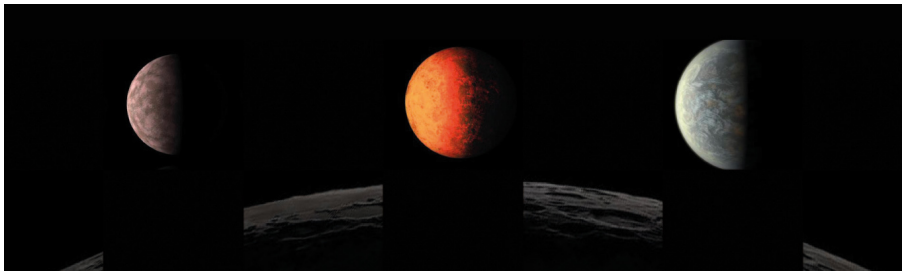

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Identification of ore minerals on Mars based on data from Opportunity rover and research on terrestrial analogues

Friday 24 October 2025 18:00 (1 hour)

In our study, we compare Martian concretions and some chosen terrestrial analogs. Data of Martian concretions were obtained by the MiniTES spectrometer on the Opportunity rover. Terrestrial analogues include spherules from the Dakota and Navajo formations (Utah, USA) and the Trovants from Romania. These analogs were examined using X-ray (Microprobe and EDS) and microscopic techniques to determine their mineralogical composition. One of the key findings was the presence of elements such as copper, as well as iron oxides and sulfides, in the terrestrial analogues, indicating a high degree of mineralization. Correspondingly, MiniTES data revealed spectral signatures consistent with ore-related minerals such as e.g. pyrite, ilmenite, hematite, and jarosite. These minerals are known indicators of metal ores, including copper, gold, and silver, i.e. elements important for future exploitation. Our results suggest that both the Martian environment and its Earth analogues may harbor conditions favorable for ore mineral formation. This has significant implications for the planning of future missions to Mars, particularly in the context of identifying potential sites for resource
extraction. The results suggest that at least some of the concretions in Meridiani Planum may have formed through low-temperature ore-related processes, analogous to those observed in terrestrial settings. This supports the hypothesis that ancient Martian environments may have hosted localized hydrothermal systems or prolonged groundwater circulation favorable to increase metal concentration. As such, these findings strengthen the case that the Martian subsurface could have supported formation of complex mineral structures and also geochemical processes conducive to the accumulation of potentially economically valuable resources.

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