Ph.D. Candidate

Fadel Bahr

Graduate Academic Unit

Earth Sciences

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June 30, 2021

1:00 p.m. (Atlantic)

Virtual Defence

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Examining Board:
Dr. John Spray (Earth Sciences)
Dr. Bruce Broster (Earth Sciences)
Dr. Ben Newling (Physics)
Dr. David Keighley (Earth Sciences) Supervisor

External Examiner: Dr. John Waldron
Dept. of Earth & Atmospheric Sciences
University of Alberta

The Oral Examination will be chaired by:
Dr. Kevin Englehart, Associate Dean of Graduate Studies

BIOGRAPHY

Universities attended (with dates & degrees obtained):

2015 – present	Ph.D. candidate, University of New Brunswick
2007	MSc in Geology, Libyan Academy
1995	BSc in Geology, Tripoli University

Publications:

Bahr, F., and Keighley, D., Stratigraphy and sedimentology of the Pennsylvanian Grande Anse Formation, Cumberland Basin, eastern Canada: its relationship to salt tectonics and co-eval strata of the Joggins World Heritage Site. Canadian Journal of Earth Sciences. (In Press)

Bahr, F., and Keighley, D., Chemostratigraphy of Cumberland Group (Pennsylvanian) strata influenced by salt tectonics, Joggins Fossil Cliffs UNESCO World Heritage Site, eastern Canada. Submitted to Journal of Sedimentary Research. (Accepted with minor revisions)

Conference Presentations:

Bahr, F., and Keighley, D., Comparative chemostratigraphy of halokinetically influenced Cumberland Group (Pennsylvanian) strata, Joggins area, eastern Canada. Atlantic Geoscience Society Colloquium, Truro, Canada, February 2020 – talk

Bahr, F., and Keighley, D., Carbonate cement within strata of the Pennsylvanian Grand Anse Formation, southeast New Brunswick. Atlantic Geoscience Society Colloquium, Fredericton, Canada, February 2019 – Poster

Bahr, F., and Keighley, D., Lithofacies analysis and diagenesis of strata in a salt-withdrawal mini-basin: Bashkirian Grand Anse Formation, Maringouin Peninsula, southeast New Brunswick, and Minudie Point, Nova Scotia. Atlantic Geoscience Society Colloquium, Truro, Canada, February 2018 – Talk

Bahr, F., and Keighley, D., Diagenetic history of the Bashkirian Grand Anse Formation, Maringouin Peninsula, southeast New Brunswick. N.B. Department of Energy and Resource Development: Exploration, Mining and Petroleum, New Brunswick 2017, Fredericton, Canada, November 2017 - Poster

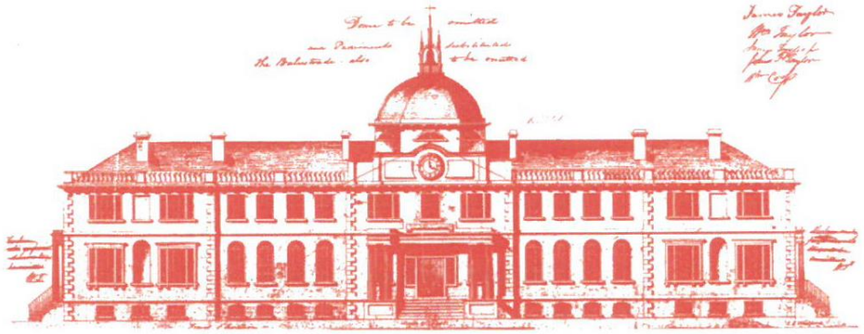
Bahr, F., and Keighley, D., Diagenetic history of the Bashkirian Grand Anse Formation, Maringouin Peninsula, southeast New Brunswick. Atlantic Geoscience Society Colloquium, Fredericton, Canada, February 2017 – Poster

Bahr, F., and Keighley, D., Diagenetic history of the Bashkirian Grand Anse Formation, Maringouin Peninsula, southeast New Brunswick. Atlantic Geoscience Society Colloquium, Fredericton, Canada, February 2017 - poster

Sedimentology and chemostratigraphy of the Grande Anse Formation, Cumberland Basin, eastern Canada: its relationship to salt tectonics and strata of the Joggins World Heritage Site

Abstract

The Pennsylvanian stratigraphy of the western Cumberland Basin has been influenced by salt tectonics, specifically the formation of the Minudie Anticline, a salt wall. South of the Minudie Anticline, in the Athol Syncline, the strata exposed along the Joggins UNESCO World Heritage shoreline have been extensively studied. Here, the post-Boss Point Formation succession of strata are assigned to the Little River, Joggins, Springhill Mines, and Ragged Reef formations. In contrast, north of the Minudie Anticline, the little studied Grande Anse Formation lies in angular unconformity on the Boss Point and basal Little River formations. Investigation of the Grande Anse Formation sedimentology indicates four lithofacies associations: floodplain, braided channel, sheet flood, and debris flow deposits. A comparative lithostratigraphic study suggests two possible depositional models. One model has the Black Point sub-basin with its own hydrological system, completely separated from the Athol Syncline. The second model proposes that the strata north of the salt wall were exposed to erosion during accumulation of Joggins and Springhill Mines formations. Subsequently, the sediment of the lithologically similar Ragged Reef and Grande Anse formations either (i) were deposited unconformably on all the underlying strata, or (ii) gradually onlapped to the north, becoming unconformable on the folded Boss Point Formation. To further assess the two models, forty sandstone samples from the post-Boss Point Formation strata were geochemically analyzed to determine major element compositions. The results show statistically significant differences between the Little River, Joggins, and Springhill Mines formations and the Grande Anse Formation, whereas the Ragged Reef and Grande Anse formations statistically show no significant difference. These latter two units show greater maturity likely due to more intense chemical weathering under sub-humid to humid climate. Thus, the deposition of the Ragged Reef Formation in the Athol Syncline may have gradually iii onlapped across the Minudie Anticline and then continued further north as the Grande Anse Formation. Petrographic investigations reveal that the Grande Anse Formation has undergone various diagenetic alterations, most extensively in the eodiagenetic near-surface sub-realm. Initially, dissolution of unstable minerals followed by precipitation of iron oxides and kaolinization occurred under slightly acidic porewaters of the vadose zone. Fluctuation to higher pH in the lower vadose zone and upper phreatic zone, due to close proximity of the salt wall, produced microcrystalline calcite, and silica phases comprising quartz overgrowths, macrocrystalline quartz, chalcedony, and pseudomorphous silica after gypsum. Later phases of high Mn calcite and ferroan dolomite, indicate anoxic phreatic conditions during shallow burial. The deep burial mesodiagenetic realm reflects only minor alterations including dickite and illitization of kaolinite.



Home of the School of Graduate Studies, Sir Howard Douglas Hall was designed by J.E. Woolford in 1825 and is the oldest university building in Canada still in use.

The University of New Brunswick recognizes that the university sits on traditional Wolastoqey territory. The river that runs right by our university – the St. John River – is also known as Wolastoq, along which live the Wolastoqiyik -- the people of the beautiful and bountiful river.

UNIVERSITY OF NEW BRUNSWICK

SCHOOL OF GRADUATE STUDIES

ORAL EXAMINATION

Fadel Bahr

IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY