M.Sc. THESIS DEFENCE

by

Taylor Jane Campbell

DEPARTMENT OF EARTH SCIENCES
DALHOUSIE UNIVERSITY

"SEISMIC STRATIGRAPHY AND ARCHITECTURE OF THE JURASSIC ABENAKI MARGIN, AT COHASSET-MIGRANT, AND POTENTIAL FOR DISTAL ORGANIC-RICH FACIES"

PLACE: *The Milligan Room, 8th Floor Biology Wing, LSC, Dalhousie University*

DATE: *Friday, April 20, 2018*

TIME: *10:00 a.m.*

EXAMINING COMMITTEE:

Dr. Laurence Davis	*Husky Energy, Atlantic Region*	*External Examiner*
Dr. Mladen Nedimovic	*Dalhousie University*	*Reader*
Mr. David Brown	*Canada-N.S. Offshore Petroleum Board*	*Reader*
Dr. Grant Wach	*Dalhousie University*	*Supervisor*
Dr. John Gosse	*Dalhousie University*	*Chair*

PLEASE NOTE: *A copy of the thesis is available in the main Earth Sciences Office*

ABSTRACT

This study uses well data, extensive 3D seismic data and geologic analogs to test and extend stratigraphic concepts and models in a mixed clastic-carbonate depositional setting: the Middle Jurassic to Early Cretaceous of the Sable Sub-basin, offshore Nova Scotia. The study focuses on basinward mapping of third-order depositional sequences identified in the Abenaki carbonate bank at Deep Panuke Field and addresses: source rock potential in coeval basinal calcareous mudstones; changes in bank margin morphology related to underlying basement; the transition from a dominantly carbonate system at the shelf margin to a fluvio-deltaic system, the Sable Delta, that extends to the Late Cretaceous; the presence of thick fluvio-deltaic sediments adjacent to basinal mudstones outboard of the carbonate bank.

These depositional systems are uniquely imaged by 3D seismic data in the area around the Cohasset L-97 and Migrant N-20 well penetrations. Core studies of wells which penetrated the Abenaki carbonate bank and field studies in the Lusitanian Basin, onshore Portugal, provide calibration and analogs to shallow water carbonates in the Cohasset area. Further ancient and modern analogs are discussed in Morocco and at the termination of the Great Barrier Reef in the Gulf of Papua.

Geological, petrophysical and geophysical interpretation methods are used to interpret the depositional cycles and stratigraphic framework of limestones and calcareous shales that were deposited in increasingly deeper water outboard of the Abenaki margin. This framework formed the basis for a 3D geocellular model that was populated with lithologies from well data via a seismic inversion. This model was interpreted in terms of environments of deposition and source rock potential.

The third-order sequence stratigraphic framework was modified from a framework established at Deep Panuke gas field where commercial production began in August 2013. This third-order chrono-stratigraphic framework (“Abenaki 1-7 surfaces”) incorporates multiple litho-stratigraphically defined formations: the Mohican, Mohawk, Mic Mac, Abenaki, Missisauga and Verrill Canyon formations. Thick fluvio-deltaic successions adjacent to basinal mudstones in the Migrant N-20 well are interpreted to be structurally controlled, deposited in local depocentres, that formed in response to sediment loading, listric faulting and mobile salt substrate.

Results from the study show that condensed sections of the distal carbonate depositional system in Abenaki 1-4 sequences have potential to host organic-rich material. The basinal shales of these sequences are estimated to have been deposited in up to approximately 200 m water depths and have type 2 source rock potential. A change in seismic signatures and facies occurs between Abenaki sequences 1-4 and Abenaki sequences 5-7 reflecting encroachment of the Sable Delta, and it is interpreted that the Abenaki 5-7 sequences have predominantly type 3 source potential, with some potential for a type 2 source in intervening calcareous mudstones.