The Internal Geology and Emplacement History of the Renard 2 Kimberlite, Superior Province, Canada

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The diamondiferous Renard 2 kimberlite is one of the largest of ten pipes in the Renard cluster, and the subject of advanced economic assessment. The kimberlites were emplaced into granitoids of the eastern Superior Craton at approximately 630Ma. An undetermined amount of erosion has since occurred, with the present surface expression of the pipe estimated as 0.75 ha. This kimberlite is a steep-sided pipe with minor irregularities in the external shape. The dominant infill of the main conduit is massive volcaniclastic kimberlite (MVK), characterized by a high proportion of granitoid country rock clasts and classified as a tuffisitic kimberlite breccia (TKB). Lesser amounts of magmatic (coherent) kimberlite, characterised by fewer but more altered and digested country rock xenoliths, is also present throughout the pipe. This typically occurs as late-stage intrusions and are classified as hypabyssal kimberlite (HK). Surrounding the main conduit are zones of extensively brecciated country rock of variable width referred to as marginal breccias. These zones are typically devoid of juvenile constituents, although areas closest to the central conduit contain low proportions of juvenile constituents as well as HK dykes.

Extensive drilling and underground sampling of the pipe, coupled with detailed core logging, underground mapping, petrography, clast abundance measurements, geophysics, and diamond analysis has revealed a complex internal geology. Two distinct
phases of kimberlite, the “Blue TKB” and the “Brown” kimberlite have been identified and are characterized by contrasting macroscopic and petrographic features, and by differing diamond contents. The Blue phase exhibits features consistent with a TKB, whereas the “Brown” kimberlite is texturally complex consisting of magmatic, fragmental and texturally transitional rocks. Contacts between these two main phases are often sharp and characterized by subvertical or very steeply dipping fabrics. Xenolith distribution is heterogeneous, although the pipe walls and contact zones usually have elevated concentration of country rock clasts.

On the basis of investigations completed to date, the following emplacement history is proposed for Renard 2: (i) Preconditioning of the country rock by ascending magma and associated volatiles, leading to now variably preserved marginal breccias. (ii) Breaching of the surface and consequent explosive degassing of kimberlite magma leading to pipe excavation. During pipe generation, marginal breccias collapsed into the pipe, indicated by the presence of well-developed inward dipping fabrics. (iii) Infill of the pipe by the “Brown” kimberlite. (iv) A second pipe excavation event resulting in the removal of a significant volume of the “Brown” kimberlite and infilling by the “Blue TKB”. (v) Late stage dykes and irregular intrusions were emplaced along zones of weakness, often along geological contacts within the pipe and in the marginal breccia zones. (vi) Post-emplacement alteration of the fragmental kimberlite, resulting in significant mineral replacement. The preliminary interpretation of the Brown and Blue kimberlites is that they were formed by an in-vent column collapse process.

The geological features of Renard 2 are similar to those previously described from the Kimberley area of South Africa, the Gahcho Kué cluster of Canada and the Pimenta Bueno kimberlite field of Brazil.