaria, Q. 7, Ilha do Fundão. Rio de Janeiro, RJ, Brazil.

The Cretaceous Juína kimberlite province is located at the northern border of the Parecis Palaeozoic basin, which is underlain by the Mesoproterozoic sialic Rio Negro-Juruena mobile belt (Teixeira et al., this volume). The province was discovered by the BRGM/De Beers joint venture through stream gravel regional survey. The Parecis basin (1,250km long x 400km wide), host of the majority of Juína kimberlites, has 6000 m of siliciclastic sediments and underwent intense tectonic activity and basaltic volcanism in the Jurassic.

The explosive volcanic structures intrusive in the granite-gneiss Mesoproterozoic terrain or in the Palaeozoic sedimentary cover do not show remarkable surface features. The present study resulted from drill cores description. The cores exhibit primary volcanic textures in kimberlite tephra and sedimentary structures in resedimented volcaniclastic rocks. The rock nomenclature used follows Mitchel (1995) and the volcanism dynamic is on the analogy of Leckie et al. (1997).

The kimberlite structures occur as large (up to 55 ha), rough circular, and shallow (20 to 80 m-thick) craters. They are filled with subaereal pyroclastic and hydroclastic tephra, resedimented volcaniclastic deposits and volcanogenic sedimentary layers. The system was feeded by narrow (100 to 150 m) vents filled with volcaniclastic kimberlite breccia. Craters have champagne glass shape similar to the lamproitic bodies of the Ellendale Province, in Australia. Their walls form an angle of approximately 30° with the host rocks. The explosive kimberlite structures may be considered as maars as proposed by Lorenz (1985). It is unclear if the initial explosive stage of volcanism was driven by exsolved magmatic volatile and/or interaction with ground water. There is potential for phreatomagmatic volcanism, given the high water table in Casa Branca Formation (siliciclastic sediments with shalle intercalation). The Juína kimberlite structures are clearly different from the typical South African kimberlite bodies, which are characterised by the presence of diatremes.

Depending on the country rock, the structures can be different. The maars formed in sedimentary rocks (type 1) are composed of three facies. They are described bellow from top to bottom.

Facies 1: (thickness: from few meters to 60 m). Metachronous siliciclastic volcanogenic sedimentary deposits and rare posteruptive resedimented volcaniclastic levels. The former is destitute of juvenile components and the latter contains indicator minerals.

Facies 2: (thickness: 10 to 70 m). This facies was formed by subaerial volcanism that resulted in a complex intercalation of lappillistone kimberlite, olivine crystal-tuff kimberlite, siltstone, and sandstone volcaniclastic rocks. The resedimented material has a high proportion of juvenile clasts and is fine grained, locally microconglomeratic (matrix-supported clast). It also presents a rhythmic graded bedding and cross-bedding indicating a high-energy setting. The eruptive phase consists of reverse-graded cross-bedding and planar-bedded kimberlites lapillistone and olivine crystal tuff.

Clasts consist of kimberlite lapilli, olivine, mantle xenoliths, xenocrysts, megacryst suite (ilmenite, Cr-Ti pyrope, Cr-diopside), and crustal xenoliths. The lapilli consists of variable proportions of olivine and phlogopite plus finer-grained serpentine, calcite, and spinel. The lapilli groundmass is cryptocristalline to fine-grained and of difficult microscopic identification. The lapilli intraclast matrix is composed of kimberlite ash changed to serpentine and carbonate. The clasts are matrix supported and frequently show *pelletal* texture. The olivine crystal tuff is partly welded. Under the microscope, olivine euhedral crystals mantled by cryptocristalline to fine-grained brown material are observed. This tuff seems to result of explosive volcanic eruptions of crystal-rich kimberlite magma. Facies 2 is a consequence of a possible multiple primary eruptive phase air fall deposits and *surge fall* inside the crater itself. The preserved lapilli, globules and autoliths are consistent with relatively short transport distances. The predominance of lapilli fragments suggests the occurrence of lapilli tephra cones around the craters. The deposition mechanism of the resedimented volcaniclastic levels is probably related to gravitational flux from the crater borders due to sporadic strong rainfall in a desertic environment.

Facies 3: this is the intrusive portion of the volcanic structure and is mostly represented by heterolitic volcaniclastic kimberlite breccia and pelletal lapilli volcaniclastic kimberlite of green colour. These rocks show textural features identical to the diatreme facies of the classic kimberlites. There is a typical textural bi-modality with euhedral magmatic and rounded mantelic olivines. The pelletal structure is characterized by the occurrrence of olivine pseudomorphs in the pellets centres. The matrix is invariably fine-grained, with micro to cryptocrystalline optically irresolvable mixture of serpentine, chlorite, and clay minerals. These rocks have a great amount of xenoliths (shales, gabbros, gneiss, granites, and mantelic components).

Maars excavated in granite and gneiss (type 2) are smaller than type 1 craters. and the facies 2 is not developed (subaerial volcaniclastic kimberlite rocks interbeded with resedimented volcaniclastic material).

Facies 1: (thickness around 30 m). It corresponds to the top of the explosive structures and is composed of metachronous siliciclastic volcanogenic sedimentary deposits. Juvenile components are not present.

Facies 2: (about 80 m thick). This is characterised by a rhythmic succession of metachronous volcanogenic sedimentary levels (siltite and organic-rich argilite with interbeded metric levels of resedimented volcaniclastic material). The fine grained sediments with carbonaceous debris indicate deposition in a low energy lake setting. These sediments probably resulted from the volcanic edifice destruction by gravitational flux and direct crater deposition. Some levels are rich in amorphous carbonaceous material and present Equisetosporites ssp., Steevesipollenites spp., Classopollis classoides, Hexaporotricolpites emilianovi, Trricolpites vulgaris, Tricolpites spp. pollens and smooth and rarely ornamented Triletes-type spores. The lacustrine sediments are found directly over heterolitic volcaniclastic kimberlite breccia and pelletal lapilli volcaniclastic kimberlite.

Facies 3: similar in both maars types, it is characterized by heterolitic volcaniclastic kimberlite breccia and pelletal lapilli volcaniclastic kimberlite. Some vent portions are very rich in country rock xenoliths (gabbros, gneiss, and granites) and should be classified as crystallinoclastic kimberlite breccia. Fluidisation texture and mantle xenoliths are also found.

The occurrence of the above described volcanic explosive structures, which are similar to the Slave kimberlites, indicates that body morphology and emplacement processes should not be used to discriminate between kimberlite and lamproite. The geometry of volcanic systems does not seem to be linked to a specific kind of magma but to the local hydrodynamic conditions and/or volatile contents. It is possible that the Juína kimberlite structures were developed from a main subaerial Strombolian explosion to which the intrusive kimberlite breccia is related. The main explosive process seems to have been followed by a series lower intensity explosions producing poor to moderately sorted multiple beds of clast-supported kimberlite lapillistone. Levels of olivine crystal tuffs probably resulted from a strong explosive events, probably base surge. In general, the Juína pyroclastic rocks have a high fragmentation level, which suggests high magma discharge rates and melt fragmentation. In some structures the vents were not identified. These structures should be the result of base surge-type accumulation in depression outside the craters, similar to Fort à la Corne Saskatchewan (Leckle et al., 1997).

Acknowledgements

We thank RTDM for allowing this publication.

REFERENCES

Leckie, A.L.; Kjarsgaard, B.A.; Bloch, J.; McIntyre, D.; McNeil, D.; Stasiuk, L.; Heaman, L., 1997, Emplacement and Reworking of Cretaceous, Diamond-Bearing, Crater Facies Kimberlite of Central Saskatchewan, Canada: Geological Society of America Bulletin, v. 109, n. 8, p. 1000-1020.

Lorenz, V., 1985, Maars and Diatremes of Phreatomagmatic Origin: A Review: Trans. Geol. Soc. S. Afr., v. 88(2), p. 459-470.

Mitchell, R.H. , 1995, Kimberlites, Orangeites and Related Rocks: Plenum Press, New York, 410p.

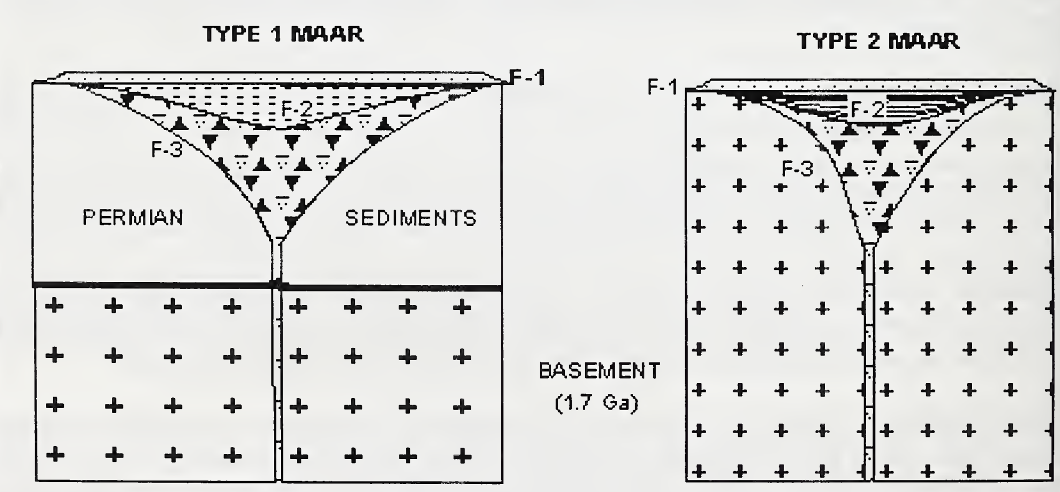

FIGURE 1