A STUDY OF SHOCKED QUARTZ IN BRECCIA FROM THE ROCK ELM IMPACT STRUCTURE.

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Introduction: Planar fractures resembling cleavage in quartz are a diagnostic indictor of shock metamorphism [1]. Occurrences of shocked-quartz bearing sandstone breccia have been reported at the Rock Elm impact structure in Wisconsin (USA). In this study we report an occurrence of suspected impact breccia from Rock Elm based on the documentation of quartz with planar fractures.

Rock Elm Impact Structure. The Rock Elm structure is recognized as an area of anomalous circular deformation over an area with a diameter of 6.5 km in west-central Wisconsin [2]. Characteristic shock-metamorphic features developed in quartz have provided evidence for the meteorite impact origin of the Rock Elm structure [3,4]. The age of the Rock Elm impact structure is approximately 470 Ma [2,3].

Planar fractures are a common microstructure that occurs in shocked quartz [1], and are believed to form at pressures <10 GPa. At Rock Elm, planar fractures are the most widely recognized indicator of shock metamorphism [3].

Samples/Methods: A sample of suspected impact breccia (sample 13RE07) was collected as 'float' from the central uplift of the Rock Elm structure in May 2013 (N 44° 43.025' W 92° 13.820'). The breccia sample is orange to red in color, and has an overall oxidized appearance (Fig. 1). The sample contains sand to pebble-sized clasts and is poorly sorted; it does not resemble well-bedded outcrops of Mt. Simon sandstone in the vicinity. Rock slabs were cut and thin sections were prepared. Plane polarized and cross-polarized light microscopy were used to search for quartz grains with planar microstructures.

Results: The matrix has a reddish color and is generally opaque. The sample contains individual grains of quartz and plagioclase, and also lithic clasts. Quartz grains range from rounded to angular and vary in size. Lithic clasts contain mostly clay and quartz, and some have rare muscovite; all clasts appear to be sedimentary. A total of 42 shocked quartz grains were found in two thin sections. Shocked quartz grains range from 3 mm to 0.5 mm in size, and range from rounded to angular. Up to two orientations of planar fractures were found in some shocked quartz grains, and also feather features, a previously recognized shock microstructure at Rock Elm [3].

Grain 13RE07-39 is the largest and best example of shocked quartz identified (Fig. 2).

A focused study was made on grain 13RE07-39 to measure the spacing between planar fractures. Measurements of planar fracture spacing were made along three transects. The average planar fracture spacing is 105 μm, although the mode is at approximately 40 μm.

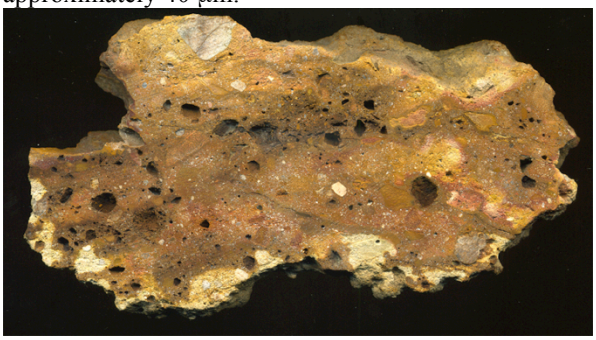

Figure 1: Cut rock slab from sample 13RE07 (unpolished). Not the heterogeneous orange-red color, and many voids. Horizontal dimension of image is approximately 20 cm.

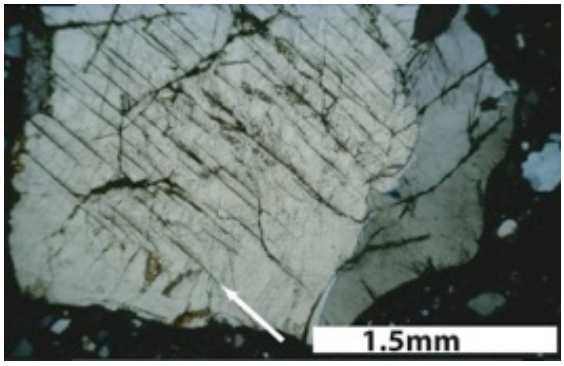

Figure 2: Quartz grain 13RE07-39. This large grain shows one dominant orientation of planar fractures (see arrow). Cross-polarized light.

Discussion: The presence of quartz with planar fractures in sample 13RE07 confirms an impact origin for this sample. We propose that this sample is a sedimentary breccia of impact origin based on the lack of sorting, lack of bedding, chaotic appearance, and highly altered state, which differs substantially from bedrock exposures of the Mt. Simon sandstone in the central uplift. Additional studies of this sample are ongoing.

References: [1] French, B. M. (1998) *LPI.* [2] Cordua W. S. (1985) *Geology, 13,* 372-374. [3] French B. M. et al. (2004) *GSA Bull., 116,* 200-218 [4] Roig C. I. et al. (2013) *LPS* Abstract #2685.