LAKE BOSUMTWI DRILLING PROJECT: SHOCK METAMORPHISM IN ROCKS FROM CORE BCDP-8A VS. EXPERIMENTAL DATA. A. Deutsch, Institut f. Planetologie, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str.10, D-48149 Muenster, Germany (deutsca@uni-muenster.de).

General context: Shock barometry via petrographic analysis helps to understand cratering mechanics, especially mass movements in the central uplift, including its collapse in the late stage of cratering. Shock pressures recorded in lithologies of the central uplift may exceed 45 GPa, e.g., in the Vorotilovo core drilled into the center of the Puchezh-Katunki structure [1]. In other craters, shock levels of 35-40 GPa have been determined in rocks forming the uplift, a pressure, at which quartz is totally converted to diaplectic glass in crystalline rocks [2]. In addition, allochtonous breccia bodies in the central uplift may contain impact melt lithologies as either matrix or clasts.

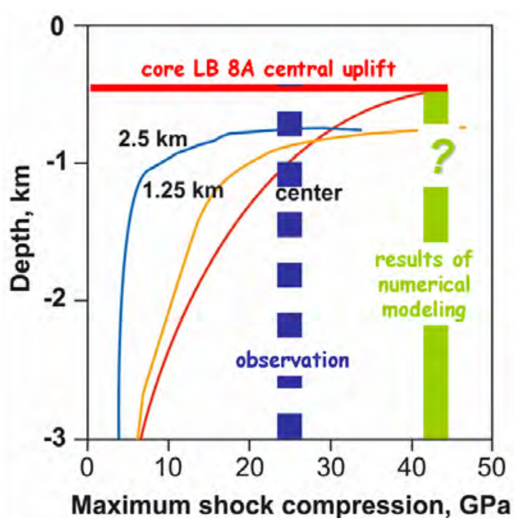

Figure 1. Depth – shock pressure graph for three modeled drilling locations at Lake Bosumtwi, at the crater center (red), 1.25 (yellow), and 2.5 km (blue) off the center. The green line corresponds to the modeled shock pressure for BCDP-8A, the blue one to the pressure recorded in the rocks. Modified after [6].

Shock metamorphism in the central uplift of the Lake Bosumtwi impact structure: There, petrography yielded a picture quite different to that one normally observed in terrestrial impact structures. The central uplift, drilled in 2004 by ICDP [3], comprises carbonaceous meta-greywackes and shales to slates, and subordinately various types of clastic-matrix breccias [4]. Surprisingly, the shock levels recorded in these rocks are only about 26 GPa [5], much less than expected (Fig. 1, [6]). Numerical modeling predicts [6] • presence of 100 – 200 m melt lithologies topping the central uplift and its flank, and • a shock level in excess of 40 GPa in the uppermost portion of the uplifted target rocks. Melt lithologies, however, are nearly absent, except for extremely rare mm-sized clasts of impact-melted material in polymict breccias. It is yet unconstrained whether this strange features are due to a specific shock behavior of the rather soft, porous and fluid-rich meta-sediments or related to so far not defined parameters of the cratering event (e.g., obliquity of the impact).

Table 1. Parameters for shock recovery experiments

Sample ∅10 mm d 0.5 mm	*P [GPa]*	*d flyer plate [mm]*	*D container [mm]*	*High explosive*
VZ-#10.929	34	4	9.5	Comp.B
VZ-#10.930	39.5	4	3.2	Comp.B

Experimental approach: To tackle the problem of the “surprisingly low shock metamorphic overprint”, shock recovery experiments were carried out with a conventional setup (Tab. 1 [7, 8]) at 34 and 39.5 GPa. The setup consists of the sample disk embedded into an ARMCO steel container as momentum trap, and an high-explosive driven flyer plate. The 0.5-mm-thick, both side polished sample disks were carbonaceous greywackes of a composition similar to the corresponding target lithology at the Lake Bosumtwi crater; i.e., a greywacke containing ≤20 vol.% calcite.

Results: Both experimentally shocked greywackes display intense fracturing (Fig. 2a) yet the respective original texture is fully preserved. At both shock levels, quartz grains display planar elements, and most of the quartz is transformed to diaplectic crystals (Figs. 2b, c). Calcite shows several sets of planar features (Fig. 2b) as well as multiple shock-induced polysynthetic twins (Fig. 2c). The observed shock effects compare well with data from single crystal shock experiments, and the generally accepted shock wave barometry [2, 8]. These results indicate that the shock behavior of carbonaceous greywackes is not completely different to that one of singly crystal quartz crystals or quartz-rich meta-sandstones [2, 8, 9].

Conclusions and outlook: Both experimentally shocked greywackes contain diaplectic quartz crystals. Suevite from locations outside the crater rim [10, 11] contain diaplectic crystals, coesite, as well as true melt glasses. In contrast to this ejecta, lithologies cored in

BCDP-8A seem to lack highly shocked material; preliminary lithological characterization of the breccias occurring in core BCDP-7A (in the annular moat) indicate also an only minor amount (if at all present) of impact melted materials there. Taken these observations together, a specific shock behavior of the soft target material (carbonaceous greywackes, shales, slates) is excluded as prime reason for the generally low shock levels recorded in different lithologies inside the Lake Bosumtwi impact crater. This surprising feature may be related rather to an oblique impact. Refined numerical modeling may help to better understand the observational data.

References: [1] Masaitis V. L. and Pevzner L.A. (eds.) *Deep Drilling in the Puchezh-Katunki Impact Structure*. St. Petersburg, VSEGEI Press, 1999, 392 pp. [2] Langenhorst F. and Deutsch A. (1998) *Mineralogy of Astroblemes - Terrestrial Impact Craters.* In A.S. Marfunin (ed.), Chapter 1.10., pp 95-119, Springer. [3] Koeberl C. et al. (2005) *Lunar Planet. Sci. Conf. XXXVI*, Abstr. #1350. [4] Deutsch A. et al. (2006) *Lunar Planet. Sci. Conf. XXXVII*, Abstr. #xxxx. [5] Luetke S. et al. (2005) *Lunar Planet. Sci. Conf. XXXVII*, Abstr. #xxxx. [6] Artemieva N., Karp T., Milkereit B. (2004) *Geochem. Geophys. Geosyst., 5*; [7] Ivanov B.A. et al. (2002) *GSA. Spec. Pap., 356*, 587-594. [8] Langenhorst F. and Deutsch A. (1994) *EPSL, 125*, 407-420. [9] Huffman A. R. and Reimold W. U. (1996) *Tectonophysics, 256*, 165-217. [10] Deutsch A. et al. (2005) *Meteoritics & Planet. Sci., 40,* A40, Abstr. #5172.

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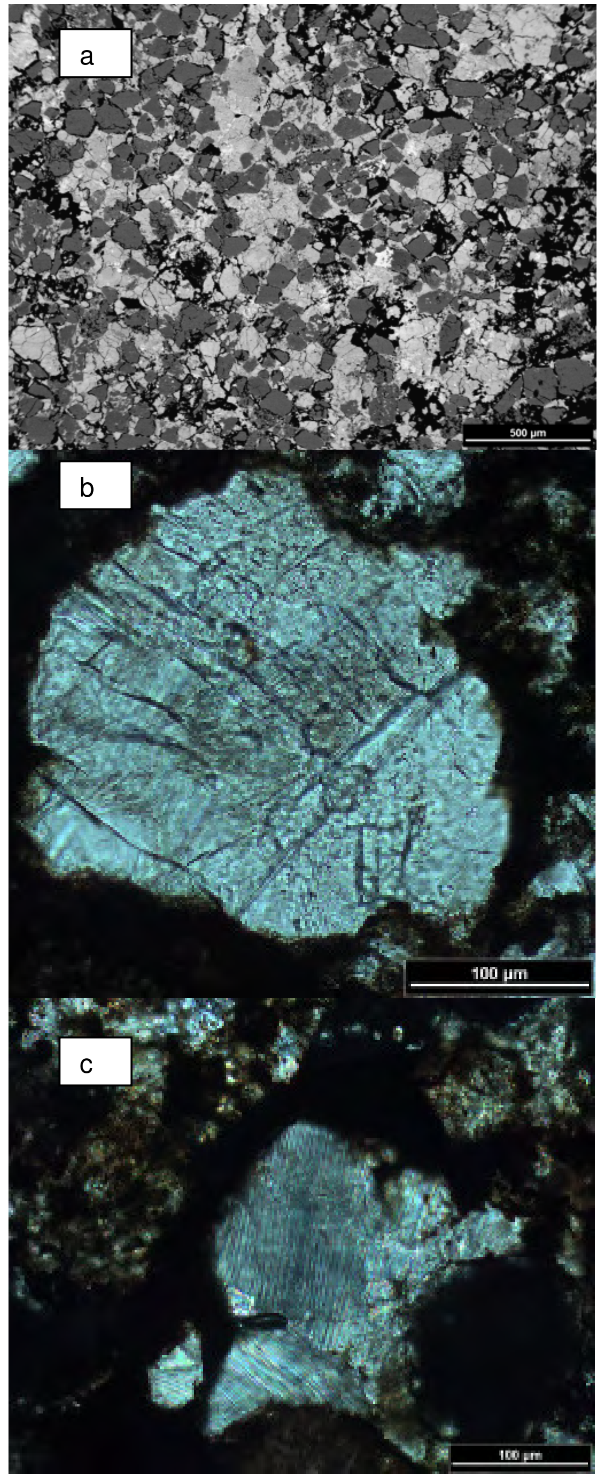

Figure 2. (a) SEM overview of an carbonaceous greywacke, shocked at 34 GPa, (b) Calcite with planar elements, and (c) mechanical twinning. Note that quartz is mostly transformed to diaplectic xx; // Nicols (Vz-# 10.929, 34 GPa, sample VÑ2).