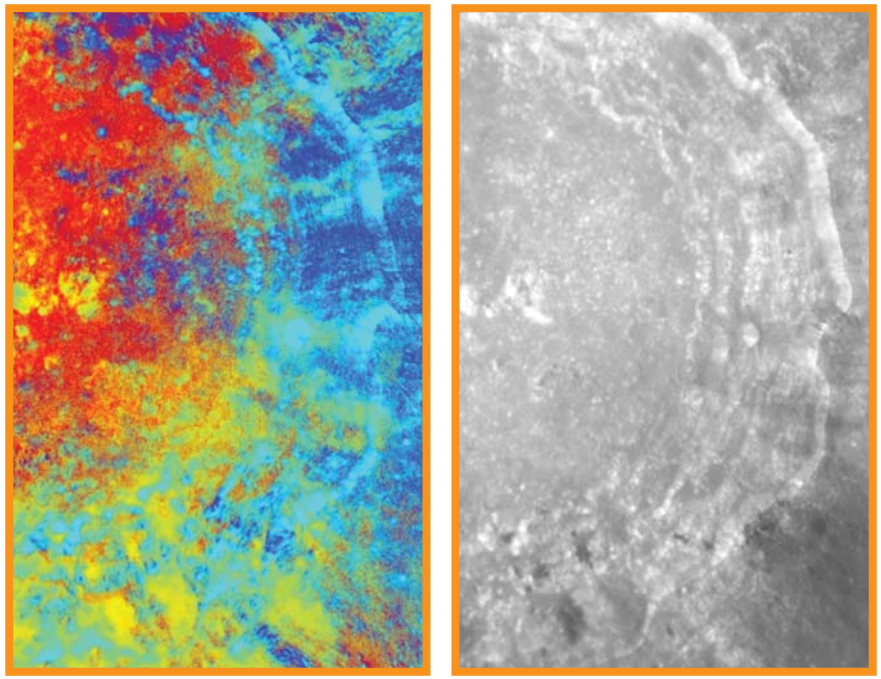
Spectrometers in Action Around the Moon

Often spectrometers are mounted on spacecraft orbiting a planet. The detectors collect data from the surface below. As the spacecraft passes above the surface, a swath of data is collected. With each spacecraft pass, more swaths of data are collected and eventually the entire surface is mapped. The Indian Space Research Organization's Chandrayaan-1 spacecraft and NASA's Lunar Reconnaissance Orbiter will maintain polar orbits around the Moon; they will stay fixed in their orbit from the north to the south pole and back again, as the Moon rotates under them. The orbiting spacecraft will gather data from the entire lunar surface once each 27.3 days when the Moon completes one turn on its axis. Scientists will analyze the spectral fingerprints collected from particular locations to determine the composition of the rocks, minerals, and elements at the surface.

The Moon Mineralogy Mapper (M^3) is a NASA instrument onboard the Chandrayaan-1 spacecraft. It will collect data from the visible to the near-infrared regions of the spectrum. Each of the 261 individual detectors will sample a unique 10-nanometer swath from 430 to 3000 nanometers, covering this entire portion of the spectrum. As the spacecraft passes over the Moon at an altitude of 62 miles (100 kilometers), 261 different measurements are taken for each point on the surface, allowing scientists to identify characteristics of features as small as 230 feet (70 meters) across. This is less than the length of a football field! While this may seem quite large, this resolution is higher than previous missions and will give scientists much more information about the Moon's surface materials than ever before.

The portion of the electromagnetic spectrum detected by a spectrometer is often from sunlight reflected from the surface, but some instruments emit (transmit) their own signal. The Mini-SAR, another NASA instrument onboard the Chandrayaan-1 spacecraft, will transmit radiowaves and detect the reflected radiowaves from permanently shadowed crater floors near the Moon's poles. These measurements will help determine if water ice is present in these locations.



Because different techniques are used to sense different wavelengths of the electromagnetic spectrum, any one spectrometer covers only a small part of the spectrum. Mini-SAR measures radiowaves. M^3 measures visible to near-infrared wavelengths. Another instrument onboard NASA's Lunar Reconnaissance Orbiter detects ultraviolet radiation from starlight reflected from permanently dark regions. Together, these instruments will allow scientists to identify where different rocks, minerals, and potential resources occur on the lunar surface.

Copernicus Crater as imaged by spectrometers onboard the Clementine spacecraft. The left side combines data collected through three different color filters. The resulting image represents different rock types and shows the geologic complexity of the crater. For example, the green-yellow areas have rocks with higher iron content. The right side shows the features in a single wavelength of 750 nanometers. Image processing by Brown University.