BACKGROUND INFORMATION ON THE INSTRUMENTS THAT WILL COLLECT THE DATA TO DETERMINE THE COMPOSITION OF EROS

The x-ray spectrometer and gamma-ray spectrometer (XRS-GRS) will identify, measure and map the abundance of various elements on the surface of Eros.

THE X-RAY SPECTROMETER

X-rays from the sun strike the sunlit part of Eros' surface. Elements absorb these x-rays, which are part of the electromagnetic spectrum, and emit or "spit back out" electromagnetic waves of their own. These emitted waves will have frequencies that are specific to that particular element. For example, aluminum will absorb x-rays from the sun (solar x-rays) then emit waves that have a particular frequency back out. When we detect or recognize this frequency we know that it is coming from the element aluminum. Magnesium will absorb the same x-rays that the aluminum did but it will spit back out a wave of a second particular frequency that tells us it's magnesium. If these frequencies were in the part of the electromagnetic spectrum that we could see with our eyes we might see aluminum giving off a blue light while magnesium gave off a green light. Unfortunately the frequencies emitted by the elements are not visible light spectra, therefore scientists have to have instruments that tell them the frequency of the emitted wave. By knowing the frequency given off we can identify the elements. We call this an element's characteristic spectra and it is much like the "fingerprint" of the element because we can use it to identify the element.

Given Eros' expected rock-metal composition, the major elements to be detected will probably be magnesium, aluminum, silicon, calcium, iron and possibly carbon, sulfur and titanium depending on the exact makeup of the asteroid.

THE GAMMA-RAY SPECTROMETER

Gamma-rays which characteristically have shorter wavelengths and higher frequencies have more penetrating power than x-rays. Gamma rays will be used to detect and measure elements 10 cm - 20 cm below Eros' surface. These gamma rays arise partly from natural radioactivity in the asteroid itself, just like there is natural radioactivity in rocks on Earth and partly from stimulation of specific elements by high energy cosmic rays. Cosmic rays are found naturally in space and are made up of protons (positively charged particles) traveling at very high speeds. They were called rays before we knew they were actually made up of protons and the name has held. They are not electromagnetic waves in the pure sense but actually streams of particles. They have a great deal of energy and they constantly bombard all bodies in space. For instance, cosmic radiation is constantly hitting the Earth as well as the asteroid Eros. Cosmic rays also hit the other planets in our solar system and anything else in space. So, the elements that make up Eros are getting hit with cosmic rays. These particles penetrate the surface of Eros further than x-rays. Elements below the surface absorb these cosmic ray particles and emit or spit back out gamma waves that are again characteristic of certain elements; their "fingerprints," if you will. (Gamma rays are electromagnetic waves. We just refer to them as rays much like we refer to the rays of the sun even though they are also electromagnetic waves.) In this way scientists will be able to tell if the composition of the asteroid is different at the surface or not. Gamma rays are simply electromagnetic waves that fall within a certain range of frequency. The gamma ray spectrometer will help us to identify elements like potassium, thorium, uranium, hydrogen, carbon, oxygen, silicon and iron.