PSEUDOTACHYLITE-FRACTURE NETWORK: A KEY STRUCTURE FOR CENTRAL UPLIFT FORMATION IN LARGE IMPACT STRUCTURES C. Lana[1], R. Gibson [2], U. Reimold[2]; [1]Earth Science and Engineering, Imperial College London, Consort Road, London SW7 BP. c.lana@imperial.ac.uk; [2]Impact Cratering Research Group, School of Geosciences, University of the Witwatersrand, Private Bag 3,P.O. Wits 2050, Johannesburg, South Africa.

The 80-km-wide Vredefort dome, South Africa, presents a unique opportunity to investigate the deep levels of the central uplift of a very large impact structure. Previous studies have suggested that exposure of progressively older strata in the collar of the dome, and of progressively higher-grade metamorphic rocks toward its center, are consistent with differential uplift, with deepest levels exposed corresponding to pre-impact mid-crust [1, 2, 3]. These studies are confirmed by our recent structural analysis in the core of the dome, which indicates that the amount of impact-related rotation decreases towards the center of the dome [3, 4]. Specifically, they show that the S2 fabric in the outer 3-6 km of the core of the dome is rotated by 90° relative to the S2 fabric found within a 12 km radius of the center [3]. Our structural modeling also indicate that the present asymmetric dips of the collar strata, with layering dipping outward at moderate angles in the southeastern sector but being overturned and dipping inwards in the northwestern sector, and the eccentric distribution of the pre-impact metamorphic isograds around the core of the dome can be reconciled with symmetric rotation of an initially obliquely NW-dipping target sequence during central uplift formation [3]. The remaining question is whether rotation of the deep-seated Archean fabrics was associated with movements along fault zones separating large-scale blocks of crust as observed in similar, but less deeply eroded, impact structures [e.g., 5]. Although the limited exposure of the crystalline basement rocks in the Vredefort dome relative to the collar rocks hampers investigation of large-scale impact-related faulting in the core of the dome, we have identified no obvious fault- or breccia-bounded megablocks. Instead, the continuity of the Archean fabrics suggests that the rotations necessary to create the central uplift were achieved in a more coherent way and that the necessary displacements and rotations were distributed more evenly through the rock volume.

Gibson and Reimold [6] have argued that the bulk, if not all, of the pseudotachylitic breccias in the Vredefort dome formed during the shock compression phase as a consequence of shock melting, with or without a frictional heating component. The presence of a pervasive network of fractures, locally lubricated by these melts, may have provided the necessary temporary strength degradation in the basement and collar rocks during crater modification to allow a large-scale ductile response and to accommodate the differential rotation and slip required for central uplift formation. Although there is no evidence of large slip-magnitudes along major veins of pseudotachylitic breccia, the consistent millimeter- to centimeter-scale displacements of the basement fabrics and collar bedding along the veins suggest that the high-strain deformation could have been distributed as discrete shear in the pseudotachylite-fracture network.

Reference: [1] Stevens, G. et al. (1997) *Precamb. Res.* 82, 113-132 [2] Lana, C. et al. *GCA* **68**, 623-642. [3] Lana, C. et al. (2003) *MAPS*, **38**, 1093-1107. [4] Lana, C. et al., *EPSL* (2003) **206**, 133-144; [5] Ivanov, B. et al. (1996) *LPI XXVII*, 589-590. [6] Gibson, R. and Reimold, U. (2003) *LPIC XXXI* 22-23.