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Department of Geology  
University of Iowa  
Iowa City, Iowa 52242

Experiment to evaluate feasibility of utilizing SKYLAB-EREP remote sensing data for tectonic analysis of the Bighorn Mountains region, Wyoming-Montana

Quarterly Progress Report, October 1 - December 31, 1974

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Principal Investigator - Richard A. Hoppin

Coinvestigator - Alan L. Swenson

Research Assistant - James P. Caldwell

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NASA Technical Monitor - Martin Miller, NASA, JSC, PIMO, Mail Code TF6, Houston, Texas 77058

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(E75-10151) EXPERIMENT TO EVALUATE  
FEASIBILITY OF UTILIZING SKYLAB-EREP REMOTE  
SENSING DATA FOR TECTONIC ANALYSIS OF THE  
BIGHORN MOUNTAINS REGION, WYOMING-MONTANA  
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Unclas  
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## STATUS SUMMARY

### Data products received during period

- a. SL-2 - S-192 - Roll 915- Orbit 6 Precision corrected bands 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13-2.
- b. SL-2 - S-192 - Roll 916 - Orbit 10 Precision corrected bands 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13-2.

Noise still apparent on some bands.

- c. S1-4 - S190B
  - 1) Roll #92 (Color 9" x 9" transparencies)(2 copies)  
Frames 156-157 totally obscured by clouds  
Frames 158-173 cloud cover is light to heavy
  - 2) Roll #93 (color infrared 9" x 9" transparencies)(2 copies)  
Frames 118-119 totally obscured by clouds  
Frames 120-138 cloud cover is light to heavy
  - 3) S192- MSS - Roll #924 - Orbit 92 - one image, band 13-1

### ACCOMPLISHMENTS FOR PERIOD

#### Analysis and field checking in the Black Hills - Alan L. Swenson

Skylab and ERTS imagery were examined for structural and linear features in the Central and Northern Black Hills of South Dakota and Wyoming. The imagery was examined under magnification and stereoscopically where there was sufficient overlap between frames.

Numerous linears were observed on both types of imagery. The patterns that developed were essentially the same for both kinds of imagery but the total number was greater on the Skylab (SL-2) imagery. This is presumably related to the greater resolution of the Skylab system and the larger scale format that was examined. Most useful Skylab imagery was S-190A B & W (red) and color, and S-190B color. Comparison of the linear patterns with published geologic maps shows a direct relationship between the linears and the geology. The Precambrian metamorphic and igneous rocks of the central part of the uplift were represented by a different linear pattern than the surrounding Paleozoic sedimentary rocks. The Precambrian rocks have a higher linear density and a strong NNW direction.

Adjacent Skylab images were examined stereoscopically. Topographically the Precambrian rocks are characterized by mature topography with the Harney Peak granite in the center of the Precambrian using above the the surrounding metamorphic rocks. The sedimentary rocks which surround the Precambrian rocks are low in relief with a youthful type of topography. The apparent contact with the Precambrian is indicated by an escarpment facing the Precambrian core of the uplift.

Field checking of the Skylab and ERTS imagery was carried out during August of 1974. The checking concentrated on determining the geologic nature of the linears observed on the imagery, measuring fracture orientations at several points in the sedimentary and Precambrian rocks, and observing the nature of the Paleozoic-Precambrian contact.

The linears in the Precambrian are geologically related to foliation in the schists which comprise most of the Precambrian, and to fractures in the Harney Peak granite which has intruded the schists. The linears in the schists are represented by valleys and ridges which parallel the foliation in the schist.

The Harney Peak granite rises above the surrounding schists and is cut by fractures which have weathered to form the linear pattern seen on the imagery. Two fracture stations measured in the Needles area showed two dominant fracture directions  $\sim$ N60E and  $\sim$ N45W. This compares favorably with the general trend of the linear noted on the imagery.

Just south of Custer, Gwynne (1944, S.D. Geol. Surv. Rept. Inv. 48), has noted a strong linear pattern in pegmatites intruding schists. They range up to 100 feet in thickness and 1000 feet in length. Gwynne notes that these are easily detectable on aerial photography. However, careful examination of the same area on the Skylab imagery does not reveal the presence of the pegmatites.

The general topography of the Precambrian that was observed stereoscopically on the Skylab imagery proved to be consistent with the actual topography. The Precambrian schists have been maturely dissected into linear ridges and valleys and the Harney Peak granite rises in elevation above the schists.

The sedimentary rocks of the uplift form a plateau usually capped by the Mississippian Pahasapa limestone. The plateau dips gently away from the Precambrian center of the uplift.

The largest concentration of linears in the Paleozoic rocks occurs between the west edge of the uplift, which is defined by the Fanny Peak monocline and the Precambrian rocks to the east. No conclusion could be drawn about the geologic nature of these linears. Topographically the linears are shallow grass lined valleys. Unfortunately, the valleys haven't been cut deeply enough to have exposed the Pahasapa limestone where fractures could be measured. Several fracture stations were recorded in the vicinity of the linears in the Pahasapa limestone. None of the prominent directions were parallel to the general trend of the linears.

One fracture station was recorded along Inyan Kara Creek in the Cretaceous Fall River sandstone. Inyan Kara Creek flows linearly for 40 kilometers along the northwestern flank of the Black Hills. The direction the creek flows is N30W. The fractures measured grouped in two directions, a prominent N35-60E direction and N30-50W minor set. Bergendahl and others (1961, U.S.G.S. Bull. 1082-J) also observed two dominant fracture directions of N55-75W and N20-25W in the Carlile, Wyoming quadrangle at the northwest end of the linear stretch of the creek.

Comparison of the four fracture stations taken in the Precambrian rocks (two in the schists and two in the Harney Peak granite) with those measured in the adjacent sedimentary shows that different patterns have developed in each. One general direction (ENE) is found in three of the stations recorded in the Pahasapa limestone and the two in the schist. No linears in either the Paleozoic or Precambrian rocks were found with this direction.

The Precambrian-Paleozoic contact is characterized in places, especially along the west edge of the Precambrian, by an escarpment developed in the Pahasapa limestone. As previously indicated the Precambrian and Paleozoic rocks have different topographic forms. The Precambrian is mature in form and the sedimentary rocks are youthful in appearance.

By examining the Skylab imagery stereoscopically the contact between the Precambrian and Paleozoic can be fairly accurately defined. The contact can be most reliably placed on the west side where the topographic differences are most pronounced.

#### Other Activities for the period

The analysis of the SL-3 190A and 190B imagery in the Owl Creek Mountains is continuing. The experiment in having six students do interpretive overlays of the same frame was completed. One was excellent but the rest were of less reliable quality. This was due to a combination of inexperience and varying ability between individuals. This is, of course, to be expected but it reemphasizes the importance of experience and skill in photo interpretation, even if the highest possible quality imagery is available. Even so, considerable detail could be mapped.

We were not able to do as much with the S-192 imagery as we had planned because of problems related to moving the department to new quarters. At this point we are not very optimistic about the usability of this imagery. Even in the precision corrected segments, many bands have too much noise and/or low tonal contrast. The best bands appear to be in the low IR range. In one case the S-192 IR bands 7 and 8 are sharper than the S-190A IR B & W.

#### ACTIVITIES PLANNED FOR NEXT QUARTER

We are at the point where we are reproducing prints of key images and overlays for the final report. It should be noted that we are operating on an extension of the contract through June 30, 1975. Most of our work is now being concentrated on the most useful frames. This will be a spotty coverage because of the cloud problems.