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SPRING GARDEN QUADRANGLE

# GEOLOGIC MAP OF THE SPRING GARDEN QUADRANGLE, VIRGINIA

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## EXPLANATION

### UNIT CHARACTERISTICS

### GEOLOGIC AND ECONOMIC FACTORS AFFECTING LAND MODIFICATION

CENOZOIC QUATERNARY

al — Alluvium: Silt, sand, and gravel with clay at base

td — Terrace deposits: Rounded pebbles and cobbles in a clay or sandy clay matrix.

d — Diabase dikes: Fine- to medium-grained, dark gray to black diabase

cr — Cataclastic rocks

MESOZOIC — Triassic sedimentary rocks

EARLY PALEOZOIC — Shelton Formation; Leatherwood Granite; Rich Acres Formation

PRECAMBRIAN — Metamorphosed volcanic-sedimentary rocks; Fork Mountain Formation

[illegible]

## KEY

CONTACTS — Exposed or approximate; Covered or inferred

FOLDS

ATTITUDE OF ROCKS

JOINTING

FOLIATION

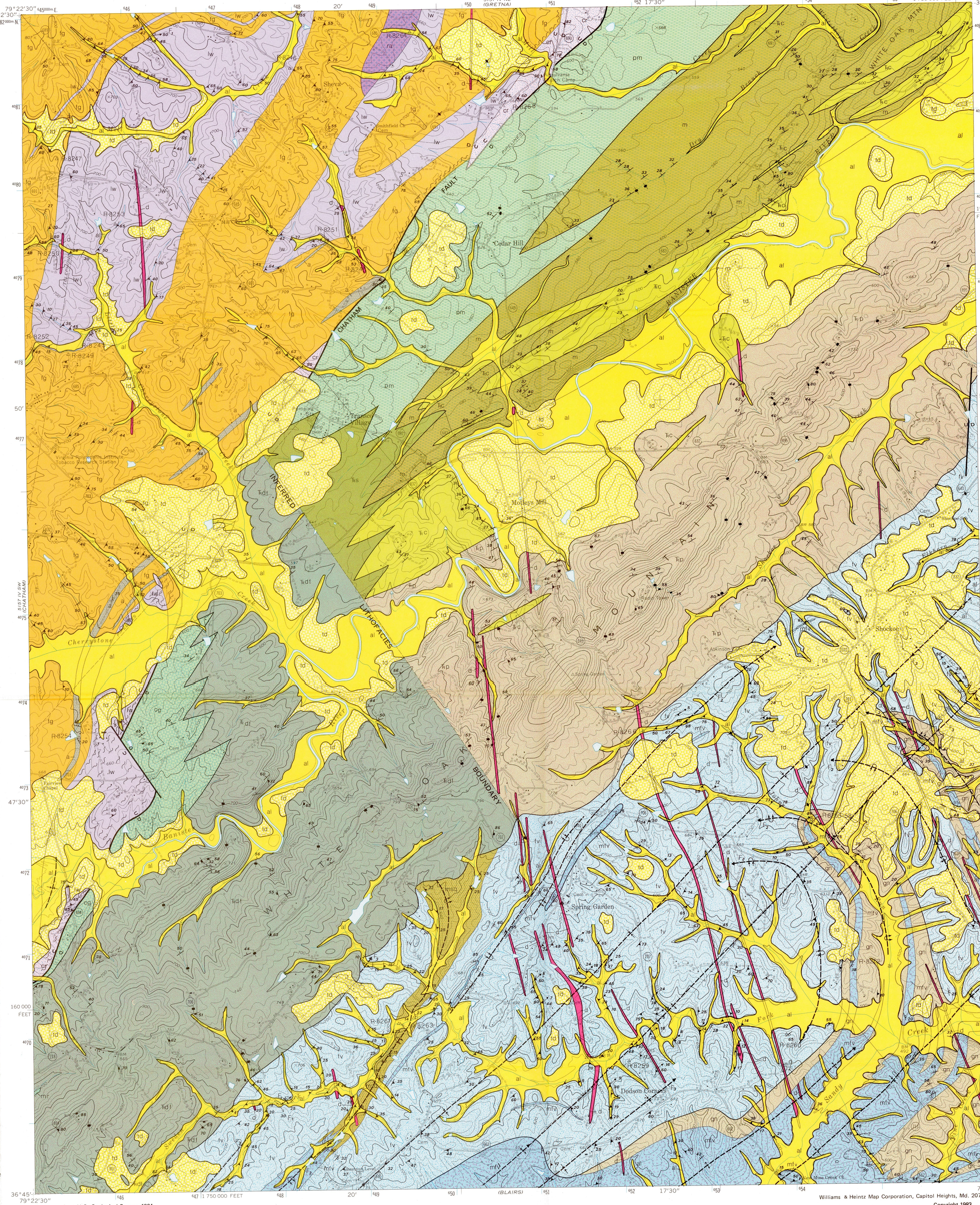
SHEAR ZONE

LINEATION

QUARRY — Abandoned crushed-stone quarry

SAMPLE LOCATIONS

FAULTS



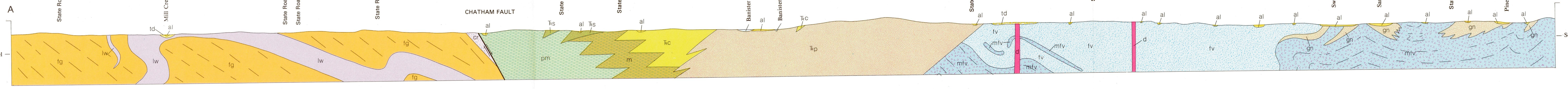
Base map from U.S. Geological Survey, 1964
Spring Garden Quadrangle, 7½ Minute Series

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

1983





CROSS SECTION DESIGN
1. No vertical exaggeration.
2. Subsurface structure interpreted from surface measurements.
3. Thickness of terrace deposits and alluvium diagrammatic.

## INTRODUCTION

The Spring Garden quadrangle comprises an area of approximately 60 square miles within the Piedmont province in Pittsylvania County, in south-central Virginia. White Oak Mountain, a prominent northeast-trending hogback ridge, composed of well-indurated Triassic feldspathic sandstone, is the most conspicuous topographic feature in the region. Elevations range from 980 feet on White Oak Mountain to 480 feet along Bannister River. The Triassic rocks of the Danville basin divide a group of metamorphic rocks lying northwest of the basin from a different group of metamorphic rocks lying southeast of the basin. The area has undergone considerable uranium exploration activity in recent years.

## STRATIGRAPHY

### Late Precambrian — Paleozoic Rocks
### Fork Mountain Formation

The Fork Mountain Formation (fg) was named by Conley and Henika (1973) from exposures of garnet-mica schist and garnet-biotite gneiss along Fork Mountain near Martinsville, Virginia. In the Martinsville area these metasedimentary rocks are intruded by a large pluton composed of mafic and felsic rocks named the Martinsville igneous complex by Ragland (1974). The granitic phase of this complex was dated radiometrically at 450 my by the U. S. Geological Survey (Rankin, 1975). This date provides a minimum (Paleozoic) age for the Fork Mountain Formation. No maximum age has been established, although the formation is part of the Smith River Allochthon which is thought to be thrust over known Precambrian rocks in the Sauratown Mountain anticlinorium (Conley and Henika 1973). Exposures of garnet-mica schist and garnet-biotite gneiss show complex polymetamorphic fabric and silimanite porphyroblasts which are similar to those in the Martinsville area. They appear to be limited to the area northwest of the eliptical pluton of Leatherwood Granite mapped in the northwest corner of Spring Garden quadrangle. The unit to the southeast is predominantly a planar-layered, medium- to fine-grained, biotite gneiss with thin silvery-gray muscovite schist. The planar-layered gneiss contains concordant amphibolite and amphibole gneiss layers (a) along the northwestern margin of the Danville Triassic basin. The amphibole gneiss is thought to be of volcanic origin although diagnostic volcanic minerals and textures similar to those preserved in amphibolitic layers of the Fork Mountain near Phipott Dam in the Martinsville area (Conley and Henika, 1970) are lacking.

### Metamorphosed Volcanic-Sedimentary Rocks

A sequence of metamorphosed volcanic and sedimentary rocks lies beneath the Triassic angular unconformity along the southeastern margin of the Danville basin. The unit was named for exposures to the southwest in the Danville area (Henika, 1977). The metavolcanic nature of some of the units in the sequence was documented from exposures of rocks of upper greenschist metamorphism along the Triassic basin margin in the Mount Hermon quadrangle.

The metamorphosed volcanic and sedimentary rocks are divided into a lower unit containing recognizable volcanic features such as euhedral quartz, feldspar phenocrysts (Henika, 1977), and wavy foliate (eutaxic) structure (Ross and Smith, 1961). The features that characterize the felsic metavolcanic units in the Danville area appear to be limited by increasing metamorphic crystallization and shearing towards the north and east. The unit in Spring Garden quadrangle is generally at amphibolite grade except for an area along Sweden Creek near the southern boundary of the quadrangle. There phenocrysts are abundant, and the wavy foliate structure is preserved. To the northeast the felsic units are generally recrystallized to gneiss with locally abundant granite and pegmatite stringers.

Where intermixed amphibolite and biotite gneiss are predominant over the felsic interlayers, the lower unit is represented by (mfv); mica schist and quartzite layers are represented independently by (msq). The complex patterns shown by these lithologies are probably the result of both intricate folding and interdigitation of volcanic, volcaniclastic, and sedimentary facies. A *transitional unit* between the mixed mafic-felsic gneisses in the *lower unit* (mfv) and the homogeneous felsic gneiss of the *upper unit* (fv) occurs just north of the boundary between the Mount Hermon and Spring Garden quadrangles. This unit (gn) has a fine salt- and-pepper texture, planar gneissic layering, and mineralogical composition (quartz-plagioclase-biotite) similar to the metasedimentary beds in the mfv unit. It appears to replace the predominant mineral assemblage of the fv unit (quartz - microperthite - muscovite) progressively towards the northeast and to the east. Reconnaissance mapping in adjacent quadrangles indicates that the (gn) unit becomes predominant and there may be no easy distinction between the (gn) unit and similar fine-grained biotite gneiss in the lower (mfv) unit. This change is thought to be caused by the intertonguing of felsic volcanic flows with volcaniclastic sediment away from the volcanic vent(s).

The metamorphosed "volcanic and sedimentary" rock sequence is cut by granitic plutons of Shelton Formation (Henika 1980). The Shelton near Danville was radiometrically dated at 425 my (Kish, et al., 1979). This date provides a minimum (Paleozic) age for the metamorphosed volcanic and sedimentary rock sequence.

### Rich Acres Formation

The Rich Acres Formation (ra) is poorly exposed along a tributary to Mill Creek approximately 1000 feet east of State Road 685. It is a dark-greenish-gray, massive to locally schistose metagabbro containing coarse uralitic hornblende crystals. Near the contact with the Leatherwood Granite the Rich Acres contains abundant dikes and sills of leucocratic granite and quartz-tourmaline veins. The contact with gneiss and schist of the Fork Mountain Formation is poorly exposed.

Lenticular xenolithic screens of foliated biotite-hornblende gneiss, resembling some parts of the older Rich Acres metaggabbro seen in the Martinsville igneous complex (Conley, 1978), are included in the central part of the larger area of Leatherwood Granite in the northwestern part of the quadrangle.

### Leatherwood Granite

In the Spring Garden quadrangle the Leatherwood Granite (lw) has a strongly developed cataclastic texture. Gradational, interdigital contacts with mylonitic rocks occur along the Chatham Fault zone at the northwestern border of the Danville basin. The sheared granite exposed in the center of the largest pluton is generally coarser and contains more biotite than the Leatherwood towards the southeast.

The granite cuts the Fork Mountain and the Rich Acres formations in the northwestern part of the area. Its contacts with the Fork Mountain are interdigitated, and the granite may form lit-par-lit injections along the regional strike of foliation. A cross cutting relationship between the granite and the gneissic metasedimentary rocks is most apparent on the geologic map along the southern end of the large pluton on Little Cherrystone Creek. There the foliation in the Leatherwood is roughly parallel to that of the Fork Mountain, but the granite contact can be traced across the foliation at the southwestern end of the pluton. The Leatherwood was radiometrically dated at 450 my by the U. S. Geological Survey (Rankin, 1975).

### Shelton Formation

The Shelton Formation (st) is exposed in the core of a small dome along Johns Run Creek southeast of the Danville Triassic basin. The unit is a coarse orangish-pink gneissic granite that is pegmatitic along the contacts, and pegmatite dikes similar to the Shelton cut across biotite and amphibole gneiss layers of the mafic and felsic unit. The Shelton is exposed in the cores of similar but much larger domes to the southwest in the Danville area where it has been quarried extensively. A radiometric date from granite in the Shelton quarry just south of Danville indicates a Silurian (425 my) age of crystallization (Kish et al., 1979).

### Upper Triassic Sedimentary Rocks

[illegible]

### Cataclastic Rocks

[illegible]

### Diabase Dikes

[illegible]

## STRUCTURE

[illegible]

### Danville Triassic Basin

[illegible]

### Chatham Fault Zone

[illegible]

### Basin History

[illegible]

## ECONOMIC GEOLOGY

### Crushed Stone

Dry Fork sandstones and mudrocks are currently being quarried for crushed stone from White Oak Mountain in the adjacent Mount Hermon quadrangle. Lithologically identical rocks in the part of White Oak Mountain lying in the mapped area are potentially useful as a source for crushed stone. The area contains potential sites for quarrying operations because of steep local relief (which may be an aid to quarrying) and close proximity to U. S. Highway 29 and the Southern Railroad at Chatham.

Portions of the Leatherwood Granite and porphyroblastic gneiss layers in the Fork Mountain Formation may prove to be potential sources of crushed stone. Another location of porphyroblastic gneiss layers that may prove useful is in the felsic gneiss units southeast of the Danville Triassic basin. A small quarry, now abandoned, in the granite along Little Cherrystone Creek was operated by the Virginia Department of Highways for production of road stone many years ago. The rock at this area is fresh, medium to coarse-grained gneissic granite with interlayers of Fork Mountain biotite gneiss.

### Clay

The results of tests made on weathered shales of the Stoneville and Cow Branch formations north and northeast of Motleys Mill along the Banister River (Meyertons, 1963) indicate that these shales may have potential use for the manufacture of building brick and structural wares. Silty shale from the Cowbranch Formation (R-3667), east of Chatham on State Road 683 has a potential use in most structural clay products including sewer pipe and possible use as a foundry soil (Sweet, 1973). Because the water table along the Banister River and its tributaries is high, only elevated areas on the northwest side of the river should be considered as potential sources.

### Lightweight Aggregate

Some 15 miles to the southwest, in the Draper quadrangle, Virginia Solite Company utilizes black shales and mudrocks of Cow Branch Formation for the manufacture of lightweight aggregate. Similar rocks occur northeast of Motleys Mill, Spring Garden quadrangle, and in the northwestern part of the adjacent Java quadrangle. Most of the rocks near Motleys Mill are beneath alluvium and terrace deposits along Bannister River, an area subject to flooding. Small areas of Cow Branch strata occur above the floodplain on the north side of the river.

### Uranium

The Danville Triassic basin was targeted for uranium exploration (Dribus, 1978) because of the location of the basin near possible granitic sources of uranium, the probable existence of stratigraphic traps in areas of the basin, and indications of uranium from airborne surveys. The Shelton Formation and granitic rocks interlayered within the upper felsic gneiss unit provide a possible source southeast of the basin, and the Leatherwood granite provides a possible northwestern source of uranium. Concentration in the sedimentary rocks of the basin may come from leaching the granitic rocks and deposition along potential roll fronts or by deposition of detritus from these rocks or by both means. Intertonguing shale and sandstone near Motleys Mill form a potential stratigraphic trap to concentrate uranium-bearing solutions.

Henika and Johnson (1980) outline another uranium depositional model, that of groundwater "ponding" adjacent to diabase dikes and at impermeable cataclastic rocks. Anomalous radioactivity associated with cataclastic rocks along the Chatham fault zone at the northern quadrangle boundary may be explained by this latter process. A detailed gamma-ray spectrometry survey which was conducted during geologic mapping indicated that radioactive elements are concentrated along steeply dipping fractures that cut the mylonitic rocks.

Marline Uranium Corporation announced on July 21, 1982, the discovery of a significant concentration of uranium mineralization, in the Spring Garden and [redacted], along the Chatham fault zone. According to the announcement, a reserve report prepared by Pincock, Allen, and Holt, an independent mining engineering firm, indicates higher grade geological reserves totaling approximately 30 million pounds of uranium oxide ($U_3O_8$) with an average grade in excess of four pounds per ton of ore. In addition, larger quantities of lower-grade geological reserves were also identified (Virginia Division of Mineral Resources, 1983).

ERRATUM: Java quadrangle to the east should read Gretna quadrangle to the north.

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