GEOLOGIC LANDFORM ANALYSIS IN THE CENTRAL PIEDMONT OF VIRGINIA AND NORTH CAROLINA, I

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Introduction

This report records progress and preliminary conclusions achieved in identifying and interpreting ERTS 1 images of geologic landforms in the central Piedmont of Virginia and North Carolina. Images of a real synform and apparent domal structures are stressed in this report. The former has been confirmed in the field as a real structure during this report period, and the latter confirmed as a false structure. Other structures partly interpreted include Triassic basins and volcanic stratigraphy. Primary effort has been directed toward interpreting imagery over the Greensboro, N.C.-Va. 2° AMS topographic Map NJ17-12, which is the principal area of the author's geologic mapping effort. The Greensboro 2° sheet is bounded by lats. 37° and 36°N and by longs. 78° and 80°W.

ERTS 1 MSS imagery has been visually scanned for evidence of geologic structure. Apparent enhancement of imagery and improvement in resolution of geologically interesting features was obtained; (1) by stereoscopically viewing areas of overlap between adjacent photos; (2) by "stereoscopically" viewing two photos of the same area each photo taken during different seasons. False color composits were prepared by the Diazo Specialty Co. process using yellow for band 4, magenta for band 5, and cyan for band 7. The composits were prepared in the U.S.G.S. EROS project offices through the courtesy of Dr. William R. Hemphill. Excessive density of many of the original MSS photos precluded using the Diazo process for most of the imagery obtained. Bands 6 and 7 appear to be of most use for geologic interpretation in this area.

Republican Grove Synform

This is a newly discovered major structure (Fig. 1, #3) in the Piedmont named for the community of Republican Grove near its northern terminus. It exceeds five miles in width and 20 miles in length, closure being apparent only on the northern end. The term synform is herein used as a descriptor, rather than syncline, because it is presently indeterminate whether the youngest or oldest rocks occur in the center of the structure. Geometrically, however, it is a downfold of synclinal shape. Field work supported by this project has demonstrated the synformal nature of the structure, and has revealed that the metamorphic rocks in the fold have compositional layering generally parallel to schistosity. Schistosity and compositional layering curve around the northern nose of the fold, and a well developed axial plane cleavage of the synform has not been found. Thus the synform appears to result from a late folding event that refolded already metamorphically deformed and schistose rocks.

Subtle reflection in the topography of compositional layering in the structure is primarily responsible for its appearance in the ERTS 1 imagery on photo 1234-15262-6 taken on 23 March 1973. The image of the structure is enhanced by land clearing, road building, and culture which are located preferentially on the higher and flatter portions of the ridge crests.

The structure can also be seen on the Greensboro 2° map (1:250,000 scale) where its topographic expression compares favorably with that on the ERTS-1 photos. The topographic map of the Riceville, Va. area

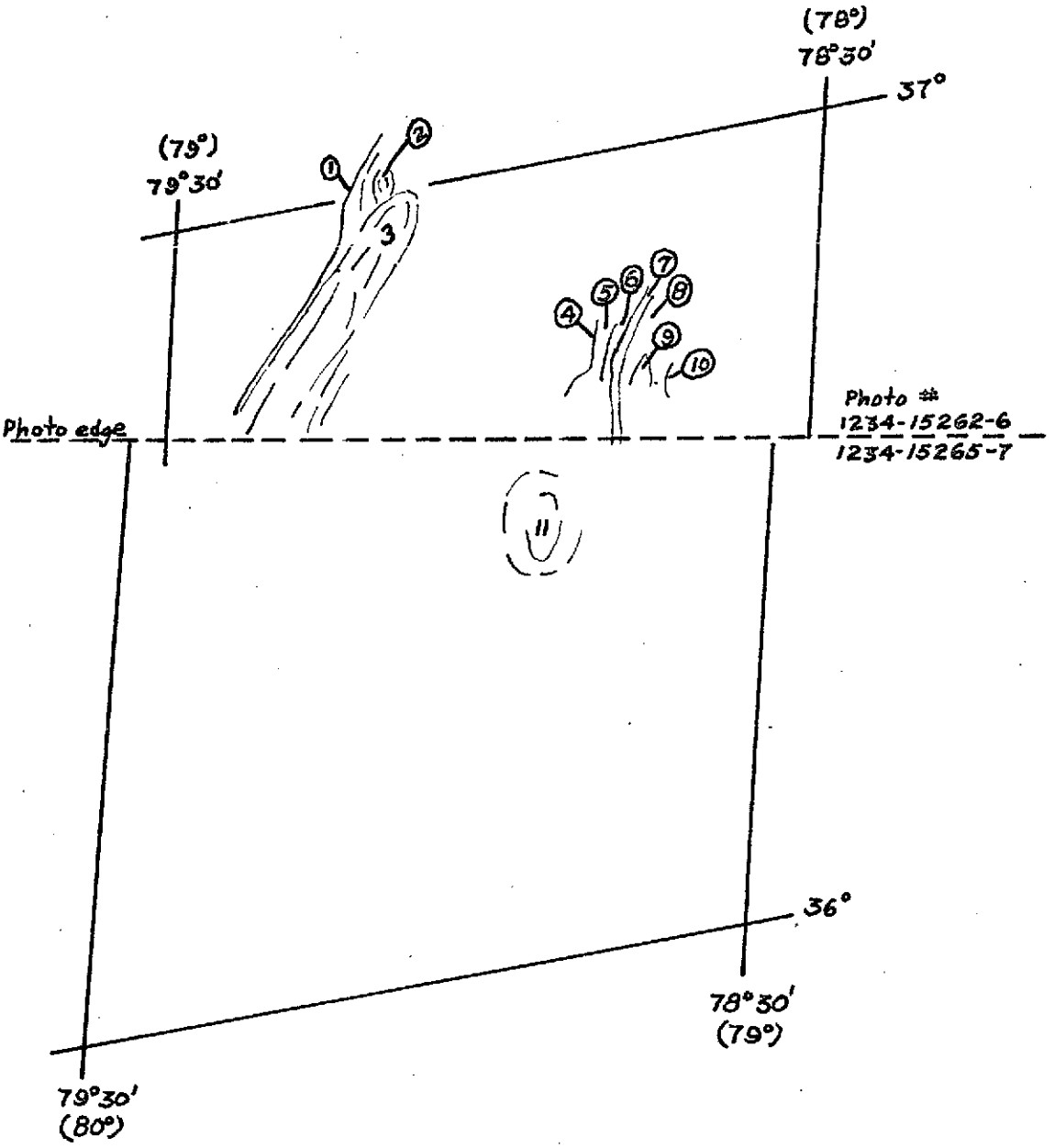

Figure 1.- Some geologic structures and pseudostructures observed on ERTS 1 imagery. Longitudes shown in parentheses are those recorded incorrectly on the respective ERTS photos.

(1:62,500) also shows the structure well expressed in topography, and culture location. The ERTS-1 image does not yield as much information about the structure as does the 1:62,500 map. ERTS data has focused attention on the area and led to the discovery of this structure by the geological community. However, the structure could easily have been discovered from existing 1:62,500 maps, and it might have been discovered from existing 1:250,000 maps.

Other Real Structures Whose Study is Partially Complete

On Figure 1, the eastern edges of Triassic basins (features #1 and 4) are rather sharply delineated from ERTS imagery. These basins are areas that are down faulted on one side in the metamorphic terrain. They accumulated sandstone and shale that is only lightly indurated. Oddly, the western faulted margins of the basins are not as evident as the eastern margins which are of depositional origin. Study of these features is continuing.

Boundaries within the metavolcanic Carolina slate belt sequence have been observed only at the features marked 5, 6, 7, 8, 9, and 10 shown on Figure 1. The boundary between 5 and 6 is the contact between felsic metavolcanics of the Hyco quartz porphyry (Laney, 1917) on the west and the metasandstone of the Aaron slate (Laney, 1917) on the east. Unit 7 is the Virgilina greenstone (Laney, 1917) that overlies the Aaron slate, and unit 8 is an unnamed metasedimentary unit. Unit 9 is more greenstone of uncertain structural position. Unit 10 is granites and gabbroic intrusive. Contrasting weathering characteristics of the underlying rocks produce subtle topographic expression in this sequence. Elongate

hills half a mile to more than a mile wide with generally less than 100 ft. of relief outline the surface expression of stratigraphy and structure seen on the ERTS photos. Invariably the metasedimentary units occur in deepest valleys and the greenstones on the highest hills. Intermediate elevations are occupied by the felsic volcanics and intrusive rocks. Study is continuing in this sequence.

False Structures

False or pseudostructures occur on ERTS 1 imagery at locations 2 and 11 on Figure 1. Both of these features were checked in the field. Feature #11 is underlain by a heterogeneous sequence of metavolcanics and meta-intrusive rocks that strike northeasterly through the feature and are unaffected by it. Land clearing and cultural features contribute most to the production of the pseudostructure image, and in this case bear complex or random relations to the underlying geology.

Another pseudostructure occurs at feature #2 on Figure 1. This also appears as a dome-like structure similar to #11. Field checking demonstrated that the pseudostructure is underlain by uniform granitic rock whose contacts and structure are not reflected in the topography.

Programs for the next Reporting Interval

Field checking of the imagery over the Triassic basins and parts of the metavolcanic sequence is scheduled for the next reporting interval.

Conclusions

Tentative conclusions at this stage of the investigation include:

(1) ERTS 1 imagery yields data on geologic structure comparable to 1:250,000 AMS Maps in the central Piedmont. U.S.G.S. topographic maps at 1:62,500 scale are often superior to ERTS imagery for structural interpretation.

(2) False, or pseudostructures appear on these photos probably in part according to the skill and experience of the user. Field checking of interpretations will be a necessary part of programs in landform analysis.

(3) Doubling the resolution and providing stereoscopic overlap would increase the geologic usefulness of these photographs many fold.

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Reference

Laney, F. B., 1917, The geology and ore deposits of the Virgilina district of Virginia and North Carolina; Va. Geol. Survey Bull. 14, 176p.