EARTH OBSERVATION SYMPOSIUM (B1)
Interactive Presentations (IP)

Author: Ms. Elise Harrington
University of Western Ontario (UWO), Canada, eharrin5@uwo.ca

POLARIMETRIC SYNTHETIC APERTURE RADAR FOR REMOTELY MAPPING SALT DIAPIRS

Abstract

Remote Earth observation is becoming increasingly important in economic geology. Traditional geological field mapping techniques are time consuming, costly, and are frequently seasonally restricted. Therefore, there is a need to improve remote mapping methods using available satellite data. Synthetic Aperture Radar (SAR) is an underused tool in remote geological mapping. Here, we introduce quad-polarimetric SAR as a tool for mapping salt diapirs in remote regions.

Salt diapirs are economically valuable, as they commonly provide traps for petroleum reservoirs and lead-zinc ore deposits. Differentiating diapirs and remobilized salt sediments is essential to pinpointing where resources may be located. This study maps and characterizes the radar signatures of diapirs and remobilized salt deposits on Axel Heiberg Island, Canada, which hosts the second highest concentration of diapirs in the world. Because evaporites have lower hardness and increased solubility than other sedimentary rocks, diapirs erode readily and have rough surface expressions. In contrast, eroded and remobilized salt sediments are found on smoother surfaces such as the bottoms of river valleys. SAR is sensitive to surface roughness at the scale of its wavelength, and can be used to differentiate between smooth and rough surfaces. By combining SAR with orbital spectroscopic data, it is possible to locate salt signatures and determine if they are diapiric in origin based on their observed roughness.

Six new RADARSAT-2 C-Band (5.5 cm) and nine pre-existing PALSAR-1 L-Band (23.6 cm) fully polarimetric images have been acquired over Axel Heiberg Island. These images have been processed and terrain corrected to produce circular polarization ratio (CPR) mosaics. Anhydrite salt-rich regions have been initially identified via spectroscopic signatures using composite imagery from ASTER Thermal Infrared (TIR) data. Mapped TIR signatures are overlaid on CPR images in ArcGIS to contrast CPR values for diapiric and deposited anhydrite exposures. By using two different radar wavelengths, we can constrain the surface roughness of the salts at different scales. Salt diapirs appear moderately rough in both C- and L-Bands, suggesting that they remain rough over a variety of scales. In contrast, the remobilized deposits appear consistently smooth in C-Band, while some deposits appear rough in L-Band. This is possibly a result of variations in rock sizes found in the river beds.

Future work will compare the effects of salt mineralogy on surface roughness as seen in radar by comparing RADARSAT-2 coverage of halite diapirs in Iran with the anhydrite diapirs on Axel Heiberg Island.