

COSMIC IMPACT IN THE PIEDMONT OF GEORGIA? THE WOODBURY STRUCTURE. E. F. Albin,¹ D. T. King, Jr.,² R. S. Harris,³ L. W. Petrunk,⁴ S. J. Jaret,¹ J. C. Gibson.² ¹Dept. of Space Sciences, Fernbank Sci. Center, Atlanta, GA 30307 [ed.albin@fernbank.edu], ²Dept. of Geology, Auburn Univ., Auburn, AL 36849, ³Dept. of Geol. Sci, Brown Univ., Providence, RI 02912, ⁴AstraTerra Research, Auburn, AL 36831-3323.

Introduction: The Woodbury structure (also known as Cove Dome) is located 6 km SSE of the town of Woodbury, Meriwether County, Georgia. The center of the structure is located approximately 32°55'N; 84°32'W. A nearly circular structure almost 7 km in diameter (Fig. 1), it is a conspicuous feature in the eastern Pine Mountain terrane which skirts the southern edge of the Appalachian Piedmont.

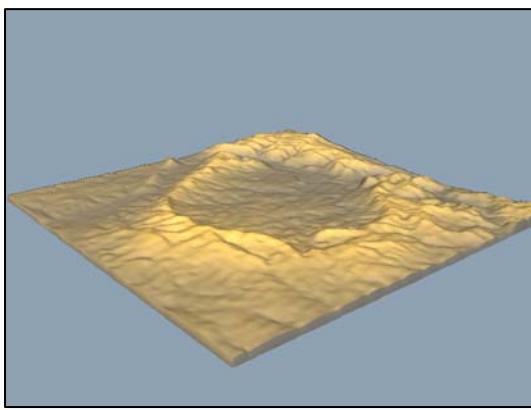


Figure 1. DEM of Woodbury structure, from Shuttle Radar Topography Mission data, looking towards the northeast.

Geologic Setting: The structure consists of an elevated quartzite rim and rather flat floor comprised of schist and gneiss. Relief from floor to rim ranges from 100 to 150 meters (Fig. 2). The Flint River, an antecedent stream, cuts through the rim in the northeastern quadrant and exits through the structure's rim in the southeastern quadrant.

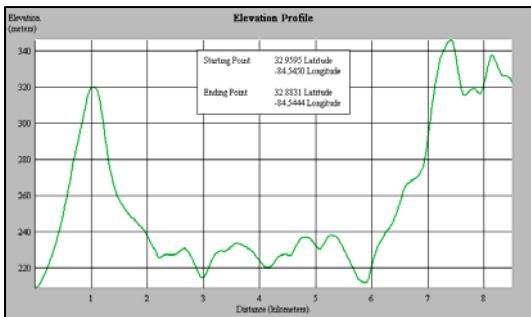


Figure 2. North to south profile across Woodbury feature.

The Woodbury structure has been previously interpreted as a “structural dome which post-dates the development of regional metamorphic foliation” [1].

The age of the Late Paleozoic rim rocks (Hollis Quartzite) is quite different from the underlying Grenvillian rocks (Woodland Gneiss) of the structure’s floor [1]. This relationship has been interpreted as a tectonic contact and/or a major unconformity[1]. The Hollis Quartzite dips radially away from the center of the structure; the average Hollis dip is approximately 20 degrees [2]. Rocks on the eastern rim show overturned folding that also dips away from the structure’s center (Fig. 3).



Figure 3. Overturned beds of Hollis Quartzite on eastern rim.

Other arcuate ridges of uplifted and tightly folded Hollis Quartzite occur in the region; but unlike those occurrences the Woodbury “dome” does not appear to coincide with an obvious positive magnetic anomaly belying the source of the uplift [3]. Gravity data of sufficient quality to investigate the structure has not been available.

Pseudotachylitic Breccia: Streamcuts into the northern limb of the structure, near Dixon Mountain, expose an unusual reddish quartzite which crops out beneath the steeply dipping white quartzites comprising the rim. Thin sections reveal that the red color is due to iron oxide staining and replacement of a dense network of pseudotachylitic veins.

Pseudomorphed spherulites are observed in thin sections and some delicate flow structures can be seen in hand specimens. Although individual veins typically are <1 mm wide, they are concentrated within sharply defined cm-size dikelets which appear to have transported tiny clasts of muscovite schist and other foreign rock fragments into the quartzite along with the melt.

Quartz Deformation: Quartz grains in this breccia commonly exhibit 1 to 3 sets of sub-planar to planar microstructures (PMs) seen chiefly as arrays of closely-spaced linear fluid inclusions. Many of the observed fabrics are quite planar (Fig. 4) and appear similar to shock-induced decorated planar deformation features (PDFs) reported from ancient impact structures (e.g., Sudbury [4]). A few sharper PMs (Fig. 5) are observed which superficially resemble both PDFs and unusual tectonic lamellae in friable quartzites described by [5]. But unlike the latter examples, those here occur at low angles to the *c*-axis and in sets with multiple PMs. Preliminary data (Fig. 6) from Universal-stage orientation analyses show some similarity with shock fabrics [4], but additional data is needed to distinguish the Woodbury deformation as impact-generated.

In addition to possible PDFs, some quartz grains contain microfaults and well-developed rectilinear and rhombohedral patterns of planar fracturing (with 10 to 20 μm spacing). Although not unequivocal evidence of impact, planar fracturing commonly occurs with other PMs in shocked rocks [6].

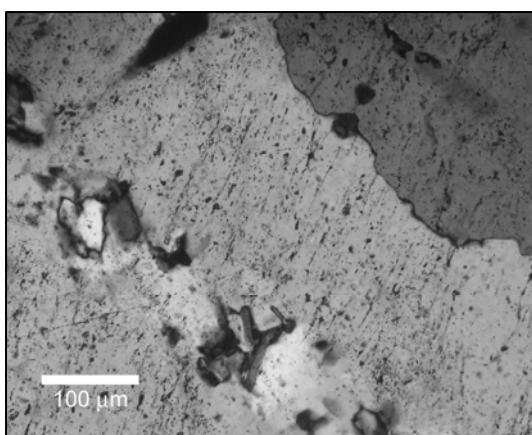


Figure 4. Plane-polarized light (PPL) photomicrograph of planar microstructures defined by fluid inclusion trails in quartz from the pseudotachylitic quartzite breccia.

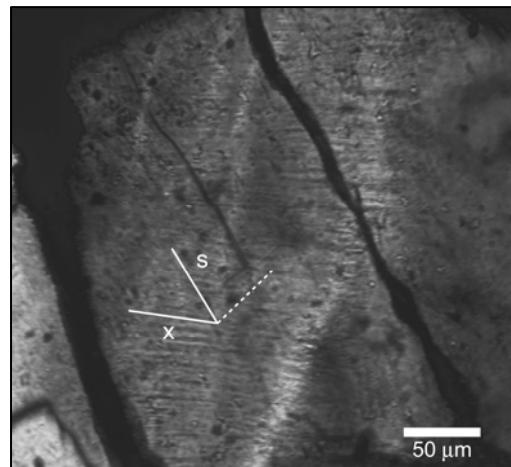


Figure 5. PPL photomicrograph of multiple sets of planar microstructures in quartz with orientations consistent with $s\{11-21\}$ and $x\{51-61\}$. A fainter third set of PMs is observed parallel to the dashed line.

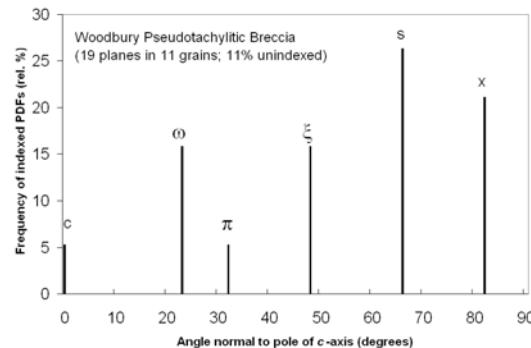


Figure 6. Histogram showing the orientations of a small set of planar microstructures measured with the U-stage according to [7]. Uncertainty is estimated as $\pm 4^\circ$.

Conclusions: The presence of unusual pseudotachylitic breccias and quartz grains exhibiting planar fractures and multiple sets of planar microstructures (similar to decorated PDFs) warrant a more extensive investigation into a possible impact origin for the enigmatic Woodbury structure. The structure lies in a tectonically complex region; therefore, extra caution must be employed in testing the impact hypothesis.

References: [1] Kish S.A. et al. (1985) GSA Annual Mtg. Guidebook. [2] Higgins M.W. et al. (1988) U.S. Geol. Survey Prof. Paper 1475. [3] Zietz I. et al. (1980) U.S. Geol. Survey, Geophysical Investigations Map GP-940. [4] French B. M. (1998) Traces of Catastrophe; LPI, Houston, 120 pp. [5] Lyons et al. (1993) *Earth Planet. Sci. Lett.*, 119, 431-440. [6] French B.M. et al. (2004) *Bull. Geo. Soc. Am.*, 116, 200-218. [7] Engelhardt W. v and Bertsch W. (1969) *Contrib. Min. Petrol.*, 20, 203-234.