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MAPPING OF SPOIL BANKS USING ERTS-1 PICTURES

Professor Moid U. Ahmad and David A. Kantner, *Geology Department, Ohio University, Athens, Ohio 45701*; John W. Antalovich, President, *Kucera and Associates, Inc., Mentor, Ohio*

Abstract

NASA's Earth Resources Technology Satellite (ERTS-1) is sending good quality pictures. Four pictures of different wave lengths (MSS 4,5,6,7) are used in the study of two strip mine areas in Southeastern Ohio. The first area is near Piedmont Lake and the second area is near New Lexington. In this study 9.5 inch prints were examined under a binocular microscope and the gray tone is correlated with the actual ground conditions at several sites. For the New Lexington area, color infrared pictures taken at an elevation of 18,000 feet were also used for correlation with the ERTS-1 imagery. The results indicate that MSS 5 and 7 are most useful in defining the stripped land and show that the hydrological and soil characteristics are remarkably different than the surrounding lands.

Method of Investigation

We have received two good sets of images of Southeastern Ohio. The rest of the images were spoiled due to the cloud cover. In this investigation we examined 9.5 inch prints under a 10-25 power binocular microscope with under and over lighting capabilities.

We were interested in the reclaimed strip mine areas, unreclaimed strip mined areas, and undisturbed land. We selected two areas for detailed work - (1) near Piedmont Lake and (2) near New Lexington. The location of these areas is shown on Fig. 1.

Strip mined areas near Piedmont Lake were identified on the ERTS-1 pictures and the gray tone described. Two methods of describing the gray tone were used, the objective numerical gray scale which is included on each ERTS-1 picture and a subjective verbal description. It was found that the verbal description seemed better for making comparisons between pictures because of inconsistencies in gray scales between pictures and the narrow range of usable tone on some of the gray scales. The strip mine areas were also located on topographic maps and the ground conditions were checked by visiting each site.

The graytone data obtained for each site for each MSS band is not included because of lack of space. We found MSS5 (Red) and MSS7 (Infrared) showed well defined features. Figures 2 and 3 are the enlargements of ERTS-1 pictures for the areas near Piedmont Lake and Table 1 (end of paper) describes the condition of each site.

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Original photography may be purchased from
EROS Data Center
10th and Dakota Avenue
Sioux Falls, SD 57198

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We followed a similar procedure for New Lexington area but also used color infrared pictures (Kodak Ektachrome Infrared Aero Film 8443) supplied by the Manager of Wayne National Forest. The gray tone data obtained for each site for each MSS band is not included. Figures 4 and 5 are the enlargements of ERTS-1 pictures and Fig. 6 and 7 are the copies of color infrared. Table 1 describes the ground condition of each site.

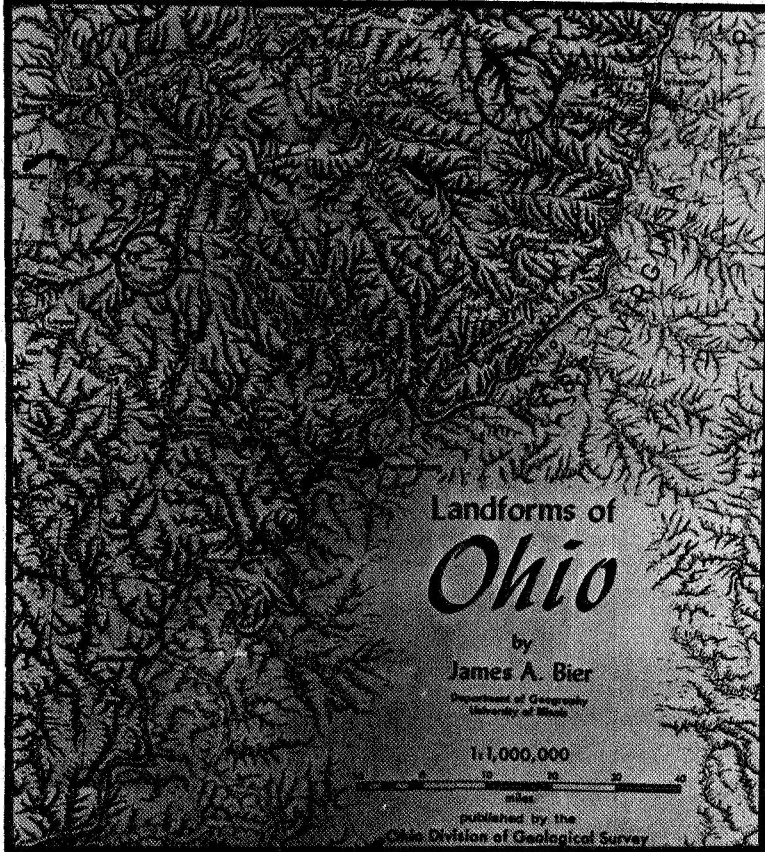


Fig. 1 - AREA
OF
STUDY

- No.1 - LAKE PIEDMONT
STUDY AREA
- No. 2 -NEW LESINGTON
STUDY AREA

Discussion of Data

Highways

Certain highways were valuable reference features which were used to locate areas on the ERTS-1 pictures. Highways are best distinguished on the Red (MSS5) pictures. They are represented as light gray lines against a darker background. They show up fairly well on the Green (MSS4) pictures as light gray lines. They barely show up on the Infrared pictures as vague medium gray lines against a lighter background. Major four lane concrete highways are depicted best. Minor highways only show occasionally.

Water Bodies

Bodies of water were also used as reference features because they are prominent visible features. They are most visible on the Infrared pictures and are represented by a distinct black shade. It appears that the black areas representing bodies of water (lakes and rivers) show up larger or wider than they actually are. This may be due to water saturated areas adjacent to these bodies. The Red and especially Green pictures are poor for identifying lakes because the lake areas appear to blend in with the vegetative tone on the picture and are hard to distinguish from the picture background. The Ohio River channel, however, is better distinguished from its floodplain on these two pictures (especially Red) than on the Infrared pictures.

Coal Concentrations

Coal piles and spills are best shown on the Infrared pictures as black areas. This is why the town of Holloway and the Hanna processing plant show up so well on the ERT-1 pictures when other settlements their size do not.

Natural Vegetation

The general background tones on the ERTS-1 pictures represent the natural vegetation of the area, a combination of mainly hardwood forests and grassy areas where the trees have been removed. The background tone of the Infrared pictures is a light gray. The vegetation doesn't show well and details of the general topography of the land surface are more readily visible. The Red and Green pictures have a mottled background which seems to show the differences in vegetation, although it was not studied in detail. The darker tones in the mottled background may represent the trees covering most of the ridges and the lighter shades represent the more grassy valley bottoms. This might turn out to be a crude method to determine the topographic pattern of ridges and valleys.

Unreclaimed Strip Mined Lands

The unreclaimed areas show up as the darker grays to black on the Infrared pictures (e.g., site 5, Fig. 2) against a light gray background. They show up as white to light gray on the Red pictures (e.g., site 5, Fig. 3) against a mottled light gray to dark and black background. They show up on the Green pictures as light gray against a mottled lighter gray background. So far, specific larger strip mines have been observed on the ERTS-1 pictures and located by using their relationship to other identifiable features on the pictures and comparing the shape of the areas with mapped strip mines and the general topography.

Stripped lands show up well on all the MSS bands. Undoubtedly, the reason is that they are more or less barren of vegetation and composed of rock and soil material with different hydrologic characteristics which cause a marked difference in the reflectance as compared to vegetated land. It is possible that the stripped lands may be confused with similar barren areas such as plowed fields, but this has not yet been investigated. Strip mines do seem to have a characteristic irregular shape and are often large enough to be seen easily on this scale of picture which may aid in their identification. Very small strip mines have not yet been investigated sufficiently to determine their visibility on ERTS-1 pictures.

Reclaimed Lands

In the Piedmont Lake area, the reclamation was fairly recent (less than five years), graded first to some semblance of the original contour and planted with grass. From the small amount of data we have been able to collect at present, it appears that under these conditions the reclaimed land may show up as slightly darker than the unreclaimed stripped areas on the Green and Red pictures (e.g., sites 16 and 5, Fig. 3) and a little lighter than the unreclaimed areas on the Infrared pictures (e.g., sites 16 and 5, Fig. 2).

The sites studied in the New Lexington area are older, and were stripped and reclaimed 20-30 years ago. The spoil was not graded at all and the land was planted with trees which have grown relatively large and dense by this time. The study sites were fairly well defined on the Infrared picture (Fig. 4) but were poorly defined on the Red (Fig. 5) and Green pictures. On the Infrared, the reclaimed areas appear to be slightly darker than the natural forest areas (e.g., sites 5b and 7, Fig. 4). More work is needed here to find out if distinction between older tree reclaimed areas and natural wooded areas is possible from the ERTS-1 pictures.

Reclaimed lands seem to be the most difficult areas to distinguish. Not enough work has been done yet to show whether this is inherent or just lack of data. Research should continue in the direction of finding some consistent method of defining reclaimed areas on the basis of the tone that represents them on the four ERTS-1 bands. One problem lies in the variety of conditions that can exist for such land. For example, the type of vegetative cover, the percentage of coverage, and the time since stripping and/or reclamation efforts might all affect the tone recorded on the pictures.

There is a need for continued research to determine if there is a measurable and consistent change visible on ERTS-1 pictures in reclaimed land from the stripped condition to grading, planting, and the establishment and growth of vegetation to a point in time when conditions may blend back into the natural vegetative background, at least as far as the ERTS-1 imagery is concerned.

Conclusions

- (1) Large scale unreclaimed stripped land can be easily distinguished on all the MSS bands.
- (2) It may be possible to distinguish reclaimed land from the natural vegetative background and unreclaimed land but more intensive research is required.
- (3) The stripped land appears to have different soil and hydrological characteristics than the surrounding land.

Acknowledgements

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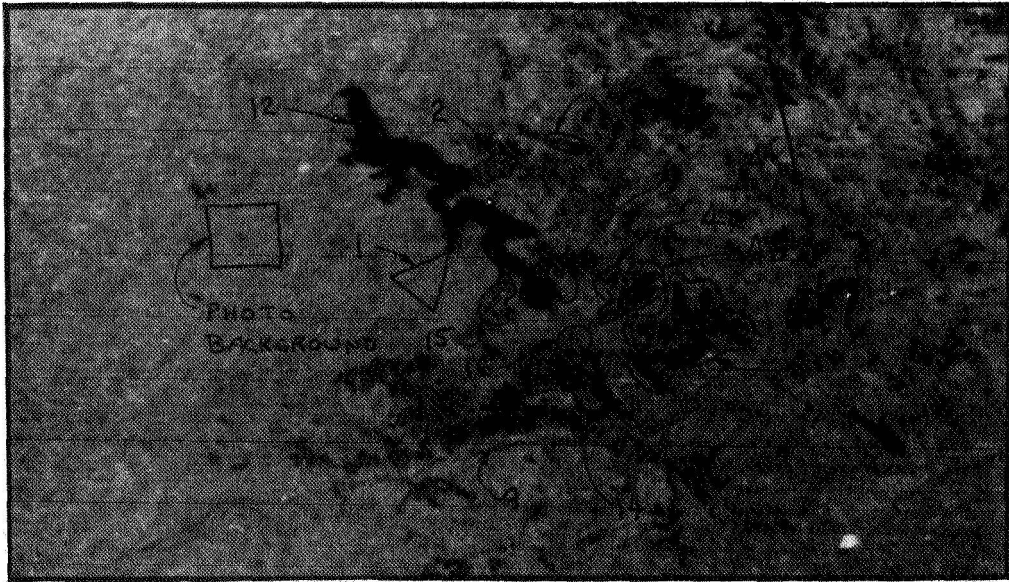


Fig. 2 - LAKE PIEDMONT STUDY AREA

Close up of Aug. 21, 1972 Infrared ERTS-1 (MSS7) (Photo ID. No. E-1029-15361-5N000) showing sites studied
Scale 1 cm. - 1.77 mile

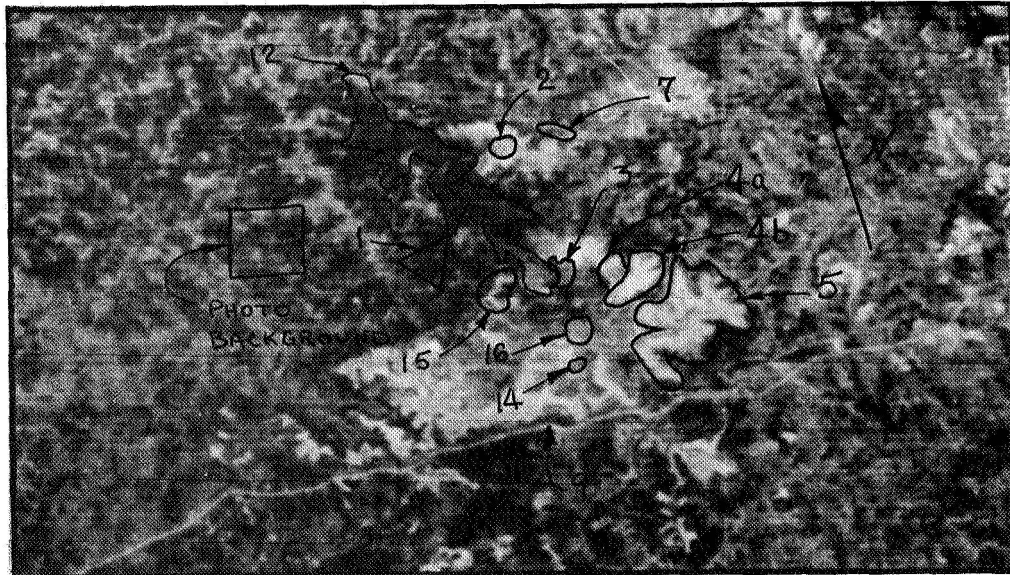


Fig. 3 - LAKE PIEDMONT STUDY AREA

Close up of Aug. 21, 1972 Red ERTS-1 (MSS5) (Photo ID. No. E-1029-15361-5N000) showing sites studied
Scale 1 cm + 1.77 mile

SEE TABLE NO. 1 FOR SITE DESCRIPTIONS

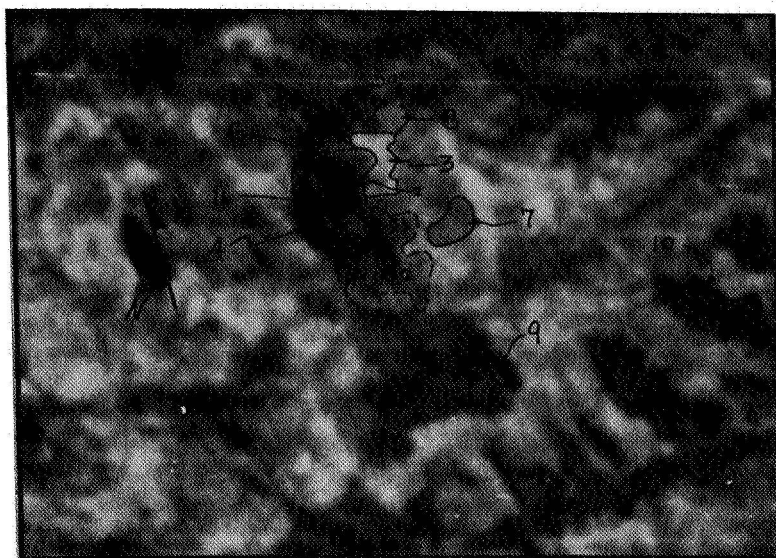


Fig. 4 - NEW LEXINGTON STUDY AREA

Close up of Oct. 15, 1972 Infrared ERTS-1 (MSS7) showing sites studied
Scale 1cm = .61 mile
Photo ID. No. E-1084-1545-5N000



Fig. 5 - NEW LEXINGTON STUDY AREA

Close up of Oct. 15, 1972 Red ERTS-1 (MSS5) showing sites studied
Scale 1cm = .61 mile
Photo ID. No. E-1084-1545-5N000

SEE TABLE NO. 3 FOR SITE DESCRIPTIONS

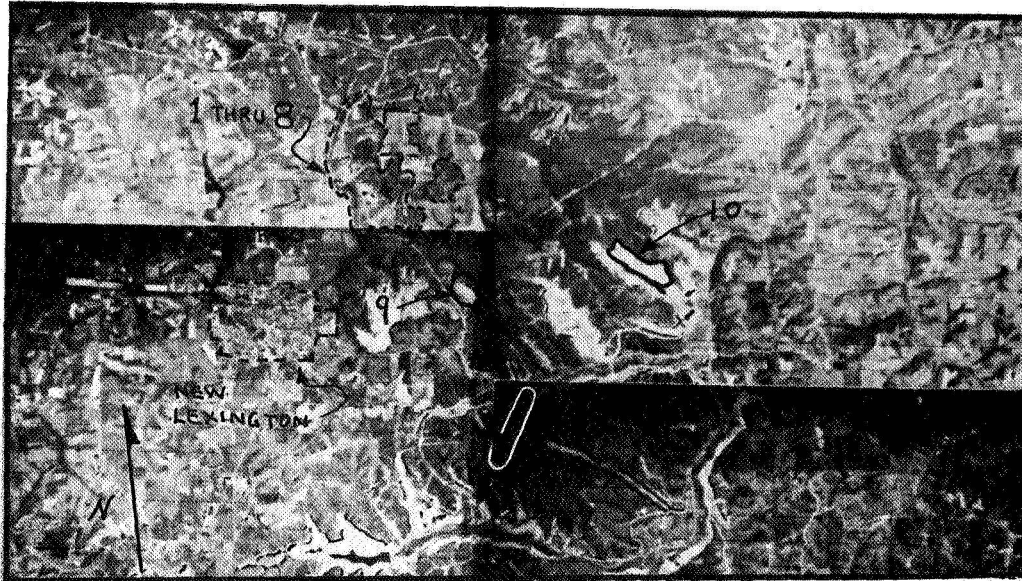


Fig. 6 - NEW LEXINGTON STUDY AREA

Color Infrared photo mosaic (courtesy Wayne National Forest) showing sites studied



Fig. 7 - NEW LEXINGTON STUDY AREA CLOSE UP

Close up of color infrared photo (courtesy Wayne National Forest Service) showing sites studied
 May 11, 1972, Altitude 18,000 feet, Copy Scale 1cm.= .17 mile

SEE TABLE NO. 1 FOR SITE DESCRIPTION

TABLE 1 - SITE DESCRIPTIONS

Site Code No.	SITE DESCRIPTION (Unstudied sites omitted)
LAKE PIEDMONT STUDY AREA	
1	Natural hard wood forest area.
2	Stripped area reclaimed in 1968 according to Ohio Law. Area now has grass and brush growing on it and some small trees. Coverage somewhat sparse.
3	Grass reclaimed area, well graded. Fairly good coverage.
4a	Stripped valley which has been graded and newly grassed and what appears to be slightly restripped near the highwall.
4b	Stripped valley which had been graded but not yet grassed.
5	Large valley which has had massive stripping on both sides. Large highwalls and spoil banks. Entire valley practically devastated. No reclamation.
7	Location of the town of Holloway. Shows up because of coal piles and spills along an eight track wide railroad switch yard.
9	Rt. 70 - A four lane concrete highway.
12	Lake Piedmont Reservoir.
14	Location of Hanna's coal processing plant. An area of coal piles and spills.
15	A narrow stripped bench.
16	A predominantly grass reclaimed area. Graded, some scattered trees, vegetation generally sparse and patchy.
NM	New stripping of site no. 5 found on the Oct. 15 picture which is generally obscured by clouds. Not shown on the site location picture.
NEW LEXINGTON STUDY AREA	
1a	Black shale and coal slag piles.
1b	Black shale and coal slag piles.
2	Small ponds.
3	Normal farm grass pasture land.
4	Black shale and coal slag piles in moist stream bottom areas.
5a	According to a resident, this area was stripped some time in the 1940's. It was stripped by the area method and reclaimed soon after stripping by the normal trees used at that time. The trees are now large (up to 8" - 10"). Some normal hardwoods.
6	According to a resident, this area was stripped some time in the 1940's. It was stripped by the area method and reclaimed soon after stripping by the normal trees used at that time. The trees are now large (up to 8" - 10"). Some normal hardwoods. Fairly densely grown.
7	Normal forested land. Not dense, with grassy areas.
8	Normal dense forested area.
9	A practically barren spot in a strip mine mined by the area method.
10	Barren strip mine mined by the contour method.