GeoConvention 2015
GEOSCIENCE
new horizons
Telus Convention Centre • 4-8 May 2015 • Calgary, AB Canada

Using hyperspectral imaging to enhance the detection of bioturbation in Athabasca oil sands hand samples in weathered and fresh surfaces

Paulina Hauf, Michelle Speta, Benoit Rivard, Murray Gingras
University of Alberta, Department of Earth and Atmospheric Sciences

Summary

Bioturbation is the disruption of primary sedimentary fabric by living organisms. Characterizing the degree of bioturbation in sediments is of value for the interpretation of depositional environment, facies classification and assessing resource quality. However this task can be difficult in dark, fine-grained sediments such as oil sands. Previous studies have investigated techniques such as digital photo enhancement and x-ray radiography to improve the visibility of ichnofabrics (e.g. Magwood & Ekdale, 1994; Löwemark, 2003). In this study we explore the use of hyperspectral imaging, a remote sensing technique, to enhance the detection of the extent of bioturbation in Athabasca oil sands samples.

Four hand samples with varying degrees of bioturbation and bitumen content were selected from the McMurray Formation. Shortwave infrared reflected light imagery was acquired (1.0-2.5 µm, 256 bands) for both weathered and fresh surfaces of each sample. The spatial resolution of the imagery was captured at both 1.0 and 0.25 mm per pixel. The degree of bioturbation in the samples ranged from 1-5 as per the scheme outlined by Droser & Bottjer (1986). Spectral images were analysed to determine spectral band combinations which proved optimal in enhancing the appearance of bioturbation in fresh vs. weathered surfaces. As part of the results we present examples of successful enhancements of ichnofabric at the scale of a few millimeters and discuss the capabilities and limitations offered by spectral imaging. These techniques should be useful in the spectral analysis of bioturbation in oil sands drill core and mine and outcrop sites.

Acknowledgements

The authors would like to thank Jilu Feng and Philip Lypaczweski for their contribution to the collection and pre-processing of the data.

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