Planetary Science Project Abstract

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Mercury surprised the scientific community with it's relatively low abundances of iron and titanium. These results are from the of MErcury Surface, Space ENvironment, GEochemistry,and Ranging (MESSENGER) mission's Gamma Ray Spectrometer (GRS). The paper considered here discusses data taken during the flybys in 2008 and 2009 (in hopes that the data may be publicly available).

Rhodes et al examine in their 2011 paper the GRS data that was taken at closest approach to the planet during the flybys. This data is particularly advantageous to investigate because the spacecraft passed significantly closer to the planet during the second flyby than normal mission operations (closest approach was ~200 km above the surface). The data presented in the Rhodes et al paper has a limited integration time (implying fewer photon counts) and therefore the constraints on the data are somewhat limited. They are able to give a 3σ confidence level (99% confidence) for silicon detection but only a 2σ confidence level (95%) most elements they were able to detect. This allowed them to derive upper bounds on the weight % abundances for iron, titanium and other elements. The unusually low abundances of iron and titanium allow scientists to constrain the type of formation processes that could have occurred on Mercury.

GRS observations yield information about specific abundances of elements; those elements are usually bound, in some form, into minerals on the surfaces of planets. This leads Rhodes et al to mid-infrared spectroscopy to help constrain the type of minerals in which these elements can be found. The discussion on page 1839 of their paper touches on diagnostic test to constrain the silicate, SiO_2, abundance on the surface of Mercury. This is more fully described in Boynton et al 2007. Rhodes et al also discuss on page 1841 models (cited in Sprague et al 2009) of laboratory spectral measurements combined with telescopic measurements that further constrain composition given the elemental abundances from GRS measurements.

The purpose of this project will be to understand the some or all of the infrared techniques cited in Rhodes et al to constrain the types of minerals the elements detected on the surface of Mercury.