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Displaying Well Control Incident Data in Petrel A Workflow for Promoting Rig Safety Across Disciplines

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The Rocks Provincial Park, Hopewell Cape, New Brunswick

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### LETTER FROM THE EDITOR

No letter from the editor.

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No message from the board.

### TECHNICAL ARTICLE

**Displaying Well Control Incident Data in Petrel A Workflow for Promoting Rig Safety Across Disciplines**

Go Take a Hike

### UPCOMING EVENTS

- Technical Luncheon
- Division Talks

### GEOCOMMUNITY TALKS

- GeoWomen Luncheon Talk

### SOCIETY NEWS

- 2019 Core Conference
- 30th Annual CSPG Mixed Golf Tournament August 23, 2019
- WIUGC Student Conference Wrap Up
- CSPG Graduate Student Thesis Award (PhD)
- Graduate Student Thesis Award (M.Sc.)
- In Memoriam
LETTER FROM THE EDITOR

It is springtime already. Spring skiing, Easter statutory holiday, race to the wire in beer league hockey and summer vacation holiday planning time. Of course, it also means daydreams of geological field trips.

CSPG still has copies of the monster 2-volume “Classic Field Trips of Western Canada”, which will soon be replaced by the “Go Take a Hike” initiative. See the website for details on how you can be involved and how your company can champion this unique e-publication. It represents a way of keeping our 21st Century CSPG publications constantly at the state-of-the-art; alive and relevant to our profession.

Speaking of relevance, why are field trips so attractive to the geoscience community? (spoiler alert! No brainer ahead). We have a visceral need to touch, break apart, examine, document and learn ever more about what is nature’s most enduring publication – the Rock Record. Be it igneous, metamorphic or sedimentary; a rock is where it is at. It feeds our intellectual needs; represents our profession; and the rock provides a cornucopia of good things for humankind. Even if a few folks seem to be of the opposite opinion.

Field trips are a never-ending string of enjoyable days in the open with old friends, new friends and a chance to share our knowledge with young folks just entering the exciting world of geoscience. They also have the pragmatic appeal of getting up close and personal with the reservoir rocks we seek to exploit to create the feedback for that cornucopia of Good Things.

Petroleum geologists have traditionally been the explorers of the petroleum business. Explore the rocks in macro- and microscale; imagine the hidden pay zones of the basin; consult with the geophysicists about the continuity of the pay zone and figure out where the traps should be. Then drill to prove it all up.

While exploration must still be an important part of the petroleum geologist’s consciousness, the reservoir itself has become an overriding corporate obsession. Global economics and politics dictate that the most effective and efficient delivery of crude to the refinery gate will reward the most effective and efficient E&P companies. This has come to mean that exploration has become of secondary importance and wringing the last looney’s worth of crude from known reservoirs is central to the survival of the company. It must also be true for petroleum geologists who need to continue making a living.

In December, the Society of Petroleum Evaluation Engineers (Calgary Chapter) released the 3rd edition of the Canadian Oil and Gas Evaluation Handbook (COGEH for short) in portable document format (pdf). This edition is entirely electronic and can be rented for a small fee by anyone who is interested at https://speecanada.org/coge-handbook-subscription/. Everyone in the upstream oil and gas business should be intimately familiar with this document, as it lays out the principles by which petroleum geology needs to be conducted in order to meet the needs of the financial community. The institutional investor is every petroleum geologist’s client and paymaster. It also provides a common link of communication with petroleum engineers and with the geophysicists and shares technical linkages that must be respected in every reserves and resources evaluation report issued.

COGEH is not a legal document per se, however it is prescribed by the Alberta Securities Commission through National Instrument 51-101 as the standard for reserves and resources evaluation and reporting purposes. NI51-101P1 (the format for the public disclosure of a company’s resources and reserves) is a legal document, however.

APEGAs has published a companion Professional Practice Standard that is available (free) on the Association

(Continued on page 18...)

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Tom Sneddon
Professional Geologist (Alberta), Professional Geoscientist (B.C.), retired recently as Director of Geoscience and Outreach for APEGAs, has been a member of the CSPG for over 40 years, and has pursued a career in geoscience since his university days. He has two degrees — both from Alberta: initially from the University of Calgary in 1969 (B.A. Geography), and from the University of Alberta (M.Sc. in Water Resources, Dept. of Civil Engineering, 1981). His initial industry experience was with Amoco Canada in 1967-69 as a “Geophysical Professional Assistant” for seismic data management, processing, and seismic section preparations.

Tom has taken his broad geoscience experience — over 30 years of earth sciences experience, including experimental watershed research, hydrology, hydrogeology, environmental geology, oil and gas prospect development, drilling programs, and extensive field work in minerals exploration and development — in both government and industry, and applied it to the promotion of professionalism within the geosciences, through his role at APEGAs.

Readers of The RECORDER, The Source, the CSPG Reservoir, and The PEG have seen Tom’s numerous articles on the role of the professional geoscientist.
CSPG Education Program Overview

Over the past several years, the CSPG revitalized its Continuing Education program through the excellent and engaged leadership of Mark Caplan as Education Director and the additional hard work of the CSPG staff and a large team of dedicated volunteers. In the past two years, both spring and fall multi-course events were held along with additional learning events throughout the year. This contributes significantly to CSPG annual budget and, more importantly, continues to be a valuable service to the society’s membership.

As Mark starts a much-deserved break from his role on the CSPG board, I have some big shoes to fill. However, having worked closely with Mark over the past two years while planning the 2018 and 2019 Spring education events, I can at least start my tenure with a pretty good idea of some of the ways I might expand on what the CSPG is already achieving in the education realm. I’m pretty excited to get working on some ideas that have come from a variety of sources including other board members and volunteers. Some of these will include:

- Creating a volunteer-based, and volunteer-led, Education Committee to advise and work closely with myself and CSPG staff in planning learning events and running the Education program in general
- Transforming the program focus from discrete spring and fall education “weeks” to a more continuous annual selection of offerings (which seems to be a better option for both instructors and attendees)
- Starting to develop a CSPG catalog of events that can be offered regularly to the public and/or on demand

There’s no Doubt About It - Education has Changed

Education in our industry isn’t what it used to be. Companies are generally no longer able to send new hires on expansive training programs with distant field trips and weeks-long courses. Instead there is a lot more on-the-job learning expected, hopefully with at least some form of mentorship. Mid-career individuals are doing the jobs that two or three people were doing a few years ago and don’t necessarily have time to attend full-day, never mind multi-day, events. Training budgets are slim at best, so trainees and/or managers must be very selective and focused in choosing what to spend them on.

Organizations that provide training today have to be alert to the changing needs of their audience and nimble in the subjects and types of events they offer. This is no easy feat. CSPG’s education program will need to evolve over the next few years to a range of learning “events” which could be instructor-led courses, online events, recorded events, field trips (real or virtual), publications and more. Some of these may need to be planned and executed in cooperation with other CSPG directors, staff or volunteer committees.

Join Me!

Would you, CSPG Member, like to join me on this journey? Volunteering on an effective committee can be very rewarding both professionally and personally. On the other hand, volunteering on a poorly organized, inefficient committee can be challenging or, worse, downright discouraging. In my experience, some characteristics of committee members that lead to fun, effective committees include:

- A passion for, or at least a strong interest in, the mandate of the committee (education!)
- A commitment to contributing to the committee activities, including following up on action items between meetings and preparing for meetings, and the ability to make it to meetings on a regular basis (of course we all miss some…)
- Employer support of volunteer activities (otherwise...stressful.)
- Good communication skill and, (big bonus) a sense of humour

In the coming months I’ll be forming the new Education committee and welcome interest in participating from any of CSPG’s members: young, retired, working, on a hiatus, with or without teaching experience. If you have ideas for how our program can better meet the needs of membership, then I want to hear from you. You can use my new, online Education suggestion box at https://goo.gl/forms/7OCfMGXE5CBhFkJQ2 or email me at education@cspg.org.◆
DISPLAYING WELL CONTROL INCIDENT DATA IN PETREL
A WORKFLOW FOR PROMOTING RIG SAFETY ACROSS DISCIPLINES

Kurt D Armbruster, P. Geol.

SUMMARY
Rig safety begins in the office. Well control incidents such as kicks and blowouts can be catastrophic. Kicks are commonly controlled, however, in the last 40 years in British Columbia, 16 out of 894 (1.7%) of the well control incidents reported to the BC Oil and Gas Commission (OGC) have resulted in blowouts. In the worst cases, these can lead to loss of rigs or loss of life.

On the Engineering side of well planning, it is a best practice in the Oil and Gas industry to mitigate the risk of kicks and blowouts by preparing Pore Pressure and Fracture Gradient (PPFG) predictions prior to drilling the well. The PPFG process should include a tabulation of any lost circulation, kick, and blowout incidents. PPFG data are ultimately used to provide a window for the mud weights while drilling, and may dictate additional casing runs.

This paper will demonstrate one workflow in which a Geologist can contribute to the safety culture of the rig crew. By preparing a simplified cross section depicting the precise stratigraphic location of well control incidents and posting the cross section in the doghouse, company man’s shack, or wellsite geologist shack, the author intends to empower rig crews to anticipate zones which may be problematic. With annotated, yet uncluttered cross sections, rig workers will be able to see a visualization of offset well control incidents in stratigraphic space, in addition to the tabular format generated during the PPFG process. For best results, the geologist should collaborate with their drilling and reservoir engineers, petrophysicists, geophysicists, and geomechanics colleagues during the entire well planning process.

This paper utilizes BC data in Petrel as a case study. The workflow may be applied to any basin in which well control incident data are available. While this workflow uses Petrel as a case study, it may be used with any visualization software with appropriate modifications to the workflow as per that software’s user experience (UX). Some data/map vendors in Canada include well-incident data in their mapping services, and allows a user to post the data on maps and cross sections with the click of a button. Regardless of the software, the author recommends this methodology be used to supply well incident and/or geohazard maps and cross sections to field personnel.

Pending data availability, the methodology may also be applied to lost circulation events, H2S flags, or any other hazard that one wishes to communicate to the rig. The methodology may be used in any basin, provided incident data are available.

Data:
While well control data are available from several private vendors in Canada, this workflow describes how data can be freely obtained from the BC Oil and Gas Commission (OGC) and focuses specifically on kicks and blowouts as reported to the OGC.

The author assumes that the bit depth in the incident report is the well depth from which the flow originated.

The OGC requires operators to report Kicks and Blowout incidents. The OGC database includes data collected since 1976. As of mid-January 2019, nearly 900 incidents have been recorded, including 879 kicks, and 17 blowouts. The Kicks and Blowout data are tabulated into a spreadsheet, which is hosted and available to access, free of charge, on the OGC’s website at: https://iris.bcogc.ca/generic_ogc/Ext_Accnt.

Logon

A free account for the OGC Website is required to access the data, and can be created at: https://iris.bcogc.ca/generic_ogc/Ext_Accnt.Welcome
Once a user has logged into the website, select the link to the “Drilling Kicks and Blowouts by Area” CSV file, and input the date range (Fig 2). The author recommends inputting a large date range to ensure no incidents are missed. Drop the CSV file directly into Excel.

Data included in the report are: Incident Type, Well Area Name, Well Authorization (WA) Number, Well Name, Drilling Event, Confidential Flag, Incident Date, Depth, Numerical Formation Code, Formation Description (Formation Name), Influx Size (m3), SIDPP (KPa), SICP (KPa), Kick Control Mud Density (kg/m3), Occurrence Mud Density (kg/m3), and comments (usually a written description of the event). For the purposes of this paper, many of the columns have been hidden in screen-captures of the workflow in order to emphasize key data columns. (Fig 3).

As stated above, the data in this example were downloaded directly from the OGC for no charge. Several vendors in Canada contain similar data from across the Western Canadian Sedimentary Basin. Call your data vendor for more details.

**Workflow Description**

When the spreadsheet has been downloaded, perform a quality control (QC) check. There are several entries in the database in which the comments “overflow” and are spread out over several rows (fig. 4). The overflow comments must be combined into a single row by either combining them into a single cell. If the comments are too large for a single cell, create more comments columns as needed.

Following the initial QC, the wells in the spreadsheet must be matched to the wells in the user’s Petrel project. If the user’s Petrel wells are identified by UWI, there is an extra step, as the OGC’s spreadsheet lacks UWI information. If the Petrel well database includes the WA numbers, copy both the WAs and the UWIs into a new tab in the spreadsheet. Otherwise, a software database such as AccuMap or GeoScout will be required to source the WA and UWI Data for the wells in the target area of interest. After the UWI and WA data have been imported into the OGC dataset, perform a VLOOKUP command to merge the UWI data into the OGC dataset as a new column.

When the UWIs have been integrated into the Kicks and Blowouts spreadsheet, the next step is to QC the remainder of the spreadsheet. It is critical to ensure that units in the spreadsheet match with the units in the Petrel Project. Any missing data cells must be represented as null values. The author suggests adding at least one extra column, providing a numerical code for kicks (1) and blowouts (2). This provides a simple method for displaying them on a petrophysical well log as point data. QC of stratigraphy must be done once the data are in Petrel, as they can easily be cross-referenced against the user’s tops picks and/or geological model. Check for missing mud weight data. If the incident mud weight, control mud weight, or incident depth is missing in the spreadsheet, look in the drilling tour sheets to find the data.

The spreadsheet can then be loaded into Petrel using the Point Well Data import functionality.

Point Well Data (PWD) can import any spreadsheet into Petrel, and allows the user to determine the types of data imported by column (ie: text, continuous or discrete numerical data, dates, etc.). The two most critical columns in the spreadsheet for the PWD import are the Well Identifier (commonly the UWI) and the depth. Assign and name the columns in the import dialogue box. When the data are imported, Petrel will assign the data points to the associated measured depth (MD) along the wellbore. Perform a QC of the data in Petrel’s database. Any data from the spreadsheet can then be displayed or modeled by Petrel.

The author also recommends that a user request the PPFG and mud density data for wells owned by their company from their reservoir engineer, and loads these data into Petrel as well-log curve data. The

(Continued on page 10...)
PPFG and mud weight plots can then be incorporated into a well-section window template for well planning purposes.

The kicks and blowouts data may be displayed many formats, including, but not limited to:

1. Well-Section window. Display the kick and control weight information as a point log, preferably with the Gamma Ray (GR) track as the GR log is the most common log in MWD tools. Include key tops in the well, especially strata that are problematic for well control. Print out (or PDF) a copy of the well-section, and provide it to the drillers and wellsite geologists. A user may consider posting the kick control mud weight along the same track. (Fig 5)

2. Map view. Display points on a 2-D map or 2-D window to get a visual representation of where incidents are relative to the proposed well. The incident formation name or other data may be posted alongside the well points. (Fig 6).

3. Intersection window. Include the geological model (tops surfaces), nearby incident wells (with GR logs), and display the desired incident data on the wells.

4. Post the kick locations with (QC’ed) formation information on a 3D window. (Fig 7).

5. Any other modeling or methodology to display data critical to operations, and control of any potential incident.

(Continued from page 9...)

Fig 5. Well section window with GR curve, tops, and kicks displayed at depth vs incident mud weight.

Fig 6. Map of Area of Interest showing positions of incidents and stratigraphy of incidents.

Fig 7. 3D Map depicting kicks at formation.
Workflow outline

1. Obtain well incident data from preferred vendor. (Fig 8)

2. Quality control check and edit the spreadsheet so it can be imported as Point Well Data.
   a. Ensure the Well Identifiers on the spreadsheet match Petrel’s Well Identifiers.
   b. Consolidate “comments” to single row.
   c. Ensure all units match the project units.
   d. Other typical cleanup so it can be imported as point well data. (Fig 9)
      i. Missing the incident mud weight or other cells. With thorough investigation into the drilling tour sheets, many of these missing data points can be found.
      ii. Assign a designated null point (such as -999.99) to cells without data.

3. Import as “Point Well Data.” QC imported data. (Fig 10/11).

4. Display data points on a log in a well section window. (Fig 5).
   a. Select a track to display data. Either on the gamma track, or create a new track:
      i. If all wells have incident mud weight, display in mud weight space.
      ii. If some mud weights are missing, use a numerical value, 1=kick, 2=blowout. This may require creating additional columns in the PWD spreadsheet in Petrel.
      iii. Include a point set for the incident control mud weight.
      iv. Alternatively, use different symbols for Kicks and blows to differentiate or import as separate PWD spreadsheets.
   b. If possible, acquire copies of the drilling tour sheets, and create a mud weight log for each incident well. Display point data along a mud weight track.
   c. If possible, annotate with linear distances from planned well to incident wells.

5. Display incident points on 2D-Map. (Fig 6). If desired, include 5, 10, and 15 km radius polygons from planned well. Data may also be displayed in a 3D window. (Fig 7).

6. Create 2D intersection window that intersects all nearby incidents and planned well. Load base geological stratigraphic model, incident wells (with GR, and other desired curves), and kicks point data.

7. Print and/or export the maps, intersection windows, well section windows, etc. 

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via pdf, PowerPoint, or other preferred delivery method. Include in planning documentation/well files.

8. Deliver exported diagrams to well delivery team, including mudlogger/wellsite geologist, drilling engineer, and OSR on Rig.

Alternatives
While this workflow specifically displays Kicks and Blowout data in Cross Section, 2D, and 3D maps, the Point Well Data import can bring any tabular data into Petrel for display and/or modelling. Other potential data that could be incorporated into a general geohazards map and/or cross section can include, but it is not limited to:

1. Lost circulation events.

2. H₂S bearing zones. Formation flags on the well section could be built to depict:
   a. No risk of H₂S in this stratigraphic horizon.
   b. Moderate risk of H₂S in this stratigraphic horizon.
   c. High risk of H₂S in this stratigraphic horizon.

3. Flag horizons known to be geomechanical risks to drilling (or completions) such as stuck pipe, hole collapse, etc.

4. Known cement bond issues. This would be more for the completions crews than the drilling crew.

Conclusions
Providing easy to understand data on well control incidents or other geohazards to front-line rig staff empowers them to be proactive with regards to potential well control incidents. Diagrams and cross sections annotated with well incident/geohazard information are an easily understood method for communicating between disciplines. A visual reference point of where incidents have occurred in local wells offers a clear way to proactively gauge when a zone in which an incident has occurred is approaching. This workflow is intended to augment a thorough PPFG examination of the surrounding wells, not replace it. The author recommends this workflow also be followed to display any lost circulation events alongside kick and blowout events, or any geohazard data which may directly affect the rig crew.

The above workflow is specific to Petrel, and OGC data. Several of the data vendors in Canada have well control incident data in their databases, and/or available via their mapping packages. If your mapping package includes these data and the ability to display the data on cross-sections and maps, the author recommends that you use your preferred software data/vendor/mapping/cross section package of choice. The key is to provide easy to understand data and figures to front line rig staff.

This methodology may also be applied in any basin where kicks and blowout data are readily available. If it is not readily available, talk with your drilling and reservoir engineers to use your company’s proprietary data.

Acknowledgements
Petrel access and screen captures courtesy of Tom Cox
Well data from IHS
Peter Wallis– Editing ✯

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SAVE THE DATE

Core to Characterization Workshop
October 3, 2019

AER Core Research Centre

In conjunction with the 2019 SPE Annual Technical Conference and Exhibition, the CSPG is conducting a one-day core workshop focused on refining and improving reservoir characterization and geomodel inputs using information gathered from core.

For more information visit: www.cspg.org/c2c
The Bay of Fundy is home to the world’s highest tides, and its coastline in New Brunswick and Nova Scotia hosts several impressive geo-hikes. The Hopewell Rocks are one of the most famous sites to hike along the coastline, and they are located only a 40 minute drive south from Moncton, NB. For birdwatchers, a large population of blue herons nest just to the south, and the entire northern part of the Bay becomes home to over 2 million migrating shorebirds from mid-July to mid-August, including 75% of the global population of semipalmated sandpipers (their only feeding stopover in a 4000 km southward migration – so please don’t scare them away!). For most other visitors, the main attractions are the coastal cliff features and the changing views and access associated with diurnal changes in sea level of over 14 m (46 ft). Rising waters can advance across 0.5 km-wide tidal flats in well under 1 hour.

The geology of The Rocks Provincial Park consists of, at the southern end by Daniels Flats, Mississippian (Visean) limestone (Lime-kiln Brook Formation, Windsor Group) interfingering with reddish polymictic pebble conglomerate and sandstone (Hopewell Cape Formation, Mabou Group). Moving north along the coast, the redbeds occur more exclusively, occasionally exhibiting cross-bedded and imbricated conglomerate and thin siltstone with reduction spots and nodular calcrites. Tectonism, in part likely associated with salt movement in formations associated with the Visean limestone, has resulted in beds tilted ~30° north and the formation of variably inclined fractures. Quaternary advance and retreat of ice sheets have also stressed and (vertically) fractured the rock.

GO TAKE A HIKE
The Rocks Provincial Park, Hopewell Cape, New Brunswick
Dave Keighley

Trailhead: Access is via the park entrance and visitor centre, open mid-May to mid-October (hours of operation vary: consult website for details). There is a gently sloping gravel path that winds down to the beach (Demoiselle Beach) at the southern end of the coastal outcrops, or a similar path with various spectacular look outs (in summer with an adjacent shuttle trail) taking visitors down to the northern end (Seawall Beach) of the outcrops. Out of season (Nov-Apr) the north beach may be the only accessible route.

Distance: 1.5 km the way the seagulls fly or wade across the mudflats; ~2.1 km from southern to northern beach access points, avoiding the mud.

Elevation change: ~50 m from the park entrance down to the (low tide) shoreline.

The Bay of Fundy is home to the world’s highest tides, and its coastline in New Brunswick and Nova Scotia hosts several impressive geo-hikes. The Hopewell Rocks are one of the most famous sites to hike along the coastline, and they are located only a 40 minute drive south from Moncton, NB. For birdwatchers, a large population of blue herons nest just to the south, and the entire northern part of the Bay becomes home to over 2 million migrating shorebirds from mid-July to mid-August, including 75% of the global population of semipalmated sandpipers (their only feeding stopover in a 4000 km southward migration – so please don’t scare them away!). For most other visitors, the main attractions are the coastal cliff features and the changing views and access associated with diurnal changes in sea level of over 14 m (46 ft). Rising waters can advance across 0.5 km-wide tidal flats in well under 1 hour.

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Following the most recent retreat of the ice and estuarine flooding, it is tidal action, along with frost and salt wedging, that have become powerful agents of weathering and erosion. Parts of the shoreline lacking fractures and finer grained beds have resisted these agents, leaving promontories and headlands. In some places less resistant rock has been exposed behind the headlands. Sea caves and arches have developed, and some arches have collapsed leaving sea stacks. Some of the stacks still retain vegetation on their tops, giving rise to the famous "flowerpot rocks", most abundant at the northern end of the park. Other stacks bear names such as "dinosaur rock", "mother-in-law", and "E-T".

Although hikers should keep their heads up to look at the cliffs and to avoid walking into rock overhangs, they should also watch their footsteps so as to avoid slippery mats of seaweed, wet rock, and the ubiquitous mud. The mud may form a thin coating on beach sand and rock, deposited during slack water at high tide. In sheltered and low lying areas, many thin coatings may have built up to form a thick cloying tidal-mud deposit. However, these recent sediments are home to surface algae and their associated food chain of invertebrates and vertebrates, including the sandpipers (many leaving traces of their activity - future trace fossils in the making).

Safety: Be mindful of the tide schedule so that you do not become trapped on the beach. Wardens recommend being off the beach 3 hours either side of the high-tide time. Many areas of the beach are covered in very slippery seaweed and, or, mud. Wear appropriate footwear. Thick mud sticking to footwear reduces traction. Walking and sliding on the mudflats is prohibited. Beware of falling rocks.

Off-season (mid-October to mid-May): No services are available and there are no wardens. Anyone choosing to access the site is doing so entirely at their own risk. Stairways to the beach are removed to prevent damage from sea ice. Cables that block off dangerous areas are removed to avoid ice damage. Sea caves and some cliffs are extremely dangerous and can collapse (one as recently as winter 2016). Off-season visitors are responsible for their own safety.

Provincial park website: www.thehopewellrocks.ca
Toll free: 1-877-734-3429
E-mail: questions@thehopewellrocks.ca
Generation, Migration, Accumulation and Recovery of Hydrocarbons in Tight Rocks: Insights from Laboratory Observations

SPEAKERS
Alexandra Amann-Hildenbrand
| Energy and Mineral Resources Group, RWTH Aachen University

Amin Ghanizadeh | Tight Oil Consortium, University of Calgary

Time: 11:30 am doors open
Date: March 19, 2019
Location: Hyatt Hotel, Imperial Ballroom 5/7/9, 700 Centre Street SE, Calgary AB T2G 5P6

ABSTRACT
A. Amann-Hildenbrand¹, A. Ghanizadeh², M. Shabani³, B.M. Krooss¹, C.R. Clarkson²
¹Energy and Mineral Resources Group (EMR), RWTH Aachen University
²Tight Oil Consortium, University of Calgary

The development of unconventional hydrocarbon reservoirs is currently a primary focus of industry in North America. In contrast to conventional hydrocarbon systems, generation, primary migration and accumulation of hydrocarbons in tight rocks occur at multiple scales within space and time, and are controlled by a variety of coupled physicochemical processes. Despite large hydrocarbon-in-place resource estimations and application of technologies such as long horizontal wells combined with hydraulic fracturing in multiple stages, the current hydrocarbon recovery - particularly light oil and condensate - from the unconventional reservoirs is very low (<10%). The key strategies for future development are therefore, to 1) understand the fundamentals of hydrocarbon generation, migration and accumulation in tight rocks and 2) investigate dominant controlling factors on primary and enhanced hydrocarbon recovery in these lithotypes with permeabilities down to the nanodarcy range.

Working on multiple potential European and productive North American unconventional oil/gas reservoirs, the current laboratory research at Energy and Mineral Resources Group (EMR) at RWTH Aachen University and the Tight Oil Consortium (TOC) at the University of Calgary is focused on a variety of research topics including, but not limited to:

• Advanced fluid and core analysis for improved understanding of hydrocarbon generation, migration, and accumulation in tight rocks (EMR)
• Investigation of the fundamental physicochemical fluid storage and transport processes in tight rocks, their interrelation and interdependence (EMR)
• Advanced core and cuttings analysis for improved characterization of fluid-rock interaction in unconventional light oil reservoirs (TOC)
• Investigation of Improved Oil Recovery (IOR) in unconventional light oil reservoirs (TOC)

This presentation provides a brief summary of these selected research topics, followed by selected examples from a variety of potential/productive unconventional resource plays in Europe and North America. The multidisciplinary research strategies followed by the EMR and TOC laboratories over the past decade(s), provide a means for industry to 1) identify and target hydrocarbon "sweet spots" more effectively in unconventional reservoirs and 2) reduce the exploration and development risks by better understanding the coupled geochemical, petrophysical and geomechanical processes in tight rocks.

(Continued on page 16...)

BIOGRAPHIES
Dr. Alexandra Amann-Hildenbrand is a Senior Research Scientist at the Institute of Geology and Geochemistry of Petroleum and Coal at the Energy and Mineral Resources (EMR) Group at the RWTH Aachen University (Germany). Dr. Amann-Hildenbrand holds a Diploma (M.Sc. equivalent) in Geoscience from RWTH Aachen University. During her PhD project at the Institute of Geology and Geochemistry of Petroleum and Coal in Aachen, she conducted experimental studies on “Fluid Transport Processes in Mudstones” and earned a PhD degree of RWTH Aachen University in 2003. From 2003 to 2008, Dr. Amann-Hildenbrand was employed as a researcher at VITO (Vlaamse Instelling voor Technologisch Onderzoek) in Belgium. She was involved in different projects regarding the CO2 sequestration potential and risks in Belgium, the quantification of the in-situ methane content of the coal-bearing sequences in NE-Belgium and the analysis of geothermal use of the flooded coal mines in Heerlen (the Netherlands). In 2008, Dr. Amann-Hildenbrand again joined the Institute of Geology and Geochemistry of Petroleum and Coal of RWTH Aachen University (Germany). In the petrophysical laboratory, she is conducting experiments with focus on fluid transport processes in fine-grained, low-permeable rocks. Data are analysed with respect to their dependence on fluid/confining pressure, water saturation, and gas type. This enables the extrapolation...
of the experimental observations to the natural geological system. Dr. Amann-Hildenbrand is author/co-author of more than 30 scientific publications.

Google Scholar: https://scholar.google.de/citations?user=8DNdMjAAAAAJ&hl=de

Researchgate: https://www.researchgate.net/profile/Alexandra_Amann

Dr. Amin Ghanizadeh is a Petrophysical Research Supervisor and Laboratory Manager at the Tight Oil Consortium at the Department of Geoscience at the University of Calgary. With a M.Sc. in Chemical Engineering and a PhD in Petroleum Geoscience, during the past 10 years, Amin has been intensively involved in industry/government-sponsored projects in Iran, Australia, Germany and Canada investigating fluid storage and transport processes in synthetic carbonaceous materials (carbon nanotubes, activated carbons) and low-permeability geological media (coals, tight sandstones/siltstones, shales/mudrocks). Arranged chronologically, these national/international projects include the Australian CO2CRC Project (www.co2crc.com.au), German CO2Seals Project, European GASH Project (www.gas-shales.org), and most recently, Canadian Tight Oil Project (www.tightoilconsortium.com). Amin’s current research interests are focused on 1) advancing core and cuttings analysis for improved characterization of geochemical, petrophysical and geomechanical properties and fluid-rock interaction in unconventional light oil reservoirs and 2) investigation of Improved Oil Recovery (IOR) in these reservoirs. Among more than 60 peer-reviewed technical articles and conference contributions, Amin is the co-author of three invited review articles that discuss a variety of field- and laboratory-scales processes governing hydrocarbon storage and transport in unconventional oil/gas resources. Amin is further the recipient of “2018 Award of Excellence: Research Staff” at the Department of Geoscience at the University of Calgary.

Google Scholar: https://scholar.google.ca/citations?user=zq6qbLkAAAAJ&hl=en

Researchgate: https://www.researchgate.net/profile/Amin_Ghanizadeh

GEOMODELING DIVISION TALK

Practical Facies for Digital 3D Models

SPEAKER
David Garner, TerraMod Consulting

Time: 12:00 pm
Date: Thursday, March 28, 2019
Location: Husky Conference Room A, 3rd Floor, +30 level, South Tower, 707 8th Ave SW, Calgary, Alberta

ABSTRACT
A key impact on success in reservoir studies is a sound strategy around facies for modeling. The modeled facies provide local geological features, patterns and properties. Facies are derived from many sources with varied definitions and purposes. Classically, facies are a visual interpretation of the face of a rock driven by concepts. For example, from outcrops, we derive an understanding of depositional architecture and stacking patterns. In petroleum reservoirs, we commonly use these surface observations of analogues in addition to sparse subsurface information to determine facies logs. Is this adequate?

For modeling purposes, the input facies each represent consistent statistical properties across a study area. Visually interpreted facies must be checked for petrophysical consistency, i.e. the distinctness of petrophysical distributions which is not guaranteed. Application of electrofacies, a multivariate classification can improve consistency and is beneficial for the hierarchy of modeling workflows (Figure 1; Martinius et al. 2017). The result of electrofacies is to enforce the lithological characteristics based on distinct rock properties measured and to be distributed in models (Figures 2 and 3; Garner et al., 2014; Manchuk et al., 2015). A brief discussion of five assumptions underlying an application of electrofacies provides practical guidance on checking and improving useful facies inputs (Davis, 1986; Nivlet, et al., 2001).

There are rules and checks for sampling facies logs and associated properties into discrete grids to maintain model fidelity. The bigger the scale, the greater the uncertainty on individual facies and the more mixed the properties become. Across larger scales, facies probabilities and proportions are introduced, similar to the concept of net-to-gross for two categories.

Trends, both vertical and lateral, must be taken into account to fairly represent the large scale reservoir features and connectivity in local areas of the 3D model. Seismic attributes sample from a relatively large scale, yield facies probabilities and can be introduced to update spatial trends for facies proportions. Fluid distributions as well as flow and
mechanical properties are dependent on the characterization by each facies. Accounting for known physical behavior, percolation and capillarity, when distributing properties facilitates reasonable physical responses in flow models.

Modeling strategy strongly benefits and depends on questions to be addressed mainly by reservoir engineering, from well understood to complex systems. Additional criteria derive from availability of data from multiple disciplines e.g. petrophysics, geophysics, geomechanics. Resource extraction for a mature reservoir waterflood generally requires a different type of model than a thermal gravity-driven extraction, i.e. SAGD-based. The scale of geological features, spatial trends, physical properties, size and architectural arrangement are all significant in the modeling process and are derived from the modeled facies. Handling facies digitally from concept to engineering is one of the most critical foundations of a successful reservoir study using geomodels. A number of techniques and examples will be noted to establish context.

References


Biography
David Garner is an internationally recognized consulting advisor in applied geostatistics and geomodeling with more than 35 years of diverse technical experience in the hydrocarbon industry. He has taught numerous public and private courses in various countries during his career. He is currently an associate of Geovariances in Fontainebleau, France and TerraEX Group in Denver. He has over 23 years of work directly in geostatistical studies in petroleum and mining. He has published and presented numerous papers, many of which were peer-reviewed.

Previously Mr. Garner held positions in applied R&D with Halliburton and Statoil, as a hands-on geomodeling advisor for Chevron and specialist at ConocoPhillips. He was president of TerraMod Consulting for 6 years applying geostatistics and geomodeling techniques mainly for large international reservoir studies and mining resources. As an active volunteer, Mr. Garner currently serves as a co-chair for the CSPG Geomodeling Technical Division committee. He was chairman/convener for the 2018 Gussow conference entitled Closing the Gap III - Advances in Geomodeling for Hydrocarbon Reservoirs, and was the chair for the CSPG 2011 and 2014 Gussow conferences, co-editor of the special edition December 2015 BCPG on Geomodeling Advances and the 2013 CSPG Memoir 20.

Mr Garner is registered as a Professional Geophysicist (P.Geoph) through the Alberta’s Association of Professional Engineers and Geoscientists (APEGA).
BASS TECHNICAL DIVISION TALK

Revising the geological history of the Canadian Arctic from the footprints of missing terranes

SPEAKERS
Daniel Alonso Torres (Independent)

Time: 12:00 p.m.
Date: Wednesday March 27, 2019
Location: geoLOGIC Classroom (2nd Floor), Aquitaine Tower, 540-5th Ave SW, Calgary, AB

ABSTRACT
With the opening of the Amerasia Basin by the Cretaceous, the landmasses once adjacent to the Canadian northern margin were disseminated and buried beneath the Arctic Ocean, hindering their direct study. However, the history and nature of these terranes can be unraveled through the footprints left on circum-Arctic sedimentary basins, some of which constitute important petroleum plays.

Preserving an exposed record of the interaction between peri-continental basins and outboard terranes is the Sverdrup Basin of the Canadian Arctic. During the Permian, carbonate factories were replaced by clastic sediments derived from a northern landmass, as the basin experienced renewed tectonism and significant changes in its physiography.

Detrital zircon geochronology, a technique broadly used for precise dating of sedimentary rocks, stratigraphic correlations, and source-to-sink analyses, reveals that Permian to Jurassic sediments were derived from a magmatically active region to the north, with ties to Russia, Alaska and the Barents Sea. Additionally, structural mapping and stratigraphic observations conducted on northern Axel Heiberg Island provide evidence of near-field tectonism during this time.

These results support a back-arc setting for the Sverdrup Basin and the redefinition of the northern margin of the continent as active, framing the tectonic setting of Arctic petroleum provinces.

BIOGRAPHY
Daniel Alonso Torres recently completed a thesis-based M.Sc. in Geology at the University of Calgary, focusing on the structural and sedimentary history of the Arctic. Through his involvement in several research projects, Daniel has produced four peer-reviewed publications, presented at international conferences, and contributed to the development of new geochronological techniques. He obtained a B.Sc. in Geology from the Complutense University of Madrid, Spain, after spending his final year at the University of Calgary with a TASSEP scholarship. During his time at the University of Calgary, Daniel was an organizer for the Friday Afternoon Talk Series and the GeoREX Conference, and he is currently a member of the CSPG Young Geoscience Professionals committee.

Field trips and the annual CSPG Core Conference are essential components of the exploration and reservoir evaluation activities that are core skills for petroleum geologists. In fact, keeping abreast of advances in the science and business of petroleum exploration and development is a serious requirement for continued employment. This complex set of core skills represent the value proposition professional geoscientists and their support teams bring to the asset management table.

It behooves us all to keep our drill bits and bed rock skill sets sharp if we are to stay in business and support the energy industry.

Tom Sneddon

Website. It governs the application of the APEGA Code of Ethics to COGEH and to NI51-101 and was carefully crafted to fit with both documents and it can be found here: https://www.apega.ca/assets/PDFs/reserves.pdf.
Applying Sequence Stratigraphy to Fluvial Reservoirs

SPEAKER
Jon Noad, Gran Tierra Energy

Time: 12:00 pm  
Date: Wednesday, April 10, 2019  
Location: geoLOGIC Classroom (2nd Floor), Aquitaine Tower, 540-5th Avenue S.W.

ABSTRACT
Fluvial reservoirs are estimated to hold 15% of the world’s oil and yet predicting their reservoir distribution can prove very challenging. River channels are limited in lateral extent and have the tendency to wander where they will. However, as we will see, applying sequence stratigraphic concepts to fluvial stratigraphy can significantly impact our understanding of reservoir distribution, net to gross ratios and correlation.

Our story begins in Dinosaur Provincial Park, where my Masters involved measuring changes in channel architecture through time. I recognized changes in channel thickness, widths and stacking patterns that could be tracked regionally, but what was the underlying driving mechanism? A beautifully written paper by Shanley and McCabe provided the key, extrapolating from the classic Exxon slug model to demonstrate how changes in relative sea level can affect accommodation space on land just as in marine settings.

Utilizing their fluvial sequence stratigraphic (FSS) approach, I was able to build a working relative sea level curve for the upper Oldman Formation. Periods of low accommodation space and slow base level rise led to amalgamated fluvial channel complexes, notably the regionally extensive Comrey Sandstone, while more rapid rises resulted in isolated channels preserved in thick floodplain mudstone beds. It also helped to explain the density of crevasse splays and meandering channel characteristics of some of my channels.

This methodology can be used to build a predictive depositional model which can be applied at both exploration and production scales to fluvial reservoirs around the world, in settings ranging from isolated channels to “layercake” fluvial reservoirs to the fluvial fill of incised valleys. Fluvial sequence stratigraphy can also be applied to electrolog interpretation in both braided and meandering reservoirs, to build a robust correlation framework. Examples from Canada, Oman, Colombia and South Africa will be presented to demonstrate the utility of this approach. The volumetric implications associated with an improved understanding of reservoir distribution are enormous.

BIOGRAPHY
Jon graduated from Imperial College, London, leading to a five year posting in South Africa mining gold and platinum. He returned to the UK and worked in undersea cable laying, meanwhile completing a Masters in Sedimentology at evening classes, with the thesis examining fluvial deposits in Dinosaur Provincial Park. This led to a PhD in eastern Borneo, after which he joined Shell International. Lots of Middle East exploration followed, before he headed to Calgary to work on the Deep Basin and the Orphan Basin. He then worked at Murphy as Exploration Manager, and Husky as Geological Specialist, before setting up his own geology training company, mostly running field trips for oil companies. He joined Gran Tierra in May 2018.

DIVISION INFORMATION
The Division’s mandate is to provide a CSPG forum for members who are interested in seeing the "wood" when they are looking at the "trees". Most of us deal with small areas in our daily work. A good understanding of the big geologic picture in which our areas are located will facilitate better geological interpretations and predictions, which will translate into higher drilling success rates. The aim of the Basin Analysis and Sequence Stratigraphy Division is to be innovative, inspiring and practical. We will try to introduce new concepts and methodologies of basin analysis and sequence stratigraphy to our group. We would also like to share inspiring interpretations of historical Canadian data. In particular, we encourage speakers to offer learnings that we can take home and apply in our daily work. The Division is also interested in running field trips or joint talks with other Divisions in the future.

2019 Book Cliffs Field Trips
May 5-10 & Nov.10-15
Registration is now open.
www.bookcliffsgeology.com
Proprietary company-specific trips are also available.
Contact: Dr. Simon A.J. Pattison, P.Geo.
pattison@bookcliffsgeology.com
**INTERNATIONAL DIVISION TALK**

*Eastern Promises: Oil & Gas Potential in Eastern Europe Through the Lens of Canadian E&Ps*

**SPEAKER**
Duncan Mackay | Serinus Energy  
Gregory Rachii | Serinus Energy

**Time:** 12:00 pm  
**Date:** Wednesday, March 13, 2019  
**Location:** For location details please visit www.cspg.org

**ABSTRACT**
Despite a very long history of oil and gas exploration, and a wealth of hydrocarbon-rich basins, geopolitical and ideological forces over the past century have left the Eastern European oil & gas industries in a far-less mature state than our own, here in Alberta.

Recently, however, growing demand for hydrocarbons in the region and complex energy dynamics have created a tight market for oil – and especially gas – in Eastern Europe. These current market forces, a decades-long drought in exploration and development capital, and a lack of modern exploration and development techniques has resulted in an abundance of commercial E&P opportunities in the region.

Romania and the Ukraine have some of the greatest remaining oil and gas potential in Eastern Europe. We highlight their geological basins from a hydrocarbon systems perspective and provide snapshots of their respective petroleum industries and how they function. Based on our professional and personal experiences in these countries, we also demonstrate how their common Soviet-era histories have produced common challenges and opportunities for Canadian E&P companies.

**BIOGRAPHIES**
Dr. Duncan Mackay completed his B.Sc. at the University of Waterloo and, after working several years full-time in the oil and gas industry, returned to academia at Queen’s University, where he received his Ph.D., studying the sedimentology of tidal depositional systems. Duncan has worked in oil and gas industry for Shell Canada, Verano Energy (a Colombian-focused E&P company) and currently is working at Serinus Energy pursuing exploration and development opportunities in Eastern Europe and North Africa. Duncan is a Director at the Canadian Global Exploration Forum – a not-for-profit industry organisation that supports Canadian-based E&P companies whose operations are focused internationally.

Gregory Rachii was born and raised in Ukraine, graduated from the Ukrainian National Technical University of Oil and Gas with Bachelor’s degree in Geology and Master’s degree in Geophysics. Gregory worked in Ukraine for the Canadian based company Kulczyk Oil Ventures as geophysicist and field operations manager. In 2015 Gregory was transferred to the head office in Calgary for Serinus Energy (formerly Kulczyk Oil Ventures) as a manager of geophysics focusing on the company’s assets in Tunisia and Romania.

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OPERATIONS DIVISION TALK

Quaternary research in Alberta – the importance of near-surface materials in regions of energy resources development

SPEAKER
Nigel Atkinson | Alberta Geological Survey/Alberta Energy Regulator

Time: 12:00 pm
Date: Wednesday, March 20, 2019
Location: geoLOGIC Classroom (2nd Floor), Aquitaine Tower, 540-5th Avenue S.W.

ABSTRACT
Understanding the origin, characteristics and thickness of Quaternary materials in regions of unconventional energy development can be fundamental to natural resources management, infrastructure planning and environmental protection. In Alberta, this recognition has motivated a long-term program of Quaternary research focused on developing maps and models of the topography of the bedrock unconformity and the characteristics of the overlying sedimentary succession. Early work was driven by the recognition that near-surface bedrock units and Quaternary deposits across the western Canadian Plains had experienced local- to regional-scale glacial thrusting and deformation.

Knowledge of the distribution, structure and hydrology of these glaciectonically disturbed masses is an important engineering consideration for surface mineable and in-situ recoverable resources, since weaknesses in these materials can trigger highwall or overburden failures, resulting in increased operational hazards. More recently, unconventional oil development in the surface mineable area of NE Alberta requires a comprehensive understanding of the role of landforming processes throughout the Quaternary and their effects on the genesis, stratigraphy and characteristics of the near-surface sediments. Three-dimensional modelling of the regional distribution, morphology and architecture of glacigenic sediment-landform associations has helped better inform operators and regulators in making sound engineering and environmental protection decisions. Features such as buried tunnel valleys are particularly important in NE Alberta, since they may constitute targets for the supply of potable water, as well as function as natural pathways for the subsurface movement of water or other fluids.

BIOGRAPHY
Nigel joined the Alberta Energy Regulator in 2005, working at the Alberta Geological Survey to develop a subsurface model of buried channel aquifers in the Fort McMurray region. He then served for 8 years as manager of the Quaternary Geological Framework Section, which developed stratigraphic maps and 3D models of the sediments overlying the bedrock unconformity. More recently, he moved back into a technical role and continues to map the surficial geology of northern Alberta.

Prior to joining the AER, he completed a B.Sc. at the University of Glasgow, Scotland, and an M.Sc and Ph.D in the Department of Earth and Atmospheric Sciences at the University of Alberta.

OPERATIONS DIVISION TALK

A Focus on H2S Release Rate Submission Requirements

SPEAKER
Gerry LaPlante, Alberta Energy Regulator

Time: 12:00 pm
Date: Wednesday, April 17, 2019
Location: geoLOGIC Classroom (2nd Floor), Aquitaine Tower, 540-5th Avenue S.W.

ABSTRACT
The Alberta Energy Regulator (AER) requires an H2S Release Rate Package be available upon request for all wells targeting sour formations or any well that penetrates a sour formation. The geological and engineering requirements for these type wells are outlined in Directive 056: Energy Development Applications and Schedules, Section 7.8.15, H2S Release Rate Assessments. Public safety is paramount in drilling sour wells and it is vital that companies and the AER have a good handle on the expected H2S release rate for any potential sour well. That being said it may be time to re-examine how release rate assessment data is currently being submitted, compared to how it could be submitted with a focus on the important and critical data. In reviewing these submissions over the last 10 years, I have encountered reports that range from one inadequate page to one hundred and fifty pages of excess. The purpose of this talk is to provide guidance on the important geological and engineering aspects of H2S release rate assessments while focusing on the most critical data.

BIOGRAPHY
Gerry LaPlante is a Certified Engineering Technologist (CET) who graduated from SAIT in 1988. He is a member of the Alberta Society of Engineering Technologists (ASET) who has 17 years of experience at a commercial Oil & Gas laboratory, performing PVT, compositional and quality control analyses of gases, condensates and oil samples. His career at the AER started in 2006 in the Reservoir Engineering Group processing Directive 65 applications. In 2008 he transferred to the Geology Group and began calculating/reviewing H2S release rate submissions and providing support in well and reservoir classification.

RESERVOIR ISSUE 2 • MARCH/APRIL 2019

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Short Courses Now Available

April 23rd - 24th, 2019
Introduction to Geosteering
Julian Stahl | ROGII
geoLOGIC Classroom | CPD Credits: 8

April 24th - 25th, 2019
Unconventional Mudrocks from a Canadian Perspective
Per Kent Pedersen & Raphael Wust
AER Core Research Centre | CPD Credits: 16

April 30th - May 1st, 2019
Basics of Geomodeling - An Overview
David Garner | TerraMod Consulting
CSPG Classroom | CPD Credits: 16

May 6th, 2019
Introduction to Type Curves
Art McMullen | Sproule
gEOLOGIC Classroom | CPD Credits: 8

May 8th, 2019
Making Maximum use XRF Data
Jean-Yves Chatellier
gEOLOGIC Classroom | CPD Credits: 8

May 10th, 2019
Unconventional Mudrocks from a Canadian Perspective
Kamal Malick |
gEOLOGIC Classroom| CPD Credits: 7.5

May 27 - 30th, 2019
Subsurface Data Analysis, Geomodeling & Geostatistics
David Garner | TerraMod Consulting
CSPG Classroom | CPD Credits: 26

May 30th, 2019
Understanding Naturally Fractured Rocks
Marian Warner & Mark Cooper
gEOLOGIC Classroom | CPD Credits: 8
PALEO 2019
Mount Royal University, 4825 Mount Royal Gate, SW, Calgary, Alberta
Presented in conjunction with the CSPG Palaeontological Division and Mount Royal University Department of Earth and Environmental Sciences

Lectures and poster displays— Saturday March 23, 2019, 9:00am-5:00pm
Workshop— Sunday, March 24, 2019, 9:00am to 12:00 noon or 1:00pm-4:00pm

Saturday events are free to the public
Fossil displays and activities of interest to a wide audience including families
Sunday workshop requires pre-registration and a fee

SPEAKER SCHEDULE
Saturday, March 23
All talks to be held in Jenkins Theatre, lower level Mount Royal University

9:00 am Opening statements by APS President Cory Gross and Symposium instructions by APS Program Coordinator Harold Whittaker

9:15 am Paleozoic Predation: Still Matters after All These Years
Dr. Lindsey Leighton, Department of Earth and Environmental Sciences, University of Alberta

10:15 am Coffee Break

10:30 am The World’s Most Famous Bird: The Story of Archaeopteryx
Jon Noad, Gran Tierra Energy & Department of Earth and Atmospheric Sciences, University of Alberta

11:00 am Earliest Carboniferous Ray-Finned Fishes from Blue Beach, Nova Scotia
Conrad D. Wilson, Graduate Student, Department of Biological Sciences, University of Calgary

11:30 am Histological Analysis of Elasmosaurid (Sauropterygia: Plesiosauria) Specimens Reveals the Presence of Small-Bodied Taxon from the Non-Marine Dinosaur Park Formation
James Campbell, Graduate Student, Vertebrate Paleontology, University of Calgary

12:00 Noon Lunch Break and Poster Display

1:00 pm An Unusual Microsite Reveals the Hidden Fauna of the Horseshoe Canyon Formation
Greg Funston, PhD Graduate, Department of Biological Sciences, University of Alberta

1:30 pm You’re a Strange Animal: Morphology of Cambrian Stenothecoida
Dr. Paul E. Johnston, Department of Earth and Environmental Sciences, Mount Royal University

2:00 pm Poster Session *Poster presenters are requested to be with their posters.

3:00 pm Cleaning-up After Barnum Brown: Relocation of Lost American Museum of Natural History Quarries in Dinosaur Provincial Park and Salvaging Forgotten Dinosaur Bones Therein
Darren Tanke, Senior Technician II, Royal Tyrrell Museum of Paleontology

3:30 pm Valleys of Hidden Secrets: Why Saskatchewan is Canada’s New Fossil Frontier
Dr. Emily Bamforth, Assistant Curator of Palaeontology, Royal Saskatchewan Museum

4:30pm Closing Remarks
Harold Whittaker, APS Program Coordinator

TRILOBITE WORKSHOP
Sunday, March 24
Mount Royal University, Lab B213

9:00am to 12:00 noon OR 1:00 pm—4:00 pm

Exploring the Wonderful and Wacky World of Trilobite Paleontology

In this workshop, participants will be immersed into the basics of trilobite palaeontology (trilobitology).

Participants will be introduced to the main trilobite orders and the features that can be used to identify trilobites from these orders. Participants will also learn about the morphology, taxonomy, life habits, and evolution of trilobites. Specimens from the major trilobite orders and from different time periods will be on hand for participants to examine and we encourage anyone to bring in trilobites that they wish to identify or show to the group.

Presenter:
Chad Morgan is a PhD Candidate in the Department of Geoscience at the University of Calgary. He is currently working on Middle Cambrian trilobite biostratigraphy of the Stephen Formation under the supervision of Dr. Charles Henderson and Dr. Brian Pratt (University of Saskatchewan).

Cost: $10 per person

REGISTRATION
Please register by emailing hgwittaker@shaw.ca or by registering at one of the monthly meetings.

Specify morning, afternoon or either session.

Registration deadline is March 15, 2019
Please specify your preference for morning, afternoon or either session.
Ammonites witnessed the growth of Canada

SPEAKER
Dr. Terry Poulton, Geological Survey of Canada, Calgary

Time: 7:30 pm  
Date: Friday, April 12, 2019  
Location: Mount Royal University, Room B108

ABSTRACT
A major role of paleontologists in a geological organization is to interpret the age and depositional characteristics of sedimentary rocks as aids to mapping, sedimentary basin analysis, and resource exploration activities. Ammonites are of exceptional value for understanding Mesozoic marine strata because of the many morphological features they exhibit, their rapid evolution and the widespread distribution of many of them. During Jurassic time, North America was actively growing by accretion of oceanic terranes to its western margin; associated east-west compression initiated the ancestral Rocky Mountains and affected the Western Canada Sedimentary Basin in the plains. The Jurassic also saw the early stages of the opening of the western portion of the Arctic Ocean, and its precursor in the Sverdrup sedimentary basin in Canada’s Arctic archipelago. Since the earliest discoveries in Canada in the 1850’s, ammonites have enabled correlations of strata over long distances and provided precise ages by comparison of their sequences with the international standards, which have been mainly established in Europe. However, the identification of ammonites, and therefore the determination of their ages, is not always straightforward, in part because of the reappearance of superficially similar forms at different times and in different lineages. Additionally, the occasional development of distinct marine faunal provinces was sometimes extreme, with few or no species in common with Europe at certain times during the Jurassic. This presentation will discuss some of the challenges and the geological contributions from several previous and on-going studies of Canadian Jurassic ammonites.

BIOGRAPHY
After completing a B.Sc. at University of Calgary in geology (1968) and field experience with the Geological Survey of Canada (GSC) during the summers, Terry was offered an opportunity to study for an M.Sc., with University of Calgary professor Dr. Philip Simony to document the sedimentary sequence and paleoenvironments in Late Precambrian low-grade metamorphic rocks west of Golden, B.C. As this was being completed (1970), he also worked with PanArctic Oils Ltd, mapping and analyzing Mesozoic strata on western Ellesmere and Axel Heiberg Islands prior to the expansion of their hydrocarbon drilling program eastward from the discovery wells on Melville Island. By agreement, the fossils collected were studied by GSC’s long-time mollusc specialists Hans Frebold and George Jeletzky. Canada was still in the post-WWII growth spurt, and GSC was actively exploring its resource potential and terrane, which included large areas of Mesozoic sandstones, mudstones and volcanics in the Arctic and the Cordillera frontiers. These strata of different ages are superficially similar, and unravelling them required knowledge of the ages derived from their fossils. To this end, GSC supported a Ph.D. project at Queens University, which led to a full-time job in early 1975 after Dr. Frebold retired. After years of undertaking specific research projects and contributions to several regional syntheses, as well as stints in lower and “middle” management in GSC, Terry continues to pursue topical research at GSC in Calgary.

In addition to the main presentation by Dr. Terry Poulton, Tako Koning will provide a brief presentation: Algal Stromatolites—From Precambrian to Present Day

For full talk abstract please visit: www.cspg.org
STRUCTURAL DIVISION TALK

An overview of the Chinook compilation map series, SW Alberta and SE B.C.

SPEAKER
Glen S. Stockmal | Geological Survey of Canada Glen.Stockmal@Canada.ca

Time: 12:00 pm
Date: Thursday, March 7, 2019
Location: Schlumberger Palliser One Building
200, 125 - 9th Ave SE, Calgary

ABSTRACT
The Chinook GIS compilation map series, compiled at a nominal scale of 1:100,000 on 1:50,000-scale topographic bases, comprises three GSC open files (7475, 7476, and 7477) that encompass twenty-six 1:50,000-scale map sheets in the Rocky Mountains and Foothills of southwestern Alberta and southeastern British Columbia (Fig. 1). Source maps and other data used in compilation include GSC and provincial survey maps and reports, published page figures, unpublished thesis maps, unpublished GSC field notes, aerial photos, and field maps, as well as spot field checking. Revision and reinterpretation during compilation involved extensive use of Google Earth™ and traditional aerial photograph imagery.

The most intensive revisions or reinterpretations of source maps and other data were made to the following areas or features, listed approximately from foreland to hinterland:

1. Fault and fold linkages and associations in the Foothills encompassed by GSC NATMAP open files south of Castle River.

2. In the hanging walls of the Livingstone Thrust and Station Creek Fault.

3. In the footwall of the Lewis Thrust, including the Oyster Syncline, the Etherington Creek Fault, and the Carbondale River–Goat Creek structure.

4. The controversial Howell Creek and Squaw Creek structures.

5. Structures bounding, within, and north of the Fernie Basin, adjacent to Wisukitsak Range and Erickson Ridge, where the Fernie Formation hosts the Fernie and West Line Creek detachments.

6. The Bourgeau Thrust – inferred to terminate at the town of Elkford, B.C.

7. The Hosmer Thrust sheet – reinterpreted as two or possibly three distinct fault slices, where the underlying thrusts merge upward with the Fernie Detachment.

8. The Gypsum Fault – formerly interpreted as the Bull River Thrust but reinterpreted as a folded, east-dipping, and east-directed detachment that separates folded sub-Devonian strata of the inverted White River Trough from overlying Devonian and younger strata.

9. The structure from Mount Broadwood northward to Mount Hosmer – reinterpreted as a blind thrust stack between the Fernie Detachment above and two overlapping detachments below: beneath the Middle Aldridge Formation in the south and the Gypsum Fault in the north.

10. Structures along Inverted Ridge, including the Hefty and Macdonald faults (the former was previously interpreted as a thrust, but is reinterpreted as a normal fault).

Some of these reinterpretations offer comprehensive solutions to well-known enigmatic structures (e.g., Howell Creek, Carbondale River–Goat Creek, Hosmer Thrust), some reconcile confusing, problematic, or contradictory previous interpretations (e.g., multiple structures on NATMAP Foothills maps), whereas others offer new views of supposedly well-understood features (e.g., Wisukitsak Range and Erickson Ridge, Bourgeau Thrust, Hefty and Macdonald faults). This overview of the Chinook compilation maps will touch briefly on each of these areas or features.

BIOGRAPHY
Glen Stockmal received a B.Sc. from the University of Manitoba (1977), an M.Sc. from the University of Calgary (1979), and a Ph.D. from Brown University (1983). Following a post-doctoral fellowship at Dalhousie University, in 1985 he joined the Geological Survey of Canada in Dartmouth, N.S. In 1991, having endured a dozen years living out of sight of the Rockies, he transferred to the GSC’s Calgary office, where he has been involved in a variety of structural geology activities. He was Editor-in-Chief of the Bulletin of Canadian Petroleum Geology from 2004 to 2009, and received a CSPG Tracks Award for his service.
A Reappraisal of the Howell Creek Structure: Indication of multiple extension events in the southern Canadian Rocky Mountains

SPEAKER
Glen S. Stockmal | Geological Survey of Canada Glen.Stockmal@Canada.ca

Time: 12:00 pm
Date: Thursday, April 4, 2019
Location: Schlumberger Palliser One Building
200, 125 - 9th Ave SE, Calgary

ABSTRACT
The Howell Creek structure, described by Jones (1977; BCPG) as “one of the most enigmatic features of the Canadian Rocky Mountains”, has been interpreted and reinterpreted in remarkably different ways since it was first mapped 60 years ago by Price (1958; Ph.D., Princeton University) as a structural window (fenster) through the Lewis Thrust. These alternatives range from the interaction and overprinting of cryptic thrust and normal faults to a coherent gravitational slide. None of these previous interpretations, including that of Price (1958, and subsequent refinements), has adequately accounted for all available observations and constraints within the context of structural styles and physiography normally encountered in thin-skinned thrust-and-fold belts. The Chinook GIS map compilation series (GSC Open Files 7475, 7476, and 7477), which encompasses the Howell Creek structure, required a reappraisal of these previous interpretations (GSC Open File 8504).

Rather than a structural window, the Howell Creek structure is interpreted to lie entirely within the Lewis Thrust sheet. The Howell Fault, which places Upper Cretaceous Alberta Group foreland basin strata onto Mississippian to Triassic platformal strata and bounds the Cretaceous exposures to the southeast (Fig. 1), is considered to be a low-angle normal fault similar to the interpretation of Labrecque and Shaw (1973; BCPG). It may have formed initially as a footwall cut-off, splaying from and merging structurally upward with a thrust fault (the Twentynine Mile Creek Fault) that bounds the Cretaceous exposures to the southwest (Fig. 1). Much of the Twentynine Mile Creek Fault was reactivated as a normal fault prior to the well-known Oligocene normal fault motion on the large-offset Flathead Fault, which lies to the east and north of the Howell Creek structure. The Shepp Fault, which is antithetic to but closely associated with the Flathead Fault, truncates the Twentynine Mile Creek Fault north of the Howell Creek structure. The Twentynine Mile Creek Fault reappears north of the Flathead Fault as the Squaw Fault, which is also reinterpreted as a normal-sense-reactivated thrust fault, explaining unusual structures near Flathead Pass. The northwest boundary of the Cretaceous exposures in the Howell Creek structure is marked by the reinterpreted and newly named Fuel Creek Fault, which is a small-displacement down-to-the-southeast normal fault. It is probably contemporaneous with the larger Harvey Fault (Fig. 1), which bounds the Cretaceous exposures to the northeast and is a down-to-the-southwest normal fault related to the development of the Flathead half-graben.

Normal-sense motion on the Twentynine Mile Creek, Howell, and Squaw faults clearly predates the Flathead and Harvey faults, by virtue of high-angle cross-cutting relationships, and may also predate or even coincide with development of sub-Lewis Thrust contractional duplex structures. The age of the Flathead Fault is constrained by the Early to early Late Oligocene Kishenehn Formation that fills the half-graben above the fault to an estimated maximum total thickness of 3.6 km (McMechan, 1981; Ph.D., Queen’s University). Isolated exposures of Kishenehn Formation lie within and immediately adjacent to the Howell Creek structure. Balanced structural reconstructions indicate erosion of a minimum of 1.5 km of Paleozoic and Mesozoic strata after initial normal-sense motion on the Twentynine Mile Creek and Howell faults, but prior to deposition of the Kishenehn Formation. Coupled with estimates of Oligocene and earlier erosion rates, this suggests that local normal-sense motion on the Twentynine Mile Creek, Howell, and Squaw faults could have occurred prior to the end of regional contractional deformation of the southern Canadian Rocky Mountains, perhaps developing above an active sub-Lewis Thrust duplex structure.

BIOGRAPHY
Glen Stockmal received a B.Sc. from the University of Manitoba (1977), an M.Sc. from the University of Calgary (1979), and a Ph.D. from Brown University (1983). Following a post-doctoral fellowship at Dalhousie University, in 1985 he joined the Geological Survey of Canada in Dartmouth, N.S. In 1991, having endured a dozen years living out of sight of the Rockies, he transferred to the GSC’s Calgary office, where he has been involved in a variety of structural geology activities. He was Editor-in-Chief of the Bulletin of Canadian Petroleum Geology from 2004 to 2009, and received a CSPG Tracks Award for his service.
GEOWOMEN LUNCHEON TALK

Transitioning from the Oil & Gas Industry: A Panel of Success Stories

PANELISTS:
Charlene Beckie | CEO Clem Geo-Energy Corp
Christeen Nahas | P.Geoph
Dennis Agbegha | Manager Entrepreneurship, ATB

MODERATOR:
Rabee Alwan | BlueSky Coaching Inc. P.Eng, PMP

Time: 12:00 pm
Date: Wednesday, March 13, 2019
Location: geoLOGIC Classroom, +15 Level, 2nd Floor, Aquitaine Tower, 540 – 5th Avenue SW

Free Event – No registration required – Everyone is welcome!

ABSTRACT
Join GeoWomen of Calgary for a panel of former geoscientists who will highlight how one can translate their geoscientific skillset into another industry successfully. There will be 3 different panelists from a variety of industries. There will be a representative from the banking, renewables and quality assurance/risk management sectors. We can find out their journey from a geoscientist from the oil and gas industry into their current roles, what new skills are required for their career transition, and what they would tell other people looking to shift industries. Rabee Alwan will be our moderator and will lead the panelists in a Q&A format as well as to inspire discussions within the panelists.

BIOGRAPHY
Charlene Beckie: Charlene spent 18 years in the oil and gas industry as a geophysicist before embarking on her own ventures in Renewable Energy in 2015 as CEO of her company, Clem Geo-Energy Corp. She has two wind farm projects in development in Alberta and has partnered with a German firm in 2018 on one of those projects. She has post-secondary education in Psychology, Business, Geophysics and Engineering. She is a member of APEGA, CSEG and CanWEA and is on the executive of the Canadian Federation of University Women (CFUW) Calgary club serving in Publications and Publicity roles. Charlene was the speaker at the first Calgary chapter event of Women in Renewable Energy (WIRE) in October of 2017.

Christeen Nahas: Christeen Nahas has a B.Sc. in Geophysics from the University of Calgary. She has nearly 20 years of experience in near-surface Geophysics, Quality Management, and Risk Management. Christeen’s geoscience career has taken her to many exotic and remote locations which challenged her mentally and physically. She was provided opportunities to manage projects, field crews, and teams which has provided a foundation of fundamental skills that allows her to be successful in any role. Christeen remains rooted in the geoscience community while focusing on Quality and Risk Management.

Dennis Agbegha: Dennis can be described by 3 words: Explorer, Selfless and Peace-maker. I started my career with ATB in February 2017 as a Service advice specialist and moved to the Digital business banking team in August 2017 and currently Manager Entrepreneurship at the Calgary Entrepreneur Centre. I was born in Nigeria and I have a Master’s Degree in Petroleum Geoscience from Imperial College in London and before working for ATB Financial, I worked as a Production Geologist for Shell International from 2007 to 2011 and as a Geoscientist for ExxonMobil from 2011 to December 2016.

Rabee Alwan: Rabee is an Engineer turned Life Coach with a passion for compassion. His mission is to help inspiring people remember how inspiring they are, help them unlock their potential, and ultimately, elevate their experience of living life to new levels. Rabee is a Computer Engineering graduate from Queen’s University. He worked in the Oil and Gas industry in Calgary as an engineer for 15 years before becoming a coach. He holds designations as a Professional Engineer (through APEGA), as a Project Management Professional (through PMI), and is a professionally trained ontological coach through Accomplishment Coaching. Rabee enjoys dreaming big and testing limits and has three kids that also enjoy dreaming big and testing (his) limits! He is also a runner, a Spartan, a self-taught guitar player, and speaks several languages.

DIVISION INFORMATION
For more information on GeoWomen of Calgary, please visit www.geowomen.org
GeoWomen of Calgary is a GeoCommunity of the CSPG www.cspg.org
GeoWomen of Calgary is a member of AWSN www.awsn.org
GEOWOMEN LUNCHEON TALK

Knowing Your Rights – A Legal Primer on Work and the Law

SPEAKER:
Catherine McAteer | Employment Lawyer

Time: 12:00 pm
Date: Thursday, April 4, 2019
Location: geoLOGIC Classroom, +15 Level, 2nd Floor, Aquitaine Tower, 540 – 5th Avenue SW

Free Event – No registration required – Everyone is welcome!

ABSTRACT
We want to see more women step into their power at work. Having a strong understanding of basic workplace legal rights is an important starting point to both negotiating your position and being a fair and balanced leader.

Join GeoWomen of Calgary for a presentation by Catherine McAteer, Calgary based employment lawyer where she will share her insights on common work-place issues including understanding the employer-employee relationship, negotiating an employment contract or consulting agreement, new developments in respectful work place laws and human rights issues.

BIOGRAPHY
Catherine McAteer: Catherine is an employment and immigration lawyer, engineer and birth photographer (yup, it's a thing). She’s worked on rigs in Colombia, emergency rooms in Calgary and in towers on Bay Street. She loves bikes, skis and espresso.

Catherine has her own law practice focused on providing practical, holistic legal advice to individuals and organizations. She believes in empowering her clients with the right knowledge and support in order to move forward in the best possible way. In addition to acting for both individuals and organizations in employment and immigration matters, she is a trained workplace investigator with additional interests and skills in mediated work place solutions.

DIVISION INFORMATION
For more information on GeoWomen of Calgary, please visit www.geowomen.org

GeoWomen of Calgary is a GeoCommunity of the CSPG www.cspg.org

GeoWomen of Calgary is a member of AWSN www.awsn.org
This year we celebrate a significant milestone in what has been a storied half-century of the CSPG Core Conference. Starting in 1969, the same year man landed on the moon and brought back basalts of extraterrestrial origin; the CSPG hosted the inaugural Core Conference. The mandate of the Original Core Conference was to highlight the importance of geoscientists to really understand the rocks, and how that understanding of the fundamental principles defines how we explore and exploit the precious resource held within them.

While this year we celebrate the anniversary of the first core conference, we must also recognize the perseverance of this event, through both the good and the bad. From our historical archive review of every core conference to date, it became clear that there were a number of gaps representing years in which Core Conference ceased to happen, likely as a result of economic headwinds. For example, from 1970 to 1973 there was no conference; at that time the price of oil was relatively flat from $3.32 to $4.75 per barrel. This was followed at a time that the world’s major industrial countries hit peak oil production, causing the 1973 Oil Crisis. The world faced substantial petroleum shortages, and price inflation. However, we found that in the conferences following those hiatuses, there was always a very strong return to solid technical presentations and a tenacious spirit that the rocks did matter. By 1978 the price of Oil, continuing on an upward trend, had increased to $14.95 per barrel. In the same manner, the focus on the rocks and resource was reflected in the Core conference as presentations went from only a few presentations per year up to eighteen!

The CSPG Core Conference on May 16th and 17th, will showcase over 22 core presentations from across Canada and the US. This year, the conference has really benefitted from the participation of our industry partners, as well as major contributions from our academic peers. A wide variety core will be presented from some of the top plays in North America including; core from prominent shale plays such as the Permian, Eagle Ford and the Austin Chalk in the US and examples from both the West & East Duvernay plays. Carbonate reservoirs in the Mississippian and the Upper Devonian that have enjoyed a renaissance in development, will be on display. Select cores from the Athabasca Oil Sands will be displayed, discussing estuarine valley fills and the effects of low resistivity Bitumen. Further to this, a number of cores related to Mannville Heavy Oil in Central Alberta will touch on the hybrid nature and sedimentology of these formations in the Clearwater, Rex and Sparky. We will also see Tight reservoir core from the Montney and Viking, along with some classic conventional cores from the Rock Creek, Mannville, Cardium and Belly River. As well, we look forward to several historical presentations ranging from an overview of the evolution of Cardium from the inaugural core conference in 1969, a discussion on the history of the Alida beds in Southeast Saskatchewan to a review of the geological concepts that shaped the major carbonate oil and gas plays from 1902-2004 in the WCSB. Finally, there will be a special presentation of the last 50 years of Core Conference, highlighting the presentations over time, and how we have evolved in our understanding of the rocks.

The CSPG 50th anniversary Core Conference is an event you will not want to miss. With core examples from plays across North America, delegates will be engaged from sequence stratigraphy to reservoir characterization. The presentations will highlight the importance of understanding the rocks, and how we continue to improve that understanding year after year. We look forward to the insight this conference will bring and hope to see you all there!

The 2019 Core Conference Organizing Committee

2019 CORE CONFERENCE
Mark your calendars, and get ready for the 2019 CSPG Mixed Golf tournament on August 23rd at Lynx Ridge Golf course, celebrating 30 years of social golf with your Canadian Society of Petroleum Geologists.

The four-golfer, best-ball tournament includes a round of golf, meals, plenty of hospitality and good times, and a chance to network with your colleagues and industry sponsors. This year we trust that we return to the typical August golf, where the course is at its finest, with the inviting fairways, smooth greens, spectacular mountains and the ever-beckoning water hazards and sand traps to capture errant golf shots, instead of smoky skies that only clear because of the rain!!!

This is a fun tournament, with balanced teams that allow all golfers to contribute to the team score, while having a great time enjoying the day and the fellowship of golfing as a team, and developing your network of geoscientists.

Please watch for further announcements, registration forms and information in the CSPG Reservoir, and make sure to register on-line at the CSPG website www.cspg.org. Register early to avoid disappointment!

We thank our previous sponsors from 2018 that stepped up and helped make our shortened tournament such great fun. We look forward to the return of members, guests and sponsors to enjoy the event.

A big thank you to our continuing committee members, Norm Hopkins, Jeff Boissonneault and co-chair Brenda Pearson.

You can address registration inquiries to David Middleton at 403-296-8844 (dmiddleton@suncor.com), or to Kristy Casebeer, CSPG Coordinator at 403-513-1233 (kristy.casebeer@cspg.org).

If you are interested in sponsoring the tournament this year, please contact Jeff Boissonneault (jeffb@siftonpet.com).

For all other issues reach out to David at dmiddleton@suncor.com or Brenda at blpearson10@yahoo.ca ♦

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WIUGC STUDENT CONFERENCE WRAP UP

By Michelle Thoms

The New Year for geology students residing in western Canada is usually marked by attending the Western University Geoscience Conference (WIUGC). This year, the 55th annual WIUGC was hosted by Brandon University, in Brandon, Manitoba. From January 9th-12th, close to 100 students from Brandon University, the University of Manitoba, the University of Saskatchewan and the University of Regina were in attendance.

The conference took place at the Victoria Inn and Conference Center in Brandon. During the conference, students were immersed in professional development sessions, short courses, industry talks and technical presentations from their peers. One of the most exciting opportunities for students at these conferences, is to network with industry professionals and gain a better understanding of career options when they graduate.

Representing the society at WIUGC was Michelle Thoms, a member of the CSPG University Outreach committee. Along with being a financial sponsor for university conferences, the CSPG sends a representative to help judge presentations and award a monetary prize to presentation winners. This year, the CSPG representative also participated in a mentorship panel, an industry fair and presented a talk about the society and what it offers students.

The conference began on Wednesday evening with an ice-breaker event followed by a themed social at a local establishment in Brandon. Thursday morning students participated in professional development lectures concerning communication skills, resumes, interview preparation and networking. In the afternoon, students gave technical presentations with topics concerning digital outcrop mapping, mineral exploration and seismic anisotropy. The judging panel consisted of 4 individuals from various industries and academia.

On Friday, students attended various short courses held at Brandon University. The short courses included topics covering hydrogeology, core logging, scanning electron microscopes, XRF data compilation and drones. Friday evening students participated in the CSEG challenge bowl, a geo-science based trivia game. This year’s challenge bowl was hosted by CSEG representatives Denika Naidu and Brandon Clayton. University of Manitoba representatives Alex Novak and Ryan Desjarlais won the event, meaning the CSEG will sponsor a portion of their trip to Calgary for the national competition!

Saturday, the final day of the conference, kicked off with a mentorship panel. The panel hosted professionals from the Manitoba Geological Survey, PDAC, Shell Canada, Cypher Environmental, Orix Geosciences and the CSPG. It was a great opportunity for students to ask pointed questions concerning topics such as graduate degrees and various industry challenges that the professionals see on a daily basis. After the panel, industry talks from companies including the Manitoba Geological Survey, HudBay Minerals, Alamos Gold Inc. and Shell gave an overview of the variety of potential career paths students could pursue. After a great day of technical content, the students had the opportunity to attend an industry fair where they could speak one on one with professionals from different companies.

On Saturday evening, the final event of the conference included a banquet, with a keynote speaker and awards ceremony. This year’s keynote speaker, Keith Barron, gave a talk titled “My Adventures on Other People’s Money”. The talk was an exciting overview about Dr. Barron’s career, which has spanned 35 years in the mining sector. In 2001 he privately co-founded Ecuador gold explorer Aurelian Resources Inc., which was listed on the TSX-V in 2003 and made the colossal Fruta del Norte gold discovery in 2006. The company was bought by Kinross Gold in 2008 for $1.2 billion.

Barron concluded his speech by stating that if he can make a discovery like Fruta del Norte, anyone in the room could do the same, a message that resonated with many students.

The awards ceremony followed the keynote speech. Awards were given for first and second place for best technical presentation. Derek Drayson took home the top prize, with Ilona Norte coming second. Both students were from the University of Manitoba.

Finally, the conference concluded as Brandon University handed over the reins to the University of Saskatchewan, the host of the WIUGC, in January of 2020. As the 55th WIUGC ended on Sunday morning, the students returned home with new found knowledge and energy to carry into their next semester.

Michelle Thoms then began her lecture tour across Alberta and Saskatchewan. By visiting the University of Alberta, the University of Saskatchewan and the University of Regina, Michelle was able to have great discussions with students and professors about the energy industry, the role a geoscientist plays in an Oil and Gas Company and the skills involved with pursuing a career in petroleum geology.

Sponsored by CSPG Foundation
CSPG GRADUATE STUDENT THESIS AWARD (PHD)

Kirsten Kennedy is the recipient of the 2019 PhD CSPG thesis award. Her thesis entitled “Paleoenvironmental and paleotectonic significance of Neoproterozoic diamictites in actively rifting basins,” was supervised by Dr. Nick Eyles at the University of Toronto. Financial support was kindly provided by Natural Science and Engineering Research Council of Canada grants to Kirsten Kennedy and Nick Eyles, while access to drillcore and logistical support was provided by Ivanhoe Mines. Kirsten is currently involved with developing online geoscience educational material for the University of Toronto, Scarborough.

This work tackled the controversial topic of enigmatic diamictite facies related to the so-called ‘Snowball Earth’ glaciations of the Neoproterozoic. Diamictites are a poorly-sorted ‘disorganized’ sedimentary rock characterized by clasts that float in a finer-grained matrix and are classically interpreted as fossilized glacial tills. The unusual thickness and global prominence of diamictites in Neoproterozoic strata has previously been regarded as evidence for glaciations of global extent. Yet in many successions, these apparent tills are intercalated with deep water sediments like turbidites and are preserved preferentially in rift basins where tectonic controls are likely to be important. Understanding the origin of diamictite facies and the basinal

Figure 1: The mixtite-model for the downslope intermixing of sediments during debris flow. Diamictites are formed as a consequence of three processes: 1) Large-scale collapse and mobilization of a heterolithic sediment source (‘slumping’), 2) granulometric and volumetric modification through basal erosion and incorporation of antecedent substrate (‘bulking up’), and 3) homogenization of the flow through grain vibration (‘churning’). Mixed diamicate is primarily the result of incomplete mixing of the components that make a diamicite. Graded diamicite can result from either early or late-stage conditions that reduce that capacity of the matrix to support the clasts. Massive diamicites reflect fully homogenized conditions with high matrix strength. Laminated diamicite likely reflects only minor remobilization of a diamicitic source such as that which may be shed off of larger debrite flow noses or upon irregular topography created by debris flow. Adapted after Sohn, 2000; Carto and Eyles, 2012. No scale intended.

Figure 2: Block model overview of the depositional environments found in the Kamoa Sub-basin.
context of diamictite-dominated successions places critical constraints on their use for interpreting Neoproterozoic successions.

Diamictites facies were examined from an impressive and newly acquired collection of some ~300 km of wide-diameter drill core through copper-hosting strata of the Grand Conglomérat, Democratic Republic of Congo, as well as from field investigations of the exceptionally well-exposed Kingston Peak Formation (KPF) in eastern California, USA. Facies types are broadly similar between the two formations: thick diamictite units are associated with distal turbidites, talus breccia and sandy and gravelly sediment gravity flow deposits intercalate close to major fault zones, large scale slope failures are demonstrated by slumps, slides, and olistostromes, and syn-sedimentary volcanism disrupts the sequences (Fig. 1). At Kamoa, the Grand Conglomérat is dominated by thick diamictite intervals (up to 300 m) with volumetrically minor turbiditic lenses, whereas the KPF diamictites are contrastingly thin and discontinuous within a thick turbidite-dominated slope succession. Nonetheless, great thicknesses of genetically related deep-water slope facies (~3 km at Kamoa, and 4 km in the KPF) suggest subsidence in both basins is related to rifting and was of sufficient pace to continually create accommodation space despite the large volume of sediment gravity flows.

The tectonic and depositional context is critical to the interpretation of the diamictites. With no evidence for shallowing or reworking of glacial sediments by meltwater, diamictite facies cannot have been deposited as primary glacial tillites. Instead, they were produced during mass flow by mixing of sediment populations downslope (Fig. 2). Elevated basin margins and tectonically oversteepened subaqueous slopes are typical of strongly subsiding rift basins and contributed to the routing of scarp-derived breccias and conglomerates into deep water through large slope failure events. As coarse grained mass flows were transported to the basin centre, they intermixed with basinal muds to form the characteristic matrix-supported texture of diamictite so often misinterpreted as characteristic of glacial origin. The great thickness of some diamictite intervals is likely the result of ponding and focussing of these debris at the base of slopes in thick slope aprons.

Even when recognized as ‘debrites’ due to their association with deep water turbidites, many have regarded diamictites to be ‘climatofacies’ deposited during ice advance as glaciogenic debris flows. While it is possible ice existed in the hinterland and periodically enhanced sediment delivery to the basin margin, the overall basin architecture and stratigraphy suggests that the primary tectonic control on the timing of debris flow activity was tectonic and not climatic. During times of tectonic stability, sediment was able to accumulate on the basin margins while the basin depocentre was comparatively starved. During times of accelerated subsidence and deepening of the basin depocentre, diamictite was generated through failure of the uplifted basin margins. In this way, kilometers of basin fill are able to accumulate without significant shallowing. It is therefore appropriate to consider the diamictites to be a ‘tectonofacies’ for accelerated subsidence within a ‘tectonosequence’ of rift basin development.

This study has important implications for existing models of the Neoproterozoic climate that invoke globally correlative and synchronous panglacial climate events. The primary tectonic control on sediment gravity flow facies requires that diamictites were deposited diachronously as tectonism waxed and waned locally. It can be speculated that the prevalence of diamictite successions in the Neoproterozoic is related to rift basins forming during the protracted breakup of Rodinia. The unusual thickness of Neoproterozoic diamictites is a byproduct of local faulting geometries and confined depocentres, and is not related to an exceptionally cold climate or accelerated till production.

Kirsten’s thesis can be downloaded at the following address: https://tspace.library.utoronto.ca/bitstream/1807/80669/3/Kennedy_Kirsten_L_201711_PhD_thesis.pdf


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Call for Presenters - GEMODELING DIVISION

Do your part to strengthen the Geomodeling community in Calgary through knowledge-sharing and collaboration:

We are currently accepting abstracts for our 2019 Technical Division Series.

If you would like to present a new and novel technique, share best practices or workflows, or showcase an interesting case study associated with either Geostatistics or Geological Modeling, consider contributing to our Division talks.

Please note the Geomodeling Division does not endorse or promote the use of specific commercial software products, and all submitted abstracts are subject to review. Talks are hosted at a downtown Calgary location, typically the last Thursday of the month, from 12-1pm.

For more information, please contact Hayley Silberg: hayley.silberg@sproule.com
Kirsten Kennedy is the recipient of the 2019 PhD CSPG thesis award. Her thesis entitled Sedimentology and Petroleum Reservoir Characteristics of the Mississippian Pekisko Formation, Northern Alberta, Canada. Her thesis was supervised by Dr. Nancy Chow at the University of Manitoba and funded by a NSERC Collaborative Research and Development Grant in partnership with ARC Resources Ltd., and by the University of Manitoba GETS program. Lauren was also the recipient of the Julie Payette NSERC Research Scholarship and was awarded the Winthrop Spencer Gold Medal for outstanding achievement in geological research for her M.Sc. thesis. She is currently at Imperial Oil Ltd. on the Kearl Operations Technical Geoscience team.

The Lower Mississippian (Tournaisian) Pekisko Formation in southern and central Alberta is a prolific oil and gas producer and has been the subject of numerous studies. In contrast, the Pekisko Formation in northern Alberta has limited production and few detailed studies have been published. A large petroleum resource has been defined in the Hawk Hills area of northern Alberta (Townships 95 to 105; Ranges 1W6 to 8W6), but several technological challenges affect potential development, including low permeability, small pores and small pore throats of the reservoir rock, and the medium to heavy gravity oil. The primary goal of Lauren’s thesis was to investigate the stratigraphy, lithofacies architecture and diagenesis of the Pekisko Formation in the Hawk Hills area and to integrate the findings in order to evaluate the reservoir characteristics of the formation.

The Pekisko Formation in the study area is 30 to 50 m thick and composed of skeletal-peloidal limestones with local shaly beds. The formation is interpreted to represent ramp development along the northern margin of the Peace River Embayment, a peri-cratonic sub-basin of the Prophet Trough. Basement fault reactivation and differential subsidence of overlying strata strongly affected depositional trends.

The Pekisko Formation is divided into four informal units: the lower carbonate, lower shaly, upper carbonate, and upper shaly. They are mainly composed of three lithofacies associations. The outer ramp to slope lithofacies association (LA 1) is composed of highly argillaceous lime mudstones and skeletal wackestones. The outer ramp lithofacies association (LA 2) comprises argillaceous skeletal wackestones and packstones. The mid- to inner ramp lithofacies association (LA 3) is composed of bituminous echinoderm-peloid packstones and rare grainstones. They are interpreted to have been deposited on a south-facing, low-energy, temperature-stratified ramp (Fig. 1).

The lithofacies associations are stacked into two decametre-scale, deepening-upward cycles composed of multiple, metre-scale, symmetrical and rare asymmetrical cycles. Cyclicity was controlled by differential subsidence and eustatic sea level change. Differing subsidence rates between the southern and northern parts of the ramp resulted in evolution of the ramp from homoclinal to distally-steepened and back to homoclinal over time (Figs. 1 and 2). The NE-SW oriented slope break of the distally-steepened ramp is interpreted to have been...
fault controlled.

The Pekisko Formation has a varied diagenetic history. Marine diagenesis included micritization and microboring of allochems and rare radial-fibrous calcite cementation. Early meteoric diagenesis was limited to formation of a paleosol horizon, rare vugs and fractures, and local clay infiltration. Burial diagenesis included the formation of neospar matrix, skeletal molds, nonferroan and ferroan blocky calcite cements, and minor nonferroan and ferroan dolomite. Late, ferroan calcite cements have low stable oxygen isotope values and minor-trace element compositions indicative of precipitation from hydrothermal fluids enriched in Fe, Mn, and Sr. These fluids were likely introduced along deep-seated basement faults and may have been related to Mississippi Valley-type mineralizing fluids. Stable oxygen isotope and minor-trace element analyses of dolomite indicate that dolomitization occurred at slightly elevated temperatures, from relatively Fe-rich fluids. Most dolomite is interpreted to have formed via the burial compaction model, but may have been influenced by hydrothermal diagenesis. Late burial and meteoric diagenesis included formation of barite cement, fluorite, and sphalerite; dissolution (reservoir porosity generation); and dedolomitization. Dissolution preferentially affected micrite matrix, micritized allochems, and allochems with a fibrous skeletal structure and was most significant in lithofacies with 15-25% micrite matrix. Porosity-generating fluids are interpreted to be mixed hydrothermal and meteoric fluids.

Oil-saturated reservoir intervals in the Pekisko Formation in the Hawk Hills area are 3-21.6 m thick and are predominantly composed of mid- to inner-ramp lithofacies. These intervals are typified by 8-20% microvuggy, moldic, and interparticle porosity, average permeabilities ranging from 0.8–49.7 mD, and oil saturations up to 76%. The best reservoir is located in the southeastern part of the study area, where Pekisko strata are both thickest at the locus of differential subsidence and dominated by packstones that were of suitable composition for pervasive and significant dissolution and porosity generation.

Figure 2: Summary of proposed depositional history for the Pekisko Formation in the Hawk Hills area. Interpreted changes in relative sea level and subsidence rates are summarized on each image.

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IN MEMORIAM
By Fed. Krause

DONALD JOHN GLASS
CSPG EDITOR EXTRAORDINAIRE

Don Glass, a long-serving, caring and keen-eyed editor of the Canadian Society of Petroleum Geologists, passed away in Calgary at the age of 92 on May 19, 2018 after a brief illness.

Don was Albertan by birth, having been born on February 23, 1926, in Pincher Creek. He grew up during the Great Depression and spent his first twelve years on the family farm in the Summerview District northeast of Pincher Creek. In 1938 the family moved into town and there, for several years, with his two younger brothers, Don sold and delivered newspapers to help his parents as times were hard. In 1944 during WWII he joined the Canadian Armed Forces and served in the European theatre in Holland. After the war’s end he enrolled in 1945 at the University of Alberta in Geology. There he gained the knowledge and skills that were to serve him so well in his geological career. Don first tried his hand in “hard rock” mining as he loved minerals. In the summer of 1946 he began working as a summer student for Cominco at the Sullivan Mine in Kimberley, British Columbia. In 1948 while travelling underground on a mine train in the Sullivan Mine, the engine’s train stopped abruptly, and a load of mine props went over the engine and crushed Don and another worker. This accident left him badly injured with multiple rib fractures and crushed vertebrae. Following his discharge from the Kimberley Hospital, Don completed his recovery at his parent’s home in Pincher Creek. He returned to work for Cominco, but this time he worked above ground and participated in the surveying and delineation of the lead-zinc deposits that subsequently became the Pine Point mine in the NWT.

His first petroleum job was in 1950 as a well-site geologist with Rotary Engineers. Four years later, in 1954, he moved over to Canadian Export Oil & Gas where he worked for the next 19½ years before moving in 1974 to Brascan Resources Ltd. as an exploration geologist. In 1977 he joined BP Exploration Canada Ltd. where he remained until retiring in the mid 1980’s. Periodically, and for several years afterwards, he took up consultant jobs that interested him.

It was in the late 1960’s that he first volunteered to help with editorial work following the International Symposium on the Devonian System held in Calgary in 1967. Don did most of his editing work at night, working at a small table in the family kitchen and well into the wee hours of the morning. His outstanding editorial skills came to everyone’s attention during the 24th International Geological Congress, held in Montreal in 1972, where he edited 64 of the guide books for this congress. He was awarded the Logan Gold Medallion in 1972 for his thoughtful and rigorous editorial work. Following this accomplishment, Don became editor for the Canadian Society of Petroleum Geologists, both as Bulletin and Memoir editor. These efforts were recognized with 3 Tracks Awards in 1976, 1986 & 1988 and Honorary Membership in 1980.

Don met his future wife, Mary, in Calgary and they were married in September 1954. Together they raised two daughters and two sons, Chris, Alison, David and Neil. An avid interest in dinosaurs led Don and Mary to participate in Dr. Phil Currie’s “Dino Tours” which went to various sites and museums in North America. Don also never lost his “hard rock” interests. He was passionate about volcanoes, and in 2008 fulfilled a life-long ambition visiting the island of Hawaii, the Hawaii Volcano Observatory and Kilauea volcano with his daughter Alison. Importantly, Don’s lifelong interests in animals, birds, fishing, astronomy, rocks, geology, mountains and natural areas outdoors, dinosaurs, woodworking, reading and other pursuits were passed on to each of his children.

Don leaves an exceptional editorial record and is remembered fondly by collaborators. Dr. Ashton Embry who worked with Don on CSPG Memoirs 14 and 17 provided the personal comments that I include below:

“I have nothing but good to say about Don both as a person and as an editor. I first was in contact with him in 1976. He was the Bulletin editor and I had just finished my PhD and was “gainfully” employed by BP. He convinced me to submit a paper on my thesis to the Bulletin and, as you likely know, the last thing one wants to do after finishing a Ph.D. is to revisit the behemoth and go through the publishing process, especially when one is in industry as opposed to academia. However, Don convinced me with his charm and logic to submit a paper which I did a few months later. Notably, I expect if I had not done it then I may not have ever done it given I soon became a father. I am very proud of that paper, which Don shepherded through the publishing labyrinth, and surprisingly it still gets referenced.

Don was the best technical editor I ever worked with and he and I teamed up for those two CSPG memoirs, along with Benoit Beauchamp and Jack MacMillan. We handled paper recruitment and scientific editing whereas Don cheerfully and efficiently handled the technical editing and all dealings with the printer (McAra). Because of this ideal partnership, both memoirs were published in just over 1 year after the actual symposium event they were based on. Not many symposium volume editors can claim such a fast publication process and it was almost all due to Don’s wonderful efficiencies. When Don asked you to do something, you just did it because you didn’t want to let him down.

Of course, Don was one of the nicest people you could meet. I never heard him say a
negative word and he always was very positive and kind. It was always a pleasure to speak with him at CSPG events and his insights regarding current events was enlightening.”

Throughout the years our society has benefited from individuals like Don who have generously given of their time to further the aims of our society. Don left an indelible mark and through his editorial efforts has enriched us all. He will be sorely missed.

ACKNOWLEDGMENTS
Fed. Krause thanks the Glass Family for their contributions. The assistance of the following individuals is also appreciated: Elanna Brown and Adriana Sanzana, Gallagher Library of Geology and Geophysics; Andrew Carew, Taylor Family Digital Library; Natasha Grisack, Geological Survey of Canada, Calgary Library; Dr. Clint Tippett, CSPG Past President; and Drs. Ashton Embry, Benoit Beauchamp and Terry Poulton.

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2. Fulton, R.J. and Halstead, E.C., Quaternary geology of the Southern Canadian Cordillera, Excursion A02, 49pp.


12. Lenz, A.C., and Pedder, A.E.H., Lower and Middle Paleozoic sediments and paleontology of Royal Creek and Peel River, Yukon, and Powell Creek, N.W.T., Excursion A14, 43pp.


34. Church, W.R., and Young, G.M., Precambrian geology of the southern Canadian Shield with emphasis on the Lower Proterozoic (Huronian) of the north shore of Lake Huron. Excursions A36 & C36, 65pp.


(Continued on page 38...)
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49. Clark, T.H., Stratigraphy and structure of the St. Lawrence Lowland of Quebec. Excursion C52, 82pp.


1990, Lexicon of Canadian Stratigraphy V4, Western Canada. CSPG, 772 pages.


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