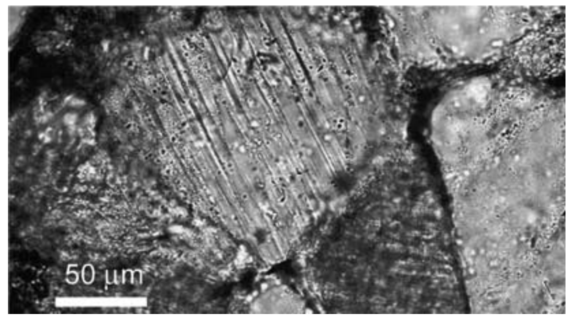
NEW STRUCTURAL CONSTRAINTS ON THE UPHEAVAL DOME IMPACT CRATER: T. Kenkmann[1] and D. Scherler[1], [1]Institut für Mineralogie, Museum für Naturkunde, Humboldt-Universität Berlin, Invalidenstrasse 43, D-10115 Berlin, Germany, thomas.kenkmann@rz.hu-berlin.de.

Introduction: The Upheaval Dome structure, Utah, is a deeply eroded complex impact crater of 6-9 km final diameter, which allows a detailed structural analysis of the crater floor due to a superb exposure. Based on a geological map of the impact structure [1] and own data, we constructed new cross sections through the crater floor. The technique, which is known as balanced section construction [2], was applied semiquantitatively using methods of thin-skinned tectonics to unravel the kinematic history of crater modification. The basic premise behind this method is the requirement of compatibility which implies a variety of geometric constraints. The constructed section must be restorable to an undeformed stratigraphic template, that was present before the impact. Deformation during crater collapse occurs on more or less radial rather than plane-strain trajectories. Therefore gains and losses of material during inward and outward flow are typical on a 2-D section. To achieve a balanced volume, the evolution of layer thickening and thinning with respect to crater position has to be mapped (Fig.2). With this information available, pre-collapse positions of layers can be calculated. However, for a complete kinematic restoration 3D balancing technique is required.

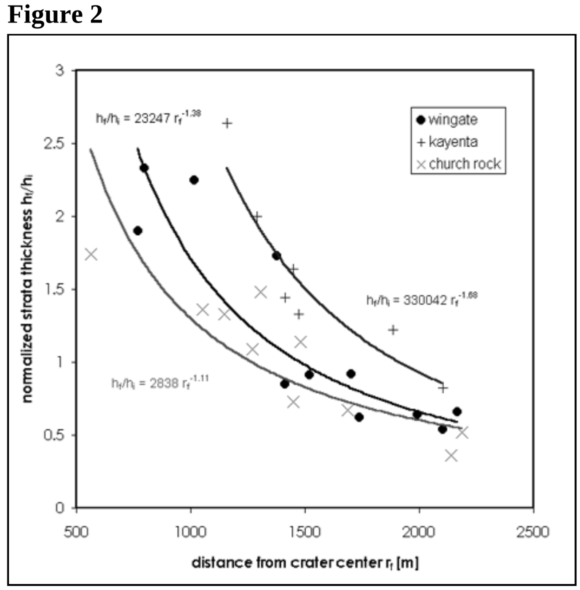
Results: Frequent findings of multiple sets of planar fractures (PF) and decorated PFs in quartz grains of the White Rim Sandstone from the innermost part of the central uplift confirm the impact origin of the Upheaval Dome structure (Fig.1). The proof of the existence of planar deformation features (PDF) by transmission electron microscopy is still to be done. PFs provide a shock pressure limit of approximately 5-7 GPa. The exposed hangingwall units such as the Wingate Sandstone do not display PFs. These informations on shock pressure can be used to define the pre-collapse position of the layers beneath the transient cavity (Fig. 3). Our preliminary restoration of the exposed layers also considers changes in layer thickness with respect to crater position. Strata thickening/thinning during convergent inward flow obeys a power law function of the form: $h_f/h_i = A\ R_f^{\ y}$, with h_f being the thickness of a layer at a radius R_f from the impact center, h_i being the initial layer thickness, and y being a power law factor, which ranges between –1.1 and –1.7 for various measurements at Upheaval Dome (Fig. 2). The initial position, R_i, and the magnitude of horizontal displacement, $R_i - R_f$, of a slab can be determined by calculating the integral of the power law function in the limits of the slab extent and comparing the area with an undeformed strata where $h_f = h_i$. Changes in layer thickness during the collapse of the transient cavity were accommodated by bedding parallel detachment faulting. The magnitude of inward motion for the marker beds displayed in Figure 3 and 4 is about 460 m for Kayenta F., 290 m for the Wingate Sandstone, and 130 m for the Church Rock Member of the Chinle Formation.

Figure 1



Based on pressure estimates, we suggest that the Navajo Sandstone was overlain by approximately 1500-1600 m sediment, when the projectile struck the Earth, corresponding to an Upper Cretaceous age of the impact. This is in principal agreement with [3]. The structure of the central uplift and surrounding ring syncline indicates an oblique impact from WNW. The cross section (Fig.4) is constructed parallel to this proposed impact vector. It shows a central uplift, that is

Figure 2



thrusted onto the eastern ring syncline along steeply dipping reverse faults. This possibly reflects the residual oblique momentum carrying material downrange. The cross section also displays an assymmetry of the central uplift: The western flank is moderately inclined in comparison to the eastern one. Bedding-parallel thrusting is more strongly evolved in the eastern part and indicates enhanced downrange shortening. Furthermore, the geological map of [1] shows a large, WNW striking radial transpression ridge [4], similar to the classical one, evolved uprange in the lunar crater King [5]. Finally, iris-like thrust lamellae, leaning up against the core of the central uplift [6], preferentially show a material transport from W to E.

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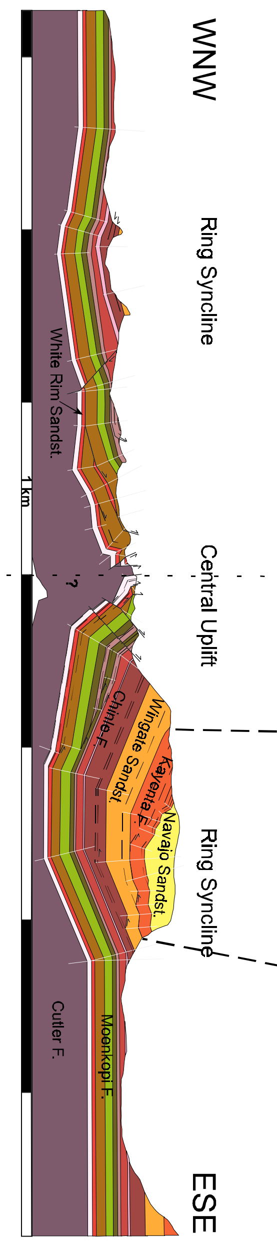

Figure 4

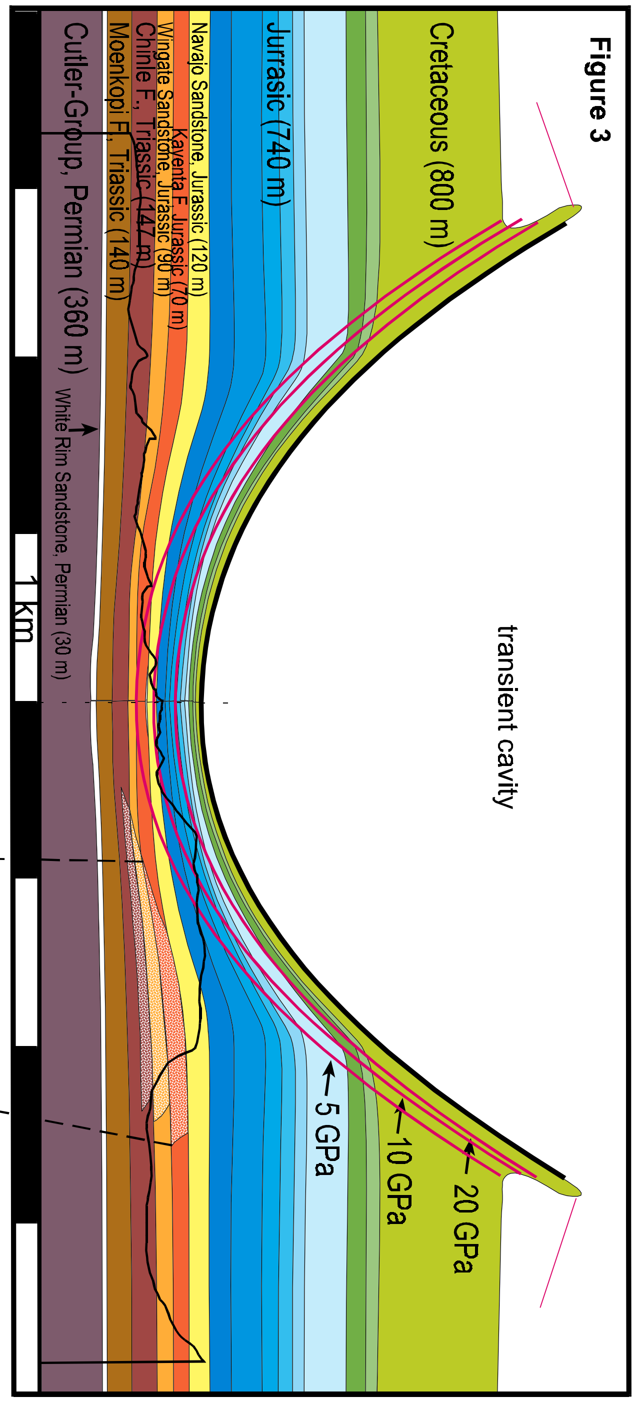

Figure 3