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Fluvial sediments, concretions, evaporates at Hanksville, Utah: An analogue field study for Gale crater, Mars

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1. Introduction, Objectives

On 6th August 2012, Curiosity landed in Gale crater, Mars. Initial measurements and pictures showed sedimentary rocks that had been deposited by fluvial activity, e.g., alluvial fan and stream deposits. Such deposits are common in desert environments on Earth. The goal of the ILEWG EuroMoonMars project (February 23rd - March 9th, 2013) was to conduct field studies in order to identify and study environments that are analogous to those that Curiosity has studied and will study at Gale crater.

Several field campaigns (EuroGeoMars2009 and DOMMEX/ILEWG EuroMoonMars from November 2009 to March 2010) had been conducted at the Mars Desert Research Station (MDRS) [3] near Hanksville, Utah, in the vicinity of the San Rafael swell. The aim of the ILEWG EuroMoonMars 2013 project was to identify terrestrial analog sites for Curiosity exploration. The stratigraphy of the area consists of Jurassic and Cretaceous strata [5] of which the Summerville Formation, the Brushy Basin Member of the Morrison Formation, and the Dakota Sandstone were studied.

Widespread inverted channels on Mars have been identified through orbiter imagery data [6], e.g., at Gale crater. Concretions also appear to be common on Mars and have been found by the Opportunity rover at Meridiani Planum [4] and the Curiosity rover at Yellowknife Bay (Fig. 1).

2. Methods

We here present preliminary results of geological investigations that are focused on the sedimentology and diagenesis of well-preserved inverted channel beds (Stegosaurus Ridge, Kissing Kamel Ridge) (Fig. 2), a variety of differently-sized and -shaped concretions [1][2] (Figs. 3 through 4), and evaporites [1]. In order to identify geological sites that could potentially be analogous to those at Gale crater, we analyzed and compared satellite imagery data from both planets: For Earth, we used high-resolution optical images (50 cm/pixel), Landsat multispectral data (57m/pixel), and field photographs taken near the MDRS. For Mars, we used HRSC optical images (12m/pixel), HRSC DTM (50-200m/pixel) and HiRISE (25 cm/pixel) images displayed in ArcGIS 9.3.

Figure 1: Concretions and white-toned gypsum veins in fine-grained sediment at Yellowknife Bay, Mars. Source: http://www.jpl.nasa.gov/msl/

3. Preliminary Results

Based on field observations and mapping as well as hand sample and thin section analysis we are currently reconstructing the fluvial history of the deposits at the MDRS site. Furthermore, we aim to understand the diagenetic processes that led to the formation of the concretions. Analysis of spectral Landsat data initially indicated the presence of carbonates, which subsequently were also identified in the field. A better understanding of the geological processes occurring on Earth in arid environments

will assist the interpretation of the sedimentary rocks and geological features found at Gale crater on Mars.

Figure 2: Well preserved inverted channel near MDRS, named “Stegosaurus Ridge” by the authors.

Figure 3: Concretions in the Dakota Sandstone

Figure 4: Concretions in the Brushy Basin Member of the Morrison Formation within a cross-bedded sandstone.

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