Structural record of an oblique impact: the central uplift of the Upheaval Dome impact structure, Utah, USA *Vortrag*

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Introduction

Most asteroids strike their target at an oblique angle (Pierazzo & Melosh 2000). The common criterion for identifying craters formed by an oblique impact is the pattern of the ejecta blanket. On Earth, however, ejecta blankets are rarely preserved and morphological, structural, geophysical as well as depositional criteria were used to infer an oblique impact (e.g. for Chicxulub, Schultz & D'Hondt 1996, Ries-Steinheim, Stöffler et al. 2003, Mjölnir & Tsikalas 2005). However, the significance of such criteria in predicting impact angle or direction is a matter of debate (*c.f.* Schultz & Anderson, 1996, Ekholm & Melosh 2001). Particularly, it is not yet known whether there is an influence of the impact angle on the displacement field during the collapse of large transient cavities, and thus, the final crater. For most impact angles, the shape of the final crater is controlled by its size. At a critical diameter (ca. 2–5 km on Earth), simple bowl shaped craters are getting gravitationally unstable and collapse to form complex craters, with a flat floor and a terraced rim (Melosh 1989). During collapse, the crater floor rises to form a central uplift, that may or may not be visible as a central peak, or, when the peak in turn collapses, as a peak ring at yet larger diameters.

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Results and Discussion

We present structural details from the central uplift of the Upheaval Dome impact structure, in SE Utah, that are diagnostic of the kinematics during crater collapse and central uplift formation. A characteristic imbrication of thrust slices towards the southeast (see Fig. 1), the pattern of strata orientation within the central uplift, dominant radial faults that accommodated NW–SE shortening and an elliptical bedding outline indicate, that the displacement field during crater collapse has not been axial symmetric. Instead, an additional lateral component, roughly towards the southeast, is preserved in the internal structure of the central uplift. The structural asymmetries are largest in the core of the central uplift and disappear outwards, thereby preserving the large-scale circular shape of the main structural elements (rim monocline, ring syncline). We propose, that this lateral component reflects a shift in the onset of crater collapse and the migration of the uplifting crater floor downrange (*c.f.* Kenkmann et al. 2005). Comparison with numerical models of oblique impacts supports this view (Shuvalov 2003, Shuvalov & Dypvik 2004) and further suggests, that the asymmetric displacement fades in the later stages of central uplift formation, which provides an explanation for the largely circular appearance of complex impact craters. Fault patterns, that are strikingly similar to that in the innermost part of Upheaval Dome, can be identified in other impact structures (Fig. 2) and

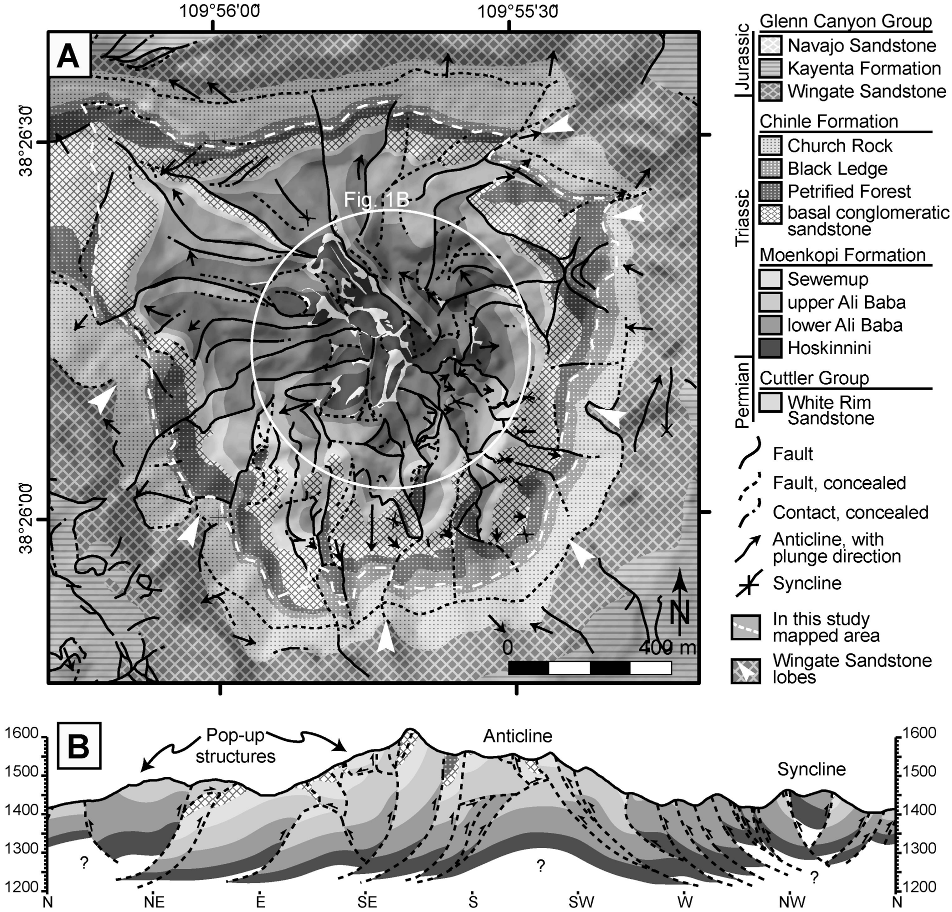

Figure 1: (A) Geological map of the central topographic depression of the Upheaval Dome impact structure. (B) Circular schematic cross section, trace as given in A. Variable thickness of the units mainly due to dip of strata out of the plane of intersection.

may serve as general criteria for identifying the impact direction of deeply-eroded impact structures.

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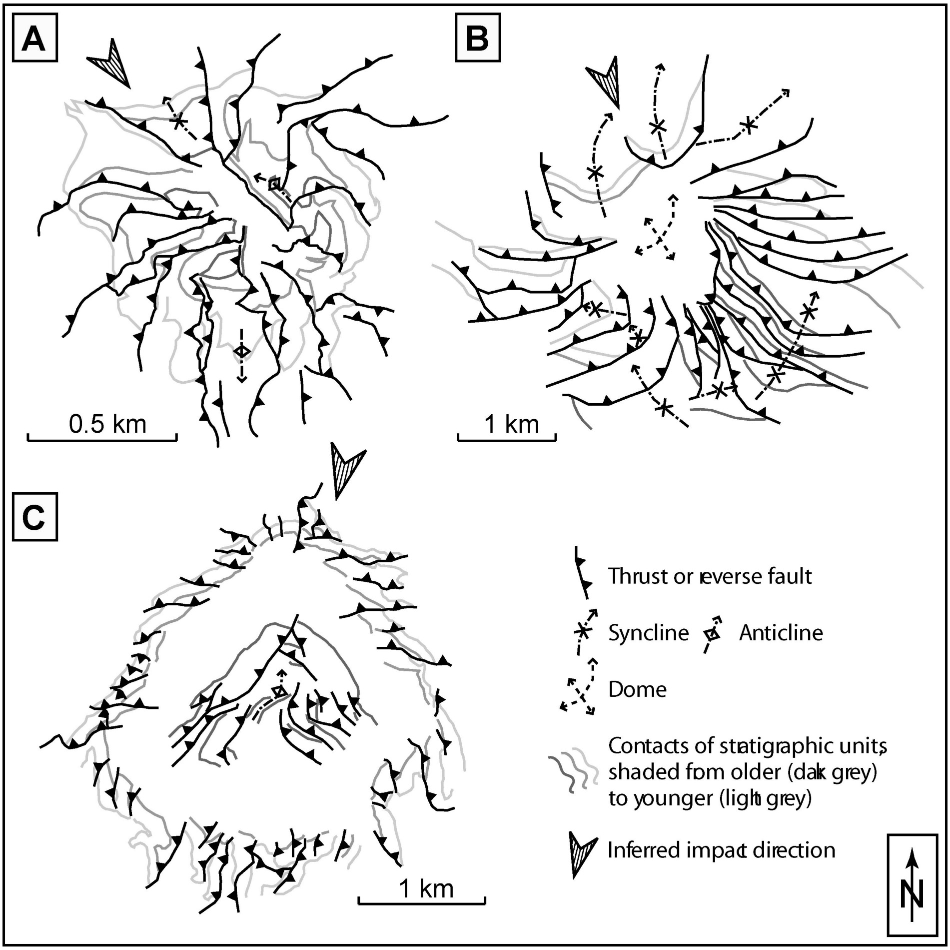

Figure 2: Simplified sketches of faults and contacts from the innermost part of the central uplifts of eroded complex craters in sedimentary target rocks: (A) Upheaval Dome, United States, D ca. 5.3 km, (B) Spider, Australia, D ca. 12 km (after Shoemaker & Shoemaker 1996), (C) Gosses Bluff, Australia, D ca. 24 km (after Milton et al. 1996).

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