

Grant D. Wach, D.Phil., P. Geo.

Professor of Petroleum Geoscience and Stratigraphy
Department of Earth and Environmental Sciences
Faculty of Science
Dalhousie University

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1. Personal and Contact Information

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2. Education

Degrees

D. Phil. (Ph.D.), Geology, 1991, University of Oxford, Oxford, England
“Sedimentology and stratigraphy of the Lower Cretaceous Channel Basin”,

M.Sc., Geology, 1984, University of South Carolina, Columbia, South Carolina, United States of America.
“Environments of deposition and sedimentology of the McMurray Formation”.

B.A. (Honours), Geography (Geology Minor), 1979, University of Western Ontario, London, Ontario, Canada. “Remnant Champlain Sea beach ridges on a Pleistocene ice-contact delta, Renfrew County, Ontario”.

Academic Experience

2002-Present	Professor, Department of Earth and Environmental Sciences, Dalhousie University
2002-Present	Cross-appointed Faculty of Computer Science, Dalhousie University
2002-Present	Director, Basin & Reservoir Lab
2003-2008	Director, Energy at Dalhousie
10/2007-01/2008	Visiting Professor, Australian School of Petroleum & CO2CRC (Co-operative Research Centre for Greenhouse Gas Technologies), University of Adelaide

2002-2008	Visiting Professor, Petroleum Geoscience Program, Faculty of Engineering, University of West Indies
1989	Visiting Lecturer, Oxford Polytechnic (now Brookes University) Lectures: Introductory Oceanography, Advanced Palaeoecology, and Advanced Economic Geology
1988-89	Lecturer & Course Coordinator, University of Oxford Department of External Studies, Course: "Geological Processes of the British Isles". Designed and coordinated the course, lectured and led field trips.
1986-89	Demonstrator, Department of Earth Sciences, University of Oxford
01/1984-05/1984	Assistant, Introductory Geology, University of South Carolina
01/1983-05/1983	Research Assistant, Santee Delta Project, University of South Carolina

3. Industry Experience

Dates	1996 – 2002
Employer	Texaco Upstream Technology, Houston, Texas, USA (now Chevron)
Position/Job Title	Research Associate (2000-02) Senior Research Geoscientist (1998-2000) Advanced Research Geoscientist (1996-98)
Responsibilities	<u>Technical & Tactical</u> Provide technical expertise on sequence stratigraphy, reservoir characterization, clastic sedimentology, ichnology and depositional systems, including non-marine, fluvial and estuarine through deepwater systems for exploration and commercialization. Evaluate the technical needs of the business units in area of sedimentology and sequence stratigraphy, develop plans for exploration and exploitation areas, cost and schedule those work plans. Initiate and lead field-scale to regional geologic evaluations.

Provide advice and recommendations for exploration, exploitation and development of onshore and offshore leases to business units and partners and advise on optimum drilling locations.

Complete and provide analysis of core and outcrop descriptions.

Provide technical and logistical expertise for field work in remote regions of the world.

Project Management

Achieve or exceed annual financial targets related to volume and/or scope of projects secured and completed; (2000 goal was \$250,000- exceeded with over \$500,000 in billings).

Prepare and administer budgets and proposals on strategic and tactical projects for business unit and management review.

Review academic liaison projects and administer funding (\$100-150,000 annually).

Liaise with legal and financial departments on contract issues.

Technology Transfer

Identify technical needs and develop in-house technical core research studies.

Develop and maintain partnerships with business units throughout Texaco, the industry and academia on deepwater depositional systems, sequence stratigraphy, reservoir characterization, reservoir management and related areas.

Identify and develop opportunities to leverage research opportunities with academic institutions, or through partnering with other companies, or research institutions where mutual goals can be attained.

Assess proposals from academic and industrial consortiums and recommend those for funding.

Develop and lead training courses, seminars and workshops to transfer sequence stratigraphy, deepwater depositional systems, clastic reservoir characterization expertise to Texaco's business units worldwide.

Develop strategic training alliances with industry and academia to provide essential training for Texaco upstream staff.

Monitor industry and academic research and recommend projects for support by Texaco.

Committees & Recruiting

Texaco's committee on higher education funding and G&G staff technical training.

Participate in the identification, interviewing and assessments of candidates being recruited for technical positions within Texaco.

Professional

Represent Texaco worldwide at scientific and technical symposium in these areas of expertise.

Make presentations in technical areas of my expertise internally and to external professional societies.

Dates	1991 – 96
Employer	Exxon Production Research Co., Houston, Texas, USA (now ExxonMobil)
Position/Job Title	Research Geologist (1991-93) Senior Research Geologist (1993-96)
Responsibilities	Developed play summary maps, sequence stratigraphic and depositional models for the 1st and 3rd Round China Tenders in the Tarim Basin and Bohai Bay. Increased potential reserves in the Suizhong Field by 25%. Developed new depositional model for the Llanos Basin, Colombia. New model led to revision of the exploration and production of the basin. Developed new play concepts for the Ordovician sediments of the Anadarko and Arkoma trend. Part of a team responsible for instructing Exxon's field schools and workshops in sedimentology and sequence stratigraphy. Developed training program and manual to transfer new technology of sedimentological analysis and depositional modeling, using trace fossils, to Exxon geologists worldwide.

Dates	1980 – 86
Employer	Syn crude Canada Ltd., Edmonton, Alberta, Canada
Position/Job Title	Geologist & Project Geologist
Responsibilities	Quaternary mapping including muskeg and peat volumes for mine-site reclamation, granular resource inventories, waste-site determination studies. Ground water flow monitoring and well installation. Log analyses and core description studies. Evaluation, depositional modeling, reserve calculations Computer verification of lease geology. Planning and supervision of drill and logging programs. Organized in-house technical courses on clastic depositional systems and stratigraphy.

Dates	1979 - 80
Employer	Syncrude Canada Ltd., Fort McMurray, Alberta, Canada
Position/Job Title	Geotechnical Inspector
Responsibilities	Field supervision of a multi million-dollar overburden removal contract. Developed standards and procedures for site evaluation. Optimized recovery of marginal reserves leading to increased production.
Dates	05/1978 - 09/1978
Employer	Ontario Geologic Survey, Ontario, Canada
Position/Job Title	Geological Assistant II
Responsibilities	Quaternary mapping of the Ottawa Valley including glacial and other geomorphologic landforms, soil and granular resource surveys and distribution of surficial units.
Dates	05/1977 - 09/1977
Employer	Ontario Geologic Survey, Ontario, Canada
Position/Job Title	Geological Assistant I
Responsibilities	Shield reconnaissance mapping and sample collection and field analysis of Northwestern Ontario, Red Lake and Sioux Lookout regions by float plane, canoe and outboard motorboat.

4. Teaching Experience

My contributions to education focus on hands-on, experiential learning to provide students with the skills they need to have successful careers and be leaders in their field. At Dalhousie University, I teach four senior courses within the Earth Sciences Department; two formal, classroom-based courses with lab and field components, and two experiential courses which allow students to learn outside of the classroom. These are all cross listed with the Faculty of Graduate Studies.

TEACHING SUMMARY:

Please note that 3303 and 4153 include labs (8-10) for 6 contact hours for each course, each week, plus and each include two one days field trips for each course.

ERTH 3303 F (01, B01, B02) Stratigraphy

ERTH 4153 F (01, B01) Petroleum Geoscience

ERTH 4131/5131 W (01) Petroleum Geoscience Field Methods

ERTH 4157 W (01) Advanced Petroleum Geoscience

Updated October 2019

Teaching outside of Dalhousie University:

External Examiner and Programme Reviewer for the Petroleum Geoscience and Petroleum Engineering programmes, in the Faculty of Engineering, the University of West Indies.

ERTH 3303 Stratigraphy, is a 3rd year course (or permission of the instructor) comprising of 3 lecture hours and 3 lab hours per week. Stratigraphy is a mandatory course for registration as a Professional Geoscientist. Students are introduced to the concepts of stratigraphy, the backbone of the geological sciences. We integrate the disciplines of sedimentology, paleontology, petrology, economic geology and structural geology to reconstruct geologic history, considering sea-level change, tectonics, and climate on sediment accumulation. This course includes field excursions to Cambridge Cove and Joggins in Nova Scotia to examine the stratigraphy and the depositional record in rift and salt withdrawal basins, respectively.

ERTH 4153 Petroleum Geology is a 4th year course (or permission of the instructor) comprising 3 lecture hours and 3 lab hours per week. Petroleum geology and petroleum systems are introduced, with focus on basin analysis, source rock evaluation, seismic and well log sequence stratigraphy, core and outcrop description, depositional facies analysis, oil sands geology, biostratigraphy, and petrophysics, among other topics. This course includes field trips to Cheverie to investigate depositional systems associated with Carboniferous sabkha environments; Rainy Cove to examine Triassic braid channel depositional systems in a rift basin; and Point Pleasant Park to study passive margin turbidites and Wilson Cycles. Lab assignments are based on integrated data sets demonstrating the power of data integration for field and basin analysis. For example petroleum systems in estuarine depositional systems are examined through study of modern analogues in the Minas Basin (Bay of Fundy), cores from the Provost field of the WCSB (Western Canada Sedimentary Basin), a lab examining cuttings from the Provost field demonstrating what is expected in well site geology, well logs from the Provost field and also a seismic data set from Provost.

ERTH 4131/5131 Advanced Petroleum Geoscience is an excellent example of experiential learning at Dalhousie University, and is one of my major contributions to this type of hand-on learning. The American Association of Petroleum Geologists Imperial Barrel Award (IBA) is an annual, international competition for small teams of geoscience graduate students. The Laurie Dake (FIELD) and Minus CO₂ Challenge are sponsored by the EAGE (European Association of Geoscientists and Engineers). Teams use the latest high-tech computers and graphics software to evaluate and visualize in 3-D, a petroleum geological dataset of 2D and 3D seismic and well logs. The goal is to determine potential prospects for oil and gas exploration, CO₂ storage and sequestration. The university teams compete to win scholarship funds for their geoscience departments while promoting petroleum geoscience training and career advancement for geoscience students. The course could be compared to “moot court” competitions in law school. The team receives a dataset to analyze (geology,

geophysics, land, production infrastructure, and other relevant materials). They then prepare for the national and international competitions. The Dalhousie teams competes against other universities from across Canada for the regional competition and the world for the EAGE International competitions.

ERTH 4157/5157 Petroleum Geoscience Field Methods is another course I developed, which focuses on hands-on learning outside of the classroom. This is an intensive class comprising 80+ hours of field, laboratory and classroom study. The field component of the course is held in Trinidad during the academic study break in February. There is preliminary class work and follow up work at Dalhousie. The course emphasizes petroleum systems, using exposed oil reservoirs, a lake of biodegraded pitch, oil seeps, mud volcanoes, analogous outcrop exposures and access to subsurface data sets from producing onshore and offshore fields. This all creates an extraordinary “laboratory” for investigation of petroleum and CO₂ systems. The region provides an excellent overview of extensional and compressional tectonics and their effect on petroleum system development, and basin configuration with an overprint of incredible rates of sedimentation into the basins.

ERTH 6701 and 6702 Graduate Internship

In 2015, I designed a graduate internship course for the Earth Sciences, which would allow M.Sc. and Ph.D. students to complete up to two industry and government internships and gain course credit towards their degrees. The course is modelled after the co-op program I directed for 10 years in the Department of Earth Sciences. This course has been approved by the Dalhousie Earth Sciences Department and Faculty of Graduate Studies.

5. Research

5.1 Research Supervision

Postdoctoral Fellows:

R. Silva, Source Rock & Geochemistry of the Central Atlantic Margins, 2013 – 2019

F. Fiorini, Micropaleontological studies of paralic depositional systems of the Canadian Atlantic margin, 2004-06

Ph.D. Students:

T. Kelly, 2016-present *“Reservoir Characterization and Reservoir Modelling of fluvial, deltaic and paralic depositional systems”*.

S. Ali*, 2016-present *Mayaro Formation*, (University of West Indies)

A. MacLean*, *Provenance & Depositional Environments of the Talparo Formation*, 2012-2018. (University of West Indies)

L. Eliuk, *Abenaki Reef Margins*, 2007-2016 PhD.

D.C. Campbell, *“The Late Cretaceous and Cenozoic Geological History of the Outer Continental Margin off Nova Scotia, Canada: Insights into Margin Evolution from a*

Mature Passive Margin", 2006-11. **Canadian Society of Petroleum Geoscientists (CSPG) Best Dissertation Award; Pengrowth Scholar**

F. Akram, *"Reservoir Modeling & Simulation"*, 2005-09 (Incomplete)

S. Sikaneta*, *"Novel Lattice Boltzmann Methods for Modeling Fracture and Flow"*, 2004-09

D. Skilliter*, *Cenozoic Biostratigraphy of the Grand Banks*, 2004-08 (Incomplete)

H. Vincent, *"Cenozoic Sediment Dispersal Patterns across Trinidad, West Indies"*, 2004-2008 **Canadian Society of Petroleum Geoscientists (CSPG) Best Dissertation Award; Commonwealth Scholar**

M.Sc. Students:

J.C. Wong, *Geo-Modelling of the Lower Jurassic of the Scotian Basin*, 2015-2018

T. Campbell, *Seismic Stratigraphy and Attribute Analysis of the Mesozoic and Cenozoic of the Penobscot Area, Offshore Nova Scotia*, 2015-2018; **Nova Scotia Scholar**

A. Hargreaves, *Source/Reservoir Rocks of the Cretaceous Offshore Scotian Shelf*, 2014-present

K. Martyns Yellowe, *Migrant structure, Scotian Basin*, 2016-present

C. Carlisle, *Source Rock Geochemistry of the Irish Atlantic Margin*, 2014-2017, **Irish Government Scholar**

N. Morrison, *Hydrocarbon Potential of the Sable Delta Producing Reservoir*, 2014-2017, **Pengrowth Scholar**

C. Skinner, *Overpressure Conditions in the Scotian Basin*, 2013-2016, **Canadian Society of Petroleum Geoscientists (CSPG) Best Thesis Award**

D. O'Connor, *"Reservoir Quality of Mesozoic Rift Basin Sediments"*, 2011-2016; **Pengrowth Scholar**

T. Kelly* (M.Eng.), *"Reservoir Architecture of Meander belt Systems using LiDAR"*, 2013-14

J. Cullen*, *Geophysical Character of the Mohican Channel Gas Hydrate, Nova Scotia, Eastern Canada*, 2008-14

S. Lucas, *"Hydraulic Fracturing: A complex and variable process"*, 2012 (Master of Resource & Environmental Management (MREM) Studies)

M. Giles*, *"Contributing Factors for the Initiation of Mass Transport Processes in the Greater Laurentian Channel Region"*, 2008-10; **Leuven King Scholar**

S. Goss*, *"Cenozoic Seismic Sequence Stratigraphic Analysis of Western Demerara Rise, Offshore Suriname, South America"*, 2007-09

V. Brake*, *"Evolution of an Oligocene Canyon System on the Eastern Scotian Margin"*, 2007-09; **Pengrowth Scholar**

L. Tveitera* (M.Eng.), *"Optimization of the Gas Production in the Brent Group During the Depressurization of the Statfjord Field"*, 2007-08

O. Imbarek, *"Evolution of the Eocene Carbonate Ramp Complex, Onshore Cyrenaica Basin, Northeast Libya: Analogs for Carbonate Reservoirs, Northwest Offshore Libya"*, 2005-07; **Libyan Government Scholar**

P. Mulcahy* (M.Eng.), *"Reservoir Modeling and Simulation of a Braided Channel Complex at Cambridge Cove, Nova Scotia"*, 2005-06

S. Newton, *"Importance of Mass Transport Complexes in the Development of the Central and Western Quaternary Nile Fan"*, 2004-06, **Shell Scholar**

K. Simpson*, *Seismic interpretation of the Torbrook Block, Scotian Margin*, 2003-06 (incomplete).; **NRCan Scholar**

B.Sc. Honours and Research Students:

E. Anderson, "Baffles and Barriers in the Triassic Wolfville Formation", 2017 **Best Thesis Presentation; University Gold Medal**

T. Campbell, "Well and seismic analysis of Penobscot area, Scotian Shelf", 2014

C. Wong, "Joggins Formation- Identification of fossil trees", 2014

L. Manoukian, "Flow Unit Characterization of the Early Cretaceous Mississauga Formation Using Cores from The Venture B-13 Well", 2013

D. Tobey, "Sequence Stratigraphy of the Banquereau Formation, Offshore Nova Scotia", 2013

M. Vaughn, "High Resolution Radar Stratigraphy (GPR) of Braided Channel Complexes in the Triassic Wolfville Formation - Controls on Reservoir Heterogeneity", 2011

J. A. Fraser, "Trends and Architecture of the Bluestone Formation Turbidites in Point Pleasant Park, Halifax, Nova Scotia", 2010

J. Nickerson, "Architecture and Geometry of Braided Channel Complex in the Triassic Wolfville Formation", 2010

M. Giles*, "Cenozoic Stratigraphy and Slope Processes, Southwestern Scotian Slope", 2007

R. Pelkey, "Depositional Environment and Provenance of the Late Aptian to Early Albian Cummings Formation, East Central Alberta, and a Discussion Concerning Secondary Source Rock", 2006

M. White*, "Late Cenozoic Seismic Stratigraphy of the Mohican Channel Area, Scotian Slope", 2005

J. Kidston, "Depositional Environment and Provenance of the Dina Formation, Provost Oil Field, East Central Alberta", 2003 **Canadian Society of Mining and Metallurgy (CIMM) Best Thesis Award**

B.Sc. Research Thesis:

J.C. Wong, "Lidar survey of the Joggins Formation in the Coal Mine Point section, Cumberland Basin (Nova Scotia, Canada)", 2014

M. Kettanah, "Reservoir Quality, Diagenetic History and Provenance of the Late Triassic Sandstones of the Wolfville Formation, Cambridge Cove, Bay of Fundy, Nova Scotia", 2008

B.Sc. Directed Independent Studies:

C. Wentzell, 2015

K. Martyns-Yellowe, 2014

A. Harnett, 2013-14

N. Morrison, 2013-14

J.C. Wong, 2013

Other B.Sc. Students Supervised:

Max Angel, Research Assistant, 2019

Ryan Taylor, Research Assistant, 2019

Phil Sedore, Co-op Research Assistant, 2014-2017; 2019

Maya Soukup, Co-op Research Assistant, 2014-2017; 2019

Colin MacAdam, Undergraduate Research Assistant, 2014-15

Connor Wentzell, Undergraduate Research Assistant, 2014-15

Ken Martyns-Yellowe, Undergraduate Research Assistant, 2014-15

Laura Broom, Co-op Research Assistant

Monique Ruhl, Co-op Research Student

Naomi Plummer, Co-op Research Assistant, 2013-14

Jillian Haynes, Co-op Research Assistant, 2013

Hayley Pothier, Research Assistant, 2011-12

Sara Mason, Research Assistant

Samantha Jones, Research Assistant

Victoria Arbour, Research Assistant

Jenn Noade, Research Assistant

Other HQP Supervised:

XinYue (Emma) Hu, M.Eng., Research Assistant, 2016-2019

D. O'Connor, M.Sc., Research Assistant, 2016- present

K. Rutledge, MLIS, Information Systems Librarian, 2014-2017

K. McVicar, M.Sc., Research Administrator, 2012-present

C. MacAdam, B.Sc., Research Assistant, 2016-2018

J.C. Wong, B.Sc., Research Assistant, 2013-2015

T. Lewis, Research Administrator, 2013- present

J. Thibodeau, Geoscience IT Support, 2009-present

C. Younger, Geoscience Technician and Curator, 2003-2008, 2014-present

Y. Kettanah, PhD, Research Associate, 2003-2015

A. Grant, MREM, Research Assistant, 2012-13

E. Bianco, M.Sc., Research Associate, 2012-13

K. Taylor, B.Sc., X-Ray Diffraction Technician, 2003-12

Thesis/Dissertation Examinations (partial list):

Greg Baniak, PhD External Examiner, University of Alberta, May 2013

Victoria Hardy, 2008, Memorial University

Michael Rygel, 2006, **Canadian Society of Petroleum Geoscientists (CSPG) Best Dissertation Award**

Mark Deptuck, 2003

Heidi McDonald, 2004

5.2 Research Activities

Basin and Reservoir Lab has a world-wide reputation and is the foremost lab east of Alberta investigating **hydrocarbon, CO₂ and methane systems**. We integrate the disciplines of stratigraphy, sedimentology, geochemistry, paleogeography and basin

analysis. We use the latest software and hardware to interpret onshore and offshore records including 2D and 3D seismic, core, well logs, ground penetrating radar, LIDAR, incorporating outcrop analogues from around the world. Our students attend national and international meetings and are regular finalists at international competitions including Madrid, Copenhagen, Pittsburgh and Las Vegas.

Funding for our research comes from a mix of sponsorship from our very successful industry consortia, provincial and federal grants and international government funding. We also benefit from considerable donations of software and data.

Research themes include:

1. Methane Mitigation, CCS and Energy Sustainability
2. Petroleum Systems Analysis including
 - a. Reservoir Characterization & Provenance Studies,
 - b. Basin & Field Analysis, and Sequence Stratigraphy,
 - c. Outcrop Analog, Core Studies & Reservoir Modeling
 - d. Source Rock Characterization and Paleoenvironmental Interpretation.

Recent Research Projects

1. Gas Seepage Project (GaSP) – Legacy Methane Emissions from Abandoned Oil & Gas Sites in Nova Scotia

The innovative and multi-disciplinary Gas Seepage Project (GaSP) was created to assess fugitive CH₄ emissions from legacy oil, gas and coal sites in Nova Scotia and New Brunswick. The objectives of this unique collaborative project were to: 1) measure CH₄ emissions from legacy fossil fuel resource sites in NS and NB, 2) identify mechanisms of gas migration (sources and pathways), 3) develop new or improve existing methane inventory models, 4) determine emission factors for legacy wells and coal adits, 5) examine the mitigation potential of legacy sites for government and industry decision making and 6) to develop sensors and field deployable analytical technology (autonomous methane sensors and drone-based measurement).

Academic Research Partners:

Dalhousie University – Grant Wach (PI), Owen Sherwood, Tom Martell

University of New Brunswick – Kerry MacQuarrie, Dave Keighley, Karl Butler, Michelle Gray

St. Francis Xavier University – David Risk, Patrick Withey

University of Waterloo – Maurice Dusseault

Joggins UNESCO World Heritage Site

Industry Partners:

Geofirma Engineering

Eosense

SkySquirrel

EXP Services Inc.

EMG Consulting

Updated October 2019

2. Source Rock and Geochemistry of the Central Atlantic Margin Consortium:

The aim of this project is to investigate known, probable and possible source rocks in the Nova Scotia, Newfoundland, and Labrador shelves and deepwater offshore areas (and comparison with contemporaneous analogs), with an emphasis in the Triassic–Jurassic time interval. This research project is designed as a Consortium, with multiple industry partners. This study is based on a reanalysis and evaluation of the existing organic geochemistry dataset, but it will also include the observation and geochemical study of selected cores and cuttings and integration with time-equivalent source rock outcrops in Canada and conjugate margins, namely Morocco, Portugal, Spain and Ireland.

Academic Research Partners:

Dalhousie University (Canada),
University of Coimbra (Portugal), Professor L.V. Duarte
University of Lyon (France), Professor Emanuela Mattioli
University of Exeter (UK), Professor Stephen Hesselbo
University Moulay Ismail-Meknes (Morocco), Professor Driss Sadki

Industry partners:

BP Canada Energy Group	Petroleum Affairs Division (PAD) and
Husky Energy	Irish Shelf Petroleum Study Group
Repsol Energy North America	(ISPSG),
Shell Canada Limited	Offshore Energy Research Association
Suncor Energy	of Nova Scotia (OERA)
Hess Energy	Petroleum Directorate of Ireland
ExxonMobil Corporation	

5.3 Research Funding – 2012-2019

Government Research Funding

2017-2018 NRCan GaSP CanMet Climate Change Program (Wach PI)
2014-2018 Petroleum Affairs Division of Ireland (Wach PI)
2012-2016 Nova Scotia Economic Development

Industry Research Funding

2017-2018 GaSP Industry Partners
2010-2019 ExxonMobil Sable Petroleum Geoscience Grant (Wach PI)
2014-2018 Offshore Energy Research Association OERA Source Rock (PI)
2014-2018 Suncor Source Rock Consortium (Wach PI)
2015-2018 REPSOL Source Rock Consortium (Wach PI)
2014-2018 Husky Energy Source Rock Consortium (Wach PI)
2014-2018 BP Energy Source Rock Consortium (Wach PI)
2014-2018 Shell Energy Source Rock Consortium (Wach PI)

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2014-2018 Hess Energy Source Rock Consortium (Wach PI)

Funds raised for Student Activities 2018

2018 Imperial Oil (PELF)

2018 OERA (Petroleum Field Methods (PELF)

2018 Shell (PELF)

Funding for the Conjugate Margins Conference 2018

Statoil

Husky

RPS

BP

CGG

Geological Survey of Canada-Atlantic / Natural Resources Canada

OERA

EQUINAORSTATOIL

BEICIP FRANLAB

In-Kind funding:

GeoLogic geoSCOUT software

Suncor Seismic Data (unprocessed) for the Orpheus Graben

ExxonMobil MegaMerge 3D data renewal

BlueBack (Cegal) Seismic Inversion software

Ion Nova Span seismic data

Ion Carib Span seismic data

Centrica ECMA Trinidad data

Provost Pembina Seismic data (Sigma)

CanStrat well data east Coast and Provost

Divestco well data

Schlumberger Petrel

Summary: Research Funding

Approximate Total Government Funding

>\$800, 000

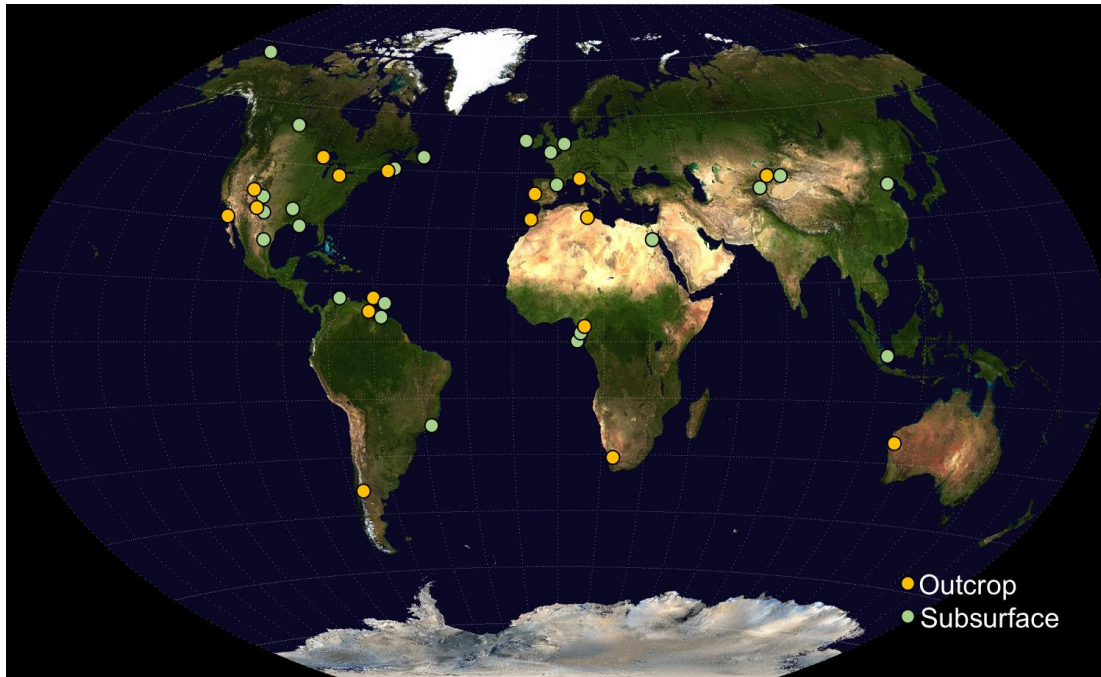
Approximate Total Industry Funding

>\$4 Million

Approximate Total In-Kind

>\$250 Million

5.4 Research Locations



6. Expert Panels, Committee Memberships and Contributions

Expert Advisor/Panels/Contributions

Current

- External Review Team – Commission for Academic Accreditation: PhD Program in Sciences, United Arab Emirates University
- UN ECE Energy Sustainability Committee- - Reserves and Coal Methane Mitigation committees
- Forensic Geology Officer, Canada - International Union of Geological Sciences (IUGS)
- International Editorial Advisory Committee, West Indian Journal of Engineering, January 2019-present

Ongoing

- Canadian Society of Petroleum Geologists Student Industry Field trip (SIFT) coordinator (Dalhousie University)
- International Editorial Advisory Committee, West Indian Journal of Engineering, January 2019-present
- Co-chair GAC-MAC-CSPG 2022 Halifax
- Elected AAPG Canada House of Delegates

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- Reviewer, Academic Standards Committee, Association of Professional Geoscientists of Nova Scotia (APGNS)
- APGNS Dalhousie University Academic Liaison
- Reviewer, AAPG Grants-in-Aid, 2014-present
- Chair, Energy Lecture Series Dalhousie University, Earth and Environmental Sciences Department
- Industry Liaison Chair for Dalhousie University, Earth and Environmental Sciences Department
- Member, Outreach at Dalhousie University, Earth and Environmental Sciences Department
- Executive Council Atlantic Geoscience Society (past president 2013-14)
- Atlantic Geoscience Society Awards Nominating/ review Committee 2015-2018
- Atlantic Geoscience Society Gesner committee
- Science Atlantic Interim Chair of the Earth Sciences Committee (past Chair 2014-2018)
- Book reviewer (2019): Trace Fossils II: Using Ichnology as a Sedimentological Tool (Elsevier)

Past

- Member of Dalhousie University Honorary Degrees Committee (2014-18)
- Member of Dalhousie University Senate July 2012-17
- Member of Dalhousie University Senate Nominating Committee (Dec 2012-18)
- Co-Chair Conjugate Margins Conference Halifax 2018
- Technical Committee, International Association of Sedimentologists Congress, Quebec City, 2018
- Co-chair GAC-MAC-CSPG 2005 Halifax
- Member, Research Advisory Council, Offshore Energy Technology Research Association
- Member, Instructor Search Committee Dalhousie University, Earth Sciences Department
- Committee Member, Forensic Soil Science and Geology Symposium, 5th International Conference on Criminal and Environmental Soil Forensics, August 2016
- Advisor, Nova Scotia Department of Energy on the Pengrowth Scholarship program
- Advisor, Initiation of the Offshore Energy Technology Research Association

- Chair, Dalhousie, Earth Sciences Department Assistant Professor Search Committee
- Technical Committee, 6th Caribbean Congress, Port of Spain, Trinidad, 2015
- Chair, Search Committee Canada Research Chair (Tier II) Petroleum Geophysics, 2015
- DAL Down Under – Alumni Relations – Organized Alumni Night for Geoscientist alumni in Perth, Australia – May 2014
- Alberta Alumni Relations – organized Alumni Night for Geoscientist alumni in Calgary at the CSPG/CSEG conference along with friends and supporters of Dalhousie University – May 2014
- Alberta Alumni Relations – organized Alumni Pub Night for Geoscientist alumni in Calgary at the Unicorn in conjunction with AAPG Imperial Barrel Award Competition – March 2014
- President of Atlantic Geoscience Society (2013-14)
- Subject of two Export Video presentations for the Department of Energy
- Advisor, Crown Panel on the Offshore Accord
- Served on the R & D Committee for the Atlantic Energy Roundtable
- Served on the organizing committee for the OTAN's CORE Conference
- Represented Dalhousie and Nova Scotia at the World Energy Cities meetings (Halifax and San Fernando, Trinidad), the Energy Council, and OTC (Offshore Technology Conference).
- Served on the Oil and Gas advisory board for Atlantic Business Magazine
- Co-chair and lead member, organizing committee for the first Nova Scotia Research and Development Forum and chaired several sessions for subsequent forums, CORE and Petroleum Society conference.
- Convened the CSPG research session on Petroleum Systems offshore of Atlantic Canada.
- Initiative on Forensic Geology (IFG) 4th Conjugate Margins Technical Committee
- EAGE (European Association of Geoscientists and Engineers), University-Industry Committee on Geoscience Education
- Assistant Editor, Journal of Marine and Petroleum Geology
- Co-chair, 1st Conjugate Margins Conference (2008), which brought 28 companies and representatives from 18 countries to Halifax for the largest petroleum geoscience conference held in Eastern Canada.

7. Professional Memberships

- Association of Professional Geoscientists of Nova Scotia – Registered Professional Geologist #223
- Canadian Society of Petroleum Geologists
- European Association of Geoscientists and Engineers
- American Association of Petroleum Geologists
- Atlantic Geosciences Society
- Canadian Society of Exploration Geophysicists
- GCAGS (Gulf Coast Association of Geological Societies)

Past Memberships

- Geological Society of America
- Society for Sedimentary Geology (SEPM)

8. Leadership – Environmental Geoscience and Sustainability

- Principle Investigator of “GaSP” the Gas Seepage Project, investigating Methane Emissions from legacy fossil fuel sites in the Maritimes funded by NRCan. This was a multi-institutional research effort with a team of 30 researchers.
- Appointed as an expert panelist to the UN Energy Sustainability Committee December 2018
- Lobbied and initiated the first environmental geoscience award to recognise excellence of research and presentation for the Atlantic Canada University Geologic Congress (AUGC), 2015
- Completed the first comprehensive overview of basins suitable for the storage of CO₂ gas, 2014
- Hosted the first public screening in Canada of the movie “*Switch- a comprehensive review of energy challenges facing the world*”, 2014
- Served on the Advisory Council of CCS Nova Scotia
- Nominated for the Wheeler Commission on Hydraulic Fracking by three groups

9. Media Requests (partial list)

I average ½ dozen media requests a year

March 15, 2019 Voice of America. Laura Sepulveda (New York Correspondent).
Topic: US imports from Venezuela of Crude oil and petroleum products. (Request declined)

January 19, 2019	Darcy MacRae, Media Relations (Dalhousie University) – Topic: BP scaling back Nova Scotia Operations (Interview Request declined)
January 3, 2019	Elizabeth McSheffrey, Global News (Halifax)
November 2018	Canadian Press: Michael Tutton
July 9, 2018	Global News – Sarah Ritchie. Topic- reaction to BPs exploratory well in Nova Scotia
January 2017	CTV Atlantic – Michael Tutton(Canadian Press): Nova Scotia's offshore oil dream awaits better news: 'It doesn't look good'
September 21, 2016	The Globe and Mail – Michael Tutton (Canadian Press): Shell abandons first deepwater exploration well off Nova Scotia
October 27, 2015	CTV Atlantic 6pm News- N.S. government says oil found in waters off the coast
October 25, 2015	CTV Atlantic 6pm News- Offshore Exploration
October 21, 2015	CTV Atlantic 6pm News- IceMAX prepares for drilling
August 2015	AAPG Explorer – Heather Saucier, “ Between Rocks and the Hard Sciences ”
December 2014	Chronicle Herald Truro – Frank Campbell: Natural Gas Storage
October 2014	Télévision de Radio-Canada (Decouverte) - Jean-Pierre Rogel: Pétrole: le rêve et l'illusion
September 2014	Dal News – Nicole LeBlanc: Leaning at 10 Degrees North
September 2014	AAPG Explorer – Carol McGowan: The Role of Industry in Developing YPs in Canada
January 2014	Quartz - Steve LeVine: How one man's wild geological treasure hunt could set off a new great oil boom
February 4, 2013	CBC News – New Brunswick well-positioned to develop shale gas rules CBC Information Morning New Brunswick – Rules of the Fracking Trade

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2009	CTV Business – Energy at Dal
2002-2009	Several media presentations

10. Awards and Recognition

2019	Stanley Slipper Gold Medal Awarded by the Canadian Society of Petroleum Geologists to recognize outstanding contributions to petroleum exploration and development in Canada or by Canadian-based petroleum geologists working internationally. This award recognizes, in part, accomplishments in business and in the broader petroleum industry through the application of the knowledge of petroleum geology.
2019	Gerald M. Friedman Award for best paper, for the “Scotian Exploration” lecture at the 2019 Petroleum History Annual Symposium
2018	Best paper award (co-award) Wroclaw Sustainability Conference “Compressed Air Storage”
2014	Nominated for the Top 6 Co-op Employers on the Planet Award , Dalhousie University Co-op Nominated to be a member of the Expert Panel on Hydraulic Fracturing in Nova Scotia
2012	Professorial Award awarded by the American Association of Petroleum Geologists Foundation for Excellence in the Teaching of Natural Resources in the Earth Sciences (first recipient of this award)
2006	Geological Association of Canada Service Award
1990	British Sedimentological Research Group Grant Award
1986-1990	Overseas Research Scholar Award
1989	CSPG/SEPM Clastic Tidal Symposium Travel Award
1988-1989	Burdett-Coutts Foundation Award
1987-1989	St. Peter’s College Graduate Grant
1988	American Association of Petroleum Geologists Grant

International Association of Sedimentologists Travel Award

1987-1989	University of Oxford Committee for Graduate Studies Grant
1986-1989	University of Oxford Scholarship
1987	Lougheed Award Finalist, Alberta Heritage Scholarships
1985	First Place (Core/Poster Session), Canadian Society of Petroleum Geologists Annual Meeting
1984	Teaching Assistantship , University of South Carolina
1983	Research Assistantship , University of South Carolina

11. Research Publications & Presentations

Publications

Ruffell, A., and **Wach, G.D.** 2019. Location of the Brecourt (Normandy, France) WW2 Howitzer battery using a geoforensic search strategy. *Journal of Conflict Archaeology*. 13 (3): 154-166

DOI: [10.1080/15740773.2018.1583480](https://doi.org/10.1080/15740773.2018.1583480)

O'Connor, D., Silva, R. L., and **Wach, G. D.** 2018. Earliest sedimentological evidence for marine incursions in the eastern North American rift system, Central Atlantic Margin. *Lithosphere*. 10 (6): 783-791

Bradley, G-M, Redfern, J., Hodgetts, D., George, A. and **Wach, G.D.** 2018. The applicability of modern tidal analogues to pre-vegetation paralic depositional models. *Sedimentology*. 65 (6) 2171-2201 <https://doi.org/10.1111/sed.12461>

Silva, R. L., Carlisle, C. A. M., and **Wach, G. D.** 2017. A new TOC, Rock-Eval, and carbon isotope record of Lower Jurassic source rocks from the Slyne Basin, offshore Ireland, Marine and *Petroleum Geology* 86, 499-511

Vincent, H and **Wach, G. D.** 2017. The detrital record of Cretaceous to Pliocene sandstones across the NE South American margin. *Journal of the Geological Society* 174 (3), 434-452

Di Maggio, R.M., Donnelly, L.J., Al Naimi, K.S., Barone, P.M., Da Silva Salvador, F.A., Dawson, L., Dixon, R., Fitzpatrick, R., Gradusova, O., Nesterina, E., Peleneva, M., Ushacova, O., Gallego, C.M.M., Pirrie, D.I., Ruffell, A., McKinley, J., Sagripanti, G., Villalba, D., Schneck, B., Sugita, R., **Wach, G. D.**, Silva, R., Forbes, S. 2017. Global developments in forensic geology, *Episodes*, 40(2): 120- 131

Campbell, T.J., Richards, F.W.(B.), Silva, R.L., Wach, G., Eliuk, L., 2015. Interpretation of the Penobscot 3D Seismic Volume Using Constrained Sparse Spike Inversion, Sable sub-Basin, Offshore Nova Scotia, Marine and Petroleum Geology. doi:10.1016/j.marpetgeo.2015.08.009.

Kettanah, Y.A., Kettanah, M.Y. and Wach, G.D., 2014. Provenance, diagenesis and reservoir quality of the Upper Triassic Wolfville Formation, Bay of Fundy, Nova Scotia, Canada. Geological Society, London, Special Publications, doi 10.1144/SP386.18

Vincent, H., Wach, G. and Kettanah, Y., 2014. Heavy mineral record of Andean uplift and changing sediment sources across the NE margin of South America: a case study from Trinidad and Barbados. Geological Society, London, Special Publications, doi 10.1144/SP386.19

Wach, G.D., Pimentel, N, Pena dos Reis, R., 2014, Petroleum systems of the central Atlantic margins, from outcrop and subsurface data. Sedimentary Basins of the World: Origin, Depositional Histories and Petroleum Systems of Continental Margins of the World. Gulf Coast Section SEPM Foundation

Fiorini, F., D. B. Scott, and G. D. Wach, 2010, Characterization of paralic paleoenvironments using benthic foraminifera from Lower Cretaceous deposits (Scotian Shelf, Canada), Marine Micropaleontology, vol. 76, no. 1-2, p. 11-22.

Fensome, R. A., J. A. Crux, I. G. Gard, R. A. MacRae, G. L. Williams, F. C. Thomas, F. Fiorini, and G. Wach, 2008, The last 100 million years on the Scotian margin, offshore eastern Canada; an event-stratigraphic scheme emphasizing biostratigraphic data, Atlantic Geology, vol. 44, p. 93-126.

Fiorini, F., D. B. Scott, and G. D. Wach, 2007, Thecamoebians from the Early Cretaceous of the Scotian Shelf, Micropaleontology, vol. 53, no. 6, p. 511-516.

Enachescu, M. and **G. Wach** (2005), Exploration offshore Nova Scotia: Quo Vadis? (Where do we go from here?), *Ocean Resources*, June-July 2005, p.23-35.

McCarty, D.K., V.A. Drits, B. Sakharov, B.B. Zviagina, A. Ruffell and **G. Wach**, (2004), Heterogeneous mixed-layer clays from the Cretaceous Greensand, Isle of Wight, Southern England. *Clays and Clay Minerals*, Vol. 52, No.5, 552-575.

Wach, G.D., C.S. Lolley, D.S. Mims and C.A. Sellers (2004), Well placement, cost reduction and increased production using reservoir models based on outcrop, core, well logs, seismic data and modern analogs- Onshore and Offshore Western Trinidad; In: *"Integration of Outcrop and Modern Analogs in Reservoir Modeling"*(G.M Grammer, P.M. Harris and G.P. Eberli, eds.) American Association of Petroleum Geologists, Memoir No. 80, 279-307.

Cathles, L.M., Colling, E.L., Erendi, A., **Wach, G.D.** and Hoffman, M.W., Manhardt, P.D. (2003). 3D Flow Modeling in Complex Fault Networks: Illustration of New Methods with an Exploration Application in Offshore Nigeria. *American Association Petroleum Geologists Data Pages Discovery Series No. 7*, pp. 177-195.

Ruffell, A.H., S.P. Hesselbo and **G.D. Wach**, 2003. Fuller's Earth (bentonite) in the Lower Cretaceous (Upper Aptian) of Shanklin (Isle of Wight, southern England). Short Communication. *Proceedings of the Geologists' Association*.

Mitchum, R.M. and **Wach, G.D.**, 2002. , Niger Delta Pleistocene leveed-channel fans: Models for offshore reservoirs. In: *Sequence Stratigraphic Models for Exploration and Production: Evolving Methodology, Emerging Models and Applications History*. 2002 GCSSEPM Foundation Bob F. Perkins Research Conference, December 8-11, 2002, Houston, Texas.

Wach, G.D., D. Kuhfal, T.S. Nemec, D.K. McCarty and M. Hugel. 2002. McAllen Ranch Field-application of a multi-disciplinary approach to the casing failure problem. *Proceedings GCAGS Annual Meeting*, Austin, Texas, October, 2002.

Wach, G.D., T.C. Lukas, R.K. Goldhammer, H. Deville Wickens and A.H. Bouma, 2000. Submarine fan through slope to deltaic transition basin-fill succession, Tanqua Karoo, South Africa; In: *Fine-Grained Turbidite Systems* (A.H. Bouma and C.G. Stone, eds.) American Association of Petroleum Geologists Memoir 72 and SEPM Special Publication 68, 173-180.

R.K. Goldhammer, H. Deville Wickens, A.H. Bouma and **G.D. Wach**, 2000. Sequence stratigraphic architecture of the Late Permian Tanqua Submarine Fan Complex, Karoo Basin, South Africa; In: *Fine-Grained Turbidite Systems* (A.H. Bouma and C.G. Stone, eds.) American Association of Petroleum Geologists Memoir 72 and SEPM Special Publication 68, 165-171.

Ruffell, A.H., and **Wach, G.D.** 1998. Comparison of depositional sequences in the arenaceous beds of the Aptian-Albian boundary (Cretaceous) in southern and eastern

England. In: Graciansky, P.C. de, Hardenbol, J., Jacquin, T. and Vail, P.R. (eds.), *Mesozoic and Cenozoic Sequence Stratigraphy of European Basins*. Society of Economic Paleontologists & Mineralogists Special Publication No. 60, Tulsa, Oklahoma., 411-421.

Ruffell, A.H. and **Wach, G.D.**, 1998. Firmgrounds - key surfaces in the recognition of parasequence sets in the Aptian Lower Greensand Group, Isle of Wight (southern England). *Sedimentology* 45, 91-107.

Wach, G.D., Hoffman, M.W., Colling, E.L., Ogunyomi, O., Fritzel, T., Russo, P. and Olear, S., 1997. The sedimentology, sequence stratigraphy and fluid migration history of non-marine and shallow marine reservoirs, North of Apoi and Funiwa fields, offshore Niger Delta. *Proceedings of the GCSEPM Foundation 18th Annual Research Conference, Shallow Marine and Nonmarine Reservoirs, December 7-10, 1997, Houston Texas* 365-376.

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Hesselbo, S.P., Coe, A.L., Batten, D.J. and **Wach, G.D.**, 1990. Stratigraphic relations of the Lower Greensand (Lower Cretaceous) of the Calne area, Wiltshire. *Proceedings of the Geologists' Association*, 101 (4), 265-278.

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Sêco, S. L. R., Silva, R. L., Watson, N., Duarte, L.V., Pereira, A. J. S. C., **Wach, G.D.** 2019. Submitted. Application of petrophysical methods to estimate total organic carbon in Lower Jurassic source rocks from the offshore Lusitanian Basin (Portugal) Journal of Petroleum Science and Engineering

Williams, J., Risk, D., Marshall, A., Martell, A., Nickerson, N., **Wach, G.D.**, Creelman, C., and Grace, M. 2019. Submitted. Methane emissions from abandoned coal and oil and gas wells developments in New Brunswick and Nova Scotia. Environmental Monitoring and Assessment.

Kelly, T.B. and **Wach, G. D.** 2018. Submitted. Reservoir Heterogeneity in "Homogenous" Sandstones. Canadian Journal of Earth Sciences.

Grace, M., Williams, J., Butler, K.E., McLachlan, E., and **Wach, G. D.**, 2018. Submitted. Comparison of Greenhouse Gas Emissions to Petroleum Geology and Legacy Well Infrastructure at Stoney Creek Field, New Brunswick, In review for publication as an Open File by the New Brunswick Department of Energy and Resource Development.

Anderson, E. and **Wach, G. D.**, Submitted. Diagenetic effects at erosional boundaries in the Triassic Wolfville formation at Rainy Cove, Nova Scotia. Submitted. Bulletin of the Canadian Society of Petroleum Geology

Silva, R.L., Duarte, L.V., **Wach, G.D.**, Morrison, N., Campbell, T., Submitted. Oceanic dissolved organic carbon as a first-order control of the carbon cycle during the Bathonian–Callovian.

Tobey, D., **Wach, G. D.** Submitted. Late Mesozoic Through Cenozoic Shelf Margin Progradation, offshore Nova Scotia. Bulletin of Canadian Petroleum Geology.

Work in Progress

Kelly, T.B. and Wach, G.D. In Prep. A Ground-Penetrating Radar Study of the Stratigraphic Architecture of the Joggins Formation, Joggins, Nova Scotia. Sedimentary Geology

Kelly, T.B. and Wach, G.D. In Prep. Stratigraphy, Facies, and Depositional Environments of the Logan Canyon Formation, Sable Subbasin, Offshore Nova Scotia. Marine and Petroleum Geology,

Kelly, T.B. and Wach, G.D. In Prep. Reservoir Characterization of the Logan Canyon Formation using Integrated Stochastic Inversion. American Association of Petroleum Geologists Bulletin

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2018

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Ricardo L. Silva, Grant D. Wach, Luis V. Duarte, Juan Gómez, Stephen P. Hesselbo, Driss Sadki, João G. Mendonça Filho, Bruno Rodrigues, and Darragh O'Connor - Lower Jurassic organic matter preservation events in the central and north Atlantic conjugate margins

Darragh O'Connor, Ricardo Silva, and Grant Wach - Sedimentological evidence for Late Triassic (Rhaetian) marine incursion in the Central Atlantic Scotian Margin

Grant D. Wach, Ricardo Silva, Juan C. Wong, Natasha Morrison, Taylor J. Campbell, Trevor B. Kelly, Carla H. Skinner, Kenneth T. Yellow-Martyn, Darragh E. O'Connor, Anne C. Hargreaves, Charlie Carlisle, Leslie Eliuk, Xinyue Hu, Maya Soukup, and Philip Sedore - Overview of the Petroleum Systems of the Central Atlantic Margin

Erin D. Anderson, Jennifer Lee, and Grant Wach - Diagenetic effects at erosional boundaries in the Triassic Wolfville Formation at Rainy Cove, Nova Scotia

Anne C. Hargreaves, F.W. Richards, Ricardo Silva, and Grant D. Wach - Seismic and Lithological Characterization and Source Rock Potential of the Aptian Naskapi Shale Member, Logan Canyon Formation, Offshore Nova Scotia

Trevor B. Kelly and Grant D. Wach - 3-D Seismic Geomorphology of Paralic Channel Complexes, Sable Sub-basin, Offshore Nova Scotia

Kenneth Martyns-Yellowe, Darragh E. O'Connor, Ricardo Silva, and Grant D. Wach—The Aeolian Triassic Rift Fill Sediments at Red Head, Five Islands, Nova Scotia, Canada

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Natasha M. Morrison, Ricardo L. Silva, F.W. (Bill) Richards, and Grant D. Wach - Seismic Inversion and Source Rock Evaluation on Jurassic Organic Rich Intervals in the Scotian Basin, Nova Scotia

Carla H. Skinner, Grant D. Wach, and Juan C. Wong—High Pressure Situations: Understanding Reservoir Compartmentalization in the Sable Subbasin

Juan C. Wong, Xin Yue Hu, Ricardo L. Silva, and Grant D. Wach - The effects of salt on Lower Jurassic Source Rock maturation on the Scotian Margin

AGS 44th Colloquium Truro, Nova Scotia

Ricardo L. Silva, Luís V. Duarte, Juan J. Gómez, Stephen Hesselbo, João G. Mendonça Filho, Driss Sadki, Bruno Rodrigues, Darragh O'Connor and Grant Wach 2018. Lower Jurassic organic matter preservation events and their record offshore Nova Scotia. AGS 44th Colloquium and Annual Meeting, Truro, Nova Scotia

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Fillon, R. H., Waterman, A. S., and **Wach, G. D.** 2014. Where are the Gulf of Mexico upper Paleogene deepwater reservoirs? Oh Canada. Gulf Coast Association of Geological Societies Transactions, v. 64, p. 693

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Wach, G.D. - Sedimentary Basins: Origin, Depositional Histories, and Petroleum Systems - Keynote Address - 2014 GCSSEPM Conference

Eliuk, L.S. and **Wach, G.D.** - Reefs and Deltas at the edge - the highly unusual close association of a thick Abenaki carbonate platform and the major Sable delta, Mesozoic offshore Nova Scotia Shelf Canada. 4th Atlantic Conjugate Margins Conference 2014

Vincent, H., Wach, G.D., and *Kettanah, Y.*, Detrital framework of sandstones across the NE South American margin and implications for the uplift history; a case study from the islands of Trinidad and Barbados.

G.D. Wach, *L. Eliuk, R.L. Silva, Y. Kettanah, C.H. Dickson, D. O'Connor, T. Kelly, T. Campbell, C. Wong, N. Morrison and N. Plummer,* 2014, Petroleum systems and risk elements of the offshore Eastern Canada – Geo Convention 2014 FOCUS

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2019

Wach, G. D. 2019 Dr. Abraham Gesner, FGS – Horse Trader, Government Agent, Physician, Scholar, Geologist and Father of the Petroleum Industry (Keynote Address). Petroleum History Annual Symposium. Saint John, New Brunswick, June 27, 2019

Wach, G.D., Shanley, Keith W., and Boyles, Mike. 2019. Non-marine and marine trace fossil assemblages within the Cretaceous Blackhawk Formation, U Professor Pemberton Memorial Session. GeoConvention, Calgary, Alberta, May 13-15, 2019

Wach, G. D. 2019. Petroleum Systems and Source Rocks of Atlantic Canada. Geological Survey of Canada. Halifax, Nova Scotia. April 8, 2019

Updated October 2019

Wach, G. D. 2019. Petroleum Systems and Source Rocks of Atlantic Canada. University of Jean, Andalucia, Spain. March 19, 2019

Wach, G. D. 2019. Petroleum Systems and Source Rocks of Atlantic Canada. Department of Earth Sciences Seminar Series, Dalhousie University. Halifax, Nova Scotia March 14, 2019

Wach, G. D. 2019. Petroleum Systems and Source Rocks of Atlantic Canada. Department of Geology Seminar Series, Saint Mary's University. Halifax, Nova Scotia March 8, 2019

Wach, G.D. 2019. Hans Kugler and John Saunders – An Overview of Trinidad Mapping and Stratigraphy. Overview and Evolution of Stratigraphic Concepts in Trinidad, Geological Society of Trinidad and Tobago and AAPG Young Professionals of Trinidad and Tobago. February 19, 2019

Kelly, T. and **Wach, G.D.** Ground-penetrating radar investigation of the fluvial meanderbelt strata of the Carboniferous Joggins Formation, Nova Scotia. 45th Atlantic Geosciences Society Colloquium, Fredericton, New Brunswick, February 8-9, 2019.

Wach, G. D., Wach, G. E., and O'Connor, D. E. - Calibration of the Lower Cretaceous Type Sections and Petroleum Systems of the Atlantic Margin. GeoConvention, Calgary, Alberta, May 13-15, 2019

Juan, C. Wong; XinYue Hu; Ricardo, L. Silva and **Grant, D. Wach** - Lower Jurassic Source Rock of the Scotian Margin: Effects of Salt on Maturation and Implications on the Petroleum System. GeoConvention, Calgary, Alberta, May 13-15, 2019

Anne C. Hargreaves, F.W. Richards, Ricardo Silva, and **Grant Wach** - Seismic and Lithological Characterization and Source Rock Potential of the Aptian Naskapi Shale Member, Logan Canyon Formation, Offshore Nova Scotia. GeoConvention, Calgary, Alberta, May 13-15, 2019

Kenneth T. Martyns-Yellowe, **Grant D. Wach**, Frank W. Richards and Neil Watson - Investigating the role of crestal faulting on hydrocarbon trapping in rollover structures of the Sable Subbasin, Offshore Nova Scotia - Insights from the Migrant Structure. GeoConvention, Calgary, Alberta, May 13-15, 2019

Grant D. Wach and Carla, H. Skinner - High Pressure Situations: Understanding Reservoir Compartmentalization in the Sable Subbasin. GeoConvention, Calgary, Alberta, May 13-15, 2019

Xinyue Hu; Carlos Wong; Ricardo Silva and **Grant Wach** - 1D and 2D Petroleum System Modelling of Potential Lower Jurassic Source Rock on Scotian Margin. GeoConvention, Calgary, Alberta, May 13-15, 2019

Trevor B. Kelly and **Grant D. Wach** - Stratigraphy, Depositional Setting, and Reservoir Quality of the Logan Canyon Formation, Offshore Nova Scotia. GeoConvention, Calgary, Alberta, May 13-15, 2019

Professor Pemberton Memorial Session: **Grant D. Wach**, Keith W. Shanley and Mike Boyles - Non-marine and marine trace fossil assemblages within the Cretaceous Blackhawk Formation, Utah. GeoConvention, Calgary, Alberta, May 13-15, 2019

David Brown and **Grant Wach*** The History of Petroleum Exploration on the Scotian Margin and the Sable Field Development. Petroleum History Annual Symposium. Saint John, New Brunswick, June 27, 2019. Gerald Friedman Best Paper award.

Grant Wach*, Michael Knappertsbusch, and John Frampton. Hans Kugler & John Saunders and their influence on Trinidad Exploration and the Development of Biostratigraphy. Petroleum History Annual Symposium. Saint John, New Brunswick, June 27, 2019

2018

Wach, G.D. 2018. "GaSP – Methane Mitigation in the Canadian Atlantic Provinces" UNECE 27th Session of the Committee on Sustainable Energy, Geneva, Switzerland. September 26-27, 2018

Wach, G. D. 2018. Petroleum Systems and Source Rocks of Atlantic Canada. Directorate of the Polish Geological Institute - National Research Institute. Warsaw, Poland. September 20, 2018

Wach, G. D. 2018. Methane Emissions from Legacy Fossil Fuel Sites. Directorate of the Polish Geological Institute - National Research Institute. Warsaw, Poland. September 19-21, 2018

Wach, G. D. 2018. Compressed Air Energy Storage in Salt Caverns in the Maritimes. Directorate of the Polish Geological Institute - National Research Institute. Warsaw, Poland. September 19-21, 2018

Wach, G. D. 2018. "Compressed Air Energy Storage" 1st Sustainable Solutions for Growth Conference, Wroclaw, Poland. September 17-18, 2018 Selected as one of the best two papers.

Ricardo L. Silva, Luís V. Duarte, Juan J. Gómez, Stephen Hesselbo, João G. Mendonça Filho, Driss Sadki, Bruno Rodrigues, Darragh O'Connor and Grant Wach Lower Jurassic organic matter preservation events and their record offshore Nova Scotia. AGS 44th Colloquium and Annual Meeting, Truro, Nova Scotia

Silva, R.L., Duarte, L., **Wach, G.D.** Toarcian Anoxic Event (TAE), Coimbra, Portugal Sept 3-8th.

Wach, G. D. 2018. "Compressed Air Energy Storage" 1st Sustainable Solutions for Growth Conference, Wroclaw, Poland. September 17-18, 2018 Selected as one of the best two papers.

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Ruffell, A.H. and **Wach, G.D.**, 2018, Electromagnetics: locating sites of buried military activity, NSGG Recent Works in Archaeological Geophysics meeting 4th December 2018, Geological Society of London.

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2. *Silva, R.L.*, Duarte, L.V., Gómez, J.J., Mendonça Filho, J.G., Wach, G., Sadki, D., Rodrigues, B.*, *Carlisle, C.*, Caniço, A., Lower Jurassic organic matter preservation events, an oceanic anoxic event, and carbon cycle perturbations. Goldschmidt2017, Paris, France.

2016

Silva, R.L. and **Wach, G.** 2016. Source rock consortium and relevant inferences to the Scotian Margin. Central Scotian Slope Workshop, NS Canada.

Silva, R.L. and Wach, G., 2016. Evidence of Lower Jurassic climatic hot snaps and organic matter production: implications and practical applications of recent research developed in the Atlantic margins. Technical Talk with the Geological Society of Trinidad and Tobago.

Wach, G. D. 2016. Petroleum systems & risk elements of the offshore Atlantic Canada. AGS Colloquium 2016, Truro, Nova Scotia, Feb. 5-6th, 2016

2015

Vincent, H. and **Wach, G. D.** 2015. Insights from sandstone detrital framework on the uplift history of the NE South American margin. Caribbean Geological Congress, Port of Spain, Trinidad May 2015

Wach, G. D. 2015. Petroleum systems & risk elements of the offshore Atlantic Canada. CSPG Lecture Tour, Calgary, January 21, 2015

Wach, G. D. 2015 3D Facies and Petroleum Systems of Subsurface Reservoirs. CSPG Lecture Tour, Edmonton, January 22, 2015

2014

Silva, R.L., Wach, G., 2014. Lower Jurassic organic-rich intervals along the Central-Northern Atlantic Margin. Conjugate Margins 2014

Silva, R.L., Wach, G., 2014. Overview of Lower Jurassic source rock intervals along the Central-Northern Atlantic Margin. GAC-MAC 2014

Ketannah, Y., **Wach, G. D.**, and Zentilli, M. 2014. The nature and behaviour of fluids within rock salt: Are salt domes suitable repositories for pressurized hydrocarbons? Environmental Research Symposium (Poster Session), Dalhousie University

2013

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Wach, G. D. 2013. Depositional environments, petrography and provenance of the mid-Cretaceous Dina and Cummings formations, Alberta. GAC-MAC, Winnipeg, May 22-27, 2013

Wach, G. D. 2013. Analogues for Atlantic Canada Reservoirs from the Wessex (England) and Lusitanian (Portugal) Basins. AAPG Annual Convention & Exhibition, Pittsburg, May 19-22, 2013

Dickson, C. and **Wach, G. D.** 2013. Overpressure conditions and reservoir compartmentalization on the Scotian Margin. geoConvention, Calgary, May 6-11, 2013

Grant, A. and **Wach, G. D.** 2013. Steps to Make Natural Gas a Lower Emission Energy Source. geoConvention, Calgary, May 6-11, 2013

Wach, G. D. 2013. The History of the Petroleum Industry in Canada and the Maritimes. Invited Lecture at the University of Waterloo, Waterloo, Ontario, March 11, 2013.

O'Connor, D. and **Wach, G. D.** 2013. The Orpheus Graben Triassic Eurydice and Chedabucto formations and their relationship to the Fundy Basin Wolfville Formation. Atlantic Geosciences Society Colloquium, Halifax, February 1-2, 2013

Eliuk, L. and **Wach, G. D.** 2013. Abenaki Carbonate Platform to Sable Island Delta Transition: In search of modern analogues and towards a seismic-and-well-based model for a major depositional facies change - Late Jurassic, Nova Scotia Shelf, Canada. Atlantic Geosciences Society Colloquium, Halifax, February 1-2, 2013

Tobey, D. and **Wach, G. D.** 2013. High resolution sequence stratigraphy of the Banquereau Formation, Offshore Nova Scotia. Atlantic Geosciences Society Colloquium, Halifax, February 1-2, 2013

Wach, G. D. 2013. Burning Rocks: The History of the Petroleum Industry in Canada and the Maritimes. Atlantic Geosciences Society Colloquium – Banquet Speaker, Halifax, February 1-2, 2013

2012

Wach, G.D. 2012. The History of Oil and Gas Exploration in Canada and the Maritimes, St. Francis Xavier University, October 29, 2012

O'Connor, D. and **Wach, G. D.** 2012, Reservoir quality and architectural elements of Mesozoic rift basin sediments, Scotian margin. Conjugate Margins Conference Poster Session, August 22-24, 2012, Dublin, Ireland

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2010

Fraser, J.A. and **Wach, G.D.** 2010, Trends and architecture of Low Density Turbidites of the Lower Ordovician Meguma Supergroup, Nova Scotia. GeoCanada 2010, Program with Abstracts, May 10-14, 2010, Calgary, Canada.

Goss, S.J., Mosher, D.C., and **Wach G.D.**, 2010, Cenozoic seismic sequence stratigraphic analysis of the Suriname margin, South America, GeoCanada 2010, Program with Abstracts, May 10-14, 2010, Calgary, Canada.

Mosher, D.C., **G.D. Wach, D.C. Campbell, M.K. Giles, V.I. Brake**, 2010, Reservoir distribution and characterization: continental slope depositional systems along the Scotian margin. GeoCanada 2010, Program with Abstracts, May 10-14, 2010, Calgary, Canada.

Giles, M.K., Mosher, D.C., and **Wach, G.D.**, 2010. Mass Transport Deposits on the Southwestern Newfoundland Slope: Eastern Canada, GeoCanada 2010, Program with Abstracts, May 10-14, 2010, Calgary, Canada.

Wach. G.D. Mosher, D.C., **D.C. Campbell, M.K. Giles, V.I. Brake** 2010, Margin evolution and reservoir distribution- examples from Cenozoic of the Central Atlantic margin, American Association of Petroleum Geologists Annual Convention and Exhibition, Program with Abstracts, New Orleans, April 2010.

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2009

Wach, G.D.; **Y. Kettanah,** A. Mory, 2009, Provenance of the Tumblagooda Sandstone, Western Australia, American Association of Petroleum Geologists Annual Convention and Exhibition, Program with Abstracts, Denver, Colorado, June, 2009.

Giles, M.K., Mosher, D.C., Piper, D.J.W., Nedimovic, M.R., and **Wach, G.** 2009. Continental Slope Sedimentation Models: Laurentian Channel and Halibut Channel Regions, eastern Canada. American Association of Petroleum Geologists Annual Convention and Exhibition, Program with Abstracts, Denver, Colorado, June, 2009.

Brake, V., Mosher, D., and **Wach, G.** 2009. Oligocene canyon development: Implications for sediment delivery on the eastern Scotian Margin. American Association of Petroleum Geologists Annual Convention and Exhibition, Program with Abstracts, Denver, Colorado, June, 2009.

Mosher, D.C. and **Wach, G.D.**, 2009 “Passive” margin sedimentation and reservoir distribution along the Scotian margin. Extended Abstract, Canadian Society of Petroleum Geologists Conference, Calgary, Alberta, May 4-7, 2009

Campbell, D.C., D.C. Mosher, M.E. Deptuck and **G.D. Wach,** 2009 The formation of a Miocene Deepwater Erosional Unconformity and Subsequent Deposition Patterns on the Western Scotian Slope, Canada Canadian Society of Petroleum Geologists Conference, Calgary, Alberta, May 4-7, 2009.

Goss, S.J., Mosher, D.C., **Wach, G.D.** 2009. (Abstract) Cenozoic Shelf to Slope Transition along a Passive Continental Margin: Suriname, South America, American Association of Petroleum Geologists Annual Convention and Exhibition, Program with Abstracts, Denver, Colorado, June, 2009.

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Brake, V.I., Mosher, D.C., and **Wach, G.,** 2008. Oligocene canyon and fan development: the respective roles of sea level and sediment delivery in evolution of the eastern Scotian margin. Extended Abstract, Proceedings of the Canadian Society of Petroleum Geologists joint annual convention, May 12-15, 2008, Calgary, Alta, Abstract 122.

Brake, V., Mosher, D., and **Wach, G.** 2008. Oligocene canyon development: Implications for sediment delivery on the eastern Scotian Margin. Central Atlantic Conjugate Margins Conference. Dalhousie University, Halifax, Nova Scotia. August 13-15, 2008. Abstract and Poster

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Goss, S., and Mosher, D.C., and **Wach, G.**, 2008. Continental margin development of the equatorial gateway, Suriname, South America. In: (Brown, D. and Watson, N., eds) Extended Abstract Proceedings and POSTER, Central Atlantic Conjugate Margins Conference, Halifax, Nova Scotia, August 13-15, 2008, p. 282-291.

Eliuk, L. and **G. Wach.** 2008, Carbonate and siliciclastic sequence stratigraphy – examples from the Late Jurassic Abenaki limestone and West Venture deltaic beds, offshore Nova Scotia, Canada. In; Brown, D.E., ed., Program & Extended abstracts Central Atlantic Conjugate Margin Conference, CD and website, p. 410-437.

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Wach, G.D., **Vincent, H.**, 2008, Reservoir Heterogeneity and Characterization in Deltaic Depositional Systems – Outcrop Analogues for Heavy Oil and Oil sand Developments, Search and Discovery Article #50064 (2008), Extended abstract, AAPG Hedberg Conference “Heavy Oil and Bitumen in Foreland Basins – from Processes to Products”.

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Brake, V.I., Mosher, D.C., and **Wach, G.**, 2007. Oligocene canyon and fan development on the eastern Scotian Slope. Nova Scotia Offshore Basin Forum, Program with Abstracts, October 1-2, Halifax, NS.

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analogue to the Scotian slope. Offshore Energy Technical Research Association: Nova Scotia Offshore Basin Forum, October 1-2, Halifax, Nova Scotia.

Vincent, H., Wach, G.D., 2007a, Paleogene slope deposits; Examples from the Chaudière, Pointe-a-Pierre and San Fernando formations, Central Range, Trinidad, Kennan, L., Pindell, J., Rosen, N., The Paleogene of the Gulf of Mexico and Caribbean Basins, Processes, Events and Petroleum Systems, 27th Annual GCSSEPM Foundation Bob F. Perkins Research Conference, p. 554-585.

Vincent, H., Wach, G.D., 2007b. Sequence Stratigraphy, Depositional Environments and Reservoir Characterization of the Lower Morne L'Enfer Formation, Southwest Trinidad. Field Trip #1, The 4th Geological Conference of the Geological Society of Trinidad and Tobago, Port of Spain, Oral Sessions and Field Trips.

Vincent, H., Wach, G. D., Johnson, N., 2007, Lithofacies and depositional processes in the Morne L'Enfer Formation: Outcrop insights into Pliocene Southern Basin sedimentary fill, The 4th Geological Conference of the Geological Society of Trinidad and Tobago, Port of Spain, Oral Sessions and Field Trips.

2006

Wach, G.D. and C. Archie, 2006, Reservoir Distribution and Production in Mobile Shale Basins-Examples from the Cruse Formation of Southern Trinidad. AAPG/GSTT HEDBERG CONFERENCE, "Mobile Shale Basins- Genesis, Evolution and Hydrocarbon Systems", June 5-7, 2006- Port-of-Spain, Trinidad and Tobago, Program with Abstracts.

Wach, G.D. Vincent, H.L.G., and Akram, F., 2006, Testing production sensitivity in a constrained 3-D fluvial estuarine channel complex, Trinidad. 3-D Outcrop Imaging, Reservoir Analogs and Teaching (SEPM). 2006 AAPG Annual Convention Houston, Texas, (April 9-12, 2006) Technical Program Abstracts.

Kettanah, Y. and Wach, G.D., 2006, the provenance of heavy minerals in the Mesozoic and Tertiary formations at the Venture B-13 borehole, offshore Nova Scotia, Canada. Non-bio and Chemostratigraphy (SEPM). 2006 AAPG Annual Convention Houston, Texas (April 9-12, 2006) Technical Program Abstracts.

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Fiorini, F., Scott, D. and **Wach, G.D.**, 2006. Foraminiferal, sedimentological and ichnological analysis of Early Cretaceous sediments (Scotian Shelf). Integrating Biostratigraphy into Geological Models (SEPM/NAMS). 2006 AAPG Annual Convention Houston, Texas (April 9-12, 2006) Technical Program Abstracts.

V. Arbour, S. Mason, S.F. Jones, D. Scott, G.D. Wach, 2006, Nannofossils- Implications for stratigraphic precision in the Tertiary and Mesozoic, offshore Nova Scotia. Nova Scotia Energy Research and Development Forum, St. Francis Xavier University, Keating Millennium Centre, Antigonish, Nova Scotia, May, 2006.

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Mason, S.K., Arbour, V., D.B. Scott, G.D. Wach and Younger, C., 2006, Nannofossils and biostratigraphy of the Sauk A-57 and Shubenacadie H-100 wells, offshore Nova Scotia. Nova Scotia Energy Research and Development Forum, St. Francis Xavier University, Keating Millennium Centre, Antigonish, Nova Scotia, May, 2006.

Kettanah, Y.A., D.B. Scott, P. Stoffyn -Egli and G.D. Wach, 2006. The first submarine occurrence of baricite: a rare hydrated Fe-Mg phosphate mineral, Beaufort Sea, Canada., Atlantic Geoscience Society 32nd Colloquium & Annual General Meeting, February 2006, Wolfville, Nova Scotia, Canada.

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