Complex Crack Formation in Metavolcanic Rocks Accommodating Tool Making

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Many Early Archaic quarries and artifacts are in metarhyolite source material in the Carolina Terrane of central North Carolina, USA. The Carolina Terrane in Montgomery County, NC, comprises the Albemarle arc, a Neoproterozoic to Cambrian peri-Gondwana massif accreted to eastern Laurentia during the Late Ordovician to Early Silurian Cherokee orogeny. The arc rocks deformed under greenschist facies into regional folds that trend northeast-southwest and verge southeast; some folds are periclinal. Today, erosionally resistant metavolcanic rocks – rhyolite to rhyodacite - in the Tillery and Cid formations cap ridges separated by lowlands underlain by argillaceous metasedimentary rocks. This area is called the Uwharrie Mountains.

Geoarchaeological surveys determined several rhyolitic variants based on phenocrysts, flow banding, lithophysae, and color and grain size extracted from prehistoric quarries (Daniel and Butler, 1996.) It appears that the preferred stone tool rhyolite was dark gray, aphyric, and flow banded.

In a study area of a few hundred hectares, about 20 quarries were identified. The more extensive quarries are often on or near the shoulders of rhyolite ridges and have extensive colluvial aprons that contain flakes, intact cobbles and boulders, and a variety of rock fragments and quarry debris. It has been suggested that much of this colluvium is flaking debris, yet some ridges have few or no bedrock exposures. Investigators (Daniel and Butler, 1996) indicated that these slopes contain filled prehistoric pits.

How much of the supposed quarry debris results from natural mechanical weathering? Detailed geologic mapping in the study area finds several planar structures in metavolcanic rocks, including anastomosing axial plane cleavage, multiple systematic planar fractures or joints, exfoliation fractures, and curviplanar discontinuities related to mesoscopic cracking and spallation. Fin-like bedrock exposures have as many as six systematic fracture orientation maxima compared to two in lowland metaargillites. Exfoliation discontinuities that waver in orientation around cleavage are mode I cracks that coalesce in concave or convex detachment fractures that release sharp-edged fragments onto the erosion surface. This structure is unique to fin outcrops of very fine-grained aphyric rhyolite; they are rare on bedrock pavements, probably because the fins experience thermal cracking.

In addition to the semi-conchoidal fracture property, I suggest that the unique and inherent weathering features in aphyric rhyolite make this rock an ideal source for toolmaking because of a “natural” lithic reduction and pre-cracking bedrock. This could explain why some quarry sites do not have significant bedrock exposures. Mechanical cracking continues to operate on cobbles and boulders embedded in colluvial blankets. Many of these have cracked *in situ* in the soil.

References

Daniel, I. R., Jr., and Butler, J. R., 1996: An archaeological survey and petrographic description of rhyolite sources in the Uwharrie Mountains, North Carolina. *Southern Indian Studies, 45*, 1-37.