FRACTURE DENSITY STATISTICS ALONG RADIAL TRAVERSES THROUGH THE CRYSTALLINE BASEMENT OF THE VREDEFORT DOME, SOUTH AFRICA; **W.U. Reimold,** Wits-CSIR Schonland Research Centre and BPI Geophysics, University of the Witwatersrand, 1 Jan Smuts Ave., Johannesburg 2000, South Africa.

BACKGROUND: Evidence against a central catastrophic (large-scale shock) origin of the Vredefort structure in the centre of the Witwatersrand Basin is presented and discussed in a companion paper (1). In particular, the findings of several pseudotachylite generations formed between ~ 2.2 and 1.1 AE ago in the Vredefort basement point towards a long-term, multi-phase origin of the structure. Another example of two generations of pseudotachylite from the SW part of the basement is presented in Fig.1. Also the fact that lower Witwatersrand strata are found to lie horizontally just S of the Dome (drill core Anglo-American No.GH1, ~ 2.5km S of Koppies) instead of being up- or overturned like the strata in the W-N-NE portions of the collar around the Dome does not easily comply with a central shock origin for the structure. Reimold et al. (2) have also shown that the abundance of pseudotachylite in the crystalline basement does not increase towards the center and that this deformation phenomenon is most prominantly exposed in a semi-circular zone close to the transition from Outer Granite Gneiss (upper crustal level, amphibolite facies) into Inlandsee Leucogranofels (lower crustal level, granulite facies) (3) closer to the Dome center (cf. Fig.3). Mineralogical and geochemical results obtained along radial traverses from the contact of collar and basement in the W and NW sectors towards the centre of the Dome led to formulation of the so-called "crust-on-edge" model (3) that postulates that successively lower levels of the crust are exposed in concentric segments closing in on the center of the Dome. It was therefore necessarily assumed that not only the sedimentary collar, but also the crystalline basement was up- or overturned. On the basis of the assumption that the amount of pseudotachylite increases towards the center of the structure, and - as outlined by (4) - that increasing degrees of "shock" deformation could be determined by measuring the crystallographic orientation of planar microdeformations (that are now recognised as planar fractures (cf(5 - Fig.2); also (6)), the theory of a central catastrophic origin seemed well-founded. In contrast to this, Hart and Andreoli (7) discovered a marked change in the intensity of deformation along the chemically and mineralogically well-defined boundary between Outer Granite Gneiss and Inlandsee Leucogranofels (equiv. to pseudotachylite-rich zone) (7).

METHOD: In order to quantitatively determine deformation degrees through the Vredefort basement, fracture counts were executed following the technique described by (8) on thin sections of samples collected along a NW- (sections by courtesy of R. Hart and M. Andreoli) and a N-traverse (VNT)-(Fig.3). Whereas samples from the NW-traverse were collected at regular intervals starting from the collar, but disregarding relative distances between each sample and neighbouring pseudotachylite occurrences, the VNT-samples were taken at localities as far away from pseudotachylite (at least 1-2 m) as possible. Thus several NW-samples contained veinlets of pseudotachylite. Besides densities of planar and irregular fractures, the degree of thermal metamorphism as expressed as modal % of recrystallised quartz or feldspar was determined in each thin section. Traverses had to end where recrystallisation and alteration degrees of outcropping rocks precluded further sampling towards the center of the basement.

RESULTS: The diagrams of Figs. 4 and 5a,b show the results for both traverses, as profiles from the contact collar/basement towards the center of the Dome. For both traverses it is valid that fracture density profiles are closely related to the distribution of pseudotachylite along the traverses (Fig.3). In accordance with the observations of (3,7) it is found that fracture numbers decrease beyond the pseudotachylite-rich zone further towards the centre, as measured for the NW-traverse (Fig.4). This is however not repeated in the VNT case, but here an obvious decrease of the ratios of modal percentage quartz with planar fractures versus (Qz_{total} - $Qz_{recryst}$) percentage (Fig.5b) was measured. In general, the results for both traverses are not in agreement with the hypothesis of progressively increasing deformation towards the center of the structure. A major difference between the results for the two traverses are the different trends of recrystallization degrees along the profiles - closely imaging the deformation trend of the NW-profile (Fig.4), but being symmetrical to the deformation trend in the VNT case (Fig.5b). The author tends to explain this as a result of the different sampling philosophies for these traverses, and therefore has to conclude that **the degrees of dynamic deformation and thermal annealing observed along traverses through the Vredefort basement are related to formation and distribution of pseudotachylite**, that was possibly formed along local sutures rather than by an exceptional catastrophic shock event (cf. companion paper, (1))! However, it is understood that the method of fracture counting - by itself - is a questionable tool, as multiple material properties could bear on such results. Yet, it is hoped that this work will provoke further tests of the above given hypothesis!

REFERENCES: (1) Reimold, W.U., Jessberger, E.K., Stephan, T. (1987) this volume; (2) Reimold, W.U. et al. (1985) LPS XVI, 691-692; (3) Hart, R.J. et al. (1981) JGR 86, 10639-10652; (4) Schreyer, W. (1983) Naturwissenschaften 70, 388-395; (5) Reimold, W.U., et al. (1986) LPS XVII, 701-702; (6) Schreyer, W. and Medenbach, O. (1981) Contr. Mineral. Petrol. 77, 93-100; (7) Hart, R.J. and Andreoli, M.A.G., Disc. Forum for

Vredefort fracture statistics
Reimold, W.U.

res. in Nucl. Geol. - Progr., Abstr. and Newsl. (Pelindaba, NUCOR, PER-88), 11; (8) Reimold, W.U. and Stoffler, D. (1978) PLPSC 9th, 2805-2824.

Fig.1 A new occurrence of an older (folded, altered - light-gray, arrow) and a younger (fresh, undeformed - dark-gray) pseudotachylite generation from the extreme SW of the Vredefort basement.

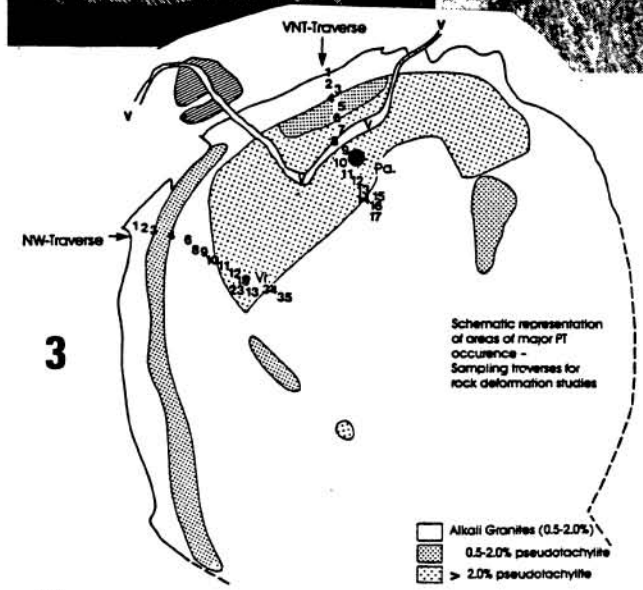
Fig.2 Open planar fractures in a VNT-sample. Width of field of view ~ 220 μm.

Fig.3 Schematic distribution of pseudotachylite as well as sampling locations for NW- and VNT-traverses.

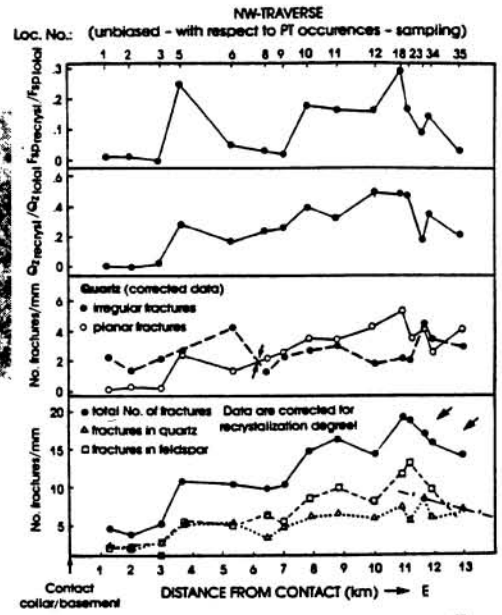
Fig.4 Deformation and recrystallisation data for NW samples.

Fig.5a Fracture densities along the VNT-traverse.

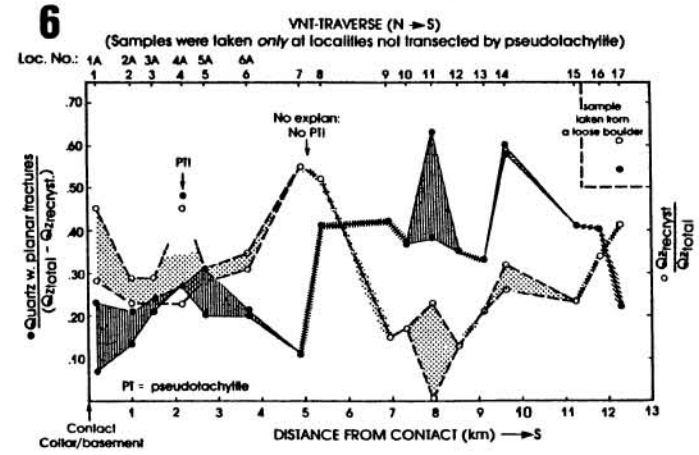
Fig.5b Ratios of modal% quartz with planar fractures vs. (total quartz minus recrystallised quartz), compared with recrystallization degrees along the VNT-line.



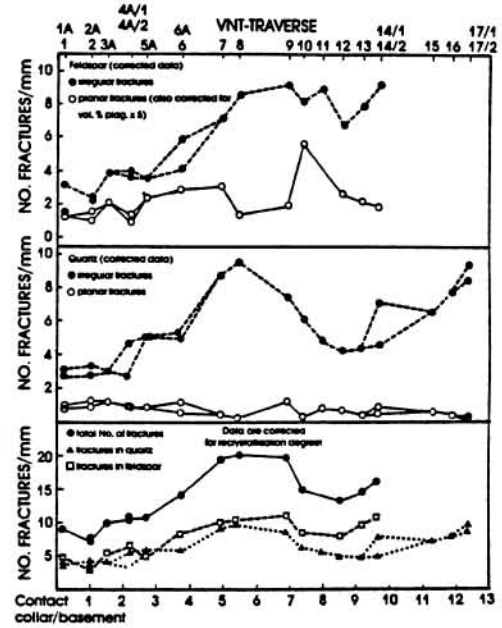
3



4



6



5