GPR Surveys of the Jurassic Navajo Sandstone: a Potential Analogue to the Burns Formation, Meridiani Planum, Mars

Charlie Bristow[1], Harry Jol[2]

[1] School of Earth Sciences, Birkbeck College, University of London, Malet Street, London WC1E 7HX email c.bristow@ucl.ac.uk

[2] Department of Geography and Anthropology, University of Wisconsin Eau-Claire, 105 Garfield Avenue, Eau Claire, WI 54702-4004, USA.

The Burns Formation of the Meridiani Planum, Mars, is interpreted as an aeolian sandstone (1), and images from the Mars Exploration Rover 'Opportunity' show exposures of cross-stratified aeolian sandstones of the Burns Formation exposed within the walls of the Victoria Crater. In this paper we show the results of GPR surveys across a terrestrial analogue for the Burns Formation, the Jurassic, Navajo Sandstone. The Navajo Sandstone has already been suggested as a possible terrestrial analog for heamatite bearing sandstones on Mars (2). At outcrop in Zion Canyon, Utah, the Navajo Sandstone forms spectacular outcrops of cross-stratified aeolian sandstones separated by beds of wet interdune sands. We used ground penetrating radar (GPR) with a range of antennas with central frequencies of 12.5, 25, 50,100, 200, 225, 450 and 900 MHz to successfully image the sedimentary structures and shallow stratigraphy within the sandstone. The results of the GPR surveys are very good, with good depths of penetration and high resolution. The longer wavelengths of the low frequency antennas (12.5 - 25 MHz) achieved depths of penetration to around 40m, while the higher frequency antennas resolve beds of cross-stratified sandstones, and the cross-strata (Figures 1 and 2).

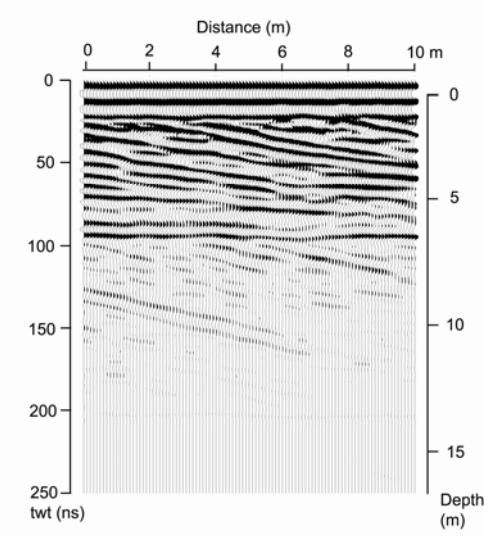

Figure 1. 200 MHz GPR profile showing first 10m of section images cross strata to 10 m

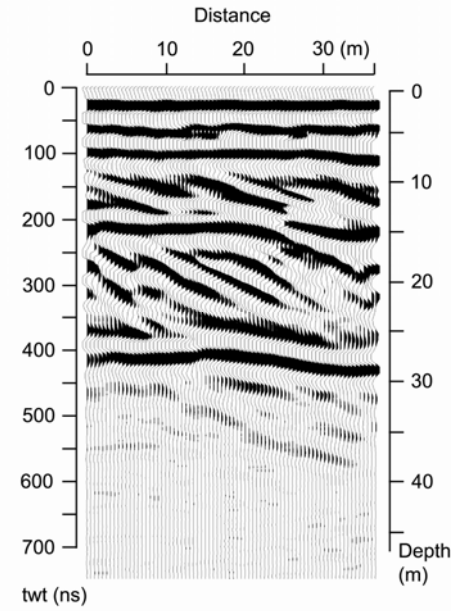

Figure 2. 25 MHz GPR profile shows strata resolved to a depth of around 40m but the shallow subsurface is obscured by the ground wave and air wave and the first two sets of cross-strata imaged in the 200 MHz profile are not resolved.

The results of the GPR surveys of the Navajo Sandstone illustrate the potential for GPR on future Mars rover missions to image the subsurface stratigraphy on Mars. On Mars where there is little or no liquid water in the shallow subsurface the depths of penetration might be greater permitting improved imaging of the shallow subsurface stratigraphy with GPR. Our results suggest that GPR mounted on a Mars rover should be able to image sedimentary structures within the Burns Formation and could be used to constrain the subsurface stratigraphy.

(1) Grotzinger, J.P., Arvison, R.E., Bell, J.F. III, Calvin, W., Clark, B.C., Fike, D.A., Golombek, M., Greely, R., Haldemann, A., Herkenhoff, K.E., Jolliff, B.L., Knoll, A.H., Malin, M., McLennan, S.M., Parker, T., Soderblom, L., Sohl-Dickstein, J.N., Squyres, S.W., Tosca, N.J., and Watters, W.A., 2005, Stratigraphy and sedimentology of a dry to wet eolian depositional system, Burns formation, Meridiani Planum, Mars. Earth and Planetary Science Letters 240, p.11-72.

(2) Chan, M.A., Beitler, B., Parry, W.T., Ormo, J., and Komatsu, G., 2004, A possible terrestrial analogue for haematite concretions on Mars. Nature, 429, p.731-734.