Fe-concretions from Jaisalmer, India: possible analogue of Martian blueberries

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Hematite concretions, referred to as blueberries have been reported from the Meridiani Planum on Mars [1]. The genesis of these diagenetic structures is thought to indicate a history of prolonged sub–surface fluid activity on the planet. Terrestrial analogues of Martian concretions can help to understand the mechanism of formation of the Martian ones [2]. Here, we describe the petrography and major-trace element geochemistry of hematite concretions in sandstones from the Jaisalmer basin in western India as a probable Martian analogue. Based on morphology and internal structure, four concretion types are identified, namely rind, layered, solid and ovoid with axial capillary. Interiors of rind concretions are poorly cemented while the rind is strongly cemented with goethite and hematite. Layered concretions have a goethite cemented core surrounded by layers with variable hematite proportion. The ovoid concretions have an axial capillary filled with goethite and hematite cement. Polygonal shrinkage cracks can be seen in the axial capillary. The goethite is replaced by hematite along these shrinkage cracks. The outermost layer in both layered and ovoid concretions is cemented with goethite. Microtextures indicate that concretion formation was a multi stage process involving the replacement of the primary carbonate cement by ferruginous cement. The earliest cement to precipitate must have been hydrous ferric oxides (Feroxyhite) which later dehydrated to goethite. Dehydration of the geothite produced polygonal desiccation cracks along which it was replaced by hematite. Presence of barite along with iron oxide/hydroxide indicates acidic condition during the precipitation of the iron oxide. The Fe-oxide cement in different layers have variable trace element concentrations. The chondrite normalized rare earth element (REE) patterns of the cement shows enrichment in the light-REEs accompanied by negative Eu anomaly.

[1] **NASA Jet Propulsion Laboratory** (February–March 2004) Mars Exploration Rover Mission.
[2] **Chan et al.** (2004) *Nature* **429**, 731-734.