UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Center of Astrogeology
601 East Cedar Avenue
Flagstaff, Arizona 86001

September 28, 1966

MEMORANDUM:

TO : Assistant Chief Geologist for Engineering Geology

FROM : Chief, Branch of Astrogeology

SUBJECT: Monthly report for Director and Secretary

1. Highlights and noteworthy results

Astrogeologic studies

Cosmic chemistry and petrology

H. J. Gabe has completed a preliminary electron microscope examination of samples exposed to the micrometeorite flux on Gemini 9. The electron microscope grids were extremely dirty as compared with those exposed on the Luster sounding rocket experiment, and this made examination of every particle present virtually impossible and the results are therefore less reliable than the results from the Luster program. The first results indicate that fewer particles were collected than anticipated from satellite data. The Gemini data indicates a flux of 27 particles larger than 0.1 μ per square meter per sec as compared with 200-10,000 from previous satellite data. This result is in agreement with the low flux rates determined in the Luster experiment. Approximately one-fourth of the possible extraterrestrial particles are of the "fluffy" type similar to those found in the Venus Fly Trap experiment.

Crater investigations

S. P. Lassiter developed an electron-excited luminescence stage to be used with the petrographic microscope. Rock thin sections are placed in a vacuum chamber and exposed to a broad beam of electrons. The electron beam excites luminescence in the specimen and permits study of compositional and fabric variants in minerals and rocks that may be inconspicuous or invisible when viewed in ordinary transmitted light. The instrument is designed to allow study of the thin sections in ordinary or cross polarized light without removing the section from the vacuum chamber.

4. Outside publications reported during month:

McCauley, J. F., The geological exploration of the Moon, in Conference on Changing Identity of Graduate Science Education, Proc.: The Georgia Institute of Technology. [Charles E. Weaver, Chairman.]

5. Personnel

The following employees entered on duty

Flagstaff, Arizona:

Elizabeth Bachstein, Clerk-stenographer
Lilas J. Carlson, Clerk-typist
Kenneth L. Stice, Engineering Aid, WAE
Linda L. Williams, Clerk-stenographer

Palisades, New York:

Orson Anderson, Physicist, WAE

Bozeman, Montana:

Glen L. Martin, Research Civil Engineer

Providence, Rhode Island:

Thomas A. Mutch, Geologist, WAE

Transfers:

Patricia L. Marshall, Cartographic Technician, transferred to Menlo Park, California.

Resignations:

Richard E. Beane, Geologic Field Assistant, Flagstaff, Arizona.
Gary S. Fuis, Geologic Field Assistant, Flagstaff, Arizona.
William F. Gibson, Geologic Field Assistant, Flagstaff, Arizona.
John R. Harris, Topographic Field Assistant, Flagstaff, Arizona.
David G. Hazard, Geologic Field Assistant, Flagstaff, Arizona.
Kenneth M. Hicks, Cartographic Aid, WAE, Menlo Park, California.
Donald L. Isaac, Geologic Field Assistant, Washington, D. C.
Richard W. Kennemer, Geologic Field Assistant, Flagstaff, Arizona.
Wilma J. Lacey, Cartographic Aid, WAE, Menlo Park, California.
Donald C. Lamb, Jr., Geologist, Flagstaff, Arizona
Lawrence J. McDonough, Geologic Field Assistant, Flagstaff, Arizona.
Eric C. Moskowitz, Geologic Field Assistant, Flagstaff, Arizona.
Peter H. Shelton, Illustrator, Flagstaff, Arizona.

6. Scientific meetings and conferences attended at home or abroad

E. M. Shoemaker, Chairman of the Geology Working Group of the Planetology Subcommittee, held a meeting of the Group at the Manned Spacecraft Center, Houston, Texas.

E. M. Shoemaker and J. W. M'Gonigle participated in a meeting of the Apollo Lunar Surface Science Simulation Working Group at the Manned Spacecraft Center, Houston, Texas.

E. M. Shoemaker attended the Apollo Lunar Surface Experiments Program interface meeting at the Manned Spacecraft Center, Houston, Texas.

M. B. Duke visited Ian Kaplan and Ronald Gibbs, Geology Department, University of California, Los Angeles, California, to discuss sedimentary geochemistry and fine particle separation and analysis.

M. B. Duke visited N. Greenman, J. A. Ryan, and F. Fish, Douglas Aircraft Corporation to discuss Luster cosmic dust experiments.

M. B. Duke visited Thomas Ahrens, Stanford Research Institute, Menlo Park, California, to discuss shock experiments on minerals.

M. B. Duke visited Klaus Keil, Donald Gault and Ted Bunch, NASA, Ames Research Center, Moffett Field, California, to discuss meteorite and shock studies.

Harold Masursky visited Z. F. Danes, Puget Sound University, Tacoma, Washington, to discuss results of mathematical studies of isostatic rebound in lunar craters and continuing work in this field.

J. J. Wooldridge visited Beverly Oak, California Institute of Technology, Pasadena, California and James Gunn, Jet Propulsion Laboratory, Burbank, California to discuss plans for a voltage converter for the isodensitracer.

R. L. Wildey and E. C. Phillippi visited Holloman Air Force Base personnel, Alamagordo, New Mexico, to discuss current progress in low resolution image-orthicon photometry of the Moon through entire lunation; and visited Advanced Communications, Inc., Palo Alto, California, personnel to discuss problems of digitizing video tape for the computer analysis of the Moon's photometric function.

Harold Masursky visited M. Thompson, Director, Langley Research Center, Hampton, Virginia, to present a summary of early Lunar Orbiter results.

R. E. Eggleton visited Leonard Martin, Aeronautical Chart and Information Center, Flagstaff, Arizona to arrange for use of Navy 5818 and 5819 near-full moon plates.

Harold Masursky and Al Filice, Jet Propulsion Laboratory, Pasadena, California, visited Edward Courtright, Oran Nicks, Ben Milwitsky, and Steve Dwornik at NASA Headquarters to aid in Surveyor II site selection.

D. A. Bremmer, G. G. Schaber, and D. H. Dahlem attended a course on activation analysis at General Atomics, San Diego, California.

D. L. Schleicher and M. H. Hait took part in KC-135 flights at Wright-Patterson Air Force Base, Dayton, Ohio, in which lunar geologic equipment was tested at 1/6 gravity and zero gravity.

M. H. Hait attended a meeting of the Y-12 group in Oak Ridge, Tennessee, to discuss lunar sample return containers.

R. H. Barnett visited Westinghouse Corp., Baltimore, Maryland, to discuss lunar television cameras; and Electronics Command, Fort Monmouth, New Jersey, to discuss results of laser ranging tests.

G. A. Swann, E. C. Phillippi, R. H. Barnett, J. D. Crossen, W. T. Borgeson, and R. A. Mills conferred with members of the Astrionics group at Marshall Space Flight Center, Huntsville, Alabama, concerning problems of vehicle navigation for field tests of the Apollo Applications Program and Advanced Systems program, and for lunar missions.

7. Talks or papers presented

Speaker and organization	Subject
Harold Masursky NASA Photograph Utilization Committee Langley Research Center Hampton, Virginia	Operational plan for Lunar Orbiter screening.
M. B. Duke American Geophysical Union Los Angeles, California	Shergotty meteorites - magmatic and shock metamorphic features.
M. B. Duke Ames Research Center Moffett Field, California	Shergotty meteorites - magmatic and shock metamorphic features.
C. H. Roach NATO-USAF Conference on the Application of Thermoluminescence to Geological Problems Spoleto, Italy	The influence of stress history on low-temperature thermoluminescence of halite.
E. M. Shoemaker Summer Commencement Eastern New Mexico University Portales, New Mexico	Exploring the Moon: the challenge and the rewards.
E. M. Shoemaker American Geophysical Union Los Angeles, California	Fine structure of the lunar surface at the Surveyor I landing site (E. C. Morris, co-author).
E. C. Morris American Geophysical Union Los Angeles, California	Craters and fragmental debris of the lunar surface around Surveyor I (E. M. Shoemaker, co-author).
H. E. Holt American Geophysical Union Los Angeles, California	Photometric properties and photoclinometry of the lunar surface from Surveyor I television.
M. F. Kane Geologic Training for Astronauts Katmai, Alaska and Valles, New Mexico	Geophysical lectures.

8. Visitors

Visitor	Visited and purpose
J. K. Dienes General Atomics San Diego, California	E. M. Shoemaker--discussed computer modeling of craters.
Alfred L. Fenaughty, President Information International Inc. Los Angeles, California	Kenneth Watson and E. F. Kiernan--discussed high-speed data reduction equipment.
Milton Kurtz Beckman and Whitley Mountain View, California	E. F. Kiernan and J. J. Wooldridge--discussed new developments being pursued at Beckman and Whitley's concerning the Isodensitracer.
John A. O'Keefe Goddard Space Flight Center Greenbelt, Maryland	E. C. T. Chao--discussed origin of the Aouelloul glass.
Donald A. Beattie NASA Headquarters Washington, D. C.	E. C. T. Chao--discussed evaluation of proposals on lunar sample analysis.
Sandy Kramer and Geoffrey Beauchamp Lockheed Aircraft Corp. Sunnyvale, California	H. J. Moore and N. J. Trask--discussed properties of the lunar surface.
Dedrich Bernas, Chemist Geological Survey of Israel	Frank Cuttitta--discussed application of X-ray fluorescence and atomic absorption spectroscopy to geochemical problems.
Dr. Thomas C. Atchison, Dave Fogelson, and Rollie Blake Bureau of Mines Twin City Airport, Minnesota	D. J. Milton, H. J. Moore, and N. J. Trask--discussed the selection and testing of simulated lunar rocks and problems of utilizing indigenous resources on the Moon.
C. H. Marshall, R. H. Olds, and D. J. Shapland Lockheed Aircraft Company Sunnyvale, California	D. E. Wilhelms and N. J. Trask--discussed post-Apollo mission profiles drawn up by Lockheed for the MIMOSA study.

Mr. Duane Walker Sandia Corp. Albuquerque, New Mexico	J. D. Alderman, P. E. Krauss--discussed XY plotter operation and programming.
Mr. A. Ocone General Dynamics Fort Worth, Texas	J. D. Alderman, P. E. Krauss--discussed XY plotter operation and programming.
Mr. A. Mann Plastic Crafts Denver, Colorado	J. D. Alderman--discussed materials for 3-D model construction on XYZ plotter.
Otha Vaughn Marshall Space Flight Center Huntsville, Alabama	J. F. McCauley--discussed lunar geological mapping.

LUNAR GEOLOGIC MAPS

REPORT FOR MONTH OF September

	PRELIMINARY MAPS								FINAL MAPS							
	ACIC Bases Received	Author's Geological Work in Progress	Cartography - Scribing & Assembly in Progress	1st Composite Completed	1st Explanation Completed	Map in Technical Review (Branch)	2nd Composite Completed	2nd Explanation Completed	Geology Revision in Progress	Cartography - Final Map Prep	Map in Technical Review (Branch)	Submitted to APU	Director's Approval Received	Map Materials Transmitted to BTI	Transmitted to BMR	Published
Equatorial Belt																
ARISTARCHUS LAC 39	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX	XXXX	XX
BYRGIUS LAC 92	XX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXXX								
CLEOMEDES LAC 44	XX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX					
COLOMBO LAC 79	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX							
COPERNICUS LAC 58	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX		XXX	XXX	XXXX					
FRACASTORIUS LAC 97	XX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXXX								
GRIMALDI LAC 74	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX							
HEVELIUS LAC 56	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX		
JULIUS CAESAR LAC 60	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX				
KEPLER LAC 57	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX	XXXX	XX
LANGRENUS LAC 80	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX								
LETRONNE LAC 75	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX	XXXX	XX
MACROBIUS LAC 43	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX					
MARE HUMORUM LAC 93	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX		
MARE SERENITATIS LAC 42	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX	XXXX	XX
MARE UNDARUM LAC 62	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX								
MARE VAPORUM LAC 59	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX					
MONTES APENNINUS LAC 41	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX	XXXX	XX
MONTES RIPHAEUS LAC 76	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX	XXXX	XX
PETAVIUS LAC 98	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX								
PITATUS LAC 94	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX	XXXX	XX
PTOLEMAEUS LAC 77	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX							
PURBACH LAC 95	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX								
RUPES ALTAI LAC 96	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX							
SELEUCUS LAC 38	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX					
TARUNTIUS LAC 61	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX							
THEOPHILUS LAC 78	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX						
TIMOCHARIS LAC 40	XX	XXXX	XXXX	XXX	XXX	XXXX	XXX	XXXX	XXX	XXX	XXXX	XXX	XXX	XXXX	XXXX	X
Northern Hemisphere (32°N - 64°N)																
ARISTOTELES LAC 13																
CASSINI LAC 25		XXX	XXX													
EUDOXUS LAC 26																
GEMINUS LAC 27																
J. HERSCHEL LAC 11		XXX														
PLATO LAC 12		XXX														
RUMKER LAC 23		XXX														
SINUS IRIDUM LAC 24		XXX	XXX													
Southern Hemisphere (32°S - 64°S)																
CLAVIUS LAC 126		XXX														
HOMMEL LAC 127		XXX														
MAUROLYCUS LAC 113		XXX	XXX													
RHEITA LAC 114		XXX														
SCHICKARD LAC 110																
SCHILLER LAC 125																
TYCHO LAC 112		XXX														
WILHELM LAC 111																
North Polar Cap																
ANAXIMANDER LAC 2																
BAILLAUD LAC 1																
METON LAC 4																
PHILOLAUS LAC 3																
South Polar Cap																
[illegible]																
[illegible]																
[illegible]																
[illegible]																
[illegible]																

LUNAR GEOLOGIC MAPS
Scale 1:500,000

REPORT FOR MONTH OF September

PRELIMINARY MAPS

AIC NUMBER	Preliminary AIC Base Received	Published AIC Base Received	Author's Geological Work in Progress	Cartography - Scribing & Assembly in Progress	1st Composite Completed	1st Explanation Completed	Map in Technical Review (Branch)	2nd Composite Completed	2nd Explanation Completed
57C	XXXXX		XXXXXX						
57D	XXXXX								
58C	XXXXXX	XXXXX	XXXXXX						
58D	XXXXXX	XXXXX	XXXXXX						
59C	XXXXXX	XXXXX	XXXXXX						
59D	XXXXXX	XXXXX	XXXXXX						
60C	XXXXXX	XXXXX							
60D	XXXXXX	XXXXX	XXXXXX						
61C									
61D	XXXXXX	XXXXX	XXXXXX						
75A	XXXXX		XXXXXX						
75B	XXXXX		XXXXXX						
76A	XXXXX		XXXXXX						
76B	XXXXXX	XXXXX	XXXXXX						
77A	XXXXXX	XXXXX							
77B	XXXXXX	XXXXX	XXXXXX						
78A	XXXXXX	XXXXX							
78B	XXXXXX	XXXXX							
79A	XXXXXX	XXXXX	XXXXXX						
79B									

General Information

Astrogeologic studies

Some members of the Branch in Menlo Park are giving a 15-week course in Astrogeology at San Jose State College, San Jose, California. The introductory lecture was given by D. E. Wilhelms. The second lecture was given by H. J. Moore. Approximately 30 students are enrolled.

Geologic mapping

M. J. Grolier reports that a procedure to make isodensitracings on stable base material has been developed and is now operational. Original tracings are made on stabilene film, 0.050-inch thick, underlain by a sheet of carbon paper with the emulsion side up. The write-outs are then transferred to sensitized scribe-coat by arc-light, from which right-reading ozalid prints can be obtained.

A complete scan of Navy Plate 8288D of the Full Moon, dated June 3, 1966 was made at the scale of 1:5,000,000 using a scanning slit of 0.173 mm x 0.173 mm. Several single-scan traverses on the isodensitracer simulated photoelectric traverses at the telescope. An isodensity map is being contoured from the tracings. The contours are indexed, and their relative density values may easily be converted to corresponding absolute albedo values, computed by the photometry section. Some albedo values obtained in this manner were furnished the Lunar Orbiter Office, NASA, prior to photographing Mission-A Lunar Orbiter sites.

Navy Plate 5818, dated October 9, 1965, is one of the highest resolution earth-based photographs of the lunar surface ever taken. The phase angle is about 15.7 degrees. This plate, which is the property of the U. S. Air Force, was kindly loaned to the U. S. Geological Survey for scanning. The northern hemisphere of the Moon was scanned from this plate at a scale of approximately 1:1,000,000. Scanning of a 16-degree band along the equator is now proceeding. Tracings at the 1:1,000,000 scale have already been distributed to lunar mappers. Tracings at the 1:500,000 scale in the equatorial belt are being distributed to lunar mappers as soon as they become available.

Screening and evaluation procedures have been concentrated on the 10-meter resolution photography of the Apollo belt in order to determine relative roughness and, therefore, to pick areas to be analyzed in greater detail. A wealth of geologic information is contained in these photographs as well as the limb and the far side region. Preliminary analysis indicates significant differences in crater and rock fragment size-frequency distribution on the maria. Analysis of upland areas has been deterred by over-exposure in these areas.

R. E. Eggleton recognized in Lunar Orbiter photographs a class of 1/10 kilometer to 1/2 kilometer diameter craters having a ring terrace on the interior wall. This may reflect a lithologic discontinuity between the harder material below and the softer material above. This possibly could be etched out by low-velocity impacts (about 1 km per second).

Steep slopes (about 30 degrees), 1/2 kilometer or more in width, seen with partial shadow in Lunar Orbiter photos have surfaces consisting of rather angular hillocks, pits, ridges, and troughs with horizontal dimensions of 20 to 200 meters. A more gently sloping, finer textured, convex-upward surface (up to a few hundred meters wide) at the toe of the lower part of these slopes, abuts sharply on the adjoining plain. T. N. V. Karlstrom points out that the toe material encroaches on and covers parts of older craters. Eggleton interprets the slope material as an impact-produced particulate or slightly indurated surface material which is undergoing mass-wasting. The movement probably occurs in pulses which are triggered by seismic waves from impacts and possible interior seismicity, and may be lubricated by permafrost.

Lunar and planetary physics

N. J. Trask has completed the measurement of the maximum polarization of 20 additional points of geologic interest on the western hemisphere of the Moon during recent favorable declinations with the setting terminator. Generally the maximum polarization is inversely related to albedo but there are small departures from this relation among the darker units. Of special interest is the fact that the Surveyor I landing site has the highest polarization of any area measured thus far.

Crater investigations

S. P. Lassiter has moved the electronic development laboratory from building 56 to building 25 to consolidate the Denver electronic research and development facilities.

Surface planetary exploration

Early Apollo investigations

Mock-ups of Early Apollo lunar hand tools were tested at 1/6 g by space-suited subjects in a KC-135 aircraft. The activities included hammering, coring, scooping, walking with tool carrier loaded with 40 pounds of samples, transferring samples from carrier to the sample return container, and assembly and disassembly of various instruments. Each activity uncovered problem areas of the tools; design changes will be made at the Manned Spacecraft Center as a joint effort of the Experiments Program office and the Branch of Astrogeology.

A Wild A-5 universal stereoplotter has been installed in the headquarters building in Flagstaff. Although the plotter will not accommodate photographs taken with Early Apollo cameras in every possible orientation, it can be used for intensive preliminary testing of prototype cameras.

Apollo applications program investigations

A vehicle navigation system for installation in the field test vehicles was demonstrated to Branch personnel at the Marshall Space Flight Center, Huntsville, Alabama. Preparations for installation, calibration, and use of this system are underway.

Apollo Applications Program field test 7 was concerned with developing data-handling procedures and with polishing field geologic techniques in an atmosphere of critical rehearsal. The following two days were spent in demonstrating the Apollo Applications Program test procedures and needs to visitors from Manned Spacecraft Center, Houston, Texas, and NASA Headquarters, Washington.

Advanced systems investigations

The evaluation of α-K α spectrometer data from Apollo Applications Program test 6 has been completed. The results and recommendations are:

(a) Either the resolution of the flow proportional detector that was used was not sufficient, or the data reduction program was not sophisticated enough for Apollo Applications Program purposes.

(b) The power supply was not stable enough during the test for obtaining shift free spectra.

(c) Output from the spectrometer, during the subsequent tests, should be routed through a computer for analysis before being sent to the scientific data facility because the raw data cannot be used directly.

Current laboratory evaluation of the instrument at Goddard Space Flight Center indicates that the above objections can be alleviated.

Field study of the SP Crater flow is almost complete and this site, along with approximately 1/2 of the Southwest Needmore quadrangle (immediately southwest of SP Crater) will be ready for future field tests by October 15.

Evaluation of the ORNL α-computer program for use in reducing α -K spectrometer data is under way. This program will have application in both future neutron activation and α-spectrometer studies.

D. A. Bremmer, G. G. Schaber and D. H. Dahlem discussed the application of activation analysis techniques to lunar surface analysis with personnel from General Atomics, San Diego, California. First indications are that in order to obtain the degree of accuracy required in petrologic studies, either a small nuclear reactor or Cockcroft-Walton accelerator would be required. Use of isotopic neutron sources such as Am^{241} or Cf^{252} would probably have an adverse effect on the accuracy of the instrument. Studies of the activation analysis techniques are continuing.

Astronaut training

Twenty-four astronauts participated in a five-day field trip to the Katmai area, Alaska. The Katmai trip was under the guidance of Robert L. Smith and Roy Bailey, both of the U. S. Geological Survey. Twenty-one astronauts participated in a field trip to Valles, New Mexico. The Valles trip was under the guidance of Robert L. Smith.

Geophysics

The seismograph at the Weatherford Road Geophysical Station recorded successfully for several days. Operations have been suspended for calibration purposes. The rubidium vapor magnetometer has resumed operation after being loaned to Gordon Bath of Special Projects for a short time.

Work is continuing on the determination of attenuation coefficient by computer methods. Core is being obtained from the severely broken-up rock in the flow by cementing methods at SP Crater. The hole is down 72 feet. Preliminary work has been done on a down hole-surveying device and bearing-capacitor device.

Progress continues on reduction of magnetic and gravity data from the geophysical station and from site studies.