

COMPOSITION OF TERRESTRIAL INVERTED CHANNEL DEPOSITS FROM THERMAL IR SPECTROSCOPY: IMPLICATIONS FOR MARTIAN EQUIVALENTS. E. B. Rampe¹, N. L. Lanza², C. Okubo³, and T. G. Sharp¹, ¹School of Earth and Space Exploration, Arizona State University, Box 871404, Tempe, AZ 85281, Liz.Rampe@asu.edu, ²Institute of Meteoritics, University of New Mexico, Albuquerque, NM; ³U.S. Geological Survey, Flagstaff, AZ.

Introduction: Orbital data from Mars have identified several locations with positive-relief fluvial deposits, including Holden and Eberswalde craters and Juventae Chasma [1-3]. On Earth, inverted channel deposits (ICDs) commonly form by cementation of fluvial sediments and subsequent erosion of the surrounding terrain [4]. Cements are generally silica- and/or carbonate-rich and reveal important information about the aqueous history of the deposits. Thermal infrared (TIR) and visible-near infrared (Vis-NIR) spectroscopy are primary methods for determining the composition of the Martian surface. Amorphous silica has been identified in many locations on Mars through Vis-NIR spectroscopy, including ICDs in Juventae Chasma [3], but carbonates are generally absent on the surface. In this study, we test the ability of IR spectroscopy to identify the composition of cements in fluvial deposits by examining TIR emission spectra and spectral models of terrestrial ICD samples from the Cretaceous Cedar Mountain Formation near Green River, Utah [5,6].

Experimental Methods: TIR emission spectra of natural surfaces and fresh interiors of conglomerate, quartzite, and coarse-grained sandstone samples were measured at the Mars Space Flight Facility at Arizona State University using a Nicolet Nexus 670 spectrometer configured to measure emitted energy [7,8]. Spectra were scanned 150 times over the course of ~3 minutes, from 200-2000 cm^{-1} with 2 cm^{-1} spectral resolution. We modeled the mineralogy by linear deconvolution [9] using a spectral library containing common silicates, carbonates, sulfates, and oxides.

Results: TIR spectra of natural surfaces and fresh interiors show strong absorptions from SiO_2 phases (Figure 1). Spectral models indicate surfaces and interiors are mostly composed of quartz and/or a cryptocrystalline SiO_2 phase, primarily chalcedony. TIR spectra of the interiors and downward-facing surfaces of some samples have minor absorptions from carbonates; however, the upward-facing surface spectra of the same samples lack carbonate absorptions (Figure 1).

Discussion: TIR spectra and spectral models of natural surfaces and interiors of ICDs compare favorably to compositions determined by SEM, reported in a companion abstract [10]. Our data show TIR emission spectroscopy detects silica- and carbonate-rich cements if they are exposed at the rock surface. However, carbonate cements are not exposed on upward-facing surfaces of our samples because: 1) SiO_2 cements coat

carbonate cements so that carbonates are not detectable; or 2) carbonate cements dissolve at rock surfaces.

Implications for Martian ICDs: This study suggests that TIR spectroscopy is an effective method for identifying silica-rich cements on Mars. However, if carbonate cements are present in Martian ICDs, they may not be exposed at the surface and would not be detected by TIR spectroscopy. This emphasizes the importance of ground truth investigations of these locations. Holden and Eberswalde craters are proposed landing sites for Mars Science Laboratory [11]. The instruments on board MSL could determine cement compositions, providing important information about past aqueous environments.

References: [1] Malin M. C. and Edgett K. S. (2003) *Science*, 302, 1931-1934. [2] Mangold N. et al. (2004) *Science*, 305, 78-81. [3] Milliken R. E. et al. (2008) *Geology*, 36(11), 847-850. [4] Maizels J. (1990) *Palaeogeog. Palaeocl.*, 76, 241-277. [5] Williams R. M. E. et al. (2007) *LPS XXXVIII*, Abstract 1821. [6] Garrison Jr. J. R. et al. (2007) *Cretaceous Res.*, 28, 461-494. [7] Christensen P. R. and Harrison S. T. (1993) *JGR*, 98, B11. [8] Ruff S. W. et al. (1997) *JGR*, 102, 14,899-14,913. [9] Ramsey M. S. and Christensen P. R. (1998) *JGR*, 103, 577-592. [10] Lanza N. L. et al. (2010), this volume. [11] Golombek M. et al. (2008) *LPS XXXIX*, Abstract 2181.

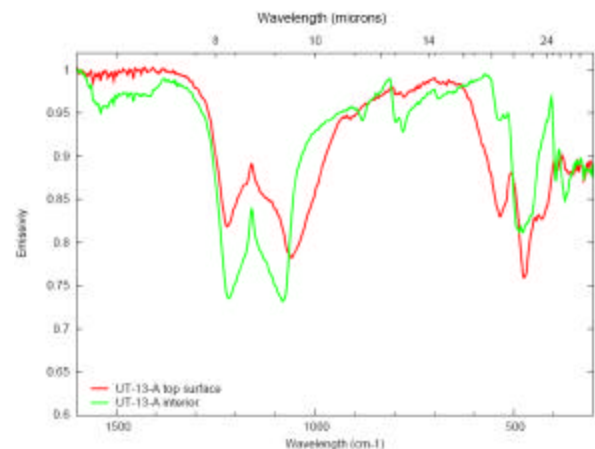


Figure 1. TIR spectra of a top surface (red spectrum) and interior (green spectrum). Doublets at ~1300-1000 cm^{-1} are from SiO_2 phases and the absorption at ~1600-1400 cm^{-1} in the interior spectrum is from carbonate.