SHOCK EFFECTS IN MICA AND RUTILE FROM IMPACT BRECCIA MATRIX, WETUMPKA IMPACT CRATER, ALABAMA

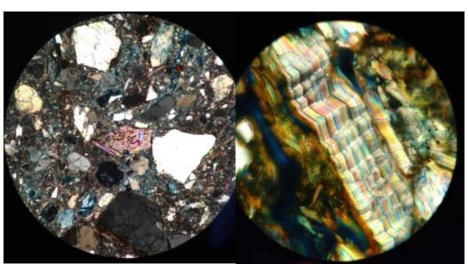
N. S. Chinchalkar[1], W. E. Hames[1] and D. T. King, Jr.[1] [1]Geosciences, Auburn University, Auburn, AL 36849 USA

Introduction: The Wetumpka impact structure is an arcuate rimmed feature of the inner Coastal Plain, which is irregular in shape and possesses a maximum diameter of 7.6 km. Wetumpka is a Late Cretaceous (84.4 ± 1.4 Ma) [1] shallow-marine impact structure [2], which is located in and near the town of Wetumpka in Elmore County, Alabama. The impact structure is composed of a raised, crystalline rim, an unconsolidated Upper Cretaceous sedimentary crater-filling deposit, and an external, southern terrain composed of dipping fault blocks [2]. The target materials were weathered crystalline rock, which was overlain by poorly consolidated sediments of the (1) Tuscaloosa Group and (2) Eutaw Formation. Coeval Moorville Chalk, which crops out nearby, was forming on the adjacent continental shelf, and at the crater, now occurs as thin, intermittent layers of a marine resurge deposit [2]. Discovered by the late Tony Neathery [3], Wetumpka's confirmation as an impact structure was established by analysis of quartz with impact-induced PDFs and a cosmic element trace-element analysis [2].

The current research focuses on the central outcrops which consist of an unusual polymict impact breccia facies, which contains various sub-rounded to sub-angular fragments of quartzites, schists, and gneisses (from the pre-Mesozoic basement) that reside in sandy matrix derived from the disintegration of Upper Cretaceous target rocks [4]. This breccia facies has been interpreted as proximal ejecta that has moved back into the impact structure due to rim failure and collapse [4].

Rationale and Findings: Proximal ejecta at many impact structures of comparable size to Wetumpka are known to have coarse textures and high shock levels [4]. Outcrop samples of the breccia matrix were collected for laboratory studies to identify as many impact signatures as possible including melt particles, shock features, and high temperature/pressure polymorphs. While this work is continuing, we report here for the first time at Wetumpka, shock features that have been newly identified in thin sections: (1) kink-banding in micas and (2) apparent shock features in detrital rutile.

Results and Discussion: Figure 1 shows kink-banding in a mica from the impact-breccia matrix (L, in context, and R, another grain close up). Even though kink-banding is not strictly a diagnostic feature of impacts, we suggest the example shown below is of impact origin given its close association with shocked quartz [4] and the impact-affected rutile noted next. Back-scattered electron (BSE) imaging and energy dispersive spectroscopy (EDS) was used to further study impact-affected rutile. Figure 2 shows BSE imaging and WDS elemental mapping of Fe showed that the matrix contains a significant amount of iron. Brighter phases from the stage scan (Fig. 2A) were targeted for further analysis. The rutile which was identified with EDS showed parallel lamellae with a density contrast in BSE image (Fig. 2B) and surficial fractures in SEM image (Fig. 2C). However, Ti and Fe maps (Figs. 2D, E) do not show any particular lamellae. Shocked rutile has been reported from Chesapeake Bay impact [5] and in other ultra-high pressure metamorphism [6]. Rutile's layered structure may be due to high-pressure twinning and associated compositional change [6]. We intend to further analyze these Wetumpka rutile grains to understand how their internal structure relates to impact metamorphism.



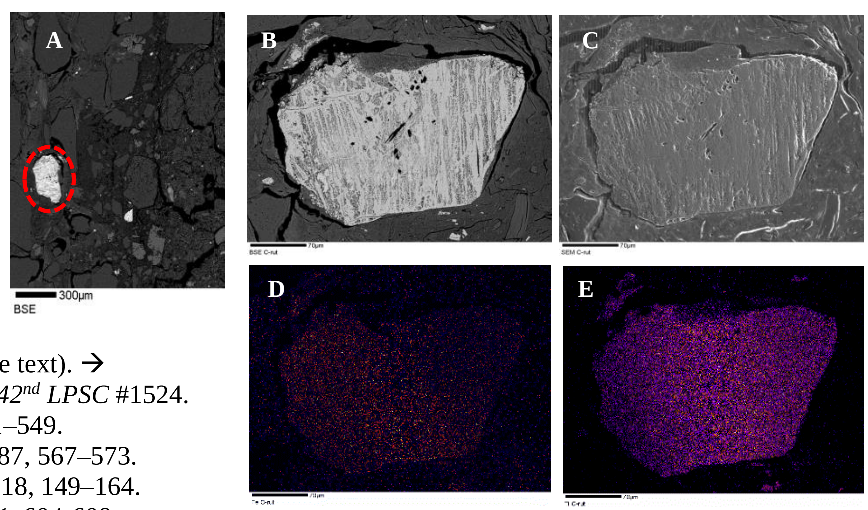


Figure 1 (above): Kink-banding in micas (see text).

Figure 2 (at right): A-E. Rutile images (see text). →

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