



## **Analysis of 6.4 keV Mössbauer Spectra obtained with MIMOS II on MER on Cobbles at Meridiani Planum, Mars**

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The miniaturized Mössbauer (MB) spectrometers MIMOS II on board of the two Mars Exploration Rovers Spirit and Opportunity have obtained more than 600 spectra of more than 300 different rock and soil targets. Both instruments have simultaneously collected 6.4 keV X-ray and 14.4 keV  $\gamma$ -ray spectra in backscattering geometry. With Spirit's MB spectrometer, 6.4 keV and 14.4 keV spectra have been obtained for all targets through sol 461. After this date, only 14.4 keV spectra were collected. With Opportunity's spectrometer, 6.4 keV and 14.4 keV spectra have been collected for all targets to date. The Fe-mineralogy of rock and soil targets at both landing sites reported to date has been exclusively extracted from 14.4 keV spectra. The comparison of 6.4 keV and 14.4 keV spectra provides depth selective information about a sample. 6.4 keV and 14.4 keV spectra have been obtained on seven cobbles along Opportunity's traverse. Cobbles at Meridiani Planum appear to have a variety of different origins.

*BounceRock (Sols 66-70):* Spectra obtained on the abraded surface of BounceRock reveal two pyroxene phases in both the 6.4 keV and the 14.4 keV spectrum without any nanophase ferric oxide (npOx) present. Spectra obtained on the undisturbed surface reveal an enrichment of npOx in 6.4 keV spectra. Additionally, a magnetic phase is

present in the 6.4 keV spectrum obtained on the spot “Fips2” (sol 68). This points to the existence of a surface layer on BounceRock, in which npOx and the magnetic phase are enriched.

*Barberton (Sol 121), and SantaCatarina (Sol 1047)*: Barberton was classified as a stony meteorite. The 14.4 keV spectrum reveals a composition of 46% olivine, 35% pyroxene, 5% npOx, and 15% kamacite pointing to its meteoritic origin. In comparison, the 6.4 keV spectrum shows a slight depletion of kamacite (10%) along with an enhancement of olivine (48%) and npOx (7%). Barberton was too small to be brushed, so these differences probably result from soil contamination on its surface.

On SantaCatarina, spectra were obtained on the undisturbed, but relatively dust free surface. This brecciated cobble is chemically similar to Barberton with 52% olivine, 26% pyroxene and 14% npOx from the 14.4 keV spectrum. Instead of kamacite, troilite (7%) is present in this rock. The 6.4 keV spectrum shows a slight enhancement of olivine (57%) and a slight depletion of pyroxene (22%), similar to what has been observed in 6.4 keV spectra obtained on Adirondack-class rocks. These differences might result from the brecciated nature of SantaCatarina.

*HeatShieldRock (Sols 348-351)*: HeatShieldRock was classified as an iron meteorite. A coating, probably a remnant of a fusion crust, is visible in Pancam spectra. MB spectra obtained on the undisturbed as well as on the brushed surface show mostly Kamacite with very little npOx. The 6.4 keV spectrum obtained on the brushed spot shows less npOx (2%) than the corresponding 14.4 keV spectrum (4%). As the instrument’s field of view contained both coated and uncoated portions of the surface, this suggests that npOx does not stem from the coating, but rather from the rock itself.

*Arkansas (Sol 551) and Antistasi (Sol 641)*: The 14.4 keV spectrum obtained on Arkansas shows 3% olivine, 16% pyroxene, 41% npOx, 7% hematite and 34% of an additional Fe<sup>2+</sup> phase. The 6.4 keV spectrum shows a significant enhancement of npOx (56%) and depletion of the Fe<sup>2+</sup> phase (16%). The Fe<sup>2+</sup> phase is probably a primary phase in the rock which is altered to npOx at the surface. Antistasi is composed of 19% olivine, 54% pyroxene and 12% npOx according to the 14.4 keV spectrum. An additional Fe<sup>2+</sup> phase (12%) and a magnetic phase (3%) are also present. The 6.4 keV spectrum shows a slight enrichment of olivine (22%) and npOx (16%), and a depletion of the Fe<sup>2+</sup> phase (6%). Because the target was not brushed, either soil contamination or minor alteration may account for these differences.