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NATURAL RESOURCES PROGRAM

SPACE APPLICATIONS PROGRAMS

TECHNICAL LETTER NASA-48

U.S. Geological Survey
Department of the Interior

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON, D.C. 20242

Technical Letter
NASA-48
October 1966

Dr. Peter C. Badgley
Chief, Natural Resources Program
Office of Space Science and Applications
Code SAR, NASA Headquarters
Washington, D.C. 20546

Dear Peter:

Transmitted herewith are 3 copies of:

TECHNICAL LETTER NASA-48

GEOLOGICAL EVALUATION OF RADAR IMAGERY, APPALACHIAN PIEDMONT,

HARFORD AND YORK COUNTIES, MARYLAND AND PENNSYLVANIA*

by

David L. Southwick**

Sincerely yours,

William A. Fischer
Research Coordinator
Earth Orbiter Program

*Work performed under NASA Contract No. R-09-020-015
**U.S. Geological Survey, Washington, D. C.

UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

TECHNICAL LETTER NASA-48

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by

David L. Southwick**

October 1966

These data are preliminary and should not be quoted without permission

Prepared by the Geological Survey for the National Aeronautics and Space Administration (NASA)

*Work performed under NASA Contract No. R-09-020-015

**U.S. Geological Survey, Washington, D.C.

Photo copies of illustrations are available for viewing at the following places:

Author(s); Discipline Coordinators; NASA Data Bank (Houston); Remote Sensing Evaluation and Coordination Staff (RESECS) and the U.S. Geological Survey Libraries (Denver, Menlo, Washington).

Geological evaluation of radar imagery, Appalachian Piedmont, Harford and York Counties, Maryland and Pennsylvania

INTRODUCTION

Radar imagery of Harford County, Maryland and adjacent parts of York County, Pennsylvania was flown at the request of the U. S. Geological Survey on August 20, 1965. Horizontally polarized high-frequency side-looking radar was employed and two images were produced from horizontally and vertically polarized components of the return signal. Overlapping strips covering about 700 sq. mi of country were obtained. The scale varies but is approximately 1:200,000.

The area surveyed contains a wide variety of metamorphic and igneous rocks that for the most part are deeply weathered and mantled by saprolite and soil. In general the topography is low and rolling with steep slopes only near incised major streams. Much of the county is farmed and the remainder is covered with hardwood forest.

It was hoped that radar would penetrate at least the vegetative cover and enhance differences in residual soil types, which in turn could be related to the type of subjacent bedrock. It was also hoped that radar would emphasize low-relief linear features that might be related to bedding traces or faults in bedrock. Unfortunately, the radar imagery reveals neither soil-lithologic variations or linear features.

Evaluation

Only features of considerable topographic relief, such as ridges standing 100 feet or more above the surrounding country, appear distinctly on the radar images. Inasmuch as ridges in this part of the Piedmont are generally a direct reflection of resistant bedrock units, and ridges 100 feet high are relatively scarce, the radar images reveal little of the geologic "grain" which is well displayed on conventional photographs. In areas of low, rolling topography it is difficult even to see the drainage net except for larger trunk streams.

Tonal differences which might be attributable to soil or bedrock variation are completely obscured by the geometric pattern of farm fields and woodlots. This distraction appears to be lessened by vertical polarization but is definitely not eliminated. Woodlots stand up in relief against adjacent fields and it is plain that radar is being reflected from the crowns of trees. It is not clear at present why there is no effective penetration of forest cover on the relatively flat Piedmont and very effective penetration in the more rugged ridge and valley terrain of east-central Pennsylvania, and other mountainous areas (see, for example, Snavely and Wagner, 1966, Tech. Letter NASA-16).

Distortion of the imagery is obvious and expecially severe close to the flight path. Consequently adjacent flight strips cannot be mosaicked to produce regional coverage.

Summary and recommendations

The radar imagery currently available of the Harford County - York County area shows nothing of the geology that could not be seen equally well or better on conventional aerial photographs. However radar is a potentially useful tool in the Piedmont and more testing should be done. Specifically, I recommend that:

1. Future radar flights over the Piedmont be scheduled for the winter months when tree foliage is sparse and most farm fields are bare. The present imagery was taken in August with the trees in full leaf and crops at near maximum stand.
2. Larger scale, higher resolution imagery be obtained. Relatively subtle topographic features may be important geologically in areas of low relief and these cannot be seen on the present 1:200,000 imagery.

The development of longer-wavelength radar sets capable of penetrating vegetation and some soil cover is awaited with considerable interest.

Figure 1. Conventional aerial photograph of a portion of north-central Harford County, Maryland. Rock Ridge and Slate Ridge are prominent topographic features that stand from 100 to 300 feet above the surrounding country. Rock Ridge is underlain by metaconglomerate and quartzite, and Slate Ridge by graphitic slate. The surrounding country is underlain chiefly by pelitic schist and schistose micaceous quartzite.

Figure 2. Radar image, at scale approximately 1:100,000, of the area shown in Fig. 2. Rock Ridge is well defined and the stream-cut through it is emphasized; Salt Ridge is very difficult to discern and probably could not be located if it were not for the water-filled abandoned quarries, which show up prominently.

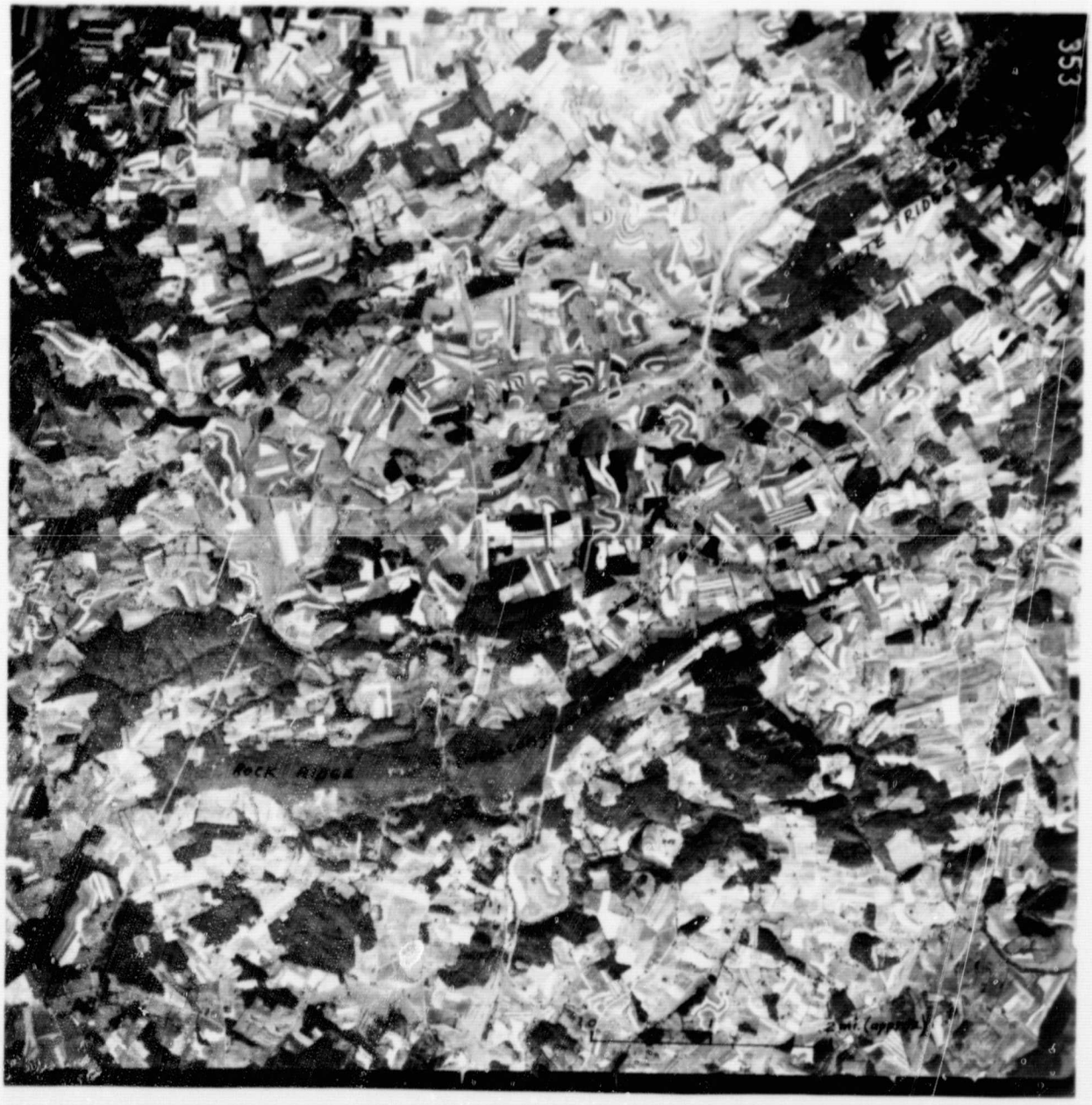

Figure 1.

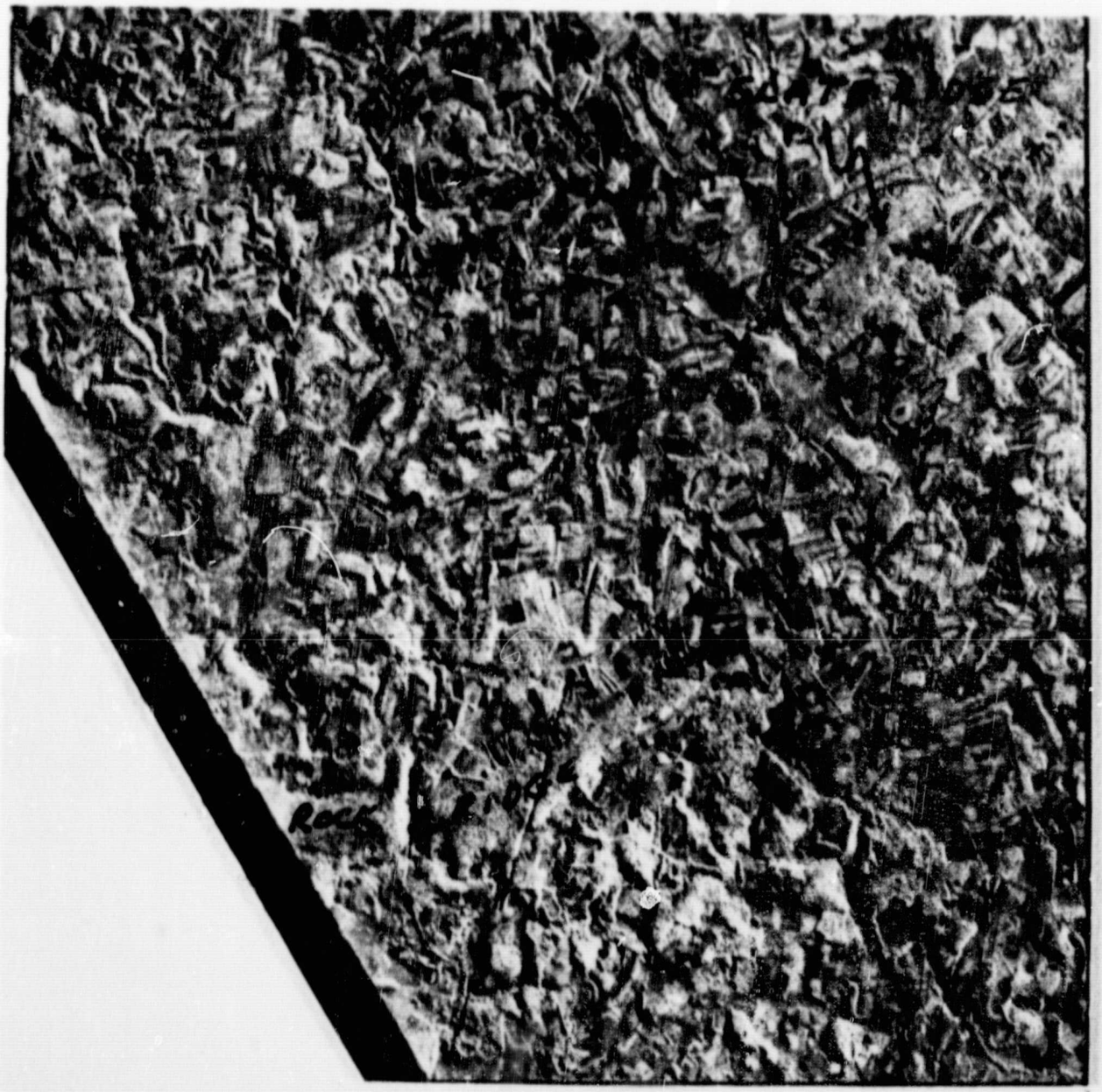

Figure 2