DETERMINE UTILITY OF ERTS-1 TO DETECT AND MONITOR AREA STRIP MINING AND RECLAMATION

Phillip E. Chase
Bendix Aerospace Systems Division
3300 Plymouth Road
Ann Arbor, Michigan 48107

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Prepared in cooperation with Wayne Pettyjohn, Department of Geology, Ohio State University.

16. Abstract

The report summarizes the technical activity over the reporting period. Data and imagery from ERTS-1 was not received during the reporting period and, therefore, significant results are not available. Analysis of the strip mine records and aerial photos in the test site (five counties in Southeastern Ohio) indicate rapidly increasing stripping in the past few years. The mines are large enough to be detected and their gross characteristics observed in the ERTS-1 imagery. Progress in adapting the Bendix ground station to handling ERTS-1 Computer Compatible Tapes is set forth.

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Preface

(a) Objective of the Program

1. To map the acreage stripped or otherwise disturbed by coal mining operations in southern and eastern Ohio.

2. To detect, identify, and map the secondary effects of coal mining operation (strip) on the environment. These include erosion, vegetative stress, and sedimentation in rivers and lakes. The effects of water drainage and mine acid seepage are also of interest.

3. To study the after-effects of mining operations and compare recovery time and effectiveness with which mined areas are restored to usefulness.

4. To investigate the feasibility of transfer of knowledge gained by this study of Ohio to other strip mining regions of the U.S.

(b) Scope of Work. The scope is to compare the ERTS-1 imagery to ground truth and to aircraft imagery. The ERTS-1 imagery will be that as received from NASA and that as produced by the Bendix data processing facility from the computer compatible tapes. Comparison of the mapping and monitoring capability for several seasons will also be made.

(c) Conclusions. It is difficult to draw many conclusions about ERTS-1 feasibility without receipt of ERTS-1 imagery and digital data of the test site. Imagery of other geographical regions (Dallas-Fort Worth scene) show a clear view of airport construction. Vegetation and its density is clearly identified in many other ERTS-1 scenes. The demonstration of this application of ERTS-1 appears to be feasible.

A cursory examination of the stratigraphy of the eastern part of the project area tends to indicate that there should be less severe ecologic stress than elsewhere in the project area due to strip mining. An interpretation of the maps developed during study of the test site tends to show area strip mining in southern and eastern Ohio was almost negligible before 1950. Although the earliest mining occurred before the war of 1812, it has increased most rapidly in the 1960-1972 time period due to the development of giant earth movers.

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1. INTRODUCTION

The purpose of this report is limited to a review of pre-receipt of ERTS-1 data preparation phase accomplishments during the time period. ERTS-1 imagery and digital data were not sent to the contractor during the reporting period. The two major areas of preparation are the development of ground truth maps of the test site area (Coshocton, Tuscarawas, Guernsey, Belmont, Muskingum Counties in Ohio) and development of the data processing facility to process Computer Compatible Tapes (CCT).

2. ACCOMPLISHMENTS DURING ERTS-1 DATA PREPARATION PHASE

2.1 TEST SITE CHARACTERISTICS. The test site area (Coshocton, Tuscarawas, Belmont, Guernsey, and Muskingum Counties in Ohio) has been studied initially for stripped and reclaimed areas. The sources of information include the collection and interpretation of state and federal records and black and white aerial photography. Maps of the stripped areas have been prepared for each county for two years: Coshocton (1950, 1971), Tuscawaras (1951, 1966), Belmont (1950, 1966), Guernsey (1951, 1966) and Muskingum (1950, 1971). In general, the high wall and the spoil banks are identified as one means of demarkation of stripped and unstripped areas. The regions of underground mining also have been added to the maps showing the total area strip mining. The scale of the base maps is one inch to the mile.

Table 1 lists total area of each county, total areas affected by stripping, percentage of total county area affected by strip mining, area affected from 1914-1947, area affected from 1948-1971, and total area reclaimed. The data, however, makes no allowance for land that has been re-affected by subsequent stripping. Consequently, the surface area is probably smaller than that indicated.

The stripped area represented by the Muskingum maps of 1950 and 1971 measured 3,827 and 9,792 acres, respectively. The difference between these values and the entries in Table 1 are accounted for in part by the difference in years (1947 to 1950), the inability to detect small strip mines on air photographs, and the errors in determining the stripped regions as described above.

TABLE 1 COUNTY DATA OF STRIP MINING, IN ACRES*

	Coshocton	Belmont	Guernsey	Tuscarawas	Muskingum
County Total	349, 000	343, 000	332, 000	353, 000	424, 000
1914-1947	622	2, 254	355	4, 956	1, 604
1948-1971	16, 818	21, 042	4, 014	18, 039	12, 280
Total Area Affected	17, 440	23, 296	4, 369	22, 995	13, 884
Percentage Total Area Affected	5, 00	6.79	1.31	6.51	3.27
Total Reclaimed	13, 390	11, 443	3, 075	14, 885	7, 699

*Data taken from Division of Forestry & Reclamation, Ohio Department of Natural Resources (March 1, 1972)

Water quality maps have been prepared, which indicate that the streams in the eastern part of the test site are either neutral or slightly basic. Many of the streams in the western part of the test site, however, are acidic. The lack of acidity is in part caused by the relatively greater amount of limestone in the eastern part.

2.2 Handling of ERTS-1 Data. The primary attention in preparation for data handling has been given to the required data handling and analysis of the Computer Compatible Tapes (CCT). The following capabilities are available.

(a) Software to read the CCT's

(b) Display selected areas in color

(c) Move the window on the color display throughout the test site area

(d) Print out grey scale line printer plots of the selected areas

(e) Conduct further processing of selected areas. Software to apply canonical analysis, to selected targets to obtain training sets and scatter plots (showing separation of desired target from background). *

3. NEW TECHNOLOGY

There has been no new technology developed to date.

4. PROGRAM FOR NEXT REPORTING INTERVAL

Seventy millimeter imagery of the test site with partial cloud cover has been received after the reporting period of this report. Therefore, the Data Analysis Plan will be prepared during the next reporting period.

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*A description of the statistical processing will be available in the Proceedings of the 8th International Remote Sensing Symposium, Ann Arbor, Michigan, October 1972. Location of Sawdust in the Penobscot River by a Multispectral Scanner. Chase, P. E., Conrod, A and Imhoff, E. Available from Bendix Aerospace Systems Division in Ann Arbor, Michigan as report #BSR 3457.

Two sets of CCT's have also been received after the reporting period. Unfortunately neither of the two scenes are the same as that in the seventy millimeter imagery. Application of the computer compatible software will await receipt of additional ERTS-1 data that provides both imagery and CCT's for the same scene. It is expected that this will occur well within the next reporting period. The computer analysis of the information contained in the CCT's will be compared to the information in the ERTS-1 imagery. The maximum useable photographic enlargement will be determined upon receipt of ERTS-1 imagery of the test area.

The ground truth activities will consist of:

(a) Preparation of maps of stream water quality as measured by hardness, pH, dissolved iron, sulfate, chloride and total dissolved solids. The data for these maps will be obtained from reports and field investigations.

(b) Preparation of maps of thickness of coal deposits.

(c) Field investigation to verify key points sites of water quality and key active mines.

(d) Field investigation of key reclaimed areas after study of the ERTS-1 imagery.

Color imagery and multispectral scanner data will be obtained for selected parts of the test site from two altitudes. The color imagery will be used to aid in interpretation of the ERTS-1 imagery, verify the maps developed from reports and not verified by field investigation, and to select surface features for training multispectral scanner data (eleven channels compared to four for ERTS-1) will be used to evaluate the processing of the CCT's.

5. CONCLUSIONS

The identification and monitoring of area strip mining from ERTS is a difficult but manageable remote sensing problem. The complexity is created by random shape mines, various stages of successful and unsuccessful reclamation of stripped areas, and the

small size of a stripped areas relative to the instantaneous field of view of ERTS. It is expected that, because of size limitation, random shape and spectral variation, the statistical processing of the ERTS-1 MSS CCT will be required. Maximum optical and electronic enlargement will be necessary to outline the smaller size phenomena such as river sedimentation, erosion, vegetation stress and mapping the smaller mined areas. Even with the complexity of the scene it is concluded that positive results will be obtained.

6. RECOMMENDATIONS

It is recommended that a series of technical reports be prepared at the completion of key phase of the work and for significant findings and conclusions that can be reported in self-contained form. These reports will be prepared on a time schedule independent of the six month Type II reports. The special reports will be either exerpted or included as appendices as appropriate. They will be prepared in the format of Type II reports.

Three special reports are recommended for technical completion and preparation in the near future.

(a) The first report is a historical and graphic (maps) description of the test area. Maps of other data, such as location of coal seams not mined and water quality will also be included. The sources of data are aerial photography and tabular data in the State of Ohio files. The objective of the report is to present the public knowledge available at the time of the receipt of the first ERTS-1 imagery.

(b) The second report will be an assessment of the economic impact upon the land values in the stripped area. It is expected that land values are reduced after stripping has occurred. The value of the coal obtained is then compared to loss in land value. There are other derived benefits and costs from stripping that will be considered if easily quantified in dollars. This would be the initial step at estimating the cost/benefit of strip mining and in turn ERTS-1 monitoring of strip mining.

(c) The third report will be a quick look interpretation of the initially received imagery (scene 1084 15415) for strip mining and geological and hydrogeological features. These other features include escarpments, flood plains and man-made changes.