Title: Extent of Cyclic and Changing Ecological Phenomena
and Semipermanent Vegetation-Ecosystem Interfaces

Subtitle: Ecological Applications of ERTS-A Imagery

Proposal No. SR No. 162-II

GSFC ID No. UN 598

Contract No. NAS 5-21882

Principal Investigator: H. R. DeSelm

First Look Report: 1 October - 1 December, 1972

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(E73-10417) EXTENT OF CYCLIC AND CHANGING ECOLOGICAL PHENOMENA AND SEMIPERMANENT VEGETATION ECOSYSTEM INTERFACES. ECOLOGICAL (Tennessee Univ.) 14 p HC $3.00 CSCL 08F G3/13
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INTRODUCTION

ERTS-A imagery of East Tennessee and adjacent area dated 15 October 1972 (108, 131, 154, 177) lend themselves to analysis for landscape features to determine ecological applications of ERTS-A imagery with special emphasis on vegetation - ecosystem bounday determination.

This was a period of clear to partly cloudy weather, showers were general in the Tennessee Valley 4, 5, 6 and 13 and 14 October but on 15 October shower activity was confined to the western and southern parts of the Tennessee Valley. In the high mountain stations, rain ranged from 0.1 to 1.2 inches averaging about 0.4 inches on 13 and 14 October. Temperatures ranged from the middle 40's to low 50's at night to afternoon highs in the low 60's to low 70's (TVA 1972, Great Smoky Mountains National Park daily weather records) depending upon elevation.

Imagery time 9:43 DST, suggests that sun angle is low enough that low elevation east and south slopes are being warmed to a much greater extent than low elevations north facing slopes and the highest mountain ridges of all aspects.

All available bands have been examined for significant boundaries, but bands 6 and 7 (Fig. 1) have proved especially useful and are used chiefly in this report although that available is not scene corrected. Locations of county boundaries and latitude - longitude lines are within ca. one statute mile on imagery margins (Overlay, 0-1).

RESULTS

Interpretation of Imagery: Geology

Prior mapping of geologic features in the study area has proceeded well into summary stages. The area is mapped as part of the Geologic Map of Tennessee at a scale of 1:250,000 (Hardeman, 1966), as East Tennessee at 1:125,000 (Rodgers, 1953), the Great Smokies are mapped at 1:125,000 (King, Neuman and Hadley, 1968), the Cumberland Plateau and Mountains (Wilson, Jewell and Luther, 1956) at 1:187,000, and various quadrangles are mapped at 1:24,000 by the State Division of Geology and the U.S. Geologic Survey. The intensely faulted and folded rocks exhibit numerous special features. Faults occur at prominent topographic breaks and some at smaller features; an example of the first is the Cumberland Mountains overthrust block (Overlay 02-1), examples of the second are the Dunn Creek Fault (Overlay 2-2) and the Greenbrier Fault (Overlay 2-3). Such synclines as the Short Mountain syncline (Overlay 2-4) is also apparent. We are unable to see, except as marked by vegetation, windows as the Cades Cove window (Overlay 2-5). We are unable to see the debris slide scars and deposits of 1952 on Mt. Le Conte in the Smokies (Overlay 2-6), nor those on Webb Mountain made in 1938 (Overlay 2-7). The block fields of the Smokies, forest covered, are not visible (Overlay 2-6). Regolith-soil boundaries are not yet visible except major ones marked by parallel topographic-geologic changes (Overlay 2-8).

Interpretation of Imagery: Topography

Most of the lowest, largest valleys here are TVA reservoir filled, these and rivers > 30m (90ft.) wide are often visible at density 12-13 (Overlay 2-9).

South and east mountain and hill slopes are warmer, light gray (5), cool north and west slopes (9-10); thus, the imagery shows mountain-valley topography best (Overlay 2-10).

In the Cumberland Mountains, Pine Mountain (Overlay 2-11) and Cumberland Mountain (Overlay 2-12) appear. The boundary between the Cumberland Plateau Physiographic Province and the Valley and Ridge Physiographic Province appears (Overlay 2-13).

In the Valley and Ridge are high sandstone ridges, Silurian as Powell Mountain (Overlay 2-14), Cambrian Rome Formation as Bays Mountain (Overlay 2-15). High cherty ridges, Knox group as Chestnut Ridge appears (Overlay 2-16). These riges are largely forested and boundaries result chiefly from land use. Other areas of the Valley are rolling dolomitic, limestone and shale landscapes where small topographic units usually result in a patchwork of densities resulting from urban, field crop, pasture and forest useage (Overlay 2-17). Much of the shale knobs are forested (Overlay 2-18). The Valley and Ridge - Blue Ridge Physiographic Province boundary is partly visible under clouds (Overlay 2-19).

Man's activities are apparent from the mottled lowlands and forested long ridges, an occasional interstate highway, as I-40 West of Knoxville (Overlay 2-20), a few cities as Knoxville (Overlay 2-21) and Maryville (Overlay 2-22), and strip mines spoil bank outslopes west of Walden Ridge (Overlay 2-23). Land use, using a sample: forest, agriculture, urban-suburban classification from a Valley portion of Loudon County is better read on band 5 than band 7 (Fig. 2).

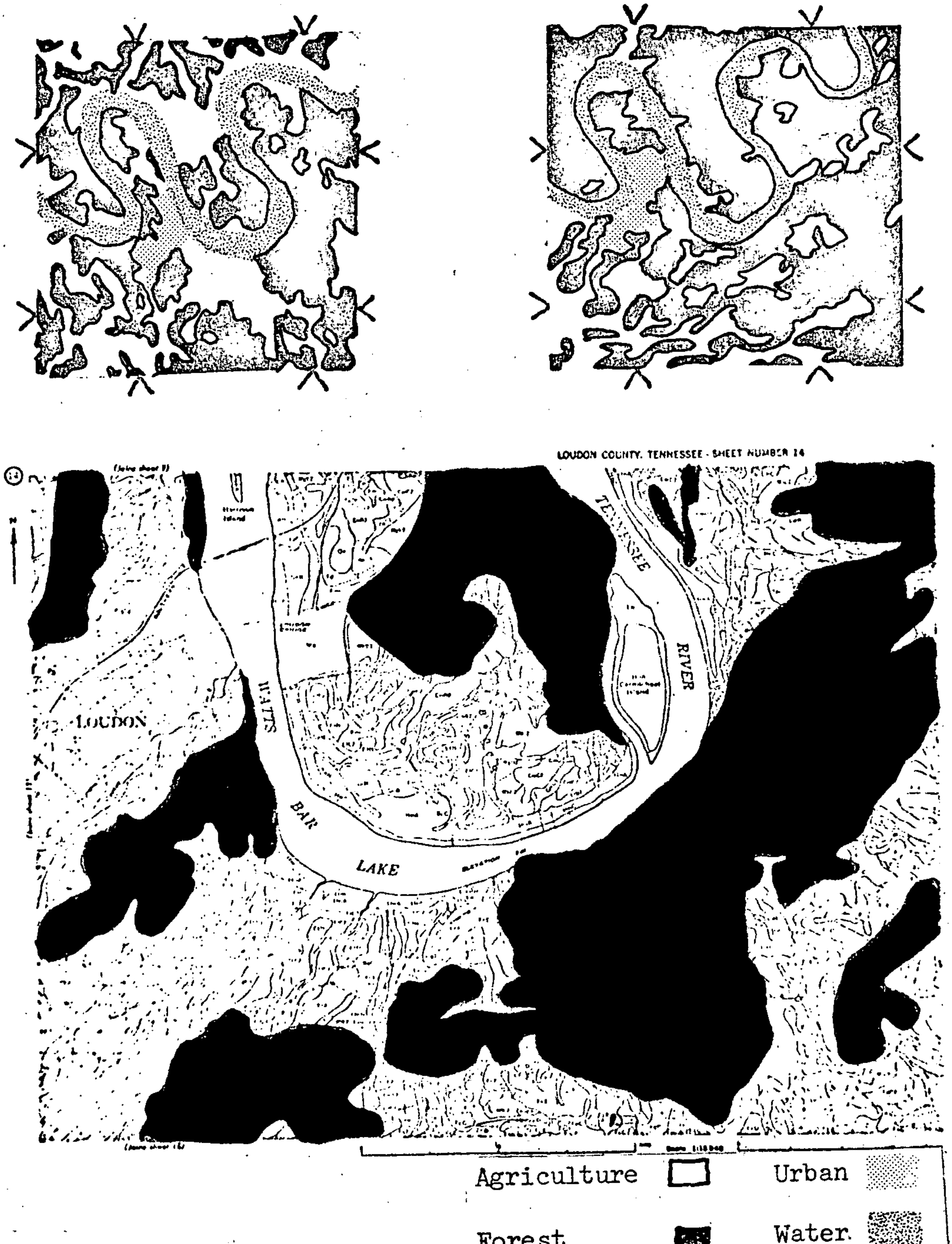

Figure 2. Copy of Sheet 14 (from Elder, et al., 1958), part of Loudon County, Tennessee. Inserts are forest-agriculture-urban, suburban interpretted on Band 5 left and Band 7 right.

Interpretation of Imagery: Vegetation-Ecosystem Boundaries.

Our analysis of vegetation-ecosystem boundaries has centered on the crest of the Great Smoky Mountains and the Balsam Mountain chain in East Tennessee and western North Carolina (Overlay 2-24). Centering on the crest is a dark area approximately the shape of the Spruce-Fir type. Comparison of the imagery boundary with a topographic map indicates that it lies above 4500 ft. October temperatures average 7F lower than temperatures in the Valley and October precipitation here is also ca. 3.6 in. higher than in the valley (TVA 1972, Shanks 1954). Measurements indicate that under spruce, litter and humus accumulations average 48 tons/acre with considerable moisture holding capacity (McGinnis, 1956). Thus, on bands 6 and 7 this is a cool (moist) area - it is also dark on bands 4 and 5 indicating that the trees are dark colored (2.5 G3/4 to 5.0 G5/8) and that the image is not simply a crest microclimate but that it is a vegetation - controlled boundary.

Simultaneous projection of bands 4-7, two at a time through Eastman filters 25 and 58, photographing the image using high speed ektachrome (EH-135) and subsequent local commercial developing and printing (Fig. 3) has so far revealed little about this boundary not known from examination of ERTS imagery directly.

The first microdensitometer scan of the 70mm chip of band 7 using the 25 micron raster and no filtration resulted in a print-out (Fig. 4) in which the 256 "Tech-Ops possible" density levels are combined into 12 symbols indicating the 15 density levels possible on the whole image (but of which ca. 12 are present on this part of the image). The area shown on Fig. 4 is the northern end of spruce-fir of Fig. 5, e.g. that on the

Figure 3. Color enhancements of: upper, Band 6 green-Band 4 red; middle, Band 5 green-Band 6 red; lower, Band 7 red-Band 4 green.

Figure 4. Microdensitometer print-out of band 7, image 177 of the Tennessee-North Carolina state line ridge in Luftee Knob and Mount Guyot U.S.G.S. quadrangles.

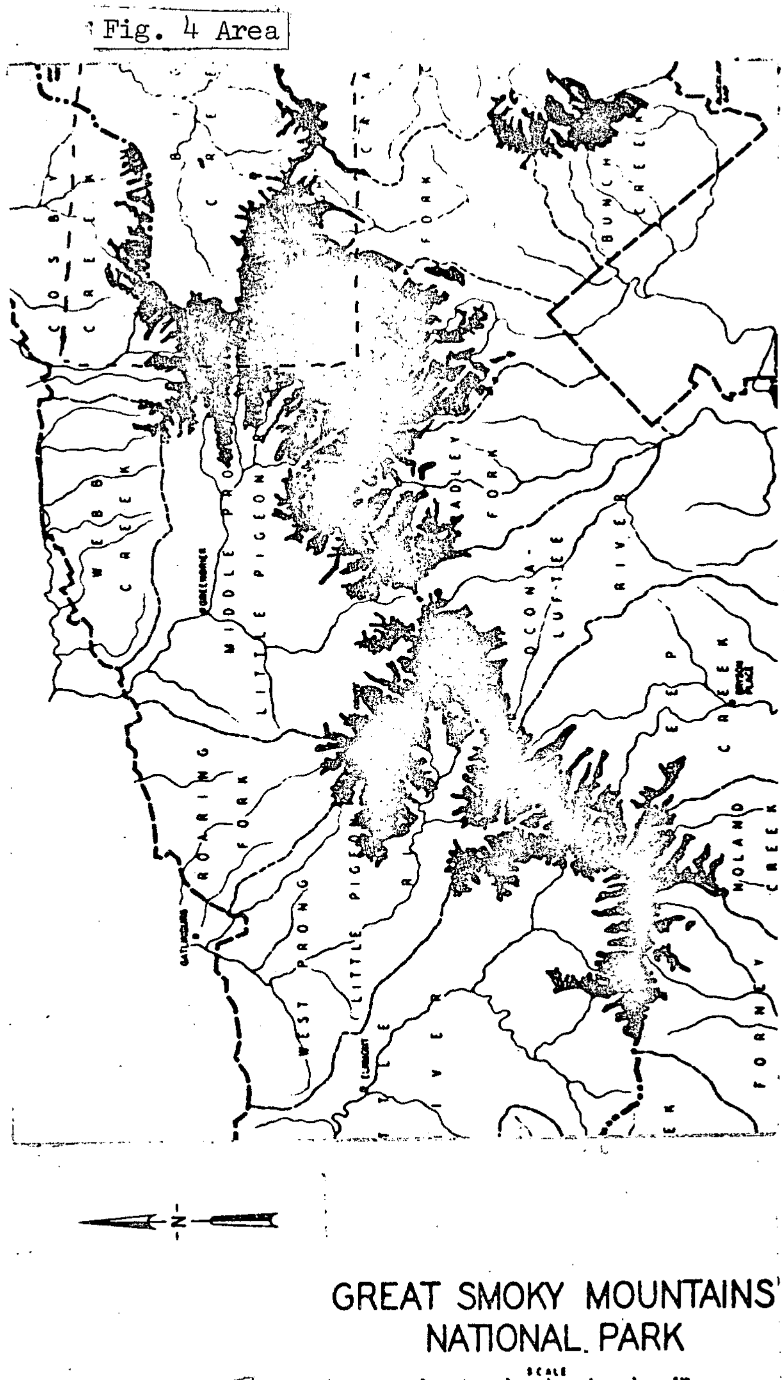

Figure 5. Portion of the 1939 T.V.A. map of spruce-fir forest in the Great Smoky Mountains National Park.

Mt. Guyot and Luftee Knob USGS quadrangles. Vertical-horizontal distortation is ca 1.6:1. Dark edge symbols represent masking. The light areas on the west at lines 62, 67, 165-200 are clouds. The parallel dark bands are spruce-fir forests on the state line ridge (north) and the Balsam-Mt. Sterling ridge (south) merging into the large spruce-fir complex extending from Mt. Guyot along Greenbrier Pinnacle, and along the state line to Pecks Corner and on Hughes Ridge. Since the imagery is not scene corrected and our first printouts are exaggerated east-west, no precise geographic comparison is yet possible. However, the general form of a fringed or frayed border ecosystem with two east extending arms uniting westward into an area where, ca. half of the uplands are spruce-fir dominated is depicted.

CONCLUSIONS

ERTS-A imagery offers the possibility of redetermining vegetation-ecosystem boundaries and the first boundary to be checked is the spruce-fir community of the high Smokies which seems to correspond to image density. Precise comparison with microdensitometer print outs await improved scene corrected imagery and print outs corrected for vertical distortion.

Modifications of proceedure have been placed in effect and are determined in the Data Analysis Plan.

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EXHIBIT C

ERTS IMAGE DESCRIPTOR FORM

USER NAME: H. R. DeSelm

DATE: 1 December 1972

USER ID: UN 598

AGENCY: University of Tennessee

PRODUCT ID (Include Band and Product)	Frequently Used Descriptors *	Descriptors
Bulk 108 band 4 131 band 5 154 band 6 177 band 7	Agriculture Valley City Conifer Croplann Deciduous Fault Grass Mature vegetation Plateau Ridge Mountain Highway Synclinal Mountain Vegetation	Spruce-Fir Vegetation

*For descriptors which will occur frequently, write the descriptor terms in these column heading spaces now and use a check (✓) mark in the appropriate ID lines. (For other descriptors, write the term under the DESCRIPTORS column).

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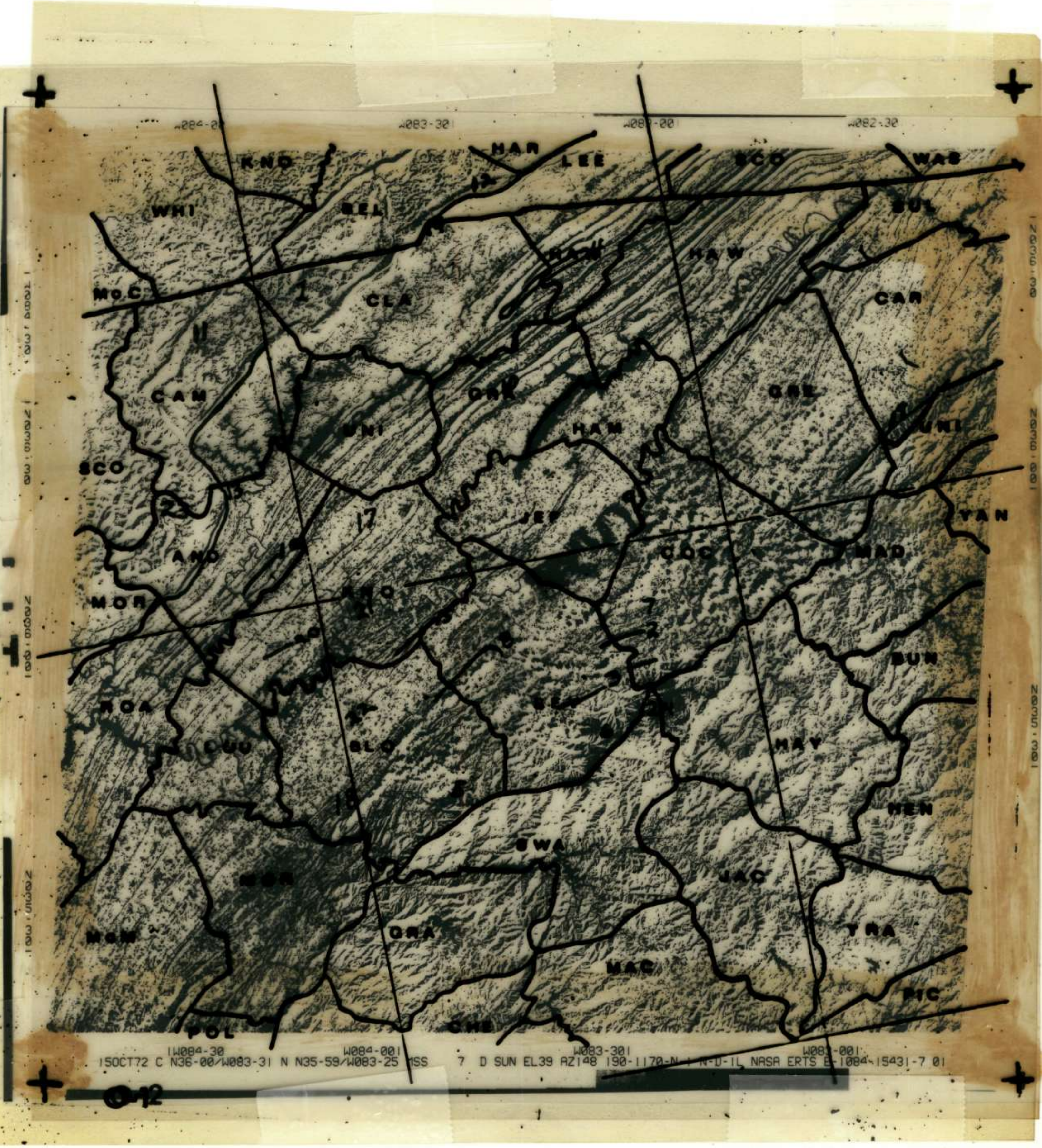

Figure 1. Positive contact print of Band 7, 15 October 1972, Image No. 177.