IMPACT RELATED PSEUDOTACHYLITIC BRECCIAS IN THE SCHURWEDRAAI AND BAVIAAN-KRANTZ ALKALI GRANITE COMPLEX IN THE COLLAR OF THE VREDEFORT DOME.

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Introduction: The formation of impact related pseudotachylitic breccias and their occurrence in large impact structures is still a matter of debate. As part of a working group [1, 2] that investigates the formation of impact related pseudotachylitic breccia bodies in the Archean Gneiss of the central uplift of the Vredefort impact structure (South Africa), the aim of this project is to contribute to the understanding of the genesis of such pseudotachylitic bodies in a different host lithology, namely the Schurwedraai and Baviaan-Krantz Alkali Granite complex in the northwestern collar of the Vredefort Dome [Fig.1] [3]. This alkali granite complex is one of five ultramafic-mafic and felsic intrusions in the Late Archean to Paleoproterozoic subvertical to overturned supracrustal collar rocks of the Vredefort Dome. The pluton intruded into the lower Witwatersrand Supergroup at ~ 2.05 Ga ago [4]. Pre-impact lithological heterogeneities are absent in the complex and pre-impact textural and structural features are scarce in contrast to the Archean granitic gneiss of the core and the metasedimentary collar strata. For the pre-impact metamorphism a temperature of 300-400℃ is estimated [5].

Results: *(a) Field observations:* The alkali granite is mainly whitish to reddish, homogeneous, and massive, with hypideomorphic minerals, and mostly of medium to fine grain size. It consists of quartz, K-feldspar, albite, potassic amphibole, potassic pyroxene, and minor biotite. Veins of aplitic and pegmatitic nepheline syenite, quartz, K-feldsdspar with hornblende and aegerine are common. No distinct foliation was found. At some locations shatter cones are present. Pseudotachylitic breccia occurrence are widespread [Fig.2]. These breccias occur typically as single veins or dykes from a few millimeters to about 1.5 m wide, or as networks up to 6 m wide; maximum extensions are delimited by the patchy outcrop conditions to about 20 m. Occasionally, they can also form irregular pods. Most of the pseudotachylitic breccia veins seem to be oriented perpendicular to the genarally subhorizontal outcrop surfaces. However, this is certainly a cutting effect, because on many vein margins in outcrop it is observed that these veins mostly dip at angles of 65 to 35 degree. Most contacts to host rock are sharp. Clasts in pseudotachylitic veins > 2 cm in wide are common. They are mainly composed of alkali granite; only at three localities “exotic” clasts of quartz or quartzite were observed. It may be possible that they represent relicts of older engulfed quartz veins or are xenoliths from the surrounding Witwatersrand quartzites. Most clasts are rounded. Some longitudinal axes of elongated clasts are oriented in strike direction of the vein, and in some rare cases clasts are located at just one side of the vein. At three localities en echelon patterns of pseudotachylitic breccia veins are observed. Flow banding in veins is common [Fig.3]. At some contacts of veins to host rock quench zones are apparent. The pseudotachylitic breccia veins crosscut the pegmatitic and aplitic veins and sometimes even displace them for distances up to 10 m.

(b) Macroscopic structural analysis: The apparent strike orientations of over 500 pseudotachylitic breccia veins were measured. The data scatter but imply a preferred NE-SW to ENE-WSW trend. Locally strike orientations of larger pseudotachylitic networks could be estimated; they show prominent directional trends at NW-SE and ENE-WSW. This indicates that larger pseudotachylitic breccia zones seemingly follow a concentric and radial pattern with respect to the center of the Vredefort Dome. In some localities dilation was observed with a mean N-S dilation vector orienttation. The structural analysis also indicates that veins < 1 m in width strike mainly ENE-WSW and NW-SE direction, but veins > 1 m in width mainly in NW-SE direction. Individual veins in networks also mainly strike ENE-WSW and NW-SE. Fractures cutting pseudotachylitic breccias mostly strike N-S and ESE-WNW. As yet, it is not clear whether their origin can be related to the modification phase of the impact event, or whether they are of significantly later post-impact age.

(c) Petrography: First microscopic analysis shows that the matrix of the pseudotachylitic veins is devitrified and composed of quartz, feldspar and amphibole. More detailed SEM and electron mircoprobe studies are required to determine the feldspar and amphibole compositions. Clasts in pseudotachylitic breccia are made up of quartz, K-feldspar and plagioclase, with feldspar grains more extensively melted and showing stronger recrystallization than quartz grains. First micro-

scopic analysis also indicates that where the contact between host rock and a pseudotachylitic breccia vein is not sharp, the host rock is thermally affected and shows heterogeneous recrystallization near the contact. The rounding of clasts seems to be related to thermal abrasion. The matrices of marginal quench zones appear compositionally similar to the matrices of vein interiors. Clasts within these margins are relatively more strongly recrystallized. Some alkali granite grains and some quartz and feldspar clasts show shock effects. Strongly fractured and mechanically twinned amphibole is noted. In a few quartz and feldspar grains PDFs, mostly one set but occasionally two sets, are observed [Fig.4]. Most PDFs are decorated; planar fluid inclusion trails in quartz and feldspar are commonly observed. These observations indicate a regional shock pressure of about 10 GPa and local attainment of shock pressures of 15-20 GPa [6], calibrated for cold targets, whereas the pre-impact temperature of the alkali granite under investigation were 300-400 ℃.

Outlook: Further petrographic analysis is in progress, and so is chemical analysis of pseudotachylitic breccia vein and host rock pairs. The macroscopic structural analysis will be complemented with microstructural studies. These results will be presented at the conference.

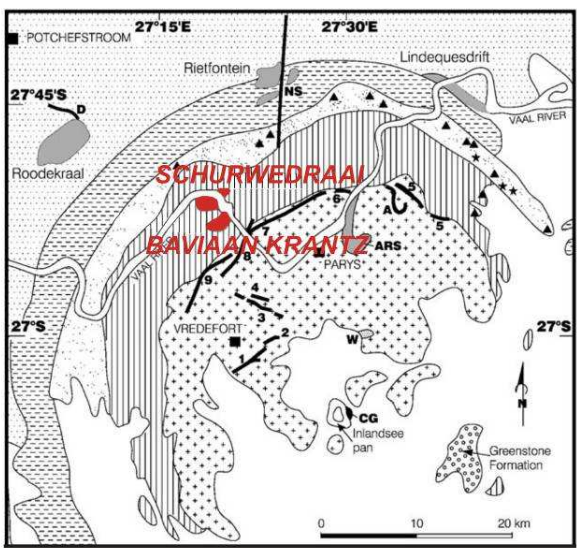

Fig.1: Simplified geological map of the Vredefort Dome with location of the Schurwedraai and Baviaan-Krantz Alkali Granite complex in the northwestern part of the collar (modified after[7]).


Fig.2: Pseudotachylitic breccia network with rounded clasts of alkali granite. Pen for scale, ~ 15 cm long.


Fig.3: Flow banding in ~ 15 cm wide pseudotachylitic breccia vein.

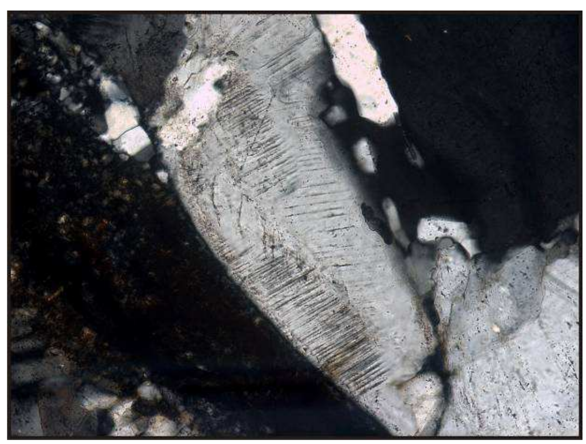
Fig.4: Two sets of PDFs in feldspar grain. Cross polarized light, width of view field 0.52 mm.

References: [1] Mohr-Westheide et al., this vol. [2] Lieger et al., this vol. [3] Gibson & Reimold (2008), Gb LMI IV Conf. [4] Graham et al. (2005), JAES 43, 537-548. [5] Gibson et al. (1995), Geol.J. 30, 319-331. [6] Stöffler & Grieve (2007), R.A.F. [7] Reimold et al. (2006), GC 66, 1-35.