

### MÖSSBAUER MINERALOGY OF SOILS AND ROCKS AT MERIDIANI PLANUM AND GUSEV CRATER ON MARS AND ITS IMPLICATIONS ON THE HISTORY OF WATER ON MARS

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**Introduction:** The Mars-Exploration-Rovers (MER) Spirit at the Gusev Crater landing site and Opportunity at the Meridiani Planum landing site are both carrying the Mössbauer spectrometer MIMOS II, which is part of the Athena instrument suite consisting of remote sensing instruments [1], and the In-Situ instruments mounted on a robotic arm (IDD): (i) Rock Abrasion Tool (RAT), (ii) Mössbauer (MB) spectrometer Mimos II [2], (iii) Microscopic Imager [1], and (iv) Alpha Particle X-ray Spectrometer (APXS) [3]. The IDD instruments are used to determine the chemistry and mineralogy of rocks and soils.

**MIMOS II Mössbauer results:** The MB results on rocks at the Gusev crater landing site show a primarily olivine-basalt composition. For some of the rocks a weathering rind has been detected using the RAT and subsequently APXS and MIMOS II. Magnetite has been identified in both soils and rocks at Gusev. All rock and soil spectra at Gusev are dominated by the mineral signature of olivine.

The Meridiani Planum landing site looks very different from Gusev crater. Opportunity landed inside a shallow crater (Eagle crater), with an outcrop covering part of the crater interior close to the rim. Mössbauer measurements show that this outcrop material consists predominantly of the Fe-sulfate jarosite, hematite, and a basaltic component (olivine, pyroxene). The same material was found again a couple of hundred meters away at the small crater Fram suggesting that the whole area is covered with this jarositic material. This strongly supports the presence of large amounts of water at this site in the past. The plains and a large portion of Eagle crater are covered by spherules with a diameter of several mm up to about 1 cm. Mössbauer data clearly show that the composition of these spherules (called 'Blueberries') is dominated by the Fe-oxide hematite. How these berries formed is still open. The composition of the soil at Meridiani is found to be basaltic, dominated by olivine similar to the Gusev site. An isolated rock close to Eagle crater (called Bounce rock) was determined by MB to be completely composed of Fe-2+ pyroxene. The data look very similar to some of the SNC meteorites. These results are supported by the APXS data [3,4].

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**Reference:** [1] Squyres S. W. et al. (2003), *J. Geophys. Res.*, 108(E12), 8062, doi:10.1029/2003JE002121. [2] Klingelhöfer et al. *J. Geophys. Res.*, 108(E12), 8067, doi: 10.1029/2003JE002138, 2003. [3] Rieder et al. *J. Geophys. Res.*, 108(E12), 8066, doi:10.1029/2003JE002150. [4,] Zipfel J. et al. (2004) this issue. [5,] Rodionov D. et al. (2004) this issue.