Ph.D. RESEARCH SEMINAR

DEPARTMENT OF EARTH SCIENCES

DALHOUSIE UNIVERSITY

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Department of Earth Sciences
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"Fluvial Paleogeomorphology and Reservoir Characterization from Outcrop and Subsurface Data"

Thursday, April 18, 2019

11:30 a.m.

Milligan Room, 8th Floor Biology-Earth Sciences Wing,
Life Sciences Centre, Dalhousie University

COFFEE AND DOUGHNUTS WILL BE AVAILABLE IN THE MILLIGAN ROOM BEFORE THE SEMINAR

Fluvial Paleogeomorphology and Reservoir Characterization from Outcrop and Subsurface Data

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Abstract

Reservoirs are a key component of any successful petroleum system. Reservoir compartmentalization from the presence of baffles and barriers segregates the petroleum reservoir into individual fluid/pressure compartments, ultimately affecting the connectivity and subsequent fluid flow of the petroleum reservoir. Siliciclastic reservoir exploration, development, and exploitation are inherently complex with recovery depending largely on the understanding of sand body architecture and interlayered baffles and barriers. My Ph.D. research is an integrated study of fluvial paleogeomorphology and reservoir characterization using both outcrop (Joggins Formation) and subsurface (Logan Canyon Formation) analogies.

At Joggins, a study was completed on the sand bodies deposited in a fluvial meanderbelt system, using the combined data from a lidar survey, a portable spectrometer and an air permeameter, as well as total porosity measurements from thin sections to characterize the sand bodies (potential reservoirs) in terms of heterogeneity. A ground-penetrating radar (GPR) survey was completed to study reservoir heterogeneity through small (e.g. bedform baffles and barriers) and large (e.g. channel bodies) scale architectural elements, as well as obtaining a three-dimensional sense of these features and extending them beyond the two-dimensional cliff face. Initial processing suggests clay-rich soil and till has caused signal attenuation, although subtle hints of the geology may be present.

The Logan Canyon Formation has been a drilling target for hydrocarbons in the Sable Subbasin, offshore Nova Scotia. Depositional environments were interpreted using core and well logs. Modern chemostratigraphic analysis determined variations in elemental concentrations within seal- and reservoir-quality rocks. These results were integrated with a compositional classification system, allowing for the classification beyond lithology type (e.g., sandstone, shale, etc.). The use of high-resolution X-ray fluorescence measurements defined five abundant (Fe-sand, Fe-shale, litharenite, shale, and wacke) and three rare (sublitharenite, subarkose, and arkose) lithofacies. Handheld air permeameter measurements demonstrated lateral and vertical permeability trends. Borehole history reports contained laboratory measured permeability and porosity values, which also revealed variable reservoir quality with baffles and barriers producing heterogeneity over short intervals. Future work includes the application of the one-dimensional stochastic inversion (ODiSI) of the Sable Megamerge 3D seismic dataset to jointly estimate reservoir properties and facies. The inversion will also be used for the qualitative and quantitative assessment of fluvial channel bodies.

The potential significance of the outcrop study includes refining the existing knowledge of reservoir heterogeneity within the Joggins Formation, which could have implications for carbon sequestration. The potential significance of the subsurface study includes defining new or refining old knowledge of reservoir heterogeneity within the Sable Subbasin, increasing petroleum system knowledge, constructing a database of the geometries and dimensions of the fluvial channel bodies, which could be useful for reservoir modelling within the basin or other analogous basins, and help to reduce associated exploration risks.