

become progressively more concentrated. The radioactives at depth helped to keep this concentrated reservoir molten, and then were locked in when it finally solidified. The impact that created the Imbrium basin had excavated deep enough to scatter some of this material across the surface.

When Fra Mauro was assigned to Apollo 13, it was deemed to be ideal for an 'H'-mission, but it had turned out to be just barely manageable, not for the task of finding the landing site, which was not difficult, but for the surprisingly undulatory nature of the 'plain'. Although the landing site had been relocated closer to Cone for Apollo 14, the trek up the ridge and back involved a round trip of 10,000 ft. If Lovell and Haise had landed at the more distant site, it is unlikely they would have reached crest of the ridge. Although Shepard and Mitchell did reach the summit, the crater eluded them. Navigation was difficult, but the fundamental limitation was *time*. Another hour on Cone's rim would have fully justified the overhead of reaching it. The portable life-support system was rated for a total of 7 hr, but this included the pre-egress time and a 2-hr post-ingress margin for troubleshooting, and the mission rules obliged the crew to re-enter the LM rather than spend an hour or so sampling the landing site. In effect, therefore, the time at Cone's rim was constrained by the need to preserve the *margin*. Apollo 14 showed the 'H'-mission format to be severely limited. Certainly, it could not do justice to the multiple-objective sites that were being proposed for the remaining missions. It was clearly impractical to devote so much of the limited time to traveling to and from a sample site; what was really needed was a *vehicle* that would not only minimize the transit time, and hence maximize sampling time, but also enable more tools to be carried and more rocks to be collected, all of which would increase the overall productivity of a traverse. The visit to Fra Mauro had achieved its primary objective, but it was clear that foot-traverses were no way to explore the Moon.

MISSION OBJECTIVES

Launch Vehicle Objectives

1. To launch on a 72–96°E of N flight azimuth and insert the S-IVB/instrument unit/ spacecraft into the planned circular Earth parking orbit. *Achieved.*
2. To restart the S-IVB during either the second or third revolution and inject the S-IVB/ instrument unit/spacecraft into the planned translunar trajectory. *Achieved.*
3. To provide the required attitude control for the S-IVB/instrument unit/spacecraft during transposition, docking, and ejection. *Achieved.*
4. To perform an evasive maneuver after ejection of the command and service module/ lunar module from the S-IVB/instrument unit. *Achieved.*
5. To attempt to impact the S-IVB/instrument unit on the lunar surface within 189 nmi (350 km) of latitude 01°35'06''S, longitude 33°15'W. *Achieved.*
6. To determine actual impact point within 2.7 nmi (5.0 km) and time of impact within 1 sec. *Achieved.*
7. To vent and dump the remaining gases and propellants to safe the S-IVB/instrument unit after final launch vehicle/spacecraft separation. *Achieved.*