UPHEAVAL DOME, UTAH, USA: IMPACT ORIGIN CONFIRMED. E. Buchner[1] and T. Kenkmann[2], [1]Institut für Planetologie, Universität Stuttgart, Herdweg 51, 70174 Stuttgart, Germany, e-mail: elmar.buchner@geologie.uni-stuttgart.de, [2]Museum für Naturkunde-Mineralogie, Humboldt-Universität zu Berlin, 10115 Berlin, Germany, e-mai: Thomas.Kenkmann@MUSEUM.HU-Berlin.de.

Introduction: Upheaval Dome is a unique circular structure on the Colorado Plateau in SE Utah whose origin has been controversially discussed for decades [1]. The "Sphinx of Geology" has been interpreted as a crypto volcanic feature, a salt diapir, a pinched-off salt diapir, and as an eroded impact crater. While recent structural mapping, modeling, and analyses of deformation mechanisms strongly support an impact origin, e.g., [2], [3], ultimate proof, namely the documentation of unambiguous shock features, has yet to be successfully provided.

Samples and methods: Our microstructural study focuses on rock samples collected from bedrocks of the Early Jurassic Kayenta Formation during a field campaign in September 2005. The samples were taken from bedrocks in the "Intermittent Creek" (Fig. 1) about 1.3 km northeast of the proposed crater center and 450 m southwest of the ring syncline axis. Here, we document a localized shock metamorphic overprint of quartz grains in sandstone samples making use of optical, scanning, and transmission electron microscopy (TEM).

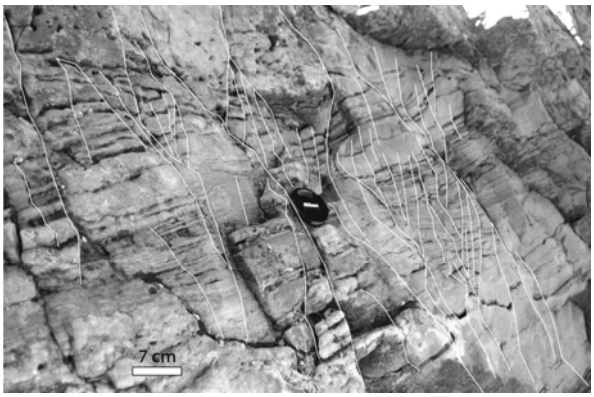

Fig. 1: Investigated rocks at the sample location about 1.3 km NE of the center of the crater. Sandstones of the Early Jurassic Kayenta Formation are partly brecciated and display narrow-spaced networks of meso-to-microscale faults.

Results and conclusions: We have documented quartz grains of the Upheaval Dome structure, Utah, USA, with multiple sets of thin planar lamellae, which we identify as decorated planar deformation features (PDFs). TEM analysis revealed that the lamellae are dislocation bands with extremely high dislocation densities that contain numerous fluid inclusions precipitated on the dislocations (Fig. 2). The original amorphous material of the lamellae was devitrified by thermal annealing. The documentation of PDFs provides the definite evidence for the impact origin of Upheaval Dome [4]. The documented PDF lamellae suggest shock pressures of ~10 GPa and probably more at 1.3 km distance from the crater center. This order of pressure magnitude is in conflict with significant lower pressures previously estimated. Possible explanations for elevated shock pressures are (a) local pressure excursions formed by shock-induced collapse of pore space, (b) impedance mismatches between feldspar and quartz, and (c) oblique impact trajectories.

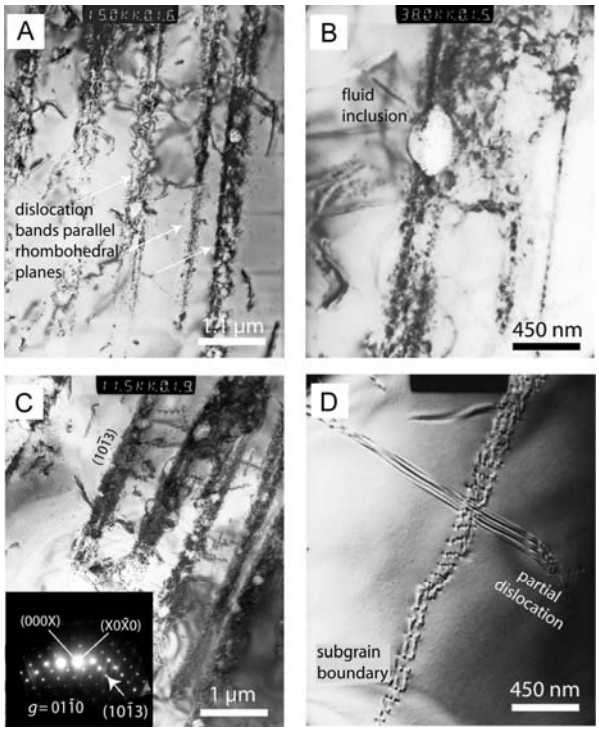

Fig. 2: Bright field TEM micrographs of quartz grains studied [4]; A: Rhombohedral lamellae are straight and parallel, and have varying thickness. The defect density is extremely high within the lamellae; B, C: the dislocation bands contain numerous bubbles and fluid inclusions <400 nm in diameter; D: Partial dislocation and low angle sub grain boundary.

References: [1] Koeberl C. et al. (1999) *Meteoritics & Planet. Sci., 34*, 861-868. [2] Kenkmann T. (2003) *Earth Plant. Sci. Lett., 214*, 43–58. [3] Okubo C. H. and Schultz R. A. (2007) *Earth Planet. Sci. Lett., 256,* 169-181. [4] Buchner E. and Kenkmann T. (2008) *Geology, 36,* 227-230.