THE APOLLO 15 MISSION

On July 30, 1971, the Apollo 15 lunar module Falcon, descending over the 4,000 meter Apennine Mountain front, landed at one of the most geologically diverse sites selected in the Apollo program, the Hadley-Apennine region. Astronauts Dave Scott and Jim Irwin brought the spacecraft onto a mare plain just inside the most prominent mountain ring structure of the Imbrium basin, the Montes Apennines chain which marks its southeastern topographic rim, and close to the sinuous Hadley Rille (Fig. 1). The main objectives of the mission were to investigate and sample materials of the Apennine Front itself (expected to be Imbrium ejecta and pre-Imbrium materials), of Hadley Rille, and of the mare lavas of Palus Putredinis (Fig. 2). A package of seven surface experiments, including heat flow and passive seismic, was also set up and 1152 surface photographs were taken. A television camera, data acquisition (sequence) camera, and orbital photography and chemical data provided more information. The Apollo 15 mission was the first devoted almost entirely to science, and the first to use a Rover vehicle which considerably extended the length of the traverses, from a total of 3.5 km on Apollo 14 to 25.3 km during three separate traverses on Apollo 15 (Fig. 3). The collected sample mass was almost doubled, from 43 kg on Apollo 14 to 78 kg on Apollo 15. A reduction in the planned traverse length was made necessary, in part by unexpected and time-consuming difficulties in the collection of the deep core sample (at the experiments package area). Thus the North Complex, a hilly, cratered region of disputable origin, was not visited. Nonetheless the mission was very successful.

The Apollo 15 mission produced both expected and unexpected results. As expected, mare basalt samples were collected on the mare plains. No evidence was found to change the pre-mission interpretation of Hadley Rille as a collapsed lava tube or channel. Mare basalts were also sampled almost in situ at the rille edge and the only observations of in situ bedrock ever made on the Moon were those on the Hadley Rille wall. The mare basalts form two distinct chemical groups, both of which have the same age (3.3 b.y.), Sr-isotopic characteristics, and rare-earth element patterns. The one group, olivine-normative, contains many vesicular specimens, and shows an olivine fractionation trend. Samples are mainly medium- to coarse-grained. The other group, quartz-normative, is pigeonite-phyric and includes both vitrophyric and coarse-grained examples. However, it shows little fractionation at all. A few other mare basalts may represent distinct flows. An unexpected find was emerald green glass, which is a mare volcanic product. It is primitive in chemistry and isotopic characteristics but has an age similar to the mare basalts. It is ubiquitous, but most common on the Apennine Front where it is locally present as fairly pure clods. Several slightly but distinctly different chemical subgroups of this very low-Ti glass occur. Two other volcanic glass types of grossly different chemistry, yellow intermediate-Ti and red high-Ti, are present at the site but are dispersed deposits.

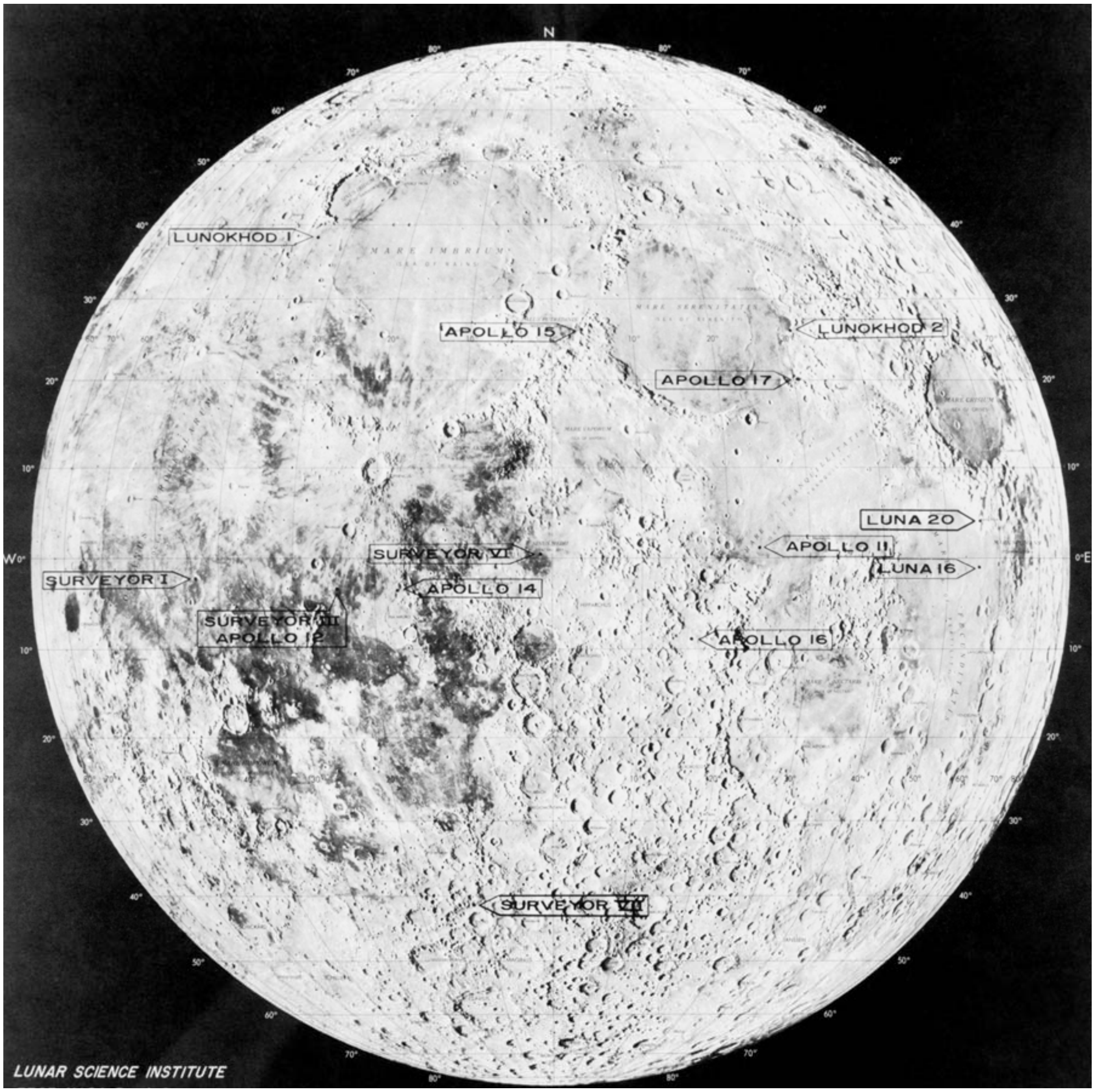
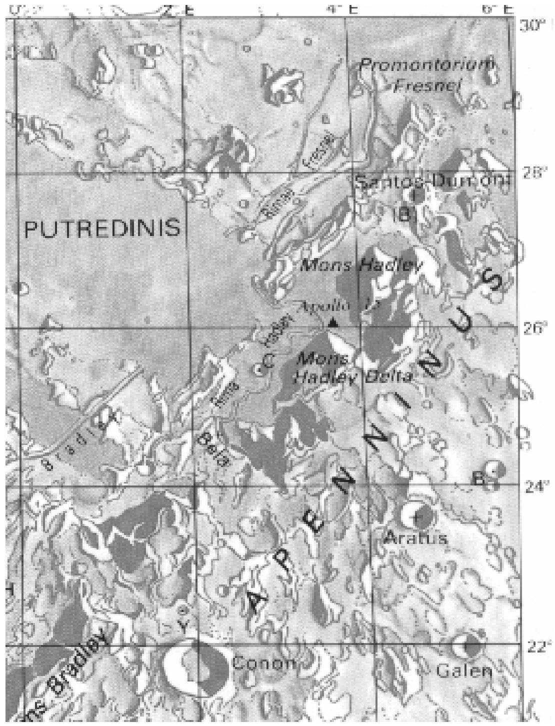
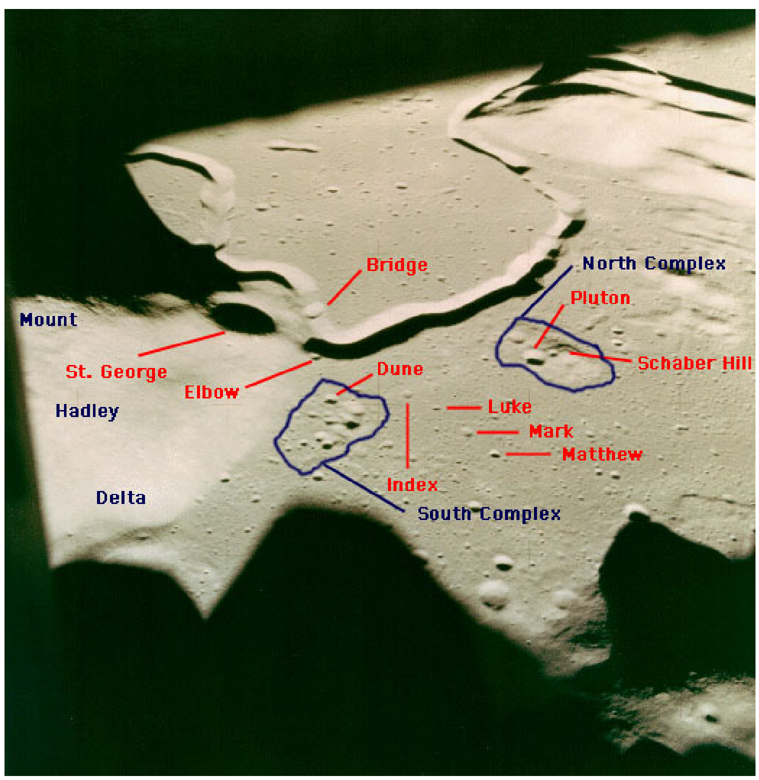


Figure 1. USAF lunar reference mosaic showing all Apollo, Luna, Surveyor, and Lunokhod landing sites. Scale = 1:10,000,000. S-76-25839



http://www.astrosurf.com/lunascan/Apollo15.htm



http://www.hq.nasa.gov/office/pao/History/alsj/a15/ap15-87-11717lbl.jpg

Figure 2. Apollo 15 landing site area

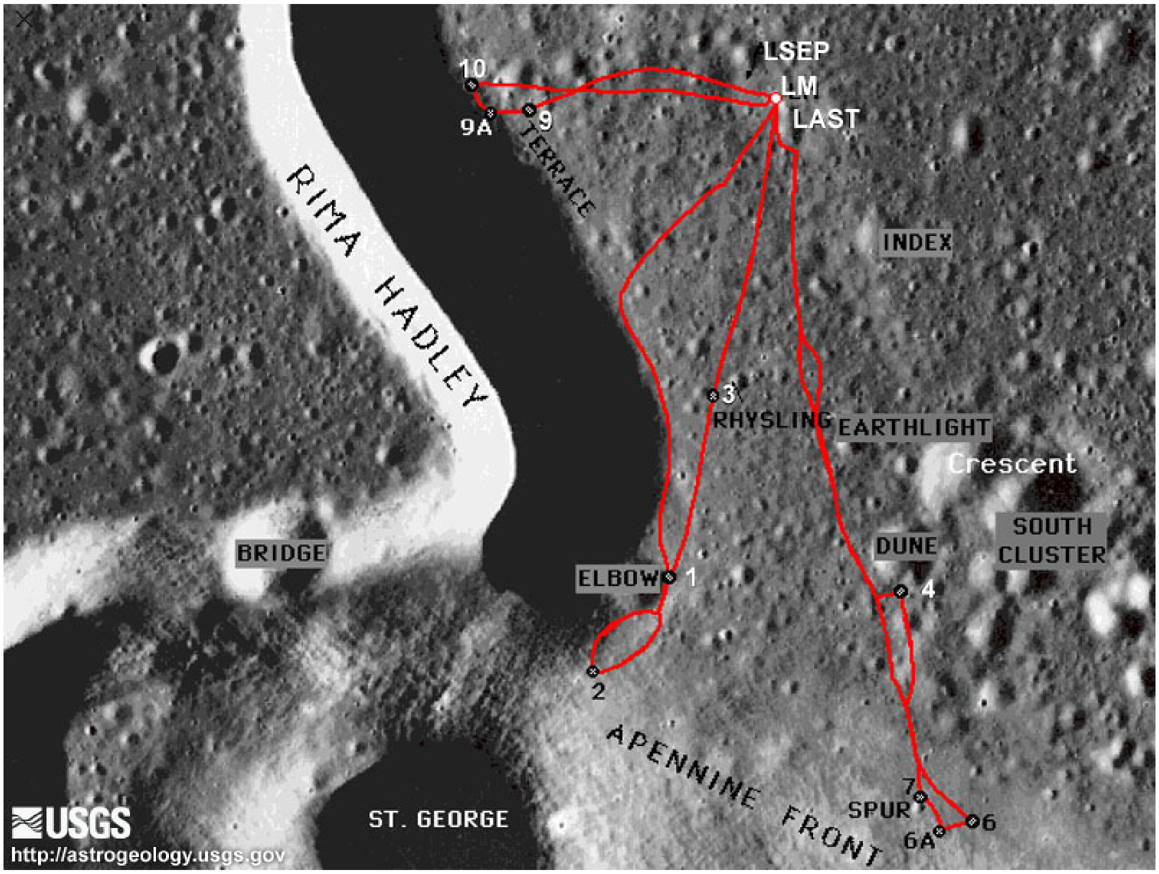


Figure 3. Showing LM location and area traversed by astronauts during EVAs.

The map was prepared as part of a project by a
United States Geological Survey (USGS) team under funding from the
USGS Technology Transfer Program and
NASA's Planetary Geology and Geophysics Program.

The Apennine Front samples include many brown glassy regolith breccias ranging from friable clods to coherent rocks. These breccias contain mare basalt and green glass and only minor conspicuous highland-derived materials, hence have an origin much later than Imbrium. Such regolith breccias, with varied chemistry generally similar to local regoliths, are common throughout the landing site. Highlands materials include cataclasized or brecciated igneous rocks including zerroan anorthosites (e.g., "Genesis rock" 15415), norites, and spinel bearing troctolites, as well as impact melts and metamorphosed breccias. Unexpectedly though, distinctly highlands samples are rare and generally small. The Apennine Front is in fact rather smooth, and only three meter-sized boulders were observed close enough to the planned traverses to sample. Two of these are post-Imbrium exotics. The average composition of the Apennine Front, as suggested by regolith chemistry mixing models and the compositions of impact glasses in the regolith, is a low-K KREEP basaltic composition ("Low-K Fra Mauro"). Several impact melt rocks have this general composition which has never been found as a pristine igneous rock type.

Another unexpected discovery was the common presence of volcanic KREEP (K, REE, P, and other incompatible-element-enriched) basalts, though only as small fragments. Only two are included among numbered rocks. They are ~3.85 b.y. old, an age indistinguishable from that of the Imbrium basin. The KREEP fragments are ubiquitous, but although pre-mare, are most common in regoliths from around the lunar module, on top of the mare flows.

The variety of Apollo 15 samples reflects the variety of terrains in the vicinity of the landing site, and the impressive stratigraphic section ranging from pre-Imbrian to Copernican.

References to detailed studies on the Apollo 15 samples are cited in the individual rock descriptions. The following list is a more general selected bibliography pertaining to the geological interpretation and rock samples of the Apollo 15 landing site:

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