FRACTURE DENSITY STATISTICS ALONG RADIAL TRAVERSES THROUGH THE CRYSTALLINE BASEMENT OF THE VREDEFORT DOME, SOUTH AFRICA - NEW DATA FROM A NNW-TRAVERSE. **W.U. Reimold[1,2], R.J. Hart[1] and M.A.G. Andreoli[3],** [1]Schonland Research Centre, [2]Economic Geology Research Unit, University of the Witwatersrand, P.O. Wits 2050, Johannesburg, RSA; [3]Atomic Energy Corp. of S.A., P.O. Box 582, Pretoria 0001, RSA.

Planar microdeformations in quartz from Vredefort lithologies have been widely regarded as impact-generated shock metamorphic effect (e.g. (1)). Others have pointed out the existence of two separate events associated with formation of planar microdeformations (2) or questioned the categorical classification of Vredefort microdeformations as bona fide planar features (syn. elements) and provided evidence for the abundance of planar fractures (e.g. (3)). (1) and (3) presented orientation data for planar microdeformations from Vredefort. They suggested that their results either favoured the impact hypothesis (1) or tectonic high-strain rate processes (3). In 1987 Reimold (1) presented the results of fracture density determinations along a N-S and a NW-SE trending profile through the well-exposed northern half of the granitic core of the Vredefort structure (compare Fig. 1). The main results were: (i) the determined deformation degrees did not progressively increase towards the center of the structure; (ii) strongest deformation was measured in samples from the so-called "Vredefort Discontinuity"(2), the charnockitic rock-bearing and pseudotachylite-rich transition zone between Outer Granite Gneiss and Inlandsee Leucogranofels, and (iii) the fracture density profiles are very similar to the pseudotachylite distribution patterns along these traverses. (iv) In the case of the NW-traverse decrease of deformation degrees from the Discontinuity towards the center of the Dome was indicated. (v) The degree of recrystallization profiles implied that annealing, too, could be related to the distribution of pseudotachylite. Reimold (1) concluded that it therefore had to be assumed that dynamic deformation as well as the annealing of Vredefort rocks were related to formation and distribution of pseudotachylite and that these, as well as the fracture density results suggested that deformation originated from local sutures rather than from a central catastrophic shock event.

As part of a general reassessment of chemical and petrographic features of the Vredefort Dome (3,4) under specific consideration of the meaning of the Vredefort Discontinuity, samples from the KK-traverse (Fig. 1), situated between the NW-and VNT-profiles of (1) and featuring a collection of very closely-spaced samples, became available for fracture index determinations. The results are presented in Fig. 2. In order to extend this profile further towards the center of the structure, samples from farms Visagies Drie (VJU-3), Rust en Vrede (186) and from the leucogranitic portion of borehole OKD-1 were studied as well. A typical photograph of specimen 186 is shown in Fig. 3, illustrating that this sample and the borehole samples are largely annealed, but still contain sizable areas with primary deformation textures. In these samples only such areas were evaluated. Thus it is important to note that while the studied quartz areas generally were rather large and easy to identify, most of the smaller primary feldspar areas could only be identified by their intense fracturing, which probably led to a bias towards higher fracture counts in feldspar from these samples (cf. Fig. 2). The ratio vol% quartz/vol% feldspar was plotted to assess whether sample mineralogy needs to be considered on interpretation of the deformation data. However, it is obvious from Fig. 2 that nearly all samples have rather similar compositions and that this profile does not compare with the fracture counting results.

Results: Samples from near to the contact with the Lower Witwatersrand strata of the collar around the granitic basement indicate a significant increase in deformation (No. planar deformations!), a result that was also suggested by some of the previous (1) data. Outer Granite Gneiss samples display a rather uniform deformation degree, until the vicinity of the Vredefort Discontinuity is approached. Over the next ca. 3 km the deformation degree is dramatically increased, before it decreases into the central Inlandsee Leucogranofels zone. The samples from the environs of the Inlandsee (centre of Dome) display variable results for planar deformation counts (very low), counts of all fractures in quartz (with one exception at normal "background" level, but generally far below the degree measured at the Discontinuity), and for counts of all fractures in quartz and feldspar (background to very high values). A probable explanation for the high feldspar values from the center has been given above (bias for measurements in feldspar). Thus the previous results from (1) - i.e. strongest deformation along the pseudotachylite-rich "Discontinuity" - and (4) - absence of shock deformation and generally low degree of "high-strain rate" deformation in the borehole samples from the center of the Dome - have been confirmed. Finally the % recrystallisation profile along the KK-traverse is completely different from the earlier results. Thermal deformation away from the contact with the collar is very low (with a few exceptions) in the region around the "Discontinuity" and from there increases again towards the interior of the structure. Previously (1) differences in sampling philosophies (away from pseudotachylite in the VNT-case, indiscriminate with respect to pseudotachylite in the NW-case), have been suggested as explanation for the variable annealing results obtained, but it appears doubtful whether this explanation can be maintained in the light of the similarity (higher values close to collar, low annealing degrees in "Discontinuity" region) between the KK- and VNT-annealing profiles. Metamorphic studies (2) have revealed that the increase of annealing degrees towards the NNW has to be associated with the contactmetamorphic aureole around the alkaligranitic intrusions (shown in Fig. 1).

In conclusion, the deformation-textural data from now three radial traverses through the basement to the Vredefort structure do not favor a central catastrophic shock event, but could be explained by major structural events taking place along intracrustal discontinuities, such as the "Vredefort Discontinuity" (see also (8) - (10)). However, the controversy about the nature and orientation statistics of planar microdeformations from Vredefort needs to be resolved, before microdeformation data alone should be used to infer genetic implications. As in this case, much further groundwork is required with regard to pseudotachylite and "shatter cone" occurrences at Vredefort, and, in particular, with respect to the

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structural description of the Vredefort Dome, and its relationship to the surrounding Witwatersrand Basin.

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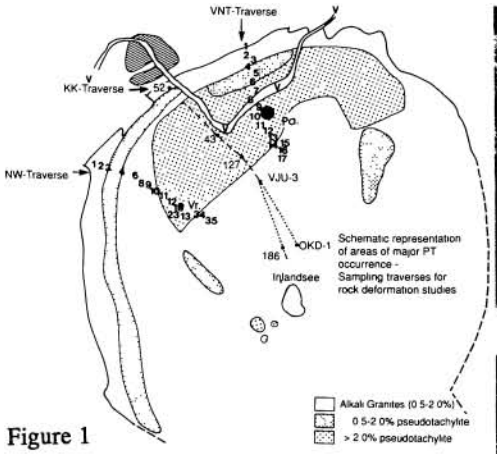

Figure 1

Figure 3, sample USA-186, width: 1.7 mm.

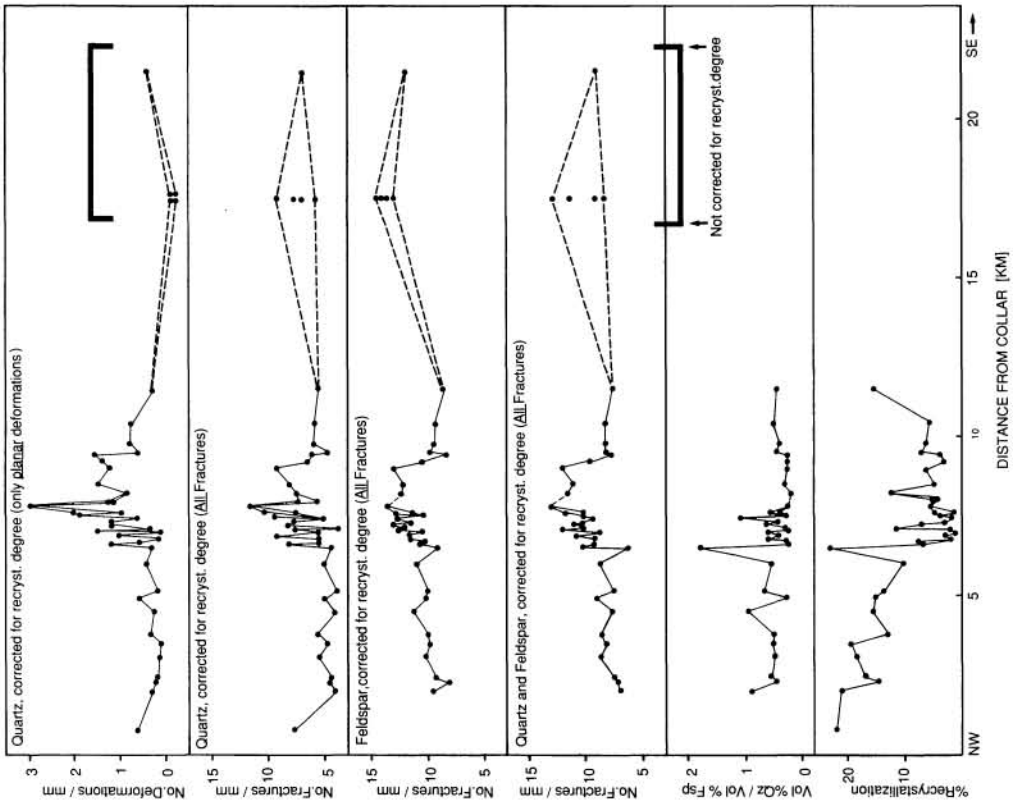

Figure 2