Rocks from Space

Lunar samples and meteorites are currently the only rocks from space that are available for scientific study and classroom examination. Lunar samples are rocks and soils collected from the Moon and returned by Apollo astronauts and unmanned Soviet Luna missions. Meteorites are rocks, mostly from asteroids, which arrived at Earth unaided by spacecraft and survived the fiery entry through the atmosphere.

NASA has a program to make lunar samples and meteorites available for classroom examination and study. Lucite disks containing six samples of different rocks or soils from the Moon or meteorites are available for pre-college classes. Sets containing 12 thin sections of either lunar samples or meteorites are available for college classes. All four sample sets include information/activity booklets and visual aids.

Lunar Samples

The Apollo and Luna missions visited both the dark mare and light highlands of the Moon. Samples were returned from 6 Apollo and 3 Luna sites. The US and USSR exchanged some samples so that both national collections include samples from all missions. Lunar samples reflect the geologic processes of differentiation, volcanism and impact. Lunar samples include rocks and soils from both mare and highland areas. The mare samples are mostly basalts and breccias and soils made from them. The highland samples are mostly breccias dominated by plutonic rocks (anorthosites, norites and troctolites), and by KREEP. The rocks and soils of each of the 9 sites were distinct from those of the others.

Meteorites

Meteorites are rocks collected by people all over the world and found to be from space. Antarctica has proven to be the best place in the world to find meteorites. In the last 20 years over 17,000 meteorite fragments have been collected there by Japanese, European and U.S. search teams. The U.S. program is a collaboration between NSF, NASA, and the Smithsonian Institution. The main types of meteorites are stony (chondrites and achondrites), stony-iron, and iron samples. Chondrites are the most common and stony-irons the least common. Most meteorites form by geologic processes (accretion, differentiation, volcanism, and impact) on asteroids, but a few were ejected by impacts from the Moon and Mars. Micrometeorites or cosmic dust may be samples of comets.

Future Sample Return Missions

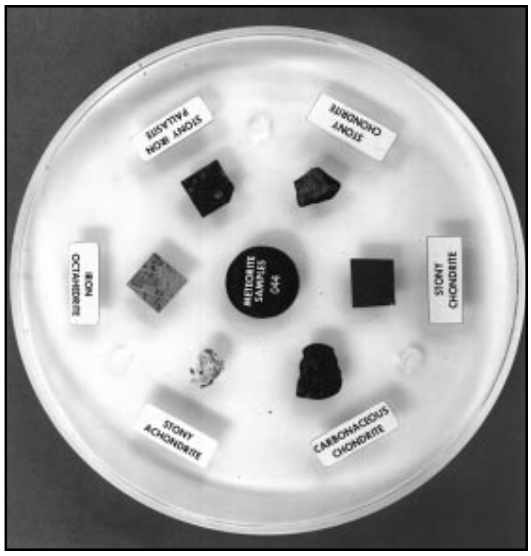
Several missions to return samples from other bodies in the solar system are in preparation or planning stages. The *Stardust* mission is an approved Discovery class mission to return samples collected from a comet. It is to be launched in 1999, encounter comet Wild-2 in 2004, and return samples to Earth in 2006. The *NEAR* mission was launched in 1996 and will encounter and map asteroid Eros in 1999. It will, however, not collect or return samples. Other missions

are being planned to return samples of an asteroid or solar wind particles.

Missions to collect and return samples from Mars have been discussed, planned and re-planned for years. It now seems likely that a Mars sample return mission will be the culmination of the current Surveyor missions sequence of robotic Mars exploration. The Surveyor program is approved to launch orbiters and robotic landers to Mars every 26 months through 2005. A Mars sample return is being planned for a 2003-2005 launch with return 2 years later. A major goal of the Mars sample return is to search for evidence of life on Mars.

Educational Sample Disks

The NASA educational sample disk program is available to schools, museums and planetariums throughout the country. The lunar sample disk program has been in operation for many years. Distribution of 200 disks has made it possible for millions of people to examine the precious Apollo lunar samples. A new meteorite sample disk program with 200 disks is just becoming available. The educational sample disks are lucite disks each containing six samples of either lunar rocks and soils or meteorites. The lunar sample disk includes three rocks and three soils. The meteorite sample disk contains three chondrites and an achondrite, a stony-iron and an iron meteorite. The samples can be examined with either a magnifying glass or a microscope.



The meteorite sample disk contains 6 meteorite chips.

The educational sample disks are accompanied by educational materials which include a teachers' guide and slide set. The teachers' guides [1,2] contain background information and hands-on activities. The slide sets include 36-48 slides with detailed captions. Both teachers' guides and slide sets are also available separately from educational disks.

The educational disk program is managed by the NASA Education Office through Teacher Resource Centers (TRC) at NASA installations around the country. A teacher must be certified to borrow the educational disks by staff of either a TRC or space mobiles that travel around the country. The certification is for both lunar and meteorite samples and is good indefinitely. The loan period is usually two weeks. Teachers should contact their nearest NASA center for information. Scientists may borrow sample disks from the Planetary Materials Office at the Johnson Space Center (JSC).

Educational Thin Sections

The NASA educational thin section sets are available to colleges around the country. The lunar and meteorite thin section sets consist of 12 samples in a padded case. The 20 lunar sets each include 3 basalts, an anorthosite, a norite, 3 breccias, and 4 soils. The 10 meteorite sets each include 5 chondrites, 4 achondrites, a stony-iron and 2 irons. The meteorite sets were prepared in collaboration with the Smithsonian Institution.

The thin section sets are accompanied by educational materials. These include a detailed booklet [3,4] with background information and petrographic descriptions and a video or slide set with captions. The lunar and meteorite educational thin section sets are available to colleges through the JSC Planetary Materials Office. Requests should be made on school letterhead to the curator. In order to borrow the lunar samples the professor will have to complete a lunar sample loan agreement detailing security matters. This is not necessary for the meteorite samples. The usual loan period is 2 weeks.

References

[1] Taylor, G.J. et al (1994) Exploring the Moon, NASA EP-306.
[2] Lindstrom M.M. et al (1997) Exploring Meteorite Mysteries NASA EG-104.
[3] Meyer C (1987) Lunar Petrographic Thin Section set, NASA JSC.
[4] MacPherson G. et al (1993) Antarctic Meteorite Teaching Collection, NASA JSC.

For more information write us at: Planetary Materials Office, Mail code SN2, NASA Johnson Space Center, Houston, TX 77058, or visit us on the Internet at: http://www-curator.jsc.nasa.gov/curator/curator.htm.