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a. Title: Remote Sensing of Permafrost and Geologic Hazards in Alaska

ERTS-A Proposal No.: SR 207

b. GSFC ID No. of P.I.: IN 386

c. Statement and explanation of any problems that are impeding the progress of the investigation:

No ERTS-1 data have been furnished to date.

d. Discussion of the accomplishments during the reporting period and those planned for the next reporting period:

No accomplishment on study of ERTS data because none available. Investigator has been acquiring additional ground truth in Alaska.

e. Discussion of significant scientific results and their relationship to practical applications or operational problems including estimates of the cost benefits of any significant results (To be prepared in scientific abstract form of 200 words or less):

None.

f. A listing of published articles, and/or papers, pre-prints, in-house reports, abstracts of talks, that were released during the reporting period:

Ferrians, Oscar J., Jr., 1972, ERTS and arctic engineering geology in Alaska: Eighth Internat. Symposium on Remote Sensing of Environment, Ann Arbor, Mich.

g. Recommendation concerning practical changes in operations, additional investigative effort, correlation of effort and/or results as related to a maximum utilization of the ERTS system:

More rapid delivery of ERTS-1 data.

h. A listing of data of any changes in Standing Order Forms:

None.

i. ERTS Image Descriptor forms:

None.

j. Listing by date of any changed Data Request forms submitted to Goddard Space Flight Center/NDPF during the reporting period:

None.

k. Status of Data Collection Platforms (if applicable):

Not applicable.

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ERTS and Arctic Engineering Geology in Alaska

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Summary

A new program to evaluate the applicability of ERTS-acquired data to aid in the solution of critical engineering-environmental problems in Alaska will be initiated by the U.S. Geological Survey in 1972. The principal objectives of this program are to determine the regional distribution and character of permafrost (perennially frozen ground), and to inventory and monitor large-scale geologic hazards. In order to obtain optimum results, the ERTS-acquired remote sensing data will be supplemented with ground-truth data derived from on-going engineering-geologic investigations. Emphasis will be placed on studying the transportation corridor in north-central Alaska through which a proposed pipeline, highway, and possibly a railroad could be constructed; however, eventually all of Alaska will be covered.

The discovery of vast reserves of petroleum on the Arctic North Slope of Alaska and all of the resultant construction, including the proposed 789-mile-long trans-Alaska pipeline for transporting the crude oil to Valdez, an ice-free seaport in south-central Alaska, have focused attention on the environmental-geologic factors that are unique to the arctic and that pose special engineering problems for the design, construction, operation, and maintenance of roads, railroads, pipelines, airfields, buildings, and other structures. Permafrost, undoubtedly, is one of the most significant of these environmental factors, and approxi-

mately 85 percent of Alaska is within either the continuous or the discontinuous permafrost zones. Alaska, primarily because of its geographic position but also because of its size and variety of landforms (three major mountain ranges and extensive lowland areas), offers a unique natural laboratory for the study of permafrost.

Permafrost occurs below the ground surface, and therefore will be studied by systematically analyzing the surface features and conditions that either control its distribution and character or result from its presence. Some of the more important features and conditions which, in many cases, are interrelated and should be considered in combination include: distribution of various types of unconsolidated materials and bedrock, drainage conditions, topographic setting, snow cover, vegetative cover, microclimatic conditions, and permafrost-related geomorphic features such as pingos, beaded drainage, and thaw lakes.

Alaska has several types of geologic hazards that pose potential danger to man and his environment. These hazards include, among others, volcanic eruptions, earthquakes, major landslides, aufeis development, flooding (including outburst floods from glacier-dammed lakes), and glacier surges. Some of the more recent and noteworthy examples of the above mentioned hazards are:

(1) the eruption of Mount Spurr in 1953 which blanketed Anchorage (over 75 miles away) with windblown ash and caused the automatic street lights to turn on in the middle of the day;

(2) the Great Alaska Earthquake of March 1964 which was the largest earthquake to occur in North America during historical times. This

geologic event caused millions of dollars in property damage and the loss of over 100 lives, and the loss would have been even greater if Alaska had not been so sparsely populated;

(3) the Turnagain landslide, which occurred during the 1964 earthquake, caused major damage to a large residential area in Anchorage;

(4) the flood of the Chena and Tanana Rivers during the summer of 1967 caused millions of dollars in damage to buildings and other property in Fairbanks;

(5) the spectacular advance of the Black Rapids Glacier of about 0.8 mile during the winter of 1936-1937, and of more than 2 miles in earlier historical advances. Today a major highway is within 2 miles of the glacier and the proposed trans-Alaska pipeline would parallel the highway.

As development spreads in Alaska and the population grows, it becomes more important to give special consideration to geologic hazards in order to minimize the risk of loss of life and property.

The wise development of Alaska requires comprehensive evaluation of environmental-geologic data, and the size and remoteness of Alaska inherently make remote sensing techniques especially well suited for acquiring such data. The repetitive and timely coverage obtainable from orbiting satellites will provide an excellent means of monitoring changing conditions, and the synoptic view afforded will provide a new and unique perspective for analyzing the regional environmental-geologic features and conditions.

The information gained by accomplishing the objectives of this program will be an invaluable aid in solving engineering-geologic and environmental problems related to route and site selection for structures such as roads, railroads, pipelines, and large installations; to distribution of natural construction materials; to construction and maintenance; and to availability of ground water. In addition, the knowledge acquired from studying Alaska will be directly applicable to solving engineering-geologic problems in arctic regions in other parts of the world.