GENESIS OF THE MAFIC GRANOPHYRE AT VREDEFORT, SOUTH AFRICA: NEW GEOCHEMICAL AND ISOTOPIC CONSTRAINTS

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Introduction: The formation of the impact melt rock – the so-called *Vredefort Granophyre* - exposed at the Vredefort Dome, the erosional remnant of the central uplift of the Vredefort impact structure, South Africa, has been debated for nearly 100 years. Renewed discussion was caused by the discovery [1] that besides the previously known felsic variety (*Felsic Granophyre)* of >66 wt% SiO_2, a second, more mafic phase of <66 wt% SiO_2 (*Mafic Granophyre*) occurs within a dike on Farm Kopjeskraal in the NW sector of the dome, in conjunction with Felsic Granophyre along the dike margins. Whereas [1] indicated that the mafic phase occurred on the dike margins and the felsic variety centrally, this was inverted by [2]. Two hypotheses have been forwarded for the genesis of the Mafic Granophyres: (1) Successive injections of impact melt of two different compositions derived from a differentiating impact melt body in the crater interior, gravitationally into extensional fractures opened in the course of central uplift formation/modification stage of impact cratering [1,3,4]; and (2), generation of the more mafic phase as a product of assimilation of a mafic country rock, the so-called epidiorite or the Dominion Group meta-lava, component to Felsic Granophyre [5,6]. The Mafic Granophyre has so far only been described from farm Kopjeskraal in the NW Vredefort Dome – all eight other Granophyre dikes do seemingly not carry this impact melt rock type.

Results and Conclusions: As it had been suggested by [1] that Mafic Granophyre could also occur along the southerly extension of this Granophyre dike onto farm Rensburgdrif, we conducted a new multidisciplinary field, petrographic, and chemical/isotopic study of the dike extension onto that property and beyond. The mafic phase was indeed observed – in the interior of the dike on Rensburgdrif, in the same fashion as along the Kopjeskraal section, with the felsic phase along the dike margins. A further sample of Mafic Granophyre was found also on the next property to the south (Zuid Witbank). New geochemical data support that the Mafic Granophyre composition could be indeed regarded a mixture between the felsic impact melt rock and a mafic host rock, although these data per se do not allow to differentiate between possible Ventersdorp Epidiorite and Dominion Group meta-lava components. Strontium-Neodymium isotope data are more conclusive with regard to discrimination of a possible mafic component: Dominion Group meta-lava data fall off the Granophyre and epidiorite data array, which favors epidiorite as likely contributor to generate Mafic Granophyre. Together with previous Sr-Nd-Os-Se isotopic, and other geochemical, data [5,6], our new results provide further strong support for the formation of Mafic Granophyre by local epidiorite assimilation/admixture to Felsic Granophyre. In addition, a detailed petrography study of Granophyre samples from Rensburgdrif revealed that the mafic variety carries a much larger mafic clast component than the felsic variety. A two-stage melt injection scheme as proposed by [1-3] is not supported by field or isotopic data presented to date.

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