SEDIMENTOLOGY AND FACIES ANALYSIS OF THE JURASSIC SUMMERVILLE FORMATION, UTAH – A POTENTIAL ANALOG FOR MARTIAN MUDSTONES.  A. White and J. Schieber, Department of Geological Sciences, Indiana University, 1001 E 10th Street, Bloomington, IN, 47405, ancwhit@iu.edu and jschiebe@indiana.edu

Introduction:
Subtle features in mudstones can reveal a great deal about the sedimentological history of those sediments. Mudstones on Earth commonly have some degree of bioturbation that has destroyed portions of the primary sedimentary structures and influenced the chemistry of that system. These added complications makes using terrestrial mudstones as Mars analogs a more complicated process.

The Jurassic Summerville Formation of the Colorado Plateau was deposited in a hypersaline, marginal marine environment [1] that was likely only capable of supporting life in the form of microbes, algae and organisms of similar hardiness. The Summerville consists of a succession of thinly bedded, reddish-brown mudstones and siltstones that are in places interbedded with very fine to fine grained green-tan, often glauconitic, sandstones and evaporite beds. The abundance of calcium sulfate, lack of macro organisms, and the presence of sedimentary features that have already been observed in Mars rover investigations, make the Summerville a valuable Earth analog for the study of Martian mudstones.

Methodology: Two detailed stratigraphic columns from Summerville outcrops approximately 6 km apart were measured and described at centimeter to decimeter scale near Hanksville, Utah. One complete section measured 46 meters thick, while the other only exposed the uppermost 20 meters. Both sections were sampled approximately every 2 meters, with representative samples collected of all facies types. These samples were slabbed and polished to reveal subtle features and are also analyzed by powder XRD analysis and thin section and SEM petrography.

Observations: From a distance (Fig. 1) the two most ubiquitous sedimentary characteristics of the Summerville Formation are its reddish-brown, thin, parallel bedded mudstones and interbeds and intervals with nodular to bedded evaporites. In addition, there are interbeds of greenish sandstone that can be seen upon closer inspection. The Summerville can be broken down into a total of seven facies types, consisting of mudstone, siltstone and very fine sandstone. Overall, siltstones are the dominant lithology.

The Summerville contains several evaporite related facies and textures that have been observed in mudstones on Mars [2, 3]. These evaporitic facies include beds of nodular calcium sulfate and crystalline calcium sulfate. Other evaporitic features include large, isolated calcium sulfate nodules, calcium sulfate filled syneresis cracks, and satin spar veins.

These evaporite facies and structures, although seemingly laterally continuous at the outcrop scale, are laterally discontinuous over larger distances (km’s). The syneresis crack bearing facies are particularly variable between the two field sites. The South Hanksville field site has few horizons with syneresis cracks, whereas the West Hanksville site has much more frequent syneresis cracks throughout the section.

Discussion: The chemically harsh but low-energy physical environment of the Summerville may be comparable to Martian environments, even though there are fundamental differences to Earth in terms of

Fig. 1: Complete section of the Summerville Formation at the South Hanksville outcrop
physical boundary conditions. Summerville evaporites, particularly calcium sulfate filled syneresis and desiccation cracks, have potential to help us better understand Martian sedimentary processes. Though rare in the sedimentary rock record, syneresis cracks, subaqueous mudcracks formed due to a salinity induced collapse in clay structure [4], are well-preserved in the Summerville. Because comparable cracks have been observed in Martian mudstones [2, 3] and are abundant in the Summerville, the Summerville is an ideal laboratory to study the sedimentary context of syneresis and associated features and applying derived insights to Mars. Because syneresis depends on water chemistry, studying these features on Earth has the potential to find thresholds of water salinity that might be applicable to Mars.