FROM MAP TO MODEL – 3D VISUALIZATION OF THE VREDEFORT CENTRAL UPLIFT, SOUTH AFRICA.
A. Jahn, U. Riller and W. U. Reimold, Museum fuer Naturkunde Berlin (Invalidenstrasse 43, D-10115 Berlin, Germany, Andreas.Jahn@museum.hu-berlin.de).

Introduction: Structural, petrological and geophysical work [1, 2, 3], as well as numerical modeling [4], have been conducted on the Vredefort impact structure to understand the mechanism of rock deformation during crater modification of large terrestrial impacts. In order to bridge the gap between geological ground truth and dynamic, numerical modeling, we aim to construct a 3D structural model of the impact structure followed by kinematic restoration of deformation that leads to formation and collapse of its central uplift.

The Vredefort Dome is the eroded remnant of a collapsed central uplift of a Paleoproterozoic impact structure[1]. The central part of the Dome, approximately 40 km wide, consists of Archean (>3.0 Ga) granitoids and is surrounded by steeply dipping and overturned sedimentary and volcanic strata of Proterozoic (3.0 - 2.1 Ga) age, known as the collar around the crystalline core. To the north and west, the collar rocks are well exposed and form a series of concentric morphological quartzite ridges and valleys along less resitant shale horizons around the core, whereas to the east and the south, the central uplift is covered by the Phanerozoic Karoo Supergroup.

Methods: Using the software *GOCAD* and *GeoModeller* (Intrepid Geophysics), we attempt to construct a 3D model of the collar rocks. The modell will include the attitude of prominent marker surfaces (sedimentary strata and lithological interfaces) as well as impact-induced discontinuities known from field analysis and geophysical imaging. Exposure of pre-impact rocks is largely limited to the northwestern quadrant of the impact structure and will, thus, constrain the 3D model. The construction of a multi-surface model from this portion of the collar will not only involve marker surfaces but also take into account the volume of lithological groups, e.g. the West Rand Group (Fig. 1), in between major lithological interfaces. As more structural information becomes available from the field and geophysical imaging, the model will consider also the geometry of major discontinuities and local deformation on lithological interfaces.

Following construction of a 3D model, the data set will be imported into *3DMove* (Midland Valley Inc.) to conduct further structural analyses and 3D kinematic restoration. The first step in this procedure will be to eliminate possible effects of post-impact deformation by restoring displacements on post-impact faults, and will result in the geometry of rocks attained upon the end of the modification stage. This model will be used to interpolate the other three quadrants to generate a full circumferential model, on which the "dome inversion tool" of *3DMove* will be applied. Passive back rotation of marker horizons and application of the "volume tracker tool" will allow to estimate the rock volume that was translated during central uplift formation. The tracker tool will also serve to check the plausibility of the kinematic restauration.

Expected results: Although the accuracy of earth models on a crustal scale is often limited, modern geophysical methods will allow to reliably image the deep structure of the Vredefort Dome. The visualization of structural elements as intended in this study will provide new insights into the deep structure of the Vredefort Dome and into the processes associated with crater modification of large terrestrial impacts. In particular, an estimate of the displaced rock volume can provide information on the relative importance of doming and inward-directed mass transport during central uplift formation. The correlation of the moved rock volumes with the current deep structure of the impact structure can also show how much material passed through the core and is today removed by erosion.

References: [1] Reimold W. U. and Gibson R. L. (2006) *Chem. Erde, 66*, 1–35. [2] Lana C. et al. (2006) *S. Afr. J. of Geol., 109*, 265-278. [3] Henkel H. and Reimold W. U. (2002) *J. Appl. Geophys.*, 43–62. [4] Ivanov B. (2005) *Sol. Sys. Res., 39*, 381-409. [5] Bisschoff A. A. and Mayer J. J. (1999), *Council for Geoscience, Pretoria*, Geol. Map 1:50.000.

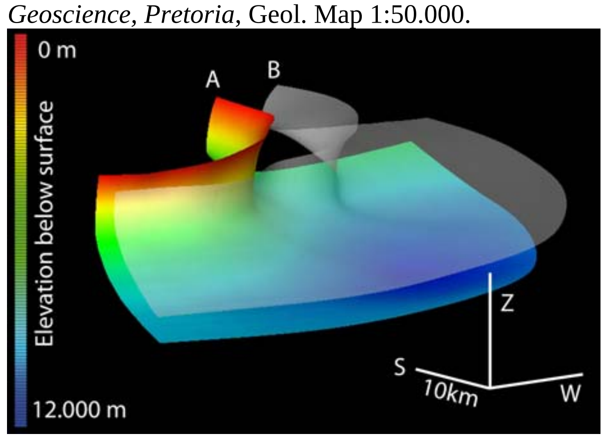

Figure 1: Crude 3D model of the northwestern portion of the Vredefort impact structure inferred from the orientation of strata at surface [3, 5]. The model shows the base (surface A) and top (surface B) of the West Rand Group. View is from northeast.