= Apollo 17 =

Apollo 17 was the final mission of NASA 's Apollo program , the enterprise that landed the first humans on the Moon . Launched at 12 : 33 am Eastern Standard Time (EST) on December 7 , 1972 , with a crew made up of Commander Eugene Cernan , Command Module Pilot Ronald Evans , and Lunar Module Pilot Harrison Schmitt , it was the last use of Apollo hardware for its original purpose ; after Apollo 17 , extra Apollo spacecraft were used in the Skylab and Apollo ? Soyuz programs .

Apollo 17 was the first night launch of a U.S. human spaceflight and the final manned launch of a Saturn V rocket . It was a " J @-@ type mission " which included three days on the lunar surface , extended scientific capability , and the third Lunar Roving Vehicle (LRV) . While Evans remained in lunar orbit in the Command / Service Module (CSM) , Cernan and Schmitt spent just over three days on the moon in the Taurus ? Littrow valley and completed three moonwalks , taking lunar samples and deploying scientific instruments . Evans took scientific measurements and photographs from orbit using a Scientific Instruments Module mounted in the Service Module .

The landing site was chosen with the primary objectives of Apollo 17 in mind : to sample lunar highland material older than the impact that formed Mare Imbrium , and investigate the possibility of relatively new volcanic activity in the same area . Cernan , Evans and Schmitt returned to Earth on December 19 after a 12 @-@ day mission .

Apollo 17 is the most recent manned Moon landing and was the last time humans travelled beyond low Earth orbit . It was also the first mission to be commanded by a person with no background as a test pilot , and the first to have no one on board who had been a test pilot ; X @-@ 15 test pilot Joe Engle lost the lunar module pilot assignment to Schmitt , a scientist . The mission broke several records : the longest moon landing , longest total extravehicular activities (moonwalks) , largest lunar sample , and longest time in lunar orbit .

= = Crew = =

Eugene Cernan , Ronald Evans , and former X @-@ 15 pilot Joe Engle were assigned to the backup crew of Apollo 14 . Engle flew sixteen X @-@ 15 flights , three of which exceeded the 50 mi (80 km) border of space . Following the rotation pattern that a backup crew would fly as the prime crew three missions later , Cernan , Evans , and Engle would have flown Apollo 17 . Harrison Schmitt served on the backup crew of Apollo 15 and , following the crew rotation cycle , was slated to fly as Lunar Module Pilot on Apollo 18 . However , Apollo 18 was cancelled in September 1970 . Following this decision , the scientific community pressured NASA to assign a geologist to an Apollo landing , as opposed to a pilot trained in geology . In light of this pressure , Harrison Schmitt , a professional geologist , was assigned the Lunar Module Pilot position on Apollo 17 . Scientist @-@ astronaut Curt Michel believed that it was his own decision to resign , after it became clear that he would not be given a flight assignment , that mobilized this action .

Subsequent to the decision to assign Schmitt to Apollo 17 , there remained the question of which crew (the full backup crew of Apollo 15 , Dick Gordon , Vance Brand , and Schmitt , or the backup crew of Apollo 14) would become prime crew of the mission . NASA Director of Flight Crew Operations Deke Slayton ultimately assigned the backup crew of Apollo 14 (Cernan and Evans) , along with Schmitt , to the prime crew of Apollo 17 .

= = = Backup crew = = =

= = = = Original = = = =

= = = = Replacement = = = =

The Apollo 15 prime crew received the backup assignment since this was to be the last lunar mission and the backup crew would not rotate to another mission . However , when the Apollo 15 postage stamp incident became public in early 1972 the crew was reprimanded by NASA and the United States Air Force (they were active duty officers) . Director of Flight Crew Operations Deke Slayton removed them from flight status and replaced them with Young and Duke from the Apollo 16 prime crew and Roosa from the Apollo 14 prime and Apollo 16 backup crews .

= = = Support crew = = =

Robert F. Overmyer
Robert A. Parker
C. Gordon Fullerton

= = = Mission insignia = = =

The insignia 's most prominent feature is an image of the Greek sun god Apollo backdropped by a rendering of an American eagle , the red bars on the eagle mirroring those on the flag of the United States . Three white stars above the red bars represent the three crewmen of the mission . The background includes the Moon , the planet Saturn and a galaxy or nebula . The wing of the eagle partially overlays the Moon , suggesting man 's established presence there . The gaze of Apollo and the direction of the eagle 's motion embody man 's intention to explore further destinations in space .

The patch includes , along with the colors of the U.S. flag (red , white , and blue) , the color gold , representative of a " golden age " of spaceflight that was to begin with Apollo 17 . The image of Apollo in the mission insignia is a rendering of the Apollo Belvedere sculpture . The insignia was designed by Robert McCall , with input from the crew .

= = Planning and training = =

Like Apollo 15 and Apollo 16 , Apollo 17 was slated to be a " J @-@ mission , " an Apollo mission type that featured lunar surface stays of three days , higher scientific capability , and the usage of the Lunar Roving Vehicle . Since Apollo 17 was to be the final lunar landing of the Apollo program , high @-@ priority landing sites that had not been visited previously were given consideration for potential exploration . A landing in the crater Copernicus was considered , but was ultimately rejected because Apollo 12 had already obtained samples from that impact , and three other Apollo expeditions had already visited the vicinity of Mare Imbrium . A landing in the lunar highlands near the crater Tycho was also considered , but was rejected because of the rough terrain found there and a landing on the lunar far side in the crater Tsiolkovskiy was rejected due to technical considerations and the operational costs of maintaining communication during surface operations . A landing in a region southwest of Mare Crisium was also considered , but rejected on the grounds that a Soviet spacecraft could easily access the site ; Luna 20 eventually did so shortly after the Apollo 17 site selection was made .

After the elimination of several sites , three sites made the final consideration for Apollo 17 : Alphonsus crater , Gassendi crater , and the Taurus @-@ Littrow valley . In making the final landing site decision , mission planners took into consideration the primary objectives for Apollo 17 : obtaining old highlands material from a substantial distance from Mare Imbrium , sampling material from young volcanic activity (i.e. , less than three billion years) , and having minimal ground overlap with the orbital ground tracks of Apollo 15 and Apollo 16 to maximize the amount of new data obtained .

The Taurus @-@ Littrow site was selected with the prediction that the crew would be able to obtain samples of old highland material from the remnants of a landslide event that occurred on the south wall of the valley and the possibility of relatively young , explosive volcanic activity in the area . Although the valley is similar to the landing site of Apollo 15 in that it is on the border of a lunar mare

, the advantages of Taurus @-@ Littrow were believed to outweigh the drawbacks , thus leading to its selection as the Apollo 17 landing site .

Apollo 17 was the only lunar landing mission to carry the Traverse Gravimeter Experiment (TGE) , an experiment built by Draper Laboratory at the Massachusetts Institute of Technology designed to provide relative gravity measurements throughout the landing site at various locations during the mission 's moonwalks . Scientists would then use this data to gather information about the geological substructure of the landing site and the surrounding vicinity .

As with previous lunar landings , the Apollo 17 astronauts underwent an extensive training program that included training to collect samples on the surface , usage of the spacesuits , navigation in the Lunar Roving Vehicle , field geology training , survival training , splashdown and recovery training , and equipment training .

= = Mission hardware and experiments = =

= = = Traverse Gravimeter = = =

Apollo 17 was the only Apollo lunar landing mission to carry the Traverse Gravimeter Experiment . As gravimeters had proven to be useful in the geologic investigation of the Earth , the objective of this experiment was to determine the feasibility of using the same techniques on the Moon to learn about its internal structure . The gravimeter was used to obtain readings at the landing site in the immediate vicinity of the Lunar Module (LM) , as well as various locations on the mission 's traverse routes . The TGE was carried on the Lunar Roving Vehicle ; measurements were taken by the astronauts while the LRV was not in motion or after the gravimeter was placed on the surface .

A total of twenty @-@ six measurements were taken with the TGE during the mission 's three moonwalks , with productive results . As part of the Apollo Lunar Surface Experiments Package (ALSEP) , the astronauts also deployed the Lunar Surface Gravimeter , a similar experiment , which ultimately failed to function properly .

= = = Scientific Instrument Module = = =

Sector one of the Apollo 17 Service Module (SM) contained the Scientific Instrument Module (SIM) bay . The SIM bay housed three experiments for use in lunar orbit : a lunar sounder , an infrared scanning radiometer , and a far @-@ ultraviolet spectrometer . A mapping camera , panoramic camera , and a laser altimeter were also included in the SIM bay .

The lunar sounder beamed electromagnetic impulses toward the lunar surface , which were designed with the objective of obtaining data to assist in developing a geological model of the interior of the Moon to an approximate depth of 1 @.@ 3 km (0 @.@ 81 mi) .

The Infrared Scanning Radiometer was designed with the objective of generating a temperature map of the lunar surface to aid in locating surface features such as rock fields , structural differences in the lunar crust , and volcanic activity .

The Far @-@ Ultraviolet Spectrometer was to be used to obtain data pertaining to the composition , density , and constituency of the lunar atmosphere . The spectrometer was also designed to detect far @-@ UV radiation emitted by the Sun that has been reflected off the lunar surface .

The Laser Altimeter was designed with the intention of measuring the altitude of the spacecraft above the lunar surface within approximately two meters (6 @.@ 5 feet) , and providing altitude information to the panoramic and mapping cameras .

= = = Light flash phenomenon = = =

Throughout the Apollo lunar missions , the crew members observed light flashes that penetrated closed eyelids . These flashes , described as " streaks " or " specks " of light , were usually observed by astronauts while the spacecraft was darkened during a sleep period . These flashes ,

while not observed on the lunar surface , would average about two per minute and were observed by the crew members during the trip out to the Moon , back to Earth , and in lunar orbit .

The Apollo 17 crew conducted an experiment , also conducted on Apollo 16 , with the objective of linking these light flashes with cosmic rays . As part of an experiment conducted by NASA and the University of Houston , one astronaut wore a device that recorded the time , strength , and path of high @-@ energy atomic particles that penetrated the device . Analysis of the results concluded that the evidence supported the hypothesis that the flashes occurred when charged particles travelled through the retina in the eye .

= = = Surface Electrical Properties Experiment = = =

Apollo 17 was the only lunar surface expedition to include the Surface Electrical Properties (SEP) experiment . The experiment included two major components : a transmitting antenna deployed near the Lunar Module and a receiving antenna located on the Lunar Roving Vehicle . At different stops during the mission 's traverses , electrical signals traveled from the transmitting device , through the ground , and received at the LRV . The electrical properties of the lunar soil could be determined by comparison of the transmitted and received electrical signals . The results of this experiment , which are consistent with lunar rock composition , show that the top 2 km (1 @.@ 2 mi) of the Moon are extremely dry .

= = = Lunar Roving Vehicle = = =

Apollo 17 was the third mission (the others being Apollo 15 and Apollo 16) to make use of a Lunar Roving Vehicle . The LRV , in addition to being used by the astronauts for transport from station to station on the mission 's three moonwalks , was used to transport the astronauts ' tools , communications equipment , and samples . The Apollo 17 LRV was also used to carry experiments unique to the mission , such as the Traverse Gravimeter and Surface Electrical Properties experiment . The Apollo 17 LRV traveled a cumulative distance of approximately 35 @.@ 9 km (22 @.@ 3 mi) in a total drive time of about four hours and twenty @-@ six minutes ; the greatest distance Eugene Cernan and Harrison Schmitt traveled from the Lunar Module was about 7 @.@ 6 km (4 @.@ 7 mi) .

= = = Biological cosmic ray experiment = = =

Apollo 17 included a biological cosmic ray experiment (BIOCORE) , carrying mice that had been implanted with radiation monitors to see whether they suffered damage from cosmic rays .

Five pocket mice (Perognathus longimembris) were implanted with radiation monitors under their scalps and flown on the mission . The species was chosen because it was well @-@ documented , small , easy to maintain in an isolated state (not requiring drinking water for the duration of the mission and with highly concentrated waste) , and for its ability to withstand environmental stress . Four of the five mice survived the flight ; the cause of death of the fifth mouse was not determined .

The study found lesions in the scalp itself and liver . The scalp lesions and liver lesions appeared to be unrelated to one another , and were not thought to be the result of cosmic rays . No damage was found in the mice 's retinas or viscera . At the time of the publication of the Apollo 17 Preliminary Science Report , the mouse brains had not yet been examined . However , subsequent studies showed no significant effect on the brains .

Officially , the mice ? four male and one female ? were assigned the identification numbers A3326 , A3400 , A3305 , A3356 and A3352 . Unofficially , according to Cernan , the Apollo 17 crew dubbed them " Fe " , " Fi " , " Fo " , " Fum " and " Phooey " .

= = Mission highlights = =

= = = Launch and outbound trip = = =

Apollo 17 was launched at 12 : 33 am EST on December 7 , 1972 , from launch pad 39 @-@ A at the Kennedy Space Center . It was the last manned Saturn V launch and the only night launch . The launch was delayed by two hours and forty minutes due to an automatic cutoff in the launch sequencer at the T @-@ 30 second mark in the countdown . The issue was quickly determined to be a minor technical error . The clock was reset and held at the T @-@ 22 minute mark while technicians worked around the malfunction in order to continue with the launch . This pause was the only launch delay in the Apollo program caused by this type of hardware failure . The count resumed and the rocket lifted off achieving a normal low Earth orbit .

Approximately 500 @,@ 000 people were estimated to have observed the launch in the immediate vicinity of Kennedy Space Center , despite the early morning hour . The launch was visible as far away as 800 km (500 mi) ; observers in Miami , Florida , saw a " red streak " crossing the northern sky .

At 3 : 46 am EST , the S @-@ IVB third stage was re @-@ ignited to propel the spacecraft towards the Moon .

At approximately 2 : 47 pm EST on December 10 , the Service Propulsion System engine on the Command / Service Module ignited to slow down the CSM / Lunar Module stack into lunar orbit . Following orbit insertion and orbital stabilization , the crew began preparations for landing in the Taurus @-@ Littrow valley .

= = = Moon landing = = =

After separating from the Command / Service Module , the Lunar Module Challenger and its crew of two , Eugene Cernan and Harrison Schmitt , adjusted their orbit and began preparations for the descent to Taurus @-@ Littrow . While Cernan and Schmitt prepared for landing , Command Module Pilot Ron Evans remained in orbit to take observations , perform experiments and await the return of his crew @-@ mates a few days later .

Soon after completing their preparations for landing , Cernan and Schmitt began their descent to the Taurus @-@ Littrow valley on the lunar surface . Several minutes after the descent phase was initiated , the Lunar Module pitched over , giving the crew their first look at the landing site during the descent phase and allowing Cernan to guide the spacecraft to a desirable landing target while Schmitt provided data from the flight computer essential for landing . The LM touched down on the lunar surface at 2 : 55 pm EST on December 11 . Shortly thereafter , the two astronauts began re @-@ configuring the LM for their stay on the surface and began preparations for the first moonwalk of the mission , or EVA @-@ 1 .

= = = Lunar surface = = =

The first moonwalk (EVA) of the mission began approximately four hours after landing , at about 6 : 55 pm on December 11 . The first task of the first lunar excursion was to offload the Lunar Roving Vehicle and other equipment from the Lunar Module . While working near the rover , a fender was accidentally broken off when Gene Cernan brushed up against it , his hammer getting caught under the right @-@ rear fender , breaking off the rear extension . The same incident had also occurred on Apollo 16 as Commander John Young maneuvered around the rover . Although this was not a mission @-@ critical issue , the loss of the fender caused Cernan and Schmitt to be covered with dust thrown up when the rover was in motion . The crew used duct tape to fix the problem by attaching a map to the damaged fender , but the dust picked up on the tape surface prevented it from sticking properly and the first fix was short lived . After an overnight rethink by the flight controllers , a better method of applying the tape resulted in a satisfactory fix that lasted for the length of the exploration . The crew then deployed the Apollo Lunar Surface Experiments Package (ALSEP) west of the immediate landing site . After completing this , Cernan and Schmitt departed on the first geologic traverse of the mission towards Steno crater to the south of the landing site , during

which they gathered 14 kilograms (31 lb) of samples ; took seven gravimeter measurements ; and deployed two explosive packages , which were later detonated remotely to test geophones that had been placed by the astronauts and seismometers that had been placed on previous Apollo missions . The EVA ended after seven hours and twelve minutes .

On December 12 , at 6 : 28 pm EST , Cernan and Schmitt began their second lunar excursion . One of the first tasks of the EVA was repairing the right @-@ rear fender on the LRV , the rearward extension of which had been broken off the previous day . The pair did this by taping together four cronopaque maps with duct tape and clamping the replacement fender extension to the fender , thus providing a means of preventing dust from raining down upon them while in motion . During this EVA , the pair sampled several different types of geologic deposits found in the valley , including the avalanche at the base of the South Massif , orange @-@ colored soil at Shorty crater , and ejecta of Camelot crater . The crew completed this moonwalk after seven hours and thirty @-@ seven minutes . They collected 34 kilograms (75 lb) of samples , deployed three more explosive packages and took seven gravimeter measurements .

The third moonwalk , the last of the Apollo program , began at 5 : 26 pm EST on December 13 . During this excursion , the crew collected 66 kilograms (146 lb) of lunar samples and took nine gravimeter measurements . They drove the rover to the north and east of the landing site and explored the base of the North Massif , the Sculptured Hills , and the unusual crater Van Serg . Before ending the moonwalk , the crew collected a rock , a breccia , and dedicated it to several different nations which were represented in Mission Control Center in Houston , Texas , at the time . A plaque located on the Lunar Module , commemorating the achievements made during the Apollo program , was then unveiled . Before reentering the LM for the final time , Gene Cernan expressed his thoughts :

... I 'm on the surface ; and , as I take man 's last step from the surface , back home for some time to come - but we believe not too long into the future - I 'd like to just [say] what I believe history will record . That America 's challenge of today has forged man 's destiny of tomorrow . And , as we leave the Moon at Taurus @-@ Littrow , we leave as we came and , God willing , as we shall return , with peace and hope for all mankind . " Godspeed the crew of Apollo 17 . "

Cernan then followed Schmitt into the Lunar Module after spending approximately seven hours and 15 minutes outside during the mission 's final lunar excursion .

= = = Return to Earth = = =

Eugene Cernan and Harrison Schmitt successfully lifted off from the lunar surface in the ascent stage of the Lunar Module on December 14 , at 5 : 55 pm EST . After a successful rendezvous and docking with Ron Evans in the Command / Service Module in orbit , the crew transferred equipment and lunar samples between the LM and the CSM for return to Earth . Following this , the LM ascent stage was sealed off and jettisoned at 1 : 31 am on December 15 . The ascent stage was then deliberately crashed into the Moon in a collision recorded by seismometers deployed on Apollo 17 and previous Apollo expeditions .

On December 17 , during the trip back to Earth , at 3 : 27 pm EST , Ron Evans successfully conducted a one @-@ hour and seven minute spacewalk to retrieve exposed film from the instrument bay on the exterior of the CSM .

On December 19 , the crew jettisoned the no @-@ longer @-@ needed Service Module , leaving only the Command Module for return to Earth . The Apollo 17 spacecraft reentered Earth 's atmosphere and landed safely in the Pacific Ocean at 2 : 25 pm , 6 @.@ 4 kilometers (4 @.@ 0 mi) from the recovery ship , USS Ticonderoga . Cernan , Evans and Schmitt were then retrieved by a recovery helicopter and were safely aboard the recovery ship 52 minutes after landing .

= = Spacecraft locations = =

The Command Module America is currently on display at Space Center Houston at the Lyndon B. Johnson Space Center in Houston , Texas .

The ascent stage of lunar module Challenger impacted the Moon December 15 , 1972 at 06 : 50 : 20 @.@ 8 UT (1 : 50 am EST) , at 19 @.@ 96 ° N 30 @.@ 50 ° E ? / 19 @.@ 96 ; 30 @.@ 50 ? (Apollo 17 LM ascent stage) . The descent stage remains on the Moon at the landing site , 20 @.@ 19080 ° N 30 @.@ 77168 ° E ? / 20 @.@ 19080 ; 30 @.@ 77168 ? (Apollo 17 LM descent stage) .

In 2009 and again in 2011 , the Lunar Reconnaissance Orbiter photographed the landing site from increasingly low orbits .

= = Depiction of mission in fiction and popular culture = =

Portions of the Apollo 17 mission are dramatized in the 1998 HBO miniseries From the Earth to the Moon episode entitled " Le Voyage dans la Lune . "

The prologue to the 1999 novel Back to the Moon , by Homer Hickam , begins with a dramatized depiction of the end of the second Apollo 17 EVA . The orange soil then becomes the major driver of the plot of the rest of the story .

The 2005 novel Tyrannosaur Canyon by Douglas Preston opens with a depiction of the Apollo 17 moonwalks using quotes taken from the official mission transcript .

Additionally , there have been fictional astronauts in film , literature and television who have been described as " the last man to walk on the Moon , " implying they were crew members on Apollo 17 . One such character was Steve Austin in the television series The Six Million Dollar Man . In the 1972 novel Cyborg , upon which the series was based , Austin remembers watching the Earth " fall away during Apollo XVII . " In the 1998 film Deep Impact fictional astronaut Spurgeon " Fish " Tanner , portrayed by Robert Duvall , was described at a Presidential press conference as the " last man to walk on the moon " by the President of the United States , portrayed by Morgan Freeman .

In the Anime Aldnoah.Zero , the Apollo 17 mission locates an ancient transporter gate leading to Mars left by an unknown , extinct alien race . This discovery is the divergence point for the story 's alternate history .

= = Multimedia = =