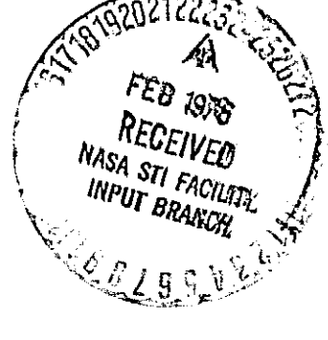
NASA CR.
144470

Investigation of the Geology, Mineral Resources, and Water Resources of the State of Maryland.
Kenneth N. Weaver, Prin. Invest.
Maryland Geological Survey
November, 1975
Final Report



(E76-10164) INVESTIGATION OF THE GEOLOGY, MINERAL RESOURCES AND WATER RESOURCES OF THE STATE OF MARYLAND Final Report (Maryland Geological Survey, Baltimore.) 21 p HC $3.50 CSCL 08F G3/43

N76-18585

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The Johns Hopkins University
Baltimore, Maryland 21218

November, 1975
Final Report

Prepared for
Lyndon B. Johnson Space Center
Houston, Texas 77058

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle *SKYLAB Imagery of the Maryland Piedmont*		5. Report Date 6. Performing Organization Code
7. Author(s) *William P. Crowley*		8. Performing Organization Report No.
9. Performing Organization Name and Address *Maryland Geological Survey* *Johns Hopkins University* *Baltimore, Maryland 21218*		10. Work Unit No. 11. Contract or Grant No. *NAS-9-13294*
12. Sponsoring Agency Name and Address *Lyndon B. Johnson Space Center* *Houston, Texas 77058*		13. Type of Report and Period Covered 14. Sponsoring Agency Code

15. Supplementary Notes
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Baltimore Gneiss Domes *Lineament Bundle* *Flexure*	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*

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4. Title and Subtitle *A Note on the Use of SKYLAB Imagery for Mineral Resource Inventories in the Baltimore area*		5. Report Date 6. Performing Organization Code
7. Author(s) *Karen R. Kuff*		8. Performing Organization Report No.
9. Performing Organization Name and Address *Maryland Geological Survey* *Johns Hopkins University* *Baltimore, Maryland 21218*		10. Work Unit No. 11. Contract or Grant No. *NAS 9-13294*
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Mineral extraction sites in the Baltimore area of sand and gravel and marble operations were inventoried using SKYLAB imagery. The sand and gravel operations have a consistent tan color while marble stands out as white or grey-white. Even with magnification the known, smaller operations could not be distinguished from cultural innovations.

17. Key Words (Selected by Author(s))	18. Distribution Statement		
Sand and Gravel *Marble*			
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle: Coastal Landform of Northern Assateague Island		5. Report Date
		6. Performing Organization Code
7. Author(s): Turbit H. Slaughter		8. Performing Organization Report No.
9. Performing Organization Name and Address: Maryland Geological Survey, Johns Hopkins University, Baltimore, Maryland 21218		10. Work Unit No.
		11. Contract or Grant No. NAS 9-13294
		13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address: Lyndon B. Johnson Space Center, Houston, Texas 77058		14. Sponsoring Agency Code

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This report points out through the use of SKYLAB imagery the unusual offset alignment of the northern end of Assateague Island. The historical changes that have brought this about and its effect on the shoreline to the south are discussed.

17. Key Words (Selected by Author(s))	18. Distribution Statement		
Base line Nodal Point Overwash			
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*

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PREFACE

Objective

The purpose of this report is to describe the usefulness of SKYLAB imagery film in the investigation of Piedmont geology, mineral resource inventory, and Atlantic Coast landform description. Appendix A describes the seasonal beach variations in the Maryland Chesapeake Bay.

Scope of Work

Piedmont geology was studied using SKYLAB imagery to determine how much detail could be recognized and value of such imagery in less intensively studied areas where crystalline rocks underlie humid, temperate areas.

Mineral extraction sites were inventoried using SKYLAB imagery of the Baltimore area.

The study of SKYLAB imagery of the Delaware-Maryland-Virginia Coast line shows an unusual offset alignment of the shoreline of north Assateague Island. The historical changes that brought this about and the effects on the shoreline to the south are discussed.

Conclusions

Study of Piedmont geology by SKYLAB imagery did not disclose any new concepts except to show areally extensive regional patterns. Of all the film viewed the S190B color positive film is considered to be the finest of all the SKYLAB imagery. A major limitation in mineral resource inventoring using SKYLAB film is that small operations of 10 acres or less could not be distinguished from cultural innovations. SKYLAB imagery was useful to show through the means of extensive areal coverage variations in the Atlantic coast line alignment.

Recommendations

SKYLAB imagery has shown to have limited use in the study of Piedmont geology and in the inventory of mineral resources, however, it has proven valuable in study of landforms of the Atlantic Coast. The major advantage of SKYLAB imagery is the extensive areal coverage thus because of this fact is is recommended as a tool in geologic studies.

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SKYLAB IMAGERY OF THE MARYLAND PIEDMONT

by
William P. Crowley

INTRODUCTION

During the period 1967-75 I have mapped in detail slightly more than 500 square miles of the Maryland Piedmont. In studying the SKYLAB imagery my objective has been to determine how much of this detail can be recognized in the satellite photography and consequently what value such photography might have in less intensively studied areas where crystalline rocks underlie humid, temperate areas.

Overall it is my conclusion that in this context the SKYLAB imagery is no more valuable than conventional aerial photography except that the coverage in a single frame is so much more aerally extensive that regional patterns are more readily recognized.

FILM EVALUATION

The S190B color positive film is unquestionably the finest of all the SKYLAB imagery from a geological point of view. The S190A RL22 film is nearly as good and somewhat better than RL45 and RL46. Color IR film (RL21) is inferior to color positive with the single exception that certain serpentine barrens stand out as purplish-blue blotchy areas on color IR but cannot be differentiated in color positive film.

Of the black and white films the S190A RL24 and RL47 are the best; RL23 not quite as food; RL19 and RL20 poorer yet, and RL43 and RL44 practically useless.

GEOLOGICAL INTERPRETATION

Clustered about Baltimore are a group of anticlimal structures known collectively as the Baltimore Gneiss domes. Where land use has been strongly

influenced by the geologic units defining these structures, they stand out markedly on SKYLAB imagery. For example the northern flank and eastern hinge of the Chattolanee dome are clearly visible, as are the northern flank and northern prong of the Towson dome, the western half of the Phoenix dome and the entire Caves anticline. On the other hand west of Baltimore where geological control of land use has been slight (probably due to the relatively minor areal extent of carbonate rocks) such well known structures as the Woodstock and Clarksville domes have virtually no photographic expression.

The most prominent linear zone in the Piedmont is the bundle of lineaments that strikes northeastward from Westminster into Pennsylvania where it can be traced at least as far as Interstate route 83, beyond which a narrow segment extends nearly to the Susquehanna. My mapping of this zone from Westminster to the Maryland-Pennsylvania boundary has demonstrated that it is the axial region of a major syncline and in all probability the major structure of the western Maryland Piedmont. The direct correlation of the lineament bundle in the SKYLAB imagery with this syncline indicates that this structure can be traced well into Pennsylvania, possibly as far as the Susquehanna. South of Westminster the lineament bundle is deflected northward in the vicinity of New Windsor, beyond which it continues southwestward and dies out. This flexure corresponds to a flexure in the synclinal axis established by the mapping of Dr. George Fisher of the Johns Hopkins University. The greater thickness of the lineament bundle in the vicinity of the Maryland-Pennsylvania boundary is probably the reflection of a zone of large, discontinuous, conglomeratic lenses that characterize that area.

A NOTE ON THE USE OF SKYLAB IMAGERY FOR MINERAL RESOURCE INVENTORIES IN THE BALTIMORE AREA

by
Karen R. Kuff

The use of SKYLAB S190B color positive film in inventorying mineral extractions sites has proven to be both helpful and limited in its application. The information gleaned from the photos includes the location and lateral extent of the larger operations, both working and abandoned, as well as showing the type of material extracted. Within the color positive frames that cover the Baltimore area, there are two basic materials being extracted, sand and gravel and marble. The large sand and gravel operations have a consistent tan color while the marble quarries have either a white or grey-white shade depending on the mineralogy of the marble. This aspect correlates with ground truth investigations. Similarily, the location of the operations were known before the SKYLAB imagery was used. One major limitation in the potential use of the photography is that, even with magnification, the known, smaller operations of 10 acres or less could not be distinguished from cultural innovations on the land. As the photos were taken in 1973, the information provided is dated and therefore cannot be used to follow the expansion of the separate operations. However, if the SKYLAB imagery was repeated at regular intervals the growth, stagnation or reclamation of the larger operations could be documented with greater efficiency.

COASTAL LANDFORM OF NORTHERN ASSATEAGUE ISLAND, MARYLAND

by
Turbit H. Slaughter

OBJECTIVE

The objective of this report is to point out through the use of SKYLAB imagery the unusual offset alignment of the northern end of Assateague Island, the historical changes that have brought this about and ultimate effect on the shoreline to the south.

SCOPE OF WORK

The shoreline of concern begins at the Ocean City inlet and extends 9.8 km south to the Maryland State Park (Figure 1). A map compilation dating from 1849 was made to show shoreline changes especially the dramatic westerly migration of the northern part of Assateague Island since August, 1933 when a hurricane created the present inlet.

INTRODUCTION

The Delaware, Maryland, and Virginia Atlantic Coast extends for a distance of 152.5 km from Cape Henlopen, Delaware, the mouth of Delaware Bay to Fishing Point, Virginia, the south entrance to Chincoteague Bay. It is remarkable that this distance of coastline is broken by only two inlets, Indian River inlet 17.4 km north of the Delaware-Maryland line, and Ocean City inlet 13.1 km south of the Delaware-Maryland line. The coastline as viewed from SKYLAB imagery S190B color positive film shows the inlets to differ considerably in that the Indian River inlet shoreline is relatively straight with only a small amount of offset, but the Ocean City inlet south shore is offset to the west showing a distinct updrift offset. The downdrift shoreline is west of the pre-1933 bay shoreline.

The northern 5.5 km of Assateague Island is low and flat lying with a mean elevation of about 1.5 m above mean sea level. There are no dunes of size. At extreme high tide water washes over the island carrying beach sand towards the Bay. This transfer of sand from the Ocean side to the Bay side is the process of migration of the Barrier Island westward. If sand were lost to Ocean side only, the island would progressivley thin and ultimately break into islets.

The process of sedimentary transfer of beach sand westward across the northern end of the barrier island has recently been investigated with the objective to determine the role of overwash in barrier island sedimentary dynamics (Fisher, Leatherman and Perry, 1974).

HISTORICAL SHORELINE RECORD

Figure 1 shows the location of the shoreline under consideration and the position of the 1849, 1933, 1942, 1964, and 1965 shorelines. The shoreline from the inlet south 8 km has the greatest erosion of the Maryland coastline for the period 1849-1933, a maximum of .3 km recession or 3.6 m per year. The present Ocean City inlet was broken through in August, 1933 by a hurricane whose track passed just west of the Chesapeake Bay. The inlet by 1934 had been stabilized by two stone jetties by the U.S. Army Corps of Engineers. As a result of construction of the inlet the predominant southerly littoral drift was prevented from by-passing the inlet creating a littoral deficit. This caused the north Assateague shoreline to accelerate its westward recession. Between 1933 and 1942 maximum recession was 122 m or 13 m per year.

The next major development began in January, 1962 when a breach formed at the extreme northern end of Assateague Island at the inshore end of the south jetty. In addition, an inlet formed about 2.4 km south of the Ocean City

north jetty (figure 2). The jetty breach and inlet were widened and deepened by the March, 1962 storm which also created another inlet 3.6 km south of Ocean City inlet (figure 3). During April and May 1962 dredging and emplacement of 1,050,000 cubic yards of fill by the U.S. Army Corps of Engineers closed the northern island jetty breach but sand moving south closed the northern inlet only during low tide. These two new inlets persisted until 1965 when 202,000 cubic yards of fill was emplaced by the Corps across the northern inlet. The southern inlet subsequently closed naturally.

In order to document parameters of shoreline migration of northern Assateague Island, black and white aerial photos of 1938, 1952, and 1956 and U.S. Geological Survey 7½ minute quadrangle maps of 1942 and 1972 have been utilized. A base line on the 1972 quadrangle map was established in line with the Ocean City boardwalk and projected southward until it coincided with the shoreline for that period. Maximum recession was measured from the base line. The coincidence of shoreline and base line is termed the nodal point. The base line is about in alignment with the pre-1933 Hurricane Shoreline. Distance of the base line was measured from the Ocean City inlet north jetty.

DATA PRESENTATION

Figure 4 is a map showing the 1942 and 1972 shorelines, the base line, and nodal points.

Maximum Recession Measured from Base Line

Date	Distance from N. Side of Ocean City inlet to point of measurement	Shoreline recession	Annual rate of recession
1938	1.7 km	170 m	
1942	1.3 km	230 m	15 m
1952	1.3 km	315 m	9 m
1956	1.6 km	380 m	16 m
1972	2.0 km	564 m	11 m

Distance from N. Side of Ocean City Inlet to Baseline Nodal Point

Date	*Distance to nodal point*	*Annual rate of southerly migration of nodal point*
1938	*5.2 km*	
1942	*5.4 km*	*78 m*
1952	*6.0 km*	*70 m*
1956	*6.2 km*	*45 m*
1972	*7.7 km*	*90 m*

DATA ANALYSIS

A rational analysis of the data does not readily indicate a simple relationship of the annual rate of recession of the shoreline to the annual rate of southerly movement of the base line nodal point. An initial conclusion indicated an anomalous situation of the mechanics or recession of shoreline to quantity of beach sand that moves predominantly southward. One would ordinarily believe that there would be a direct relationship to the two factors of beach movement, westward and southward. A possible suggested explanation is during periods of high tide and wave attack, the shoreline migrated westward from loss of beach sand by overwash and that sand which moved southward fortified the southern beach at the nodal point thus slowing up the southerly migration of the nodal point. As the amount of littoral drift moving southward diminishes, the baseline nodal point migrates southward with the natural westerly migration of the shoreline.

As previously mentioned but herein emphasized the Ocean City inlet acts as a barrier to the total sand budget moving southward which creates a littoral deficit for the northern end of Assateague Island causing it to migrate westward at a rate higher than the pre-inlet rate.

HURRICANES AND STORMS

The following is a list of hurricanes (Sugg, Pardue and Carrodus, 1971) and northeasters of note that have occurred between 1938 and 1972 that may have had some effect on Maryland's Atlantic Coast and on the westerly migration of the northern part of Assateague Island.

September	1938	Hurricane
September	1944	" "
October	1944	" "
September	1945	" "
September	1952	" "
August	1953	" "
August	1954	" "
September	1954	" "
October	1954	2 Hurricanes
August	1955	Hurricane
September	1955	Northeaster
October	1957	" "
September	1960	Hurricane
March	1962	" "
November	1962	" "
September	1964	" "
September	1967	" "
November	1968	" "
August	1969	" "
August	1971	" "

Although it cannot be documented, it is believed that the March, 1962 northeast storm has had the most significant singular effect on the westerly migration of the shoreline of northern Assateague Island through overwash and the creation of two inlets already described.

CONCLUSIONS

The westward migration of the northern part of Assateague Island as shown by SKYLAB imagery film will continue and new inlets will form during periods of high tide and storm wave activity. Between 1938 and 1972 the annual rate of southerly migration of a base line nodal point was 72 m. At this rate the 1972 nodal point will reach the northern end of the State Park property 2.4 km distant in 33 years. The figure 4 base line extends 61 m inshore of the 1972 shoreline 914 m south of the 1972 nodal point, thus it is possible to have erosion of the shoreline north of the State Park at the same time the nodal point is moving south. Therefore, the nodal point may reach the State Park in less time than 33 years.

REFERENCES

Sugg, A. L., Pardue, L. G., and Carrodus, R. L., 1971. Memorable Hurricanes of the United States Since 1873. NOAA Tech. Memo. NWS SR-56.

Fisher, J. S., Weatherman, S. P. and Perry, F. C. 1974. Overwash Processes on Assateague Island. Am. Soc. of Civil Engs. Proceedings of the 14th Coastal Engineering Conference.

Figure 2. Inlet 2.4 km south of Ocean City inlet on July 23, 1964. U.S. Army Engr. Photo

Figure 3. Inlet 3.6 km south of Ocean City inlet on Januray 8, 1963. U.S. Army Engr. Photo