APPENDIX E. GEOLOGY FIELD EXERCISES: EARLY TRAINING

Field Training Schedule for the first 3 Groups of Astronauts (29)

Date	Location	Astronauts Present
	Phase I of Geology Training	
March 5-6, 1964	**Grand Canyon, Arizona**	Aldrin, Anders, Armstrong, Bassett, Bean, Carpenter, Cernan, Chaffee, Collins, Cunningham, Eisele, Freeman, Gordon, Schweikart, Scott, See, Shepard, Williams

Fundamental geologic stratigraphic concepts of geology such as: layering, superposition, ages, structures. Mainly show and tell with questions. Led by Grand Canyon Expert Ed McKee (USGS). Other geologists present: Jackson, Milton, Wilhelms, and Chidester of USGS and Foss, Clanton, and King of NASA. 1st day-Everybody walked down the Kaibab trail in groups of 3 or 4 astronauts with a geologist. The entire sequence of rocks is well exposed from top to bottom of the canyon and provides excellent examples of many different rock types and basic geologic principles. The geologist accompanying each group of astronauts described and discussed geologic features, history, rock types and processes on the way down. 2nd day-The astronauts and geologists went up the Bright Angel Trail in the same groups as they had come down the day before. Students were asked to identify and discuss the units in perspective of previous days observations.

Mar. 12-13, 1964	**Grand Canyon, Arizona**	Borman, Conrad, Cooper, Grissom, Lovell, McDivitt, Schirra, Slayton, Stafford, Young
April 2-3, 1964	**Big Bend-Marathon, TX**	Aldrin, Anders, Bassett, Bean, Borman, Cernan, Chaffee, Collins, Cunningham, Cooper, Eisele, Freeman, Gordon, Schweikart, Scott, Shepard, Williams, Young

Another basic geology study for interpretation and mapping of well exposed structural and stratigraphic relationships. Also included was an introduction to volcanic rocks along the Rio Grande River west of Big Bend National Park. The trip was led by local expert Bill Muehlburger (Univ. of Texas). Other geologists present: Jackson, Milton, Wilhelms, Swann, and Chidester of USGS and Foss, Clanton, and King of NASA. As on the Grand Canyon trip 2 or 3 astronauts were assigned to a geologist. On the first day they mapped 2 folded and faulted structures on aerial photos. On the second day there were 4 stops. Two at road cuts of layered volcanic lavas and ash flows , a third at Bee Mountain to study an igneous intrusion, and a fourth at Santa Elena Canyon to study a large fault scarp. Radios were used to communicate between the cars thereby allowing discussion of the geology while on the move.

Apr. 15-16, 1964	**Big Bend-Marathon, TX**	Carpenter, Schirra, Armstrong, Conrad, Lovell, McDivitt, See, Stafford, White
April 30-May 2, 1964	**Flagstaff, Arizona** **Kitt Peak Observ.**	Aldrin, Anders, Bassett, Bean, Borman, Cernan, Chaffee Collins, Cunningham, Eisele, Freeman, Gordon, McDivitt, Schweikart, Scott, See, Williams

Largely show and tell of volcanic features such as lava flows, maars, cinder cones, and spatter cones in the vicinity of Sunset crater and the Bonita lava flow led by Dale Jackson and Al Chidester (USGS). Then there were fly-overs of the same features as well as Meteor crater to get the orbital perspective. They used two four-place aircraft in which either Gene Shoemaker or Jack McCauley (USGS) led the observations. At Kitt Peak the solar telescope was used at night to project images of the lunar surface for observation and discussion led by Spence Titley (Univ. Ariz.), Don Wilhelms, Jack McCauley, and Hal Masursky (USGS).

May20-22, 1964	**Flagstaff, Arizona** **Kitt Peak Observ**.	Cooper, Shepard, Shirra, White, Complete list of attendees unavailable but similar to Mar 12-13 above.

Clanton (MSC) was one of the geologists on this trip.

June 3-6, 1964	**Philmont Ranch, New Mexico**	Aldrin, Anders, Armstrong, Bassett, Bean, Cernan, Chaffee, Collins, Conrad, Cooper, Cunningham, Eisele, Freeman, Gordon, Lovell, Schweikart, Scott, See, White, Williams

This trip involved more complex geology that was more difficult to follow than in previous locations; more like typical geologic problems and probably more like lunar geology. It included both igneous and sedimentary rocks, orientation with geologic maps, measuring and describing stratigraphic sections, strike and dip measurements, and recording of field notes. The local expert was Dr. G. D. Robinson (USGS) who had just finished a report on the geology of the area. Other geologists present: Jackson, Milton, Wilhelms, Pillmore, Swann, Johnson, Gill, and Chidester of USGS and Foss, Clanton, and King of NASA. Divided into two astronauts per geology instructor for 3 days. One day spent sketching, describing and defining the exposures on Slate Hill. Note-taking and section measurements were emphasized. A second day was spent trying to correlate vertically dipping units on two parallel traverses. Mapping of the units, dip and strike measurements and note-taking were emphasized. Half of a third day was spent mapping a dike and sill. The other half was spent taking measurements with magnetometers, gravimeters and seismometers in an attempt to determine subsurface structure under the instruction of Gordon Bath, Marty Kane and Joel Watkins, all of USGS. On the final day the entire group traveled by car and made several stops at significant geologic exposures for brief discussions. The trip finished at noon.

Start of Phase II of Geology Training

October 7-9	**Newbury Crater, Bend, Oregon**	Cernan, Chaffee, Collins, Schweikart, Scott
Oct 15-17, 1964	" "	Aldrin, Armstrong, Bassett, Bean, Cunningham, See, Williams

A third running of this trip for the remaining astronauts was canceled because of the death of one of the astronauts (Freeman) in an airplane crash on Oct. 31, 1964.

The major objective of this trip was to observe, analyze and discuss various volcanic features in the vicinity of Newbury Crater, a large (50x30 mile) shield volcano. This is a complex of nested craters with an extreme range of differentiated volcanic rocks, obsidian flows, pumice cones, cinder cones and tuff rings. Aaron Waters of the University of California was the local expert. Other geologists present: Jackson, Milton, Wilhelms, Snavely, and Chidester of USGS and Foss, Clanton, and King of NASA. The first day was spent cinder cones, lava flows, ash flows, and a lava tube at several locations. The origins, time sequences, compositions, and flow mechanisms were discussed at each location. The second day commenced with a lecture by Waters on the formation of Newbury Crater. The remainder of the day was spent in and around the 5-mile diameter crater viewing and discussing pumice cones, a pumice plain, obsidian flows, and an overall view of the crater from the highest point on the rim. The third day was spent at Hole-in-the-Ground, a crater of 5,000ft diameter whose origin might be either volcanic or impact. Traverses were made across the crater with the objective of gathering data that would prove one origin or the other. The final stop of the third day was at Fort Rock to observe a ring of rock formed by development of a cinder cone eruption under lake water rather that in air.

October 23-25,	**Valles Caldera, N. M.**	Aldrin, Anders, Bean, Chaffee, Collins, Freeman, Williams
Oct. 29-31, 1964 &		Armstrong, Bassett, Cernan, Cunningham, Gordon, Scott, See
Nov. 13-14, 1964		Eisele, Schweikart

The primary objective of this trip was to view the typical characteristics of ash flow tuffs and another caldera, the 25x35 km Valles caldera in the Jemez Mountains of New Mexico, whose history is somewhat different from that seen at Newbury Caldera. The local experts were Roy Bailey, Bob Smith, R. Doell, and L. Cordell of the U.S. Geological Survey. Bailey has spent 15 years studying the area. Other geologists present: Clanton, Foss of MSC; Chidester of USGS. The first day commenced with a discussion by Bailey of the probable reason for the location and volcanic activity that produced the caldera. The remainder of

the day was spent inside the caldera at various roadcuts and vantage points observing and discussing rhyolite domes, pumice air falls, doming at the center of the caldera, comparison of the different types of volcanic materials, geophysical characteristics, and active sulfur springs. The second day included a briefing on welding and crystallization in ash flows. The group then made close inspections of several ash flows with different degrees of welding and crystallization

Jan. 19-24, 1965 **Hawaii** Aldrin, Anders, Armstrong, Bassett, Bean, Chaffee, Collins, Conrad, Cunningham, Eisele, Gordon, Schweikart, Scott, See, Williams

Incomparable display of recent basaltic volcanic features. Fresh, recent, and ancient lava-flow surfaces could be compared and related to possible lunar surface features. Howard Powers, Director of the USGS Hawaii Volcano Observatory and J. P. Eaton, Don Peterson, Dallas Peck, Dave Hill, Jim Moore (USGS) were the local experts. Other geologists present Chidester, Wilhelms, and Kane of USGS Foss and King of MSC. The first day consisted of a bus trip to several volcanic features including lava tree molds, gas and lava vents, spatter ramparts and cones, flank eruptions of aa and pahoehoe flows, fissure eruptions and beach sands of eroded lava. The second day included foot and bus traverses to observe lava tubes, lava lakes, lava blisters, Pele's tears and hair, Halemaumau fire pit, and pit craters. In the evening a briefing utilized photos of the lunar surface that were analogous to features seen during the past 2 days. The third day started with fly-overs in a 12-passenger aircraft to observe the volcanic features from the air. During the afternoon a lecture was given on the various geophysical measurements that are used to keep track of volcanic activity and determine the structure of the subsurface volcanos. On the 4th day the crews were taken to the saddle area between Muana Loa and Muana Kea where problems were posed by the geologists for the crews to solve. They then went to the summit of Muana Loa for a view of the summit crater and it's features. The 5th day included only a half day which was spent investigating "cored bombs", lava-covered crystalline rocks from either the Earth's mantle or from chambers in which the lava had crystallized and settled.

Feb. 17-18 & **Nevada Test Site** Aldrin, Anders, Armstrong, Bassett, Bean, Cernan, Collins,

24-25, 1965 & Cunningham, Eisele, Gordon, Schweikart, Scott

March 3-4, 1965, Chaffee, See

First experience with non-volcanic craters to help prepare for the study of impact craters. This allowed a view of craters that were produced by a force more similar to the impacts that were thought to produce many of the lunar craters. In addition, the NTS is in a volcanic complex, the Timber Mountain Caldera, thereby allowing for a study of volcanic features next to the nuclear craters. Local experts were Will Carr and Bob Christiansen (USGS). Other geologists present: Wilhelms and Chidester (USGS), Clanton (MSC). This trip provided an opportunity to examine in detail the craters and ejecta formed by detonation of subsurface nuclear devices in lavas and unconsolidated sediments. Use of aerial photos for interpretation of the ejecta was introduced.

April 22-23, 1965 **Meteor Crater, Arizona** Anders, Bassett, Cernan, Chaffee, Collins, Cunningham, Eisele, Gordon, Schweikart, Scott, Williams

This was the first experience with the detailed rocks and structures of a real impact crater led by local expert Gene Shoemaker (USGS). Other geologists present: Clanton (MSC), Chidester, Swann, Schmitt, O'Connor (USGS). A half day tour through the crater introduced the crews to overturned units at the crater rim, surrounding ejecta deposits, and fallback units. Astronauts were then required to recognize and document these features by mapping them on aerial photographs..

Phase III of Geology Training

June 29-July2, 1965 **Katmai, Alaska** Aldrin, Anders, Bassett, Bean, Cernan, Chaffee, Cunningham, Schweikart, Scott, Williams

Explosive eruptions in 1912 deposited silica-rich pumice and ash over a large area in the Valley of Ten Thousand Smokes in an eruption of 1912. Therefore, there is well documented historic data on the

eruption. Furthermore, subsequent stream erosion has cut deep gorges through the deposits allowing study and interpretation of details in vertical sections. The summit of Katmai collapsed by 1500 feet during the eruption. Fumaroles and vents formed in the hot ash flows and evidence for these was studied. The volcanic features are quite fresh and offer an excellent opportunity to view volcanic materials and landforms in nearly pristine condition. The group stayed at a fishing lodge and utilized helicopters from the military Air-Sea rescue group stationed nearby (see letter offering this support). Leader: Bob Smith (USGS). Other geologists present: Clanton, McKay, Foss, Richardson (MSC), Wilhelms Chidester, Stephens, McCord (USGS) This was the first of several exercises that were meant to be the start of simulations of lunar missions. This was known as "playing the Moon game" in which astronauts were divided into pairs, placed in a field location with very little prior information about the area, and pretended that they were on the moon. They also had to plan traverses and collect important and representative samples from the areas. The astronauts were equipped with radios by which they communicated with their geologist instructors. These communications were recorded and later discussed for comparison with the interpretations of the field trip leader and to improve the procedures for good communications between astronauts and scientists.

July 12-16, 1965 **Iceland** Anders, Bassett, Bean, Cernan, Chaffee, Cunningham, Eisele, Schweikart, Scott, Williams

Beautiful volcanic geology with practically no vegetation cover. Features includes calderas, ash cones, steaming volcanic vents, cinders, pumice, various types of lava flows. Probably the most moon-like of the field areas. Leaders: Sigurdur Thorarinsson and Gudmundar. Signaldson. Other geologists present: Clanton Foss (MSC), Chidester, Wilhelms, Stephens, Lee (USGS). The "Moon game" was utilized in some of the training. The geologic observations made by the astronauts around the edge of Askje Caldera produced a revision in the interpretation by Icelandic geologists of the origin of some of the units erupted from the caldera.

Sept., 1-3, 1965 **Medicine Lake, Calif.** Anders, Bean, Schweikart

Sept. 8-10, 1965 . " " " Bassett, Cunningham, Williams
2nd group returned after the 8th because of a hurricane warning in Houston

The Medicine Lake Highlands include an 8 km. caldera in a large volcanic area with volcanic flows and obsidian domes. Local expert was Aaron Waters (Univ. Calif.) for the 1st trip and Charles A. Anderson (USGS) for the 2nd trip. Other geologists present: Clanton, Foss, King (MSC) Wilhelms, Chidester (USGS). The "Moon game" and some independent mapping were included in the 1st and 2nd days of training. The 3rd day consisted of a half day tour of the regional geology.

Sept. 21-24, 1965 **Zuni Salt Lake, N. M**. Anders, Bean, Cunningham, Schweikart

Geologists present: Clanton, Foss (MSC) Chidester (USGS). Large volcanic crater with structurally complex rim material. Geophysical exercises were held and the astronauts helped lay out the traverses and used geophysical instruments to gather data and interpret the results.

Nov. 8-10, 1965 **Pinacates, Mexico** Anders, Cunningham, Schweikart, Williams

Volcanic area with explosive craters and subsidence along ring fractures. Dick Jahns (Stanford Univ.) was the local expert. Other geologists present: Foss, Clanton (MSC), Chidester (USGS).

Dec. 27-29, 1965 **Pinacates & Zuni** Make-up trips for Bassett, Cernan and Chaffee.

Field Training Schedule for the 4th and 5th Groups of Astronauts (24)

Phase I of Geology training

June 2-3, 1966 **Grand Canyon, Arizona** Brand, Bull, Carr, Duke, Engle, Evans, Haise, Irwin, Lind, Lousma, Mattingly, Michel, Mitchell, Pogue, Roosa, Swigert, Weitz, Worden

Led by Grand Canyon Expert Ed McKee. Other geologists present: Foss, Clanton and McKay from MSC; Chidester, Swann, from USGS. See field trip of March 5-6, 1964 for details.

June 23-24, 1966 **West Texas** — Brand, Bull, Carr, Duke, Engle, Evans, Givens, Haise, Irwin, Kerwin, Lind, Lousma, Mattingly, McCandless, Michel, Mitchell, Pogue, Roosa, Schmitt, Swigert, Weitz, Worden

Led by local expert Bill Muehlberger. Other geologists present: Foss, Clanton and McKay from MSC; Chidester, Hait, Swann, from USGS. See field trip of April 2-3, 1964 for details.

July 27-29, 1966 **Bend, Oregon** — Brand, Bull, Carr, Duke, Engle, Evans, Garriot, Givens, Haise, Irwin, Kerwin, Lind, Lousma, Mattingly, McCandless, Michel, Mitchell, Pogue, Roosa, Swigert, Weitz, Worden

Aaron Waters of the University of California was the local expert. Other geologists present: Foss, Clanton and McKay from MSC; Chidester, Brock, Dahlem of USGS. See field trip of October 7-9, 1964 for details.

Aug. 21-25, 1966 **Katmai, Alaska** — Brand, Bull, Carr, Duke, Engle, Evans, Garriot, Gibson, Givens, Haise, Irwin, Kerwin, Lind, Lousma, Mattingly, McCandless, Michel, Mitchell, Pogue, Roosa, Schmitt, Swigert, Weitz, Worden

Geologists present: Foss, Clanton and McKay from MSC; Chidester, Kane, Shoemaker, Smith, Bailey of USGS and Waters of the Univ. of Calif. Others: Rhoder, Zedekar and Ream of MSC. See field trip of June 29-July2, 1965 for details.

Sept. 25, 1966 **Valles Caldera, New Mexico** — Brand, Bull, Carr, Duke, Engle, Evans, Garriot, Gibson, Givens, Haise, Irwin, Kerwin, Lind, Lousma, Mattingly, McCandless, Michel, Mitchell, Pogue, Roosa, Schmitt, Swigert, Weitz, Worden

Geologists present: Foss, Clanton and McKay from MSC; Chidester, Hait, Swann, and Smith of USGS See field trip of October 23-25, 1964 for details.

Nov. 29-Dec. 2, 1966 **Pinacates, Mexico** — Brand, Bull, Carr, Duke, Evans, Gibson, Givens, Haise, Irwin, Lind, Lousma, Mattingly, Michel, Mitchell, Pogue, Roosa, Schmitt, Swigert, Weitz, Worden

Local expert: R. Jahns of Stanford Univ. Other geologists present: Foss, Clanton, Laidley, and McKay from MSC; Chidester, Kane, Swann, Ulrich, Masursky, Rust, Mills, Begay of USGS; and Waters of the Univ. of Calif. Others present: Jack Riley, Ray Zedekar, Vic Rhoder, Charles Nelms and Jack Eggleston of MSC; Don Beattie of NASA Hdqtrs.. See field trip of Nov. 8-10, 1965 for details.

Feb. 12-19, 1967 **Hawaii** — Bull, Carr, Duke, Engle, Evans, Garriot, Gibson, Haise, Irwin, Lousma, Mattingly, McCandless, Michel, Mitchell, Pogue, Worden

Howard Powers, Director of the USGS Hawaii Volcano Observatory was the local expert. Other geologists present: Foss, Clanton, and McKay from MSC; Chidester, Swann, Brock, Eaton, Fiske, Kane, Rust, Wright of USGS. Others present Bob Workman and Jack Ottinger of MSC. See field trip of Jan. 19-24, 1965 for details.

Mar. 16-17, 1967 **Pinacates, Mexico** — Make-up trip for Engle, Garriott, Kerwin, McCandless

Geologists present: Chidester, Swann, Reagon, and Kane from USGS.

March 20-24, 1967 **Hawaii** Make-up trip for Brand, Kerwin, Lind, Roosa, Schmitt, Swigert, Weitz,

Geologists present: Dietrich and McEwen of MSC; Shoemaker of USGS

May 16-19, 1967 **Zuni Salt Lake, Hopi Buttes & Meteor Crater, Arizona** Brand, Carr, Duke, Evans, Garriot, Gibson, Haise, Irwin, Kerwin, Lind, Lousma, Mattingly, McCandless, Michel, Mitchell, Roosa, Swigert, Weitz, Worden

Geologists present: Clanton, McKay, McEwen, Laidley of MSC; Chidester, Dahlem, James, Sutton of USGS; Waters of the Univ. of Calif. See field trip of Sept. 21-24, 1965 and April 22-23, 1965 for details.

May 31-June 2, 1967 **Zuni etc**. Make-up trip for Bull, Engle, Givens, Pogue

July 2-8, 1967 **Iceland** Anders, Armstrong, Brand, Carr, Duke, Engle, Evans, Garriot, Gibson, Haise, Kerwin, Lind, Lousma, Mattingly, McCandless, Michel, Mitchell, Pogue, Roosa, Schmitt, Swigert, Weitz, Worden

Leaders: Sigurdur Thorarinsson and Gudmundar Signaldson. Other geologists present: Clanton, Foss, McKay, Laidley (MSC), Chidester, Kane, Stephens, Lee (USGS). Others: Rhoder, Riley, Nelms of MSC. See field trip of July 12-16, 1965 for details.

APPENDIX F. ORGANIZATIONAL CHARTS FOR SCIENCE TRAINING AT MSC: 1963-1969

(see charts)

APPENDIX ?. GEOLOGY FIELD EXERCISES FOR APOLLO MISSIONS

APOLLO 8

Feb. 13-14, 1968	Big Bend, Texas	Borman, Lovell, Anders, Armstrong, Aldrin, Haise, Collins, Schmitt

Geologists included Clanton, McKay and Dietrich

McKay, Clanton says A-9 crew was also present

APOLLO 11

Feb. 24, 1969	Sierra Blanco, Texas	Armstrong, Aldrin, Lovell, Haise

APOLLO 12

Mar. 10-14, 1969	Quitman Mountains	Conrad, Bean
April 8-9, 1969	Kilbourne Hole, N. M.	Conrad, Bean, Gibson
May 1-2, 1969	Big Bend, Texas	Conrad, Bean, Gibson
July 10, 1969	Meteor Crater, Arizona	Bean
August 9, 1969	Hawaii	Conrad, Gibson, Scott, Irwin, Schmitt
Aug. 10-11, 1969	Hawaii	Conrad, Bean, Gibson, Scott, Irwin, Schmitt
Oct. 10, 1969	Sunset Craters, Arizona	Conrad, Bean, +??

APOLLO 13

Late Sept., 1969	Orocopias	Lovell, Haise, Young, Duke, Schmitt---Silver and grad asst Tom Anderson, 8 days See Chaikin p.392-394 for good descript.
Sept. 24-Oct. 1, 1969	Mono Crater, California	Lovell, Haise, Young, Duke
Oct. 24, 1969	Meteor Crater, Arizona	Lovell, Haise, Young, Duke
Nov. 11, 1969	Kilbourne Hole, N. M.	Lovell, Haise, Young, Duke
Dec. 17-20, 1969	Hawaii	Lovell, Haise, Young, Duke
Mar. 15-16, 1970	Flagstaff, Arizona	Lovell, Haise, Young, Duke
Mar. 16, 1970	Black Mesa Crater Field	according to Zedekar

APOLLO 14

Aug. 14, 1969	Flagstaff, Arizona	Shepard, Mitchell, Engle
Aug. 22-23, 1969	Craters of the Moon, Idaho	Shepard, Mitchell, Cernan, Engle
Feb. 14-18, 1970	Pinacates, Mexico	Shepard, Mitchell, Cernan, Engle

April 2-4, 1970	Hawaii	Shepard, Mitchell, Cernan, Engle
June 3-4, 1970	Kilbourne Hole, N. M.	Shepard, Mitchell, Cernan, Engle
June 18-19, 1970	Flagstaff, Arizona	Roosa, Evans
Aug. 11-13, 1970	Ries Crater, Germany	Shepard, Mitchell, Cernan, Engle
Sept. 11, 1970	Nevada Test Site	Shepard, Mitchell, Cernan, Engle, Evans
Nov. 16, 1970	Cottonwood, Ariz.	Shepard, Mitchell

APOLLO 15

May 6-8 & 11-13, 1970	Chocolate Mtns., Calif.	Scott, Irwin, Gordon, Schmitt
June 3, 1970	Orocopia Mtns., Calif.	Scott, Irwin, Gordon, Schmitt
June 4-5, 1970	Flagstaff, Arizona	Scott, Irwin, Gordon, Schmitt
July 15-17, 1970	Flagstaff, Arizona Merriam Crater	Scott, Irwin, Worden, Gordon, Schmitt, Brand
July 22, 1970	Medicine Hat, Alberta, Canada	Gordon, Brand, Schmitt
July 23, 1979	Medicine Hat, Alberta	Scott, Irwin, Worden, Gordon, Schmitt, Brand
Aug. 26-28, 1970	San Juan Mtns., Col.	Scott, Irwin, Gordon, Schmitt
Sept. 17-18, 1970	Buell Park, Arizona	Scott, Irwin, Gordon, Schmitt
Oct. 7-9, 1970	Northern Minnesota	Scott, Irwin, Gordon, Schmitt
Nov. 19-20,1970	San Gabriel Mtns. , Calif.	Scott, Irwin, Gordon, Schmitt
Dec. 5-12, 1970	Hawaii	Scott, Irwin, Gordon, Schmitt
Jan 18, 1971	Kilbourne Hole, N. M.	Scott, Irwin, Gordon, Schmitt
Feb. 10-12, 1971	Ubehebe Craters, Calif.	Scott, Irwin, Gordon, Schmitt
Mar. 11-12, 1971	Rio Grande Canyon, Taos, New Mexico	Scott, Irwin, Gordon, Schmitt
April 29, 1971	Coso Hills, Calif.	Scott, Irwin, Worden, Gordon, Schmitt, Brand
April 30, 197	Coso Hills, Calif.	Scott, Irwin, Gordon, Schmitt
May 20-21, 1971	Nevada Test Site	Scott, Irwin, Gordon, Schmitt
June 25, 1971	Flagstaff, Arizona	Scott, Irwin, Gordon, Schmitt

APOLLO 16

July 8-10, 1970	San Juan Mtns, N. M.	Young, Duke, Haise, Pogue, Carr
July 23, 1970	Medicine Hat, Alberta,	Young, Duke, Haise, Pogue, Carr

	Canada	
Sept. 1-2, 1970	Colorado Plateau	Young, Duke, Haise, Pogue, Carr
Oct. 12-14, 1970	Northern Minnesota	Young, Duke
Nov. 12-13, 1970	Nevada Test Site	Young, Duke
Nov. 23-24, 1970	San Gabriel Mtns., Cal.	Young, Duke
Jan. 18, 1971	Kilbourne Hole, N. M.	Duke
Jan. 19, 1971	Kilbourne Hole, N. M.	Young, Duke
Jan. 20, 1971	Kilbourne Hole, N. M.	Haise
Feb. 25-26, 1971	Flagstaff, Arizona	Young, Duke, Haise
Mar. 29-30, 1971	Flagstaff Arizona	Young, Duke, Haise at Merriam Crater
April 26-27, 1971	Camp Verde, Ariz.	Young, Duke, Haise
May 24-25, 1971	Capulin Mtns., N. M.	Young, Duke, Haise
June 10-11, 1971	Mono Crater, Calif.	Young, Duke, Haise
July 7-9, 1971	Sudbury, Ontario, Canada	Young, Duke, Haise
Sept. 9-10, 1971	Rio Grande Canyon, Taos, N. M.	Young, Duke, Haise, Mitchell
Oct. 27, 1971	Nevada Test Site	Young, Duke, Haise, Mattingly
Nov. 17-18, 1971	Coso Hills, Calif.	Young, Duke, Haise, Mitchell
Dec. 7-13, 1971	Hawaii	Young, Duke, Haise, Mitchell
Feb. 17-18, 1972	Boulder City, Nev.	Young, Duke, Haise, Mitchell
	APOLLO 17	
Oct. 19-22, 1971	Big Bend, Texas	Cernan, Schmitt
Nov. 17-18, 1971	Flagstaff, Arizona	Evans
Nov. 18, 1971	Coso Hills, Calif.	Cernan, Schmitt
Dec. 20-21, 1971	Kilbourne Hole, N. M.	Cernan, Schmitt
Jan. 24-25, 1972	Boulder City, Nev.	Cernan, Schmitt, Evans
Feb. 22-25, 1972	Chocolate Mtns, Calif.	Cernan, Schmitt, Scott, Irwin
Feb. 23-24, 1972	Flagstaff, Ariz.	Evans
March 14-15, 1972	Sierra Madera	Cernan, Schmitt

April 10, 1972	San Gabriel Mtns., Calif.	Cernan, Schmitt, Scott
April 11-12, 1972	San Gabriel Mtns., Calif.	Cernan, Schmitt
May 24, 1972	Sudbury, Ontario, Canada	Cernan, Schmitt, Evans
May 25, 1972	Sudbury, Ontario Canada	Cernan, Schmitt
June 22-26, 1972	Hawaii	Cernan, Schmitt
June 27-28, 1972	Hawaii	Cernan, Schmitt, Evans
June 29, 1972	Hawaii	Evans
July 24, 1972	Stillwater, Montana	Cernan, Schmitt, Evans, Young
July 25, 1972	Stillwater, Montana	Cernan, Schmitt, Young
Aug. 7, 1972 *	Nevada Test Site	Cernan, Schmitt, Evans, Young, Duke
Aug. 8, 1972	Nevada Test Site	Cernan, Schmitt, Young, Duke, Roosa
Sept. 6-7, 1972	Tonapah, Nevada	Cernan, Schmitt, Young, Duke
Oct. 6, 1972	Blackhawk Slide & Mojave Desert, Calif.	Cernan, Schmitt, Young, Duke
Nov. 2, 1972	Flagstaff, Arizona	Cernan, Schmitt, Young, Duke
Nov. 3, 1972	Flagstaff, Arizona	Cernan, Schmitt