

Simulation of the Evolution of Asteroids into Meteorites through Space Weathering

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Introduction

- There is a “missing link” in the evolution of asteroids into meteorites.
- Meteorites are asteroids ejected by collisions combined with orbital interaction with Jupiter and secondarily with Mars.
- Spectral reflectance measurements have been measured for numerous asteroids and meteorites representative of every known class.
- There are some meteorites for which there is no asteroid spectral type exists
- There are also spectral types of asteroids that no meteorites exist.
- The objective is to show that under “space weathering,” conditions are present that can cause asteroids to evolve into the meteorites that we find here on Earth.
- The Andromeda Chamber simulates the environmental conditions present on the asteroid.

Methods

The link between asteroids and meteorites could be the result of surface processes which result in increased iron on asteroids.

Spectral measurements are taken of a 1/4” layer of the mixture ranging in composition from 5 vol% iron up to 50 vol% iron in 5 vol% increments.

The Andromeda Chamber is evacuated.

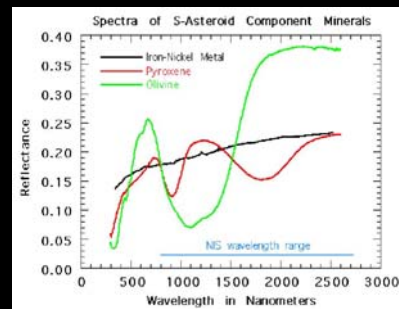
The sample is illuminated with a light source similar to the solar spectrum.

After the atmospheric conditions have been reached, a volatile (nitrogen gas or air) is pumped through the mixture.

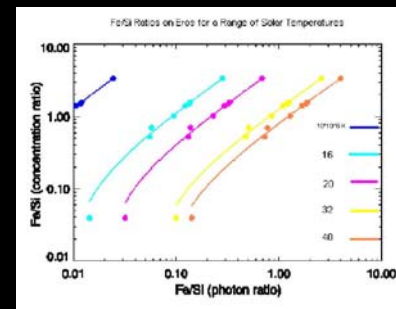
Measurements are taken using an Ocean Optics USB2000 Fiber Optic Spectrometer with a Cosine Corrected Collimating Lens.

Reflective Spectrometry

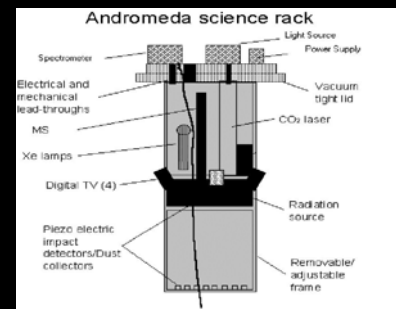
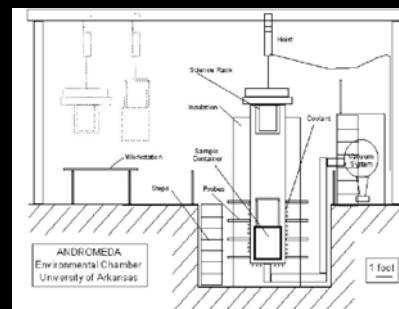
- A light source that imitates the radiation emitted from the sun is used to simulate the conditions present on the asteroid
- A lens attached to a fiber optic is placed above the iron/sand mixture.
- The light is reflected off of the mixture and the spectra is recorded.
- Data is taken from each of the ten compositions.



Note: The area of concern here is the 300-700 nm range



Note: Iron/Silicate ratio is dependent on temperature.



Predicted Results

- Based on previous results, there will be fluidization.
- The spectra obtained will help link the asteroid and meteorite data.
- The fluidization process that occurs will cause a separation of the metal and silicates.
- The metal will rise to the surface and influence the spectra.
- The separation will be the determining factor and will explain the “missing link” between asteroids and meteorites.

Conclusions

- The spectra is expected to match the predictions and, therefore, imply that space weathering does in fact cause the asteroid spectra and meteorite spectra to differ.
- Space weathering might explain the lack of an exact match between the two bodies.
- This data coincides with other findings and gives a more detailed picture of what is actually occurring on the asteroid surface.
- Further research involving a more detailed picture is needed.