MARINE RESURGE SEQUENCES AND OTHER CRATER MODIFICATION-RELATED PROCESSES AT FLYNN CREEK IMPACT STRUCTURE, TENNESSEE. L. De Marchi[1] J. Ormö[2], D. T. King Jr.[1], and D. R. Adrian[1] [1] Geosciences, Auburn University, Alabama USA (lzd0034@auburn.edu), [2]Centro de Astrobiología (INTA-CSIC), Spain.

Introduction: The Flynn Creek structure is a 3.8 km, marine-target complex crater located on the northeastern edge of the central basin of Tennessee. The impact event occured during Late Devonian in an epicontinental sea that covered Upper Ordovician flat lying carbonate rocks ranging from Knox Group to Catheys Leipers Formation [1-4]. In general, rim exposures are formed by the younger strata (Catheys-Leipers), whereas the central uplift is underlain by older Knox and Stone Rivers Groups rocks [5]. After the impact, the crater was filled with fall-back, slumping and resurge related sediments forming the breccia deposits within the crater moat. The entire structure was then overlaid by the Chattanooga Shale, which deposition had likely begun at the time of impact, but comprised a very thin, poorly consolidated target layer. The shale was then overlaid by the Mississippian Maury and Fort Payne formations.

Methods: Analysis of two drill cores, one in the northwestern moat area (FC77-3) and one in the south-eastern 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 [6, 7]. Petrographic analysis of 69 thin sections, allocated along the cores, were also carried out in order to complement the line-logging studies and identify possible impact-related petrographic features and materials. In the thin sections, we found two different types of melt fragments. Their chemical composition were studied by electron microprobe (EMP) analysis.

Results and interpretation: Line-logging and additional direct observations of the core show four main parts within the breccia deposit: (1) fall-back sediments at the bottom followed by (2) poorly sorted and coarsening upward slump deposits, in turn followed by (3) another slump deposit section distinguished by varying sizes and sorting. This fall-back and slump-sequence is overlain by (4) a better sorted, normally graded breccia unit formed by resurging water. Two occurrences of clasts with “breccia in breccia” texture, showing fall back characteristics, were observed within slump (on FC77-3) and resurge deposits (FC67-3), which are interpreted as fall-back deposits originating from the top of the central-uplift area, being incorporated into the crater moat deposit due to slumping and reworking by resurge water. Petrographic analysis allowed identification of two types of melt fragments occurring in both drill cores, within fall-back, slump, and resurge deposits. Melt type 1 (grey silica melt), as observed in a previous study [8] has a cryptocrystalline texture, a high silica content, and commonly containing euhedral dolomitic inclusions. Quantitative microprobe analysis within the silica-rich melt also shows minor concentrations of Al and traces of Na, Mg, K, Ca, Fe, and Mn. Melt type 2 is mainly light brown or amber-colored glass with a calcium- and phosphate-rich chemical composition. Type 2 grains show flow textures and inclusions of silicate and carbonate mineral materials. The volume percentage of melt, matrix, quartz grains, fossil fragments, etc. were estimated petrographically throughout both drill cores and show noteable asymmetry. Possible explanations include: non-symetrical ejecta distribution, or un-even return of resurge flows controlled by resurge gullies through the crater rim, or a combination of both.

Conclusions: Data from from drill cores FC67-3 and FC77-3 indicate that the crater flilling processes were initiated by fall back deposition, followed by slumping, and finally water-rich marine resurge deposition of both ejecta and locally reworked material. The “breccia-in-breccia” intraformational clasts indicate reworking of fall-back deposits on the top of the central-uplift area, being incorporated into the crater moat deposit by slumping (FC77-3) and resurging water (FC67-3). The deposits shows an asymmetry on opposite sides of the central uplift that may reflect primary variations in ejecta distribution or secondary variations caused by variations in the resurge flow. Melt fragments show two different sources of material. The silica content within melt type 1 may have come from silicates in the upper target basal Chattanooga Shale beds or from chert or rare sandy beds in the lower target carbonates. Melt type 2 with its high calcium-phosphate melt may be related to phosphate-rich fossil fragments within the upper target Chattanooga Shale or phophatic nodules presents within the lower lying Catheys-Leipers Formation.

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