GEOLOGY OF UTAH AND NEVADA BY ERTS IMAGERY

Proposal # 307

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Type I Progress Report

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Greenbelt, Maryland 20771

GEOLOGY OF UTAH AND NEVADA BY ERTS IMAGERY, Prop. # 307

M. L. Jensen, Univ. of Utah., GSFC ID No. UN 113.

Objective of the Contract

The objective of the contract is to evaluate the utility of satellite imagery in the study of geological structures and features and in the exploration for potential economic mineral deposits.

2. RESEARCH

2.1 Work Performed

2.1.1 Summary of the work performed during the reporting period.

Imagery for a portion of the study area was received, catalogued for in-house availability, and examined for relevant data. Topographic, geologic, aeromagnetic, and gravity maps were gathered to form a basis for comparison. Image descriptors were prepared. Overlay drawings were prepared indicating significant features for further study and eventual field checking. As features for further study are listed and mapped, route planning for field checking is beginning. Final planning for field checking will await receipt of further imagery for parts of the study area not now covered. Several enlargements of imagery for important areas have been made, mainly to facilitate relating the observations to available Army Map Series base maps.

The number of significant observations appears to be very great, and it is apparent that methods of handling the acquired information for easy access, for planning field checks, and for final presentation, must be improved. In-house methods of image description and data filing have been developed, and will continue to be developed as the project continues.

2.1.2 Significant Results

Inasmuch as the contract was not finalized until October 24, 1972, we have not yet received total imagery of the overall area. The MSS coverage obtained prior to October 24 has been requested on the Data Request Forms. In the meantime, the bulk MSS imagery that has been received has been studied with somewhat significant results.

The tracing of lithologic variations and contacts is readily noted on many of the images. Some of these features vary from what is shown on geological maps but the correlation, or lack of same, is still to be studied in the field and by comparison of ground truth geological maps with the specific images.

Area 1. (1091-18050) A B&W enlargement, 1500mm x 1500 mm, has been made of this image. There is remarkably little loss in detail. This image was chosen for greater study as there is a U. S. Geological Survey map (Wilden, 1963) of the area which includes the gross structural features that are well displayed in the image. In fact, some of these structural lineaments and faults are displayed in more detail on the enlarged image than on the map, even though both are of about the same scale.

Quartzite and indurated volcanic rocks form rugged outcrops and generally form resistant ridges. In contrast, some granitoid bodies, especially those lacking hydrothermal alteration, undergo fairly rapid exfoliation and form rounded weathered surfaces. In the Jackson Mountain area (N 41°15', W 118° 30') are two Tertiary granodiorite intrusions and Cretaceous diorite intrusions in contact with the Happy Creek volcanic series. The contacts of the volcanics with the intrusions are easily identified in the image. In contrast, the diorite intrusion, in the northern part of the Slumbering Hills, exists as a rugged outcrop occurrence

where later volcanic and carbonate formations have been deposited in contact with the intrusion, while the southernmost intrusions of granodiorite form less rugged outcrops than the intruded Happy Creek volcanic series. Field checks are needed to better determine the causes of these differences.

In the Slumbering Hills area (N 41° 15', W 118° 00'), a quartz monzonite intrusive is emplaced in phyllite, slate and quartzite rocks. The image indicates rugged topography for the latter formations and smoother slopes for the intrusive.

The enlarged image is about the same scale as the geologic map--1/250,000. It is apparent that the enlarged image could have been used as a base map and, if cut into about 8" x 8" sections, these more easily handled images in the field could have been used for field mapping with almost as much control and resulting precision as shown on the geologic map.

Area 2. (1092-18111) This image, obtained on October 23, 1972, is commonly referred to as the Pyramid Lake photo on which a circular area, located about 20 miles southwest of Pyramid Lake was noted on the initial overflight and of course obviously still persists. One interpretation is that it is a structural feature rather than an impact crater or caldera. We will do a field study of this in the near future. At the same time, a similar but smaller feature has been noted in the northwest corner of this image, the center being at N 40°45', W 119°53'. This somewhat circular feature, which is lighter in color than the surrounding formations exhibits an external radial pattern with prominent parallel trends that transect some of the radial lines. It also appears that most of the trends are carved by streams but their paths have been influenced by preexisting structures.

Although this feature is immediately west of some small mineralized deposits, there does not, at this time,

appear to be any economic importance to the feature, only scientific interest and curiosity as it has not been identified before.

Area 3. (1091-18055) A small structural crater has been noted on this image, due south of Walker Lake, and is located at about N 38°17', W 118°53'. I did geophysical work in this area more than 10 years ago, but do not recall having seen this feature. It does not appear to be a recent man-made feature nor is it a small island that was carved at the high water level of Lake Lahontan. Several such features appear on this image. It is thought, at the present time, that this feature may be a cinder cone in a caldera. This feature will be examined in the field in the near future or when snow cover allows.

Area 4. (1090-18001 and 1090-18003) These two images overlap the Tonopah and Divide mining districts, well known gold and silver camps (Nolan, 1930; Davis, et al., 1971). Twenty miles south of Tonopah is the defunct Goldfield district. These two districts are unusual in that the mineralization is post volcanic in age, which is unusual in the eastern portion of the Great Basin. As a result, however, the mineralization has resulted in hydrothermal alteration of the exposed Tertiary volcanic rocks.

Numerous lineaments, based on tonal differences, are noted in the districts, some of which extend for tens of kilometers.

A recent aeromagnetic map has been published of the Tonopah and Divide districts and extending northward throughout the San Antonio mountains (N 38°00' to N 38°25' and W 117°00' to W 117°22').

Several positive and negative magnetic anomalies are noted with the suggestion that the sources of the mineralizing fluids were derived from hidden intrusives, the positions of which may be indicated by the magnetic anomalies. There is good correlation of the lineaments noted on the images with the aeromagnetic coverage and it is known that the small plugs of extrusive rocks have "crudely elliptical shapes with major axes trending east, a direction common to the main ore bearing veins of the district" (Nolan, 1935), and similar to the more prominent lineaments noted on the images.

References Cited

Davis, W. E., Kleinhampl, F. J., and Ziony, J. I., 1971. Aeromagnetic and generalized geologic map of the San Antonio Mountains, Nevada. U. S. Geol. Surv. Geophysical Investigations Map GP-744.

Nolan, T.B., 1935. The underground geology of the Tonopah mining district, Nevada. Nevada Univ. Bull., Vol. 29, pp 1-49.

Willden, R., 1963. Geology of Humboldt County, Nevada. Nevada Bureau of Mines, Bull. 59.

2.1.3 Efforts to Achieve Reliability

The reliability of inferences drawn from ERTS imagery can only be established by field work and close comparison with various forms of ground truth. No field work has been done to date. Calibration against extant geological and geophysical data is done routinely, where such other data are available.

2.1.4 Publications

No publication of data or results took place during the first period.

2.1.5 Conformance to Work Schedule

The work is somewhat behind schedule, due to slow arrival of imagery, but the time has been well utilized in developing methods of handling the large volumes of data involved.

2.1.6 Work Progress

The progress of work is deemed satisfactory during the first period. It is hoped that when larger volumes of imagery become available, the progress will be even more rapid.

2.2 Work Planned for Next Reporting Period

2.2.1 Summary

The work for the next period will follow the pattern of the first period, with very slight modifications. More efficient routines of data handling are continually evolving, of course, but the planned work will consist of the receipt, study, and characterization of imagery, correlation of observed features with extant ground truth and low-level imagery, and the planning of field work to further evaluate observations. If weather permits, and accumulated observations warrant, some field work may be undertaken during the next period.

2.2.2 Recommendations for Changes in Operations

No basic changes in operation are contemplated at the present time.

3. MANAGEMENT

3.1 Problems

The major problem at present is the slowness of image processing and delivery, due to the very heavy demand. Imagery has been received for only a fraction of the study area, and this places some limitations on synoptic-scale analyses. Other problems are those of obtaining color-composite imagery. An attempt is being made to obtain additional material through EROS, but apparently this facility is also swamped with the demand. Alternative methods are being explored.

3.2 Adequacy of Funds

The project funding is less than optimum, particularly in view of the severe limitations placed on NASA-supplied color-composite imagery. Without the funds for a color compositor, and with external sources of imagery limited, alternative methods will have to be employed.

3.3 Changes in Standing-Order Forms

None

3.4 Changes in Personnel

Dr. Donald Grey has been employed as a Research Geologist, to help in the data management and in-house operations.

Mrs. Martha Smith has been employed as a Graduate Assistant to help in the preparation of overlays, maps, and in filing material.

Both are employed on a part-time basis.

3.5 Data Request Forms

December 8, 1972; request was filed for retrospective bulk data for areas not covered in imagery supplied since the beginning of the contract.

3.6 Image Descriptors

Standard Image Descriptor forms are supplied herewith for all imagery received to date.

ERTS IMAGE DESCRIPTOR FORM

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DATE Dec. 24, 1972

PRINCIPAL INVESTIGATOR M. L. Jensen

GSFC UN 113

ORGANIZATION Univ. of Utah

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1093-18161-7				Lakes Playas Croplands Desert Rift Faults? Extrusive Rocks Block Faults Cinder Cones Alluvial Fans Bajadas
1093-18161-4				Same
1093-18161-5				Same
1093-18161-6				Same

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1092-18114-7				Lakes Sierra Cities Moraines Glacial Valleys Croplands Faults Alluvial Fans
1092-18114-4				Same
1092-18114-5				Same
1092-18114-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1092-18111-7				Lakes Playas Radial Drainage Cities Croplands Extrusive Rocks Parallel Faults Fault Blocks
1092-18111-4				Same
1092-18111-5				Same
1092-18111-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1091-18062-7				City Reservoirs Lakes Sierra Playas Faults Extrusive Rocks Cirque Lakes Moraines
1091-18062-4				Same
1091-18062-5				Same
1091-18062-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1092-18105-7				Desert Basin and Range Cropland Playas Fault Scarps Fault Blocks Lakes Extrusive Rocks Alluvial Fans
1092-18105-4				Same
1092-18105-5				Same
1092-18105-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1091-18055-7				Lakes City Desert Basin and Range Playas Cinder cone Parallel Faults Fault Blocks Croplands Dikes Sand Dunes Craters
1091-18055-4				Same
1091-18055-5				Same
1091-18055-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1091-18053-7				Desert Basin and Range Playas Reservoir City Cinder Cones Croplands Highways Fault Blocks Parallel Faults Cinder Cones Alluvial Fans
1091-18053-4				Same
1091-18053-5				Same
1091-18053-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1091-18050-7				Desert Basin and Range Playas Incised streams Parallel Faults Fault Blocks Croplands Alluvium Cumulus clouds Alluvial Fans
1091-18050-4				Same
1091-18050-5				Same
1091-18050-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1090-18003-7				City Reservoirs Playas Faults Extrusive Rocks Fault Blocks Desert Mountains Basin and Range Alluvial Fans
1090-18003-4				Same
1090-18003-5				Same
1090-18003-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1090-18001-7				Desert Basin and Range Alluvium Volcanic Rock Fault Blocks Playas Cinder cones Reservoirs Alluvial Fans
1090-18001-4				Same
1090-18001-5				same
1090-18001-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1090-17594-7				Croplands Playas Desert Fault Blocks Basin and Range Snowlines Cirrus clouds Cumulus clouds Alluvial Fans
1090-17594-4				Same
1090-17594-5				Same
1090-17594-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1090-17592-7				Basin and Range Fault Blocks Ephemeral streams Alluvium Orographic clouds Incised Rivers Desert Alluvial Fans Bajadas
1090-17592-4				Same
1090-17592-5				Same
1090-17592-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1097-17420-7				Wave clouds, Fault scarps Reservoirs Fault blocks Contrail Basins .
1097-17420-4				Same
1097-17420-5				Same
1097-17420-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1085-17314-7				Contrails, Reservoirs, Dikes, Plateaus, Desert Cirrus clouds Cumulus clouds Rivers Meanders Monocline
1085-17314-4				Same
1085-17314-5				same
1085-17314-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1085-17305-7				Reservoirs, Rivers, Desert, Orographic Clouds, Meanders, Mountains, Basin, Lee-wave clouds, Cirrus Clouds
1085-17305-4				Same
1085-17305-5				Same
1085-17305-6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1084-17260 - 7				Radial Dikes, Dikes, Plugs, Extrusive Rocks Highways, Desert, Ring Dike, Contrail, Volcanic Field, Cirrus Clouds, Cumulus Clouds
1084-17260 - 4				Same
1084-17260 - 5				Same
1084-17260 - 6				Same

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
1085 -17303 -4				Reservoir, Meanders, Cirrus Clouds, Antecedent River, Sand Dunes Arid Lands Dome, Beach Ridges, Towns Railroad, Evaporites Altiplano Cumulus clouds
1085-17303-5				Same
1085-17303-6				Same
1085-17303-7				Same

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