SUB-CRATER BRECCIAS, FLYNN CREEK IMPACT STRUCTURE, TENNESSEE.

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Introduction: The Flynn Creek impact structure, located in Jackson County, Tennessee (36° 17' N; 85° 40' W), is a ~ 3.8 km diameter, marine-target impact crater which has an asymmetric outline, central uplift, breccia moat, and terraced crater rim [1-5] (Fig. 1). The target stratigraphic section was essentially flat-lying Ordovician carbonates, ranging from Lower Ordovician Knox Group through Upper Ordovician Catheys-Leipers Formation [1, 2, 4, 6]. In a subsequent, post-impact phase, Upper Devonian Chattanooga Shale was deposited within the impact structure and across the area on what was then a shallow marine shelf [1-6].

Flynn Creek impact structure, Jackson County, Tennessee, is one of the original six proven impact structures on Earth and the first one attributed to a marine target setting [1, 2]. The Late Devonian Flynn Creek impact structure is notably asymmetrical and generally averages ~ 3.6 km in diameter [1-3]. Flynn Creek has a rim terrain characterized by concentric normal faults, a central uplift area with breccia-laden flanks, a crater moat-filling breccia (CMFB) unit ranging from ~ 30 m to ~ 40 m thick, and a poorly known parautochthonous breccia zone, including breccia lenses of varying texture and substantial thickness.

Previous work: In 1968, David Roddy produced the first published cross section of Flynn Creek, which showed a faulted rim, shallow basin, central uplift, and CMFB of relatively uniform thickness [1]. This east-west cross section was based on field work plus 6 shallow drill cores (FC67-n) in the crater moat area obtained during 1967. Roddy's 1979 cross section [2], which relied on several unnamed, post-1967 drill cores, was different in important ways, including a CFMB that thickened near the rim of the structure and intact sub-crater stratigraphy except under the central uplift. Both cross sections showed considerable structural detail in the central uplift, an interpretation which was apparently based mainly on field work.

Our findings: Upon recent re-examination, drill core FC77-1 and two other FC79 cores, which were drilled on the western flank of the central uplift, appear to show a flanking breccia unit that ranges from 175 to 50 m thick [7]. This central uplift flanking breccia unit likely grades laterally into Flynn Creek's CMFB [8, 9]. Several Flynn Creek drill cores penetrate to depths more than 350 m, and these drill cores show that sub-crater stratigraphy was strongly affected by impact at substantial depth [9]. Large intact blocks, with varying degrees of internal deformation, comprise an as-yet-to-be-delineated parautochthonous breccia zone. These large blocks, ranging up to 10s of m thick, are separated by zones of coarse and medium, allogenic (?) impact breccia ranging from a few cm to a few m thick. This pattern is generally similar to the sub-crater deformation described at the Alamo impact local in Nevada, which was a much larger, yet – like Flynn Creek – a marine and carbonate-target Late Devonian impact event [10]. In this paper, we present a new interpreted cross section based on available drill-core photographs from several key core holes (Fig. 2). Additional drilling and/or geophysical surveying will be needed to more fully understand the actual shape and physical relationships of all cross-sectional aspects of the Flynn Creek sub-crater realm.

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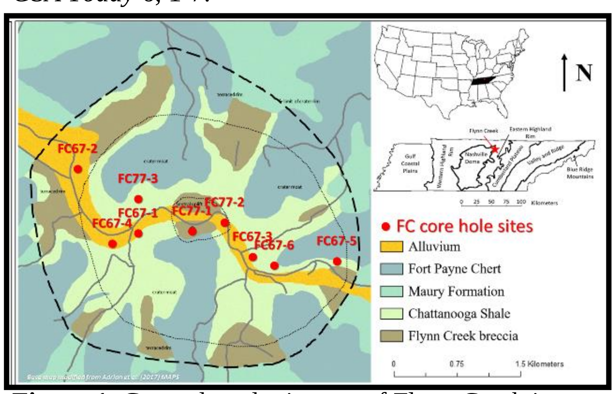
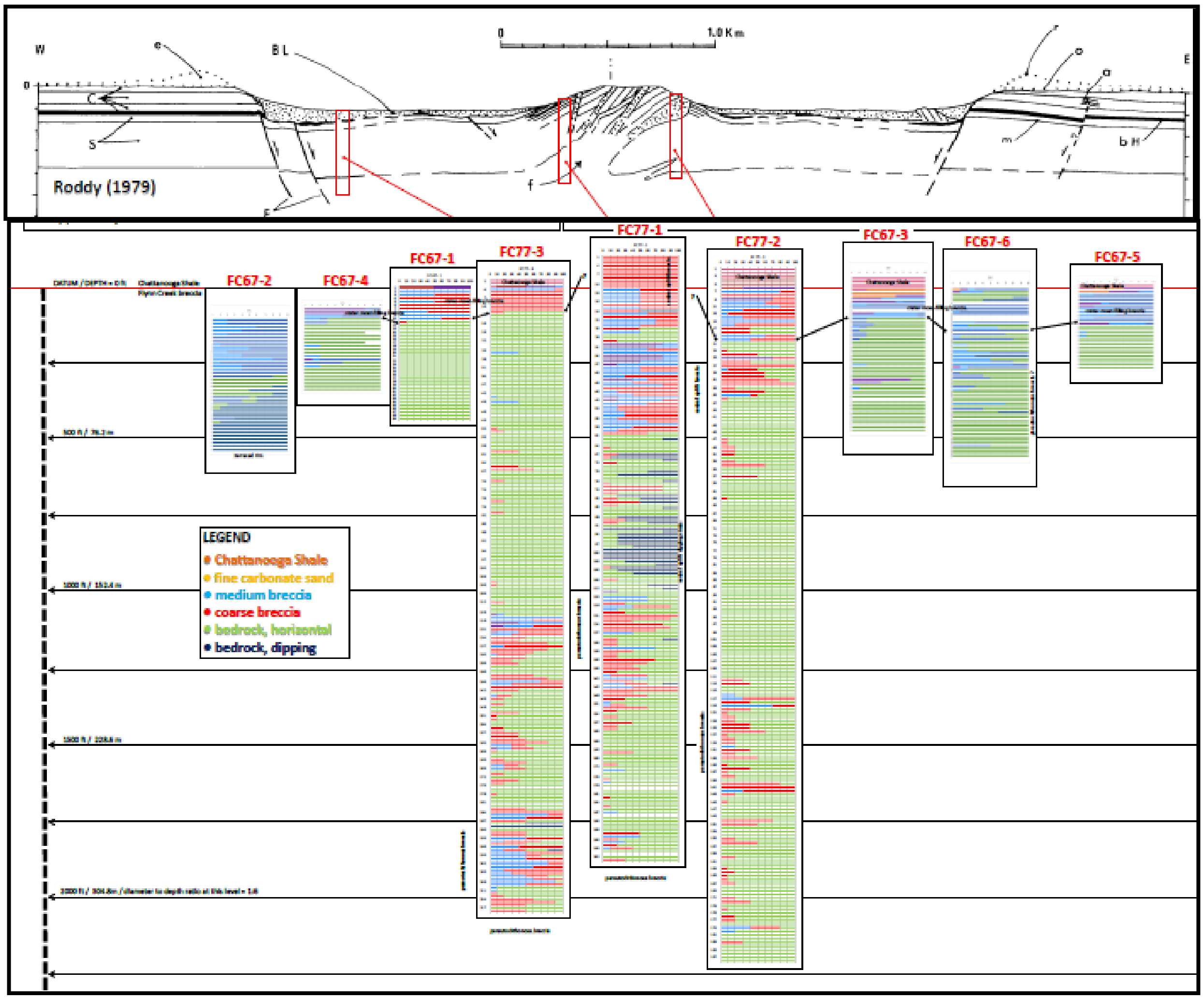


Figure 1. General geologic map of Flynn Creek impact structure area [7] showing locations of FC core hole sites for drill cores used in this report. Key to geological units at the surface is at right of map. The Flynn Creek breccia outcrop in the center is the approximate outcrop area of the central uplift. Dashed line shows Roddy's interpreted limit of crater rim [1]. Fine dotted line shows rim-crater moat transition line.

Figure 2. Drill-core data on composition (see legend) collected from each row in each drill-core box (assuming 10 ft (3.3 m)/box), color coded, and plotted relative to one another as a largely uncorrelated, serial cross section. Cross section of 1979 from David Roddy [2] is at top showing position of three core holes FC77-n. Datum is the Chattanooga Shale-Flynn Creek impact breccia contact. The single correlation line (black) shows the base of the impact breccia (CMFB). Sub-crater rocks are all strata below the black line. Note that there is a substantial amount of coarse and medium breccia in the sub-crater (parauthonous breccia) zone, but there is also a substantial volume of relatively undeformed strata that are horizontal (coded green). Dipping bedrock is mainly confined to below the central uplift and in the tilted rim.



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