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Marine resurge sequences in drill cores from Flynn Creek impact structure, Tennessee, USA.

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Abstract

The Flynn Creek impact structure, a Late Devonian marine-target crater, contains a moat-filling sequence of normal graded beds (~ 30 m) that lie atop chaotic (slump?) breccia deposits. The present report focuses on the graded beds, including their granulometric characteristics and interpreted marine-resurge origin.

1. Introduction and aim of study

Roddy [1-4] first presented evidence that the Flynn Creek impact structure is a Late Devonian, 3.8-km diameter, complex impact crater, which formed in an epicontinental shelf sea. These early works by Roddy established Flynn Creek as the first interpreted marine-target impact crater on Earth. The Flynn Creek impact structure is located in north-central Tennessee USA (36° 17' N; 85° 40' W) and is well exposed at the surface. The crater has a terraced rim with an asymmetric ("pear-shaped") outline (Fig. 1), and displays a central uplift surrounded by a breccia-filled crater moat [4-6]. The target stratigraphic section was nearly flat-lying, mostly poorly consolidated, Upper Ordovician carbonates ranging from Knox Group through Catheys-Leipers Formation [4-6]. Almost all rim exposures consist of Catheys-Leipers Formation, whereas the central uplift exposures consist primarily of Knox and Stones River Groups [4-6]. Central uplift-flanking breccias are mainly coarsening upward slump deposits [7], whereas the upper moat shows normal graded breccias (this study). Upper Devonian Chattanooga Shale deposition had likely begun at the time of impact, but comprised a very thin, poorly consolidated target layer. The main phase of Chattanooga deposition is the regional post-impact deposit [4-6, 8].

2. Methods

Analysis of two drill cores, one in the northeastern moat area (FC77-3) and one in the southwestern moat area (FC67-3) was completed using granulometric line-logging and statistical analysis following the method applied to similar deposits in Lockne, Tvären, and Chesapeake Bay (CBIS) marine-target impact craters [9, 10].

3. Results and discussion

On the northeastern side of the moat (FC77-3) the complete breccia sequence is ~ 35 m thick, whereas on the southwestern side (FC67-3) it is ~ 112 m. Results presented here focus on the upper graded beds, which comprise the upper ~30 m in both drill cores. Our line-logging shows that both drill cores contain thick sequences of chaotic (slump?) breccia with overlying normal graded beds (Figs. 2&3). In both cores, the grain size (φ=-1*Φ) decreases upward in the upper part, whereas the sorting is improving (i.e., a lowering of the standard deviation σ of φ). With upward fining, there is also a steep increase in the number of clasts per meter until the effect of the applied cut-off grain size ≤5mm becomes visible at 11.5m and 23.5m respectively (Figs. 2-4). These patterns are consistent with other suspension flow resurge deposits overlying more chaotic material moved by traction as seen at Lockne, Tvären and CBIS [9, 10].

4. Conclusions

Our data set from the upper ~ 30m of both crater-moat drill cores shows tell-tale sedimentological characteristics of water-rich marine resurge deposition in which particles entrained in the return flow of water were deposited during the early modification stage of the marine impact event.

References

[1] Roddy, D.J.: *The Paleozoic crater at Flynn Creek, Tennessee*, Ph.D. thesis, Cal Tech, 1966. [2] Roddy, D.J.: In *Shock Metamorphism of Natural Materials*, Mono Book Corporation, Baltimore, pp. 291-322, 1968. [3] Roddy, D.J.: In *Impact and Explosion Cratering*, Pergamon, New York, pp. 277-308, 1977. [4] Roddy, D.J.: LPSC X Abstracts, pp. 2519-2534, 1979. [5] Evenick, J.C.: *Field Guide to the Flynn Creek Impact Structure*, U. Tennessee, Knoxville, 2006. [6] Gaither, T.A., et al.: LPSC XLVI Abstracts, #2089, 2015. [7] Adrian, D.A., et al. Meteoritics and Planetary Science, Vol. 52 (in press), 2017. [8] Schieber, J., and Over, D.J.: In *Understanding Late Devonian and Permian-Triassic Biotic and Climatic Events: Towards an Integrated Approach*, Elsevier, New York, pp. 51-70, 2005. [9] Ormö, J., Sturkell, E., and Lindström, M.: Meteoritics and Planetary Science, Vol. 42(11), pp. 1929-1944, 2007. [10] Ormö, J., Sturkell, E., Horton, J.W., Jr., Powars, D.S., and Edwards, L.E.: Geological Society of America Special Papers, Vol. 458, pp. 617-632, 2009.

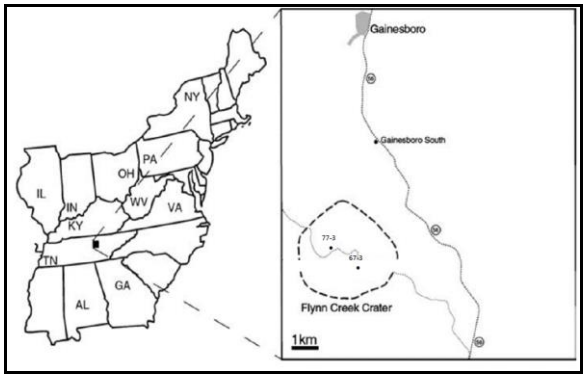

Figure 1. Map of the eastern USA; Tennessee is marked TN. Inset map shows location of Flynn Creek impact structure and relative position of drill cores FC77-3 and FC67-3 on opposite sides of the central uplift (not shown). Asymmetrical outline [1, 2] is dashed.

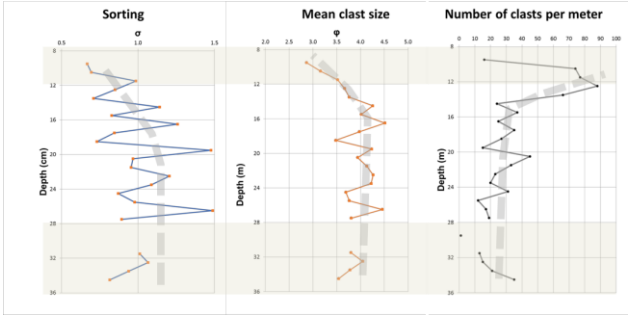

Figure 2. Main granulometric statistics from line logging of drill core FC77-3. Gray-shaded areas indicate where the cut-off grain size (top) as well as large blocks (bottom) affect the statistics [cf. 9]. Dashed line is our inferred trend line (i.e, not reflecting absolute values).

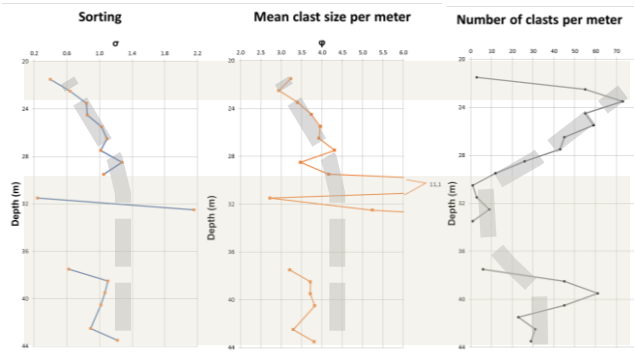

Figure 3. Main granulometric statistics from line logging of drill core FC67-3. Gray-shaded areas indicate where the cut-off grain size (top) as well as large blocks (bottom) affect the statistics [cf. 9]. Dashed line is our inferred trend line (i.e, not reflecting absolute values).

Figure 4. Representative lithological views of progressively fining upward core segments, 7.5 cm in length, from crater moat FC drill cores. From right to left: lower coarse breccia; finer upper breccia; fine upper breccia with clast size under the 5 mm cut-off grain size; and post-impact Chattanooga Shale.