

REMOTE SENSING STUDY OF THE SLATE ISLANDS IMPACT STRUCTURE, CANADA. A. M. Nuhn, G. R. Osinski, and L. L. Tornabene. Centre for Planetary Science and Exploration, Western University, London, ON, N6A 5B7 Canada (anuhn4@uwo.ca).

Introduction: A Geographic Information System (GIS) is a powerful tool that integrates hardware, software, and data for displaying, analyzing, and managing many types of geographically referenced information. Construction of a geodatabase allows us to view, interpret, question, and visualize impact related data in many ways that reveal trends, relationships, and patterns in the form of maps. A Slate Islands geodatabase to aid future field studies relies heavily on obtaining as much data as possible. Here we present the included components and construction of the Slate Islands geodatabase and preliminary results from the co-analysis of these datasets. Discussions regarding limitations as it relates to field studies and potential martian and lunar analogue studies and future work are also included herein.

Background: The Slate Islands are a 7 km-wide archipelago consisting of two main islands (Patterson and Mortimer), five minor islands and numerous islets (Fig. 1). The islands are the eroded remains of a confirmed (via bathymetric data) 30-32km [1,2] medium-sized complex impact crater central uplift. These islands are located in northern Lake Superior (48°39'30"N and 87°00'00"W) approximately 10 km southeast of Terrace Bay [1,3].

The Slate Islands archipelago is dominantly composed of Archean and Proterozoic supracrustal rocks [4]. The most dominant are the Archean (~2.7 Ga) Wawa Subprovince metamorphosed volcanic rocks. Also present (in minimal locations) are Proterozoic (1.8 to 1.9 Ga) Animikie Group sedimentary rocks, argillite and chert-carbonate-hematite ironstone of the Gunfint Formation and siltstone, possibly of the Rove Formation [4], as well as, 1.1 Ga Osler Group basalts, diabase dikes, quartz sandstone, and siltstone rocks. Archean gabbros and quartz-feldspar porphyries intrude the supracrustal rocks [4]. All the rocks of the archipelago are more or less brecciated. Estimates suggest that breccias constitute 15 to 25% of the rocks underlying the islands [5].

The presence of clastic-matrix and allochthonous breccias in dykes (i.e., pseudotachylites, polymict breccias, impact melt-bearing breccias or suevites) [1,4,6], shatter cones, and microscopic shock deformation features (PDFs in quartz and feldspar) [1,4] indicate impact origin of the islands.



Figure 1: The Slate Islands central uplift (60cm aerial imagery- Bing Maps).

Data and Methods: The suite of data included in this geodatabase are: visible and near-infrared images, elevation data (including higher level data products) and thematic maps,

Basemap: Basemap imagery was obtained via ESRI ArcGIS 10 online Bing Maps add-in. This service uses a synchronous processes that allows the browser to preload tiled map images that increase in resolution while zooming in. The highest resolution for this area includes ~30 cm/pixel aerial image from ArcGIS online. Data products including a false-colour image and vegetation cover were derived from the basemap. These are useful in displaying the dense vegetation cover on the islands.

Elevation Data: A Digital Elevation Model (DEM) from the Ontario Provincial Tiled Dataset with a ~20 m spatial resolution was obtained for the study area. Various elevation derived data products were created, including: slope, aspect, contour, shaded relief, hillshade, and slope shade. Hill shade and slope shade maps are particularly for use from a visual standpoint because they can give maps a topographic perspective when an image is overlaid on top with a reduced transparency. These are excellent for viewing terrain as well as structural features associated with the impact. Bathymetric data was also obtained and used to derive contour lines and a Triangulated Irregular Network (TIN) network.

Thematic Maps: The Thematic maps included in our database include: 1) geologic and lithologic maps, 2) structural features (faults, concentric coast trends), and 3) macroscopic and microscopic shock metamorphic features (shatter cones, impact breccias, shock

features), and 4) hypothesized crater centers (based on the highest shock level). The thematic maps vary in resolution and detail. To date none of these maps have been made into digitally manipulatable data. ESRI ArcGIS software was utilized for compilation of these maps into a geodatabase. Thematic maps were imaged ("screen-shot" - turns them into .png files), brought into ArcMap and then manually georeferenced to the basemap. Once they were georeferenced they were manually digitized into point, line, and polygon data (ESRI .shp file). The GCS_North_American_1983 coordinate system was selected for all of the digitized maps. Any supplementary information attached to these maps was then added into the designated attribute tables. To date, a total of 11 maps have been manually georeferenced and digitized into this database.

Discussion: The primary goal of this project was to construct a geodatabase to aid future impact crater field and Martian analogue studies. Due to dense vegetation cover, bedrock exposures are limited via satellite imagery. However, in areas of high slope (shorelines) there are excellent outcrop exposures. As can be seen in several of the thematic maps included herein, much of the impact related data has been collected from the so well exposed shorelines of the slate islands [2]. As such, our slope map maybe utilized to find new outcrops that have not been explored in the field (Fig. 2).



Figure 2: DEM derived Slope Map with a zoom in of the slope map overlaid onto high-resolution aerial imagery.

None of the thematic maps provided longitude or latitude data. Therefore point data is only an approximation and thus requires further ground-truth collection of Global Positioning System (GPS) waypoints. Adding point data with an attached spatial coordinate system is beneficial regarding geospatial analysis, and visualization data and will be groundtruthed in a field season at the structure this coming summer.

Martian Analogue Site: The Slate Islands are said to contain megabreccia bedrock morphologies due to breccias making up ~15 to 25% of the rocks that constitute the islands [7]. We propose that this ~30-32km mainly volcanic-target impact structure makes an excellent terrestrial analogue to Martian central uplifts and will be studied in further detail in the field (Fig. 3).

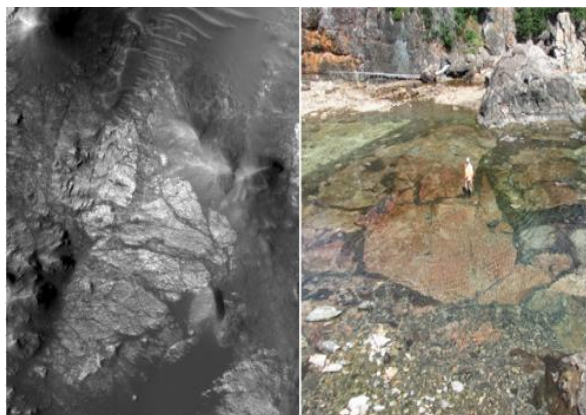


Figure 3: Left image is a ~31km diameter Megabreccia Martian central uplift [ESP_011523_1695]. Right image is Mark Smyk at the mega breccia [Image courtesy: Emily Smyk (<http://www.lakesuperiorgeology.org/SlateIslands/SlateIslands07.html>)]

Future Work: Future work on this database involves obtaining spectral data of the islands so that a mineral and vegetation analysis can be conducted via remotely (pre-field). Collection of more impact related data to add into the geodatabase will continue, and field work at the field site is planned for summer of 2013.

References: [1] Halls H. C. and Grieve R. A. (1976). *Can J Earth Sci*, 13, 1301-1309. [2] Dressler B. O. et al. (1995) *OGS, Misc. Pub.*, 164, 53-61. [3] Grieve R. A. and Robertson P. B. (1976). *Contrib Mineral Petrol*, 58, 37-49. [4] Sage R. P. (1991). *Ont. Geol. Survey Report*, 264, 1-111. [5] Dressler B. O. and Sharpton V. L. (1997) *Tectonophysics*, 275, 285-311. [6] Sharpton L. and Dressler B. O. (1996) *LPSC XXVII*, Abstract #1177. [7] Dressler B. O. et al. (1998) *Contrib. Min. and Petrol.*, 130, 275-287.