# LOWERMOST TERMINATION OF VREDEFORT GRANOPHYRE DYKE RESULTS IN UNUSUAL FEATURES

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**Introduction:** The Vredefort Impact Structure in South Africa is one of the largest three confirmed impact structures on Earth, along with the Chicxulub structure in Mexico and the Sudbury structure in Canada [1]. Comparison of these structures allows for greater understanding of the nature of large impact events. One point of similarity between the Vredefort and Sudbury structures is the presence of large melt dykes, called “Granophyre Dykes” at Vredefort and “Offset Dykes” at Sudbury [2]. The Offset Dykes are closely associated with the melt sheet, and generally thought of as injected melt directly from the melt sheet. However, at Vredefort, the deep erosion of the structure makes the exact relationship between the Granophyre Dykes and the melt sheet uncertain. A signature of the impactor has been documented in the Granophyre Dykes [3], suggesting that the dyke is a deep continuation of the same process as the Offset Dykes. There are many features of the Granophyre Dykes that are distinct from the Offset Dykes, including the clast abundance and orientation, bulk chemistry, and petrographic features. We document anomalous features observed at the Granophyre Dykes.

**Segregation Sheets:** Within the Granophyre Dykes, coarse-grained veins have been observed that are compositionally similar to the host Granophyre. The veins extend parallel to the extension of the dyke over tens of meters. The veins vary in thickness from 5-20 cm, though the edges of the veins are consistently found to be sharp and straight and not gradual or undulating. The bulk chemistry of the veins is almost indistinguishable from the host, with compositional variance only noticed in volatile elements, such as minor differences in Mn and Na. Mineralogically, the veins and host are remarkably similar, with the major minerals being plagioclase (mostly labradorite and andesine) and pyroxene (mostly enstatite and ferrosillite). The relative proportions of these minerals are slightly different between the veins and the host, with the veins tending towards more Fe-rich pyroxene phases and more K-rich feldspars. The most notable difference is grain size, with minerals in the veins being up to ten times larger than the minreals in the host. The nature of the veins are similar to documented segregation sheets observed in basaltic ponded flows [4]. These sheets develop pyroxene and feldspars with grain sizes of at least an order of magnitude greater than in the host lava flow. According to [4], segregation sheets often have minimal compositional distinctiveness from their host. Notably, such sheets are only found at the base of such flows, and suggest that the current outcrop should be near the base of the dyke.

**Geophysics:** A combined magnetometer and resistivity survey of one Granophyre Dyke found that the dyke does not extend to great depth below the surface. The magnetometer signal near the dyke is not strong, and the signal varies from cross-section to cross-section, which is atypical of features that have a deep penetration. The resistivity survey shows an anomaly that only extends to a modeled depth of 3-5 meters below the surface. This is consistent with the topographic extent of the dyke, as the dyke is most notably visible on the hilltop, and the eastern and western extent of the dyke disappear at downslope at a topographic height consistent with the geophysical implications. The observation that the dyke is the lowermost termination also explains the great clast abundance and unusual distribution of clasts previously observed in this dyke [5].

**Conclusions:** The Granophyre Dykes are comparable to the Offset Dykes as forming from the same basic process, but they represent two vastly different endmembers of these deeply penetrating dykes: the Granophyre Dykes are the bottom of the melt penetration, while the Offset Dykes are the uppermost portions of the melt. This comparison may allow for analysis of the manner in which the melt differentiates or otherwise is modified during its descent through the impact structure.

**References:** [1] Grieve R.A.F. and Therriault A. (2000) *Ann. Rev. of Earth and Plan. Sci.* 28:305-338. [2] Therriault A. et al. (1996) *Meteoritics & Planetary Science* 31:A142. [3] Koeberl C. et al. (1996) *Geology* 24:913-916. [4] Philpotts A. et al. (1996) *Journal of Petrology* 37:811-836. [5] Huber M.S. and Kovaleva E. (2017) *LPS XLVIII*, Abstract #1999.