Late Cretaceous-Cenozoic brittle faulting beneath the western South Carolina Coastal Plain: Reactivation of the Eastern Piedmont Fault System

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Late Cretaceous-Cenozoic brittle faulting beneath the western South Carolina Coastal Plain: Reactivation of the Eastern Piedmont Fault System

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The Eastern Piedmont fault system (Hatcher and others, 1977) that extends from Alabama to Virginia is characterized by long, narrow zones of Paleozoic ductile deformation marked by prominent, elongate magnetic anomalies. Later brittle deformation is associated with many of the faults. In South Carolina the Augusta and Modoc faults are part of the fault system. The Augusta fault is exposed at the Savannah River but passes beneath the Coastal Plain less than 3 miles to the northeast. The trace of the fault was inferred from magnetic anomalies. Recent geologic mapping of Piedmont inliers between Horse Creek and the North Edisto River shows silicified breccias that are associated with the Augusta fault where it crosses Horse Creek, Shaw Creek, South Edisto River, McTier Creek, and North Edisto River. At McTier Creek, south of Monetta, movement on the brittle fault has offset the Piedmont-Upper Cretaceous contact thirty feet up to the south. East of McTier Creek, map patterns of Eocene and Miocene formations (Nystrom and others,1986) north of the fault end abruptly at the fault trace. At other localities map patterns either terminate north of the fault or narrow where the formations cross the structure. The correlation indicates fault movement younger than the map units.

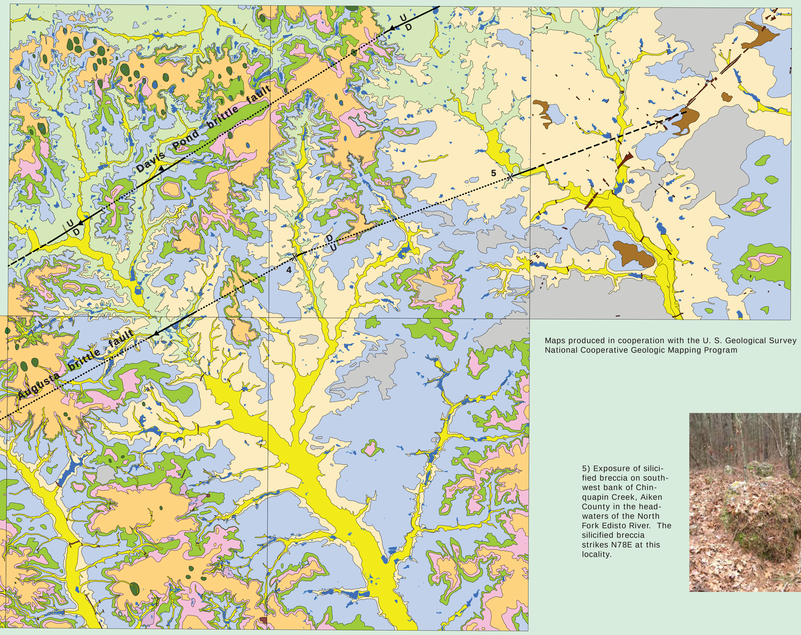
A related fault, the Davis Pond fault, occurs between the Augusta fault and the Modoc fault that it parallels. It is marked by a linear magnetic anomaly and, at least locally, is the boundary between Piedmont map units. Near Davis Pond, south of Batesburg, brittle faulting associated with the ductile structure offsets the Piedmont-Upper Cretaceous contact 20 feet up to the north, truncating the Upper Cretaceous. The Piedmont block between the Augusta and Davis Pond faults dropped down relative to the northwest and southeast. The Davis Pond fault trends N60E on strike with and connected by linear magnetic anomaly with a silicified breccia just south of Lake Murray dam. The Augusta, Davis Pond, and Modoc faults are integral elements of the Eastern Piedmont fault zone with long complex histories. Offsetting on the later brittle faults, though only a few tens of feet, continued into the late Cenozoic, effecting present day topography. The young faults remain zones of weakness where further movement could occur.

References:
Hatcher, R. D., Jr., Howell, D. E., and Talwani, P., 1977, Eastern Piedmont fault system: Speculations on its extent: Geology, V. 5, p. 636 - 640.
Nystrom, P.G.,Jr., Willoughby, R.H., and Kite, L.E., 1986, Cretaceous-Tertiary stratigraphy of the upper edge of the Coastal Plain between North Augusta and Lexington, South Carolina: Carolina Geological Society Field Trip Guidebook 1986, Columbia, South Carolina, 82p., 1 sheet, scale 1:100,000

1) Exposure and float blocks of silicified breccia on the northeast bank of Horse Creek. Locality is in Trenton 7.5-minute quadrangle, Aiken County, near the Aiken-Edgefield county line. Silicified breccia strikes N60E.

1) Close-up view of quartz-filled fracture pattern in silicified breccia. Exposure is on the notheast bank of Horse Creek.

2) Silicified breccia exposed on west bank of creek at Sunny Brook, Aiken County, near the Edgefield county line.

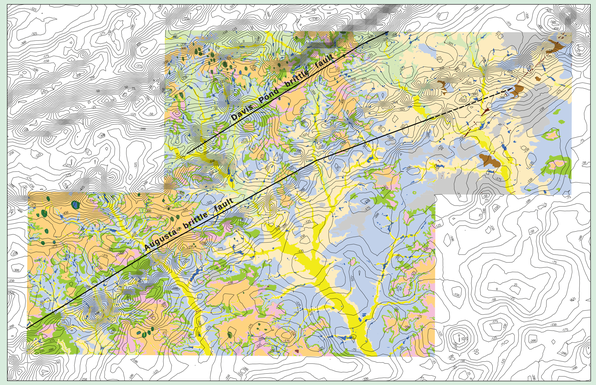


Maps produced in cooperation with the U. S. Geological Survey National Cooperative Geologic Mapping Program

Explanation

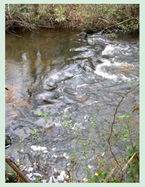
- **water**
- **moved earth**
- **disturbed ground** - Ground intermittently or irregularly exposed or covered during mining operations. Beds exposed may not correspond with mapped topography.
- **Quaternary alluvium** – Fluvial sediments deposited in floodplains of streams.
- **Carolina bay sediments** – Lake sediments deposited in Carolina bays.
- **dune field** - A deposit of yellow orange (10YR 8/6), well sorted, subangular, fine to medium quartz sand with minor fine opaque minerals along cross bedding planes. This is composed eolian sands sourced from underlying, older, stratigraphic units
- **Pinehurst Formation** – Cross-bedded to horizontally bedded, poorly sorted quartz sand with no interstitial clay. Wind-blown depositional environment. Lower Pliocene.
- **upland unit** – Cross-bedded, very poorly sorted, clayey, coarse- to very coarse-grained sand with granules, pebbles, kaolin balls, and locally, discontinuous purple clay layers. At some localities characterized by spheroidal quartz cobbles 2 to 4 inches in diameter. Fluvial depositional environment. M-U Miocene.
- **Tobacco Road Sand** – Base of the formation characterized by a clayey, discoidal quartz pebble layer a few inches to several feet thick that is a marker bed in the Tertiary section of the Upper Coastal Plain. Locally, interfingering laminae extending from the Dry Branch up into the basal Tobacco Road Sand demonstrates continuous sedimentation across the contact. Sands of the formation are generally red, purple or lavender, and characterized by abundant burrows. Shallow marine depositional environment. Upper Eocene.
- **Dry Branch Formation** – Commonly golden yellow, poorly sorted, quartz sand, burrowed in many exposures. Lower part of formation characterized by green beds of monmorillonitic clay. Also, local silicified fossil assemblages with abundant barnacles and assorted bivalves. Shallow marine depositional environment. U Eocene.
- **Huber Formation** – Lower part of the formation is characterized by fine-grained sugar sands with no interstitial clay, but with laterally continuous thin clay layers. Numerous burrows and, locally, shark and ray teeth. Upper part is characterized crossbedded, poorly sorted, kaolinitic sand with kaolin balls and, locally, thick beds of commercial kaolin. Lower part of unit marginal marine depositional environment, upper part fluvial-deltaic. L-M Eocene.
- **Upper Cretaceous sediments** – Generally poorly sorted, fine- to very coarse grained, quartz sand with kaolin balls and interstitial kaolin. Locally the top of the map unit is characterized by thick beds of commercial kaolin. Fluvial-deltaic depositional environment.
- **Piedmont undifferentiated** – Mainly thinly layered, migmatitic gneisses and schists with minor amphibolite.

- Trace of brittle fault at surface.
- Trace of brittle fault where covered.
- Projected trace of brittle fault.
- 4 X Location and number of photographed silicified breccia exposure.
- ▲ Silicified breccia exposure or float.



Map showing the Augusta and Davis Pond brittle faults in relation to the aeromagnetic pattern. (Daniels, 2005)

Reference
Daniels, D. L. 2005, South Carolina aeromagnetic and gravity maps and data: a website for distribution of data: USGS Open File Report 2005-1022, online only
http://pubs.usgs.gov/of/2005/1022/ (last accessed 15 March, 2006)

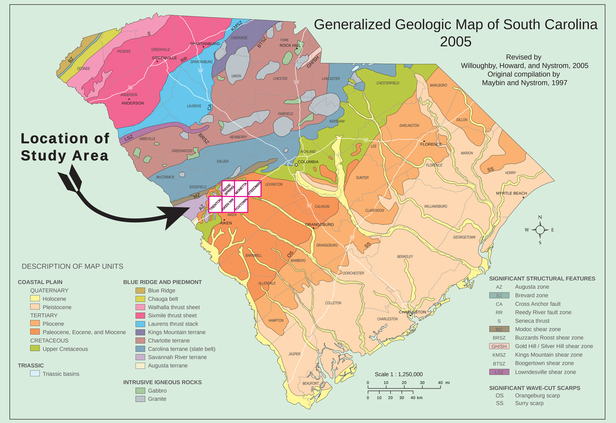


3) Riffle in Shaw Creek where the brittle fault crosses the stream. Locality is just west of Route 191 in eastern Trenton 7.5-minute quadrangle.

3) Exposure of silicified breccia on southwest bank of Shaw Creek, west of Route 191. At this locality Shaw Creek is deflected approximately 1000 feet to the northeast by the silicified breccia.

4) Silicified breccia exposure on western bank of McTier Creek south of Monetta. At this locality the Piedmont-Upper Cretaceous contact appears to be about 30 feet higher south of the brittle fault.

5) Exposure of silicified breccia on southwest bank of Chinquapin Creek, Aiken County in the headwaters of the North Fork Edisto River. The silicified breccia strikes N78E at this locality.



Cartography by Erin Hudson and Jennifer Krauser; SCDNR Geological Survey
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