FLYNN CREEK IMPACT STRUCTURE, TENNESSEE: ITS CRATER-FILLING BRECCIA IN COMPARISON TO OTHER SMALL PALEOZOIC IMPACT STRUCTURES AND THEIR BRECCIA UNITS. D. T. King[1], D. R. Adrian[1], J. Ormö[2], L. Petruny[1], J. J. Hagerty[3], T. A. Gaither[3], and S. J. Jaret[4]
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Introduction: Flynn Creek crater is a Late Famennian, marine-target impact structure, 3.8 km in diameter, which is located on the northeastern edge of the Central basin of Tennessee (Figs. 1 and 2) [1, 2]. The Flynn Creek impact occurred in an epicontinental shelf setting (Fig. 3) in marine waters that may have been a few 10s of m in depth. The target stratigraphic section was composed of Ordovician carbonates; the crater is filled with impact-related breccia several 10s of m thick. The overlying, post-impact unit is the Devonian Chattanooga Shale.

Analog Craters: We compared the crater infilling sequence at Flynn Creek crater with that of two other small, Paleozoic epicontinental marine-shelf impact craters formed in target carbonate sections that have crater-filling breccia sequences with sedimentary characteristics in common with Flynn Creek crater. They are Lockne, Sweden (7.5 km) [3, 4] and Kärdla, Estonia (4 km) [5, 6]. Specifically, the crater-filling breccia sequence found in Flynn Creek and these other two craters consists of 1) rock-avalanche deposits from the transient crater walls, which can be mixed with melt bodies and slumped material from the sedimentary target sequence (e.g., dark shale at Lockne [3]) derived from the collapsing crater rim and related ejecta flaps; 2) partially debris flow-like and partially suspension deposited marine resurge deposits that terminate in either (a) graded turbidite deposits or (b) a thick 'settling-out' sequence that has a relatively high amount of distal ejecta materials (i.e., shocked quartz grains and melt particles) that were suspended in the water column; and 3) post-impact sedimentation units (i.e., normal shelf sedimentation plus any detritus from organisms living on the raised crater rim).

Variations in water depth, size of impactor (and thus final crater size), and other factors such as impact angle and target properties (e.g., presence of interbedded clastics and/or crystalline basement) may also be factors in the differences in the composition (including whether or not there is any melt) impact breccia and thickness of the resulting impact structure-filling breccia unit. In this paper, we present a description of the Flynn Creek breccia and compare its petrology, vertical sequence, and inferred provenance to the impact-related, crater-filling breccia units at Lockne and Kärdla.

References: [1] Roddy D. J. (1968) *Shock metamorphism of natural materials*: Mono Book Corp., Baltimore, 277-308. [2] Evenick J. C. (2005) *Field guide to Flynn Creek impact structure*. [3] Ormo J. et al. (2007) *Meteoritics & Planet. Sci., 32*. [4] Sturkell E. F. F. et al. (2013) *Meteoritics & Planet. Sci., 48*, 321-338. [5] Puura V. and Suuroja K. (1992) *Tectonophysics, 216*, 143-156. [6] Purra V. et al. (2004) *Meteoritics & Planet. Sci., 39*, 425-451.

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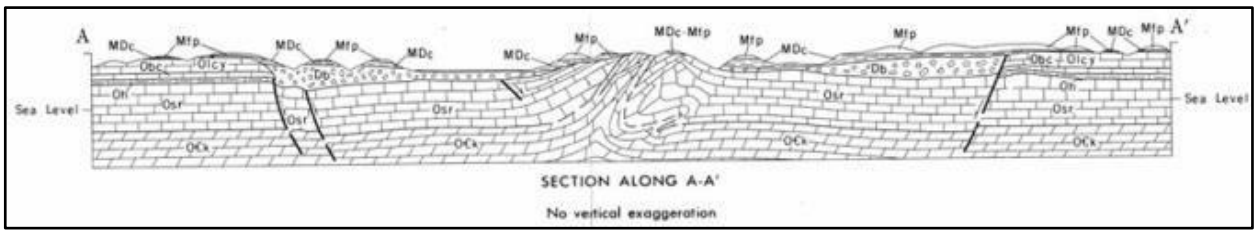

Figure 1. Cross-section of Flynn Creek impact structure, Tennessee, according to David Roddy [1].

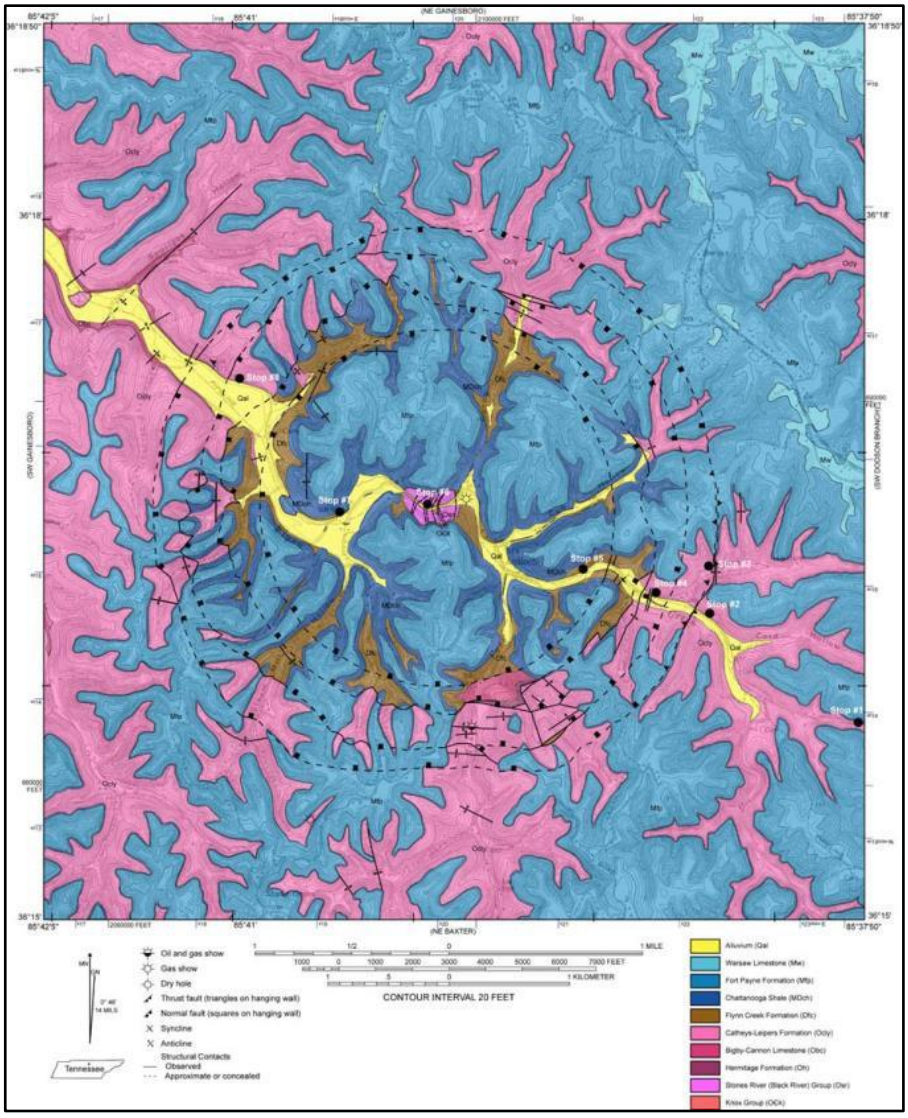

Figure 2. Geological map of Flynn Creek impact structure, Tennessee, according to Jonathan Evenick [2].

Figure 3. Paleogeographic setting of Flynn Creek impact. Star is approximate location of impact. Note U.S. state outlines. Faminnean map is from www.nau2.edu.