**ANALYSIS OF SMALL-SCALE PSEUDOTACHYLITIC BRECCIA ZONES FROM THE CENTRAL UPLIFT OF THE VREDEFORT IMPACT STRUCTURE, SOUTH AFRICA.** T. Mohr[1,] W. U. Reimold[1], U. Riller[1], R. L. Gibson[2], [1]Humboldt University in Berlin, Invalidenstrasse 43, 10115 Berlin, Germany (Tanja.Mohr@museum.HU-Berlin.de), [2]School of Geosciences, University of the Witwatersrand, Private Bag 3, P.O.Wits 2050, Johannesburg, South Africa (Roger.Gibson@wits.ac.za).

**Objectives:** Pseudotachylitic breccias represent the most prominent impact-induced deformation structures in the central uplift of the Vredefort Impact Structure [1, 2]. The development of such melt breccias in impact structures has been controversial, with both shock brecciation/melting, decompression melting, and/or friction melting mechanisms having been proposed by various authors (e.g., [3, 4]). Resolving this problem requires detailed field and microscopic structural analysis in order to characterize the nature of different occurrences and identify the exact timing of breccia formation within the rapid and complex impact event. Although field studies have previously been conducted, they have not been adequately related to microscopic studies. In order to bridge this gap, a polished 3 x 1.5 m granite slab [Fig. 1] from a dimension stone quarry in the core of the Vredefort Dome was structurally analysed. This slab provides an ideal opportunity for elucidating the relation between generation of fractures with and without melt, fracture and breccia density, and other geological parameters such as lithology, grain size and mineral fabrics [Fig. 2].

**Methods:** The geometry and pattern of thin pseudotachylitic breccia veins and microfractures in several portions of the granite slab were examined. In order to analyse the structure of veins on the mesoscopic scale, individual 10 x 10 cm large photos of the polished granite slab were assembled to a mosaic. All veins and fractures were traced on a transparent film and subsequently digitized. Characterization and mapping of microfracture and pseudotachylitic breccia networks with special regard of their orientation, density, and 3D geometry forms the basis for the ongoing structural analysis.

**Results:** Besides a several dm-wide breccia zone, two types of structures, which cut each other, are macroscopically observed, i.e., generally dark grey to black veinlets of pseudotachylitic breccias and a network of thin reddish-brown microfractures. A penetrative mineral foliation of the granitic host rock seemingly controlled the orientation of segments of the margins (contacts to host rock) of the pseudotachylitic breccias, but not that of the thin red microfractures. Mapping of the microfracture density indicates a decrease in density at a specific angle of 25° from the edge of, and away from the breccia zone. A high fracture density can, in general, be observed between thin pseudotachylitic breccia veins. Close to the breccia zone, red microfractures show a high density with variable orientations. At some distance from the breccia zone, a uniform orientation of microfractures is observed perpendicular to the breccia zone. With decreasing distance from the breccia zone, red microfractures display random orientation. The variation of fracture density seems to depend on the mineralogy of the host rock, which is mainly reflected in the variation of plagioclase and K-feldspar modal abundances of the host granite.

The cross-cutting relationships between the black and red fractures indicate two generations of pseudotachylitic breccias. Thin red microfractures cut and displace pseudotachylitic breccias, but appear not to cut the matrix of the wide breccia zone. The structural observations of the displacements of thin pseudotachylitic breccia veins indicate lateral spreading rather than a compressive regime upon melt breccia emplacement. Reassembling the rock fragments inside the wide breccia zone allowed to reconfigure their respective movement upon opening of the melt zone.

**Conclusions:** The existence of the breccia zone, as well as the reconstruction of pre-impact fragment configuration of the breccia zone, suggest that dilation played a major role during breccia emplacement. The orientation of dilational, melt-filled fractures will be used to assess the strain field and, thus, the deformation regime, under which the fractures formed. This information is important to infer the cratering stage during which the fracture formed. In this slab, the pre-impact fragmented configuration results in a uniform orientation of red fractures, wich can be observed in the re-established original state of that breccia zone. This indicates that these fractures formed prior to dm-scale pseudotachylitic breccia veins. Pseudotachylitic breccias display lateral strike separations on red microfractures that display en-echelon geometry.

The meso-scale work is followed by detailed microscopic and chemical analyses. Taking all these different analysis aspects into consideration, it may ultimately be possible to delineate different stages of the central uplift formation with the objective of better understanding the mechanics of complex crater formation.

**Significance of the study for numerical modelling:** Investigating the processes involved in the formation and collapse of central uplift structures, for example leading to intense fracturing, cataclasis, and melting, will provide crucial information with regard to the processes and kinematics involved in the formation of central uplifts of large impact structures. This will allow testing of the acoustic fluidization process. Understanding the genesis of pseudotachylitic breccias is implicit in improving our knowledge about the mechanics of central uplift formation. This study has significant implications for understanding also peudotachylitic breccia formation in meteorites and some lunar rocks (so-called "shock veins"), and the modelling of thermal energy associated with their formation on parent bodies.

**References:** [1] Dressler, B. O. and Reimold W. U. (2004) Earth-Science Reviews, 67, 1-60. [2] Reimold W. U. and Gibson R. L. (2006) GSA SP 405, 407 pp. [3] Gibson R. L. and Reimold W. U. (2001) The Vredefort impact structure, South Africa, Memoir 92, Council for Geoscience, Pretoria, 110 pp. [4] Gibson R. L. and Reimold W. U. (2005) Shock pressure distribution in the Vredefort impact structure, South Africa. Large Meteorite Impacts III. GSA SP 384, pp. 329-349.

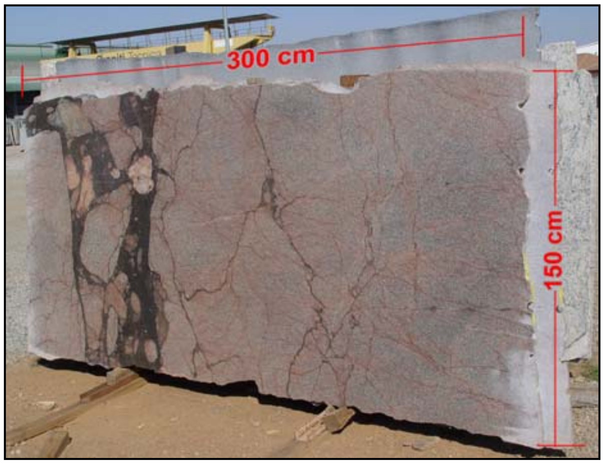


Fig. 1: Polished 3 x 1.5 m granite slab from a dimension stone quarry in the Vredefort Dome.

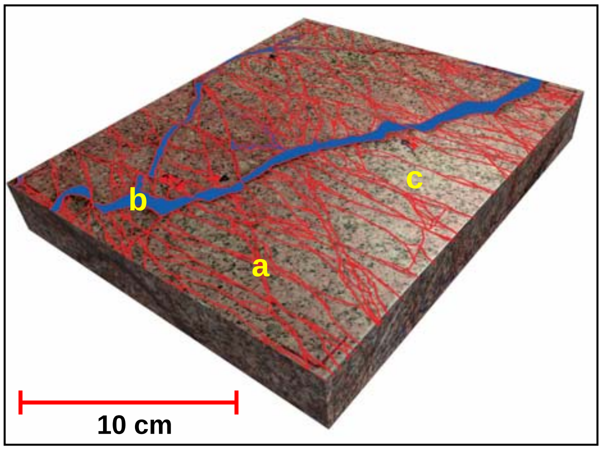


Fig. 2 : Enlarged section of a part of the granite slab. a : network of thin reddish-brown microfractures, b: pseudotachylitic breccia veins, c: granitic host rock.