THE PRETORIA SALTPAN - THE FIRST FIRM EVIDENCE FOR AN ORIGIN BY IMPACT.

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The Pretoria Saltpan (Zoutpan), located ca. 40 km north of Pretoria (lat. 25°24'30'', long. 28°04'59''E), appears as a near-circular crater structure of 1.13 km rim-to-rim diameter. However, a recently obtained (courtesy of Dr. F.J.Kruger, BPI Geophysics) Landsat TM image (Fig. 1) shows a remarkable hexagonal geometry for the Saltpan structure. The crater is formed entirely in 2.05 Ga old Bushveld granite. The rim granite is uptilted and largely overlain by granitic fragmental breccia. Karroo grit can be observed underlying this breccia in places, which indicates a post-Karroo age for the cratering event. The excellent preservation of the crater suggests an age no older than Pleistocene. Wagner (1) provided a thorough account of the Saltpan geology and concluded the structure was a "true cryptovolcano". In the 30's and 40's several workers (e.g., (2,3,)) suggested an origin by meteorite impact - mainly on the basis of morphological criteria. In 1973 Fudali et al. (4) reported results of a gravity study and Feuchtwanger (5) described the presence of radial and concentric carbonatite, trachyte and lamprophyre dykes within the crater rim, together with associated fenitisation. As no evidence for shock metamorphism had been discovered (4), the original view of a cryptovolcanic origin became widely accepted.

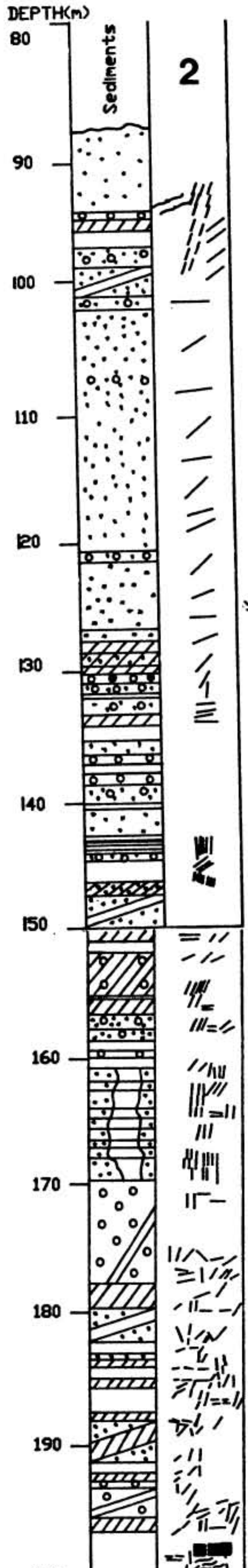
In 1988/89 a borehole was sunk by the Geological Survey of South Africa in collaboration with T.C.Partridge and L.Scott to ca. 200 m at 125 m northwest of the geographical center of the crater. The prime objective of this project was to obtain a detailed paleoenvironmental record from a study of the crater sediments, but it was also hoped that the recovery of a complete drill core could provide final clues as to the origin of the crater. First results from the drill core investigation were reported by Partridge et al. (6).

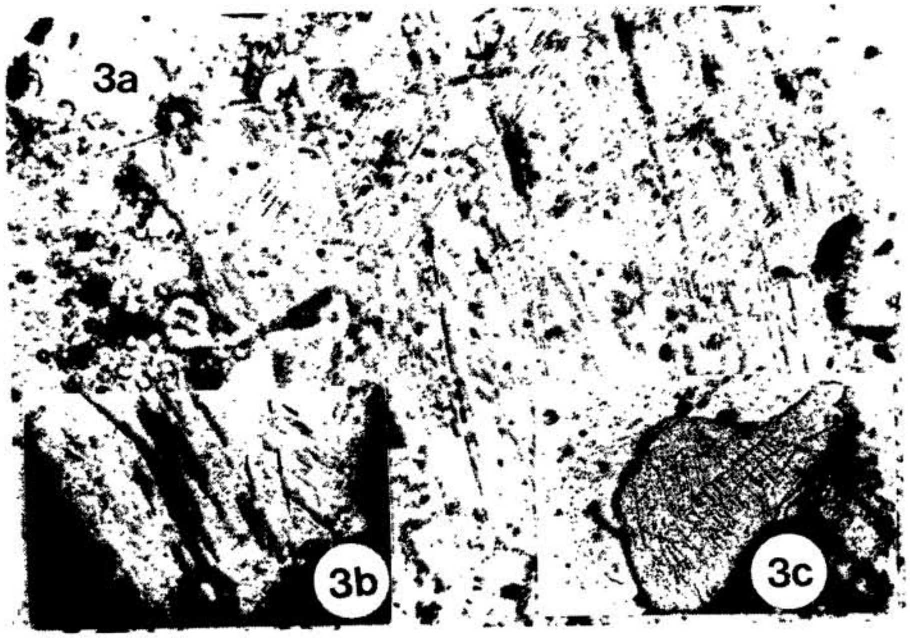
The borehole stratigraphy is schematically shown in Fig. 2. Some 87 m of saline lake sediments are underlain by alternating granitic sands and intervals of Bushveld granite (boulders?). The latter is strongly fractured, partially brecciated (cataclasites), and it was noted that the amount of solid granite increases with depth. Fracturing degrees simultaneously decrease. No volcanic rocks were intersected. As reported by (6), numerous granite samples collected from the drill core and from allochthonous and autochthonous rim granite did not reveal shock metamorphic evidence. The authors also presented preliminary chronological results: sedimentation rates determined for the crater sediments indicate a maximum age of ca. 200 000 a for the cratering event, but K-Ar and, more recent, Rb-Sr (F.Walraven, Geol. Surv. of S.Afr., pers. comm.) data obtained on biotite from lamprophyre dykes yielded 1.3 to 1.4 Ga ages for this magmatic event.

New Results: 31 grain mounts were prepared from the granitic sands at depths between 90 and 190 m. So far, in 7 sections a small number of quartz grains (up to 6 per sample) were observed to show multiple sets of planar elements (Figs. 3a-c) at 3 to more than 6 different crystallographic orientations per grain. Three samples have been discovered to contain a few grains of diaplectic quartz glass, and nearly all specimens examined display some fragments of either clear or brownish glasses (Figs. 4a, b). In addition, up to 2 cm large melt breccia fragments (agglutinates) of glassy matrix and angular granite-derived mineral fragments are abundant in the sands down to depths of ca. 150 m. They frequently contain metal spheres. These breccia fragments appear to be concentrated in up to 10 cm wide layers in the sand portions of the core, and these layers are frequently zones of enhanced alteration (presence of hydrated Fe-oxides). Most shocked particles were observed in samples from depths around 100 m. While these recent findings strongly favor an impact origin for the Saltpan crater, it is still required to further investigate its spatial association with volcanics (e.g. by detailed field studies of the provenance of the latter). We hope to be able to report on the composition of the metal spheres as well as on statistics for the crystallographic orientations of planar elements in quartz at the Conference.

Refs.: (1) Wagner, P.A. (1922) S.Afr. Geol. Surv. Mem. 20, 136pp.; (2) Rohleder, H.P.T. (1933) Geol. Mag. 70, 489-499; (3) Leonard, F.C. (1946) Univ. of New Mexico Pubs. in Meteoritics 1, p.54; (4) Fudali, R.F. et al. (1973) J. Geol. 81, 495-507; (5) Feuchtwanger, T. (1973) Zoutpan: A carbonatite-alkaline volcano. Univ. of the Witwatersrand, Dept. of Geology, unpubl. student paper; (6) Partridge, T.C. et al. (1990) Abstr. to the 53rd Ann. Meet. of the Meteoritic. Soc., Perth, p.125.

PRETORIA SALTPAN IMPACT CRATER: REIMOLD, W.U. et al.





Captions: Fig. 1: Landsat TM image - note hexagonal crater shape (enhanced just inside of the rim outline); Fig. 2: Schematic core log (-80 to -200m), comp. legend; Figs. 3a-c: 3 quartz grains with multiple sets of planar elements (widths: a) 285, b,c) 360 µm); Figs. 4a,b: Several glass fragments (widths: a) 720, b) 2200 µm).