

Mineralogy on Mars at Gusev Crater and Meridiani Planum as seen by Iron Mössbauer Spectroscopy

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The Mars Exploration Rovers Spirit and Opportunity have explored the Martian surface at Gusev Crater and Meridiani Planum for more than two Earth years. More than 15 different minerals have been identified so far by the Mössbauer instruments on board the two rovers [1,2,3]. Mössbauer spectroscopy identified the secondary Fe³⁺-bearing minerals jarosite, hematite, and nanophase iron oxides in the sulfate-rich outcrop rocks at Meridiani Planum [2]. Pyroxene may be a remnant primary Fe²⁺-bearing mineral. No precursor material to the sulfate-rich outcrop has been identified to date, but it has been inferred to be basaltic in composition [4,5].

At Gusev Crater rocks are much more diverse, ranging from little altered basaltic material in the plains to pervasively altered basalt in the Columbia Hills [3,6]. Primary minerals include the Fe²⁺-bearing minerals olivine, pyroxene, and ilmenite, as well as the mixed-valence iron oxide magnetite. Secondary minerals include the Fe³⁺-bearing minerals hematite, goethite, nanophase iron oxides, and an unspecified iron sulfate phase. The relation between primary and secondary minerals varies over short spatial scales.

In particular the minerals jarosite and goethite found at Meridiani Planum and Gusev Crater, respectively, are clear mineralogical evidence for aqueous weathering processes active at both landing sites in the past.

New results will be reported. Recent results from Gusev Crater indicate the presence of hematite in greater abundance than in many targets at Meridiani. Possible explanations for weathering scenarios will be given.

References

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