Remembering Professor S. George Pemberton

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*As of October 9th*
**Bugaboo Spire - Bugaboo Provincial Park, B.C.** This view of Bugaboo Spire, the centerpiece of the Bugaboos, was seen on a moody Fall day, looking southwest through Brenta-Cobalt Col from Cobalt Glacier in the Purcell Mountains to the southwest of Golden, B.C. The Bugaboo batholithic intrusion dates to the Early Cretaceous (approx. 135MA). It penetrated the sediments of the Neoproterozoic Horsethief Creek Group. As its magma cooled over millions of years, a coarse-grained igneous fabric was developed. Subsequent uplift and erosion of the surrounding country rock have exposed the batholith. Glaciation, still evident and active today, finished carving the spires into the form we see them at present. Their name was given to them in the late 1800’s in the aftermath of a failed gold rush. “Bugaboo” means “dead end”.

*Photo: Aleta Corbett*

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### LETTER FROM THE EDITOR

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### MESSAGE FROM THE FOUNDATION

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### REMEMBERING PROFESSOR S. GEORGE PEMBERTON EDITION

Professor S. George Pemberton Ph.D, P.Geol., F.R.S.C.
(Dec. 3, 1948 – Aug. 4, 2018)

Talking with Architects – Professor S. George Pemberton

Pemberton’s Law of Stratigraphy

### UPCOMING EVENTS

Technical Luncheon

Division Talks

### SOCIETY NEWS

Core Conference

2018 Summer Student/YP Field Trip Wrap Article

2018 – Smoking Rain for the CSPG Mixed Golf Tournament

2019 CSPG Geological Calendar Wrap-up

### GEOFUN

Geology In Your Neighborhood

CSPG Rock Analysis Workshop
REMEMBERING PROFESSOR S. GEORGE PEMBERTON

It came as a great shock to hear of George Pemberton’s passing this August. He was an icon within the petroleum community, and will very much be missed by all. This edition of the *Reservoir* is dedicated to him, the work that he did, and the community he created. Generations of Geologists, not just in Calgary, but around the world can attest to his passion for the Science that brought people together.

I had the great pleasure of attending his “Celebration of Life” at the University of Alberta on Saturday, September 29th. Not only was it amazing to reflect on the major accomplishments of George’s academic life, it was also a time to reflect on the vast array of people George was able to influence during his career. He was able to bring people together; individuals of various backgrounds, abilities, and interests and have them work together. For any of you who have had the pleasure of leading teams know that this is no small feat!

Another theme of the afternoon became very clear throughout the gathering – one of regret. Many people told stories of George’s influence on their own lives, and how they regretted not telling him how much he meant to them for these influences. Quite simply to acknowledge this and to say “thank-you.” Perhaps a lesson to us all as we ‘get older.’ Take the time to say thank-you to those people in your life that have meant something to you, influenced you, or made you who you are today. Without a doubt, we are all better for having known George, and feeling his influence.

This edition shines a spotlight on George’s life, and his accomplishments. Not only academically, but also the petroleum community he helped foster. Murray Gingras, James MacEachern and Mike Ranger have assembled George’s history and accomplishments in a very heartfelt obituary.

The interview in this edition is particularly touching, as it was one of the last pieces of work George completed before his passing. I truly believe it to be a gift to the CSPG, and the petroleum community George helped foster. Reading it now I can’t help but hear his voice, and for that I am truly grateful.

To conclude the edition we have the answers to Clinton Tippett’s “Rocks in my Neighbourhood” quiz. Please check your answers against the answer key – bragging rights are up for grabs! And if you haven’t had time to check out these wonderful specimens, please do – a quick walking tour during your lunch break will be well rewarded.

As always, thank-you for supporting the CSPG and the *Reservoir*!

Jason Frank 🌟

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**LETTER FROM THE EDITOR**

**Jason Frank**

Technical Editor for the CSPG Reservoir
Sr. Geologist at Athabasca Oil Corporation

Jason Frank is a Professional Geologist who holds a B.Sc. and M.Sc. from the University of Alberta. He has over 16 years of experience in oil and gas including technical and leadership positions in exploration and development both on and offshore. Past experience includes Shell Canada Ltd., Burlington Resources Ltd., ConocoPhillips Canada Ltd., and Talisman Energy Inc. Jason has volunteered for the Society in the past, most recently chairing the Duvernay session at the Society’s annual convention (2014) and the Honorary Address Committee.

**Travis Hobbs**

Technical Editor for the Reservoir
Professional Geologist at Encana

Travis Hobbs is an undergraduate from University of Calgary with a graduates degree from Simon Fraser University in Geology. Professionally he has worked both domestically and internationally for 19 years in the Oil & Gas industry, and is currently celebrating 15 years with Encana. Industry roles have included development, exploration, management and business development. Prior to the Reservoir, Travis has held previous roles on convention committees and six years as the Chair of Continuing Education. As free time permits Travis enjoys cycling, cross-country skiing and teaching his two daughters violin.
Welcome to the season where a good many charities begin their fundraising for the year. You may know WHAT the CSPG Foundation does year in and year out and HOW it does it, but do you know WHY our charitable organization has done this for the last 40 years?

The CSPG Foundation was created in 1978 under the name of the CSPG Fiftieth Anniversary Trust Fund. It was established to fund the two-week Student Industry Field Trip, commonly known as SIFT.

While conducting a recruiting trip to Maritime universities in 1976, CSPG member Bill Ayrton gained first-hand experience on the lack of knowledge about western Canadian geology and the oil industry. The top students he encountered were very knowledgeable about their area, but when asked what they knew about the Precambrian Shield the answer was very often "Well, not very much, I know it's very old and it's got minerals in it." "So, we put together a committee," Ayrton says, "we raised about half a million dollars from industry and donations and we put on the first Student Industry Field Trip. It's gone every year since with one student from every university across Canada." The first SIFT began with a desire to expose young geoscientists to the oil patch for a week. It ran in May of 1977 and it has grown into a two-week trip that introduces thirty-two top students to a range of activities including lectures, field trips, core workshops and an exploration game.1

From its initial funding support of SIFT, the CSPG Foundation has expanded its funding of other educational related programs to comply with charity guidelines. Currently we are funding 13 unique programs (both CSPG and non-CSPG) that meet and exceed the Foundation’s charitable mandate. This year the Trustees have approved a $200,000 budget for the 2018-2019 fiscal year. The approval process requires the programs and/or committees who requested funding to provide the trustees of the Foundation with a thought-out budget and business case. This approval process provides the board with clear and concise information to be able to commit to and support the approved funding.

The Foundation is currently comprised of a board of six trustees. Why do we volunteer as trustees for the CSPG Foundation? One could chalk it up to several different reasons. Among them are passion, experience gained from working on a board or pride in being a CSPG member.

We, as a board have had to make several key decisions over the past year. Some of these were done to provide the Foundation with tools for future board members to ensure continuity and a process to make consistent decisions within the rules for operating a registered charity. However, we need your help to raise the profile of the Foundation now and into the future. I am sure that we as members of the CSPG have a certain amount of “Pride of Membership” and would be willing to assist. As the year draws to a close, please remember to make your donation before December 31 in order to receive a tax receipt for 2018. I would also like you to consider and explore reasons for volunteering – put your name forward to be considered for a position as a Trustee with the CSPG Foundation.

Many members have shown a willingness to ensure the future of the CSPG Foundation with a bequest upon their passing of one or two percent of the net residual of their estate. We encourage members to contemplate this and please contact the CSPG office should you wish to leave your legacy.

After over ten years of volunteerism to various CSPG committees, I have a confidence that the Foundation will continue to be an important source of funding for geoscience energy-related educational programs into the future because of your pride in your membership. Thank you for supporting the CSPG Foundation.

Reference:
Professor Stuart George Pemberton passed away unexpectedly August 04, 2018. George is survived by his wife Teresa, his daughters Sarah and Erin, and his son, Joshua, a family to which he was completely devoted. George is missed not only by his family, but by the scores of colleagues and students who became dedicated to George through his charismatic teaching and unparalleled geological insights. During his time at the University of Alberta, which began in 1984, George mentored countless undergraduate honours theses, graduated 63 MSc. students, 16 PhD candidates and mentored 7 Post-Doctoral Fellows. Six of his doctoral candidates now hold professorships in other universities. Through his 107 short courses to academic societies and the hydrocarbon industry, the number of undergraduate students and industry trainees he influenced during his career would be numbered in the thousands.

Many of those students and trainees still work in the North American Oil and Gas Industry today and it is, in fact, difficult to find a geologist in that industry not trained at some point in their career by George. George had a profound impact not only on how sedimentary facies are described and interpreted but also in sharing his philosophies of science in a broader way. “Sacred cows make the best hamburger” George would love to say, gleefully using the phrase posthumously ascribed to the late Abbie Hoffman. Hoffman, of course, referred to social structures whereas George applied the words to geological models that were believed rather than proven to be true.

The Path to Alberta
George was born Dec. 3, 1948 in Preston, Lancashire England, to Ethel Mary Pemberton and George Edgar Pemberton. He emigrated to Canada with his family sometime around 1949 and became a Canadian citizen in 1958. George completed a BSc. (Honours) in Geology at Queen's University in Kingston, Ontario (1972), and a MSc. in Geology (1976) and a Ph.D in Geology (1979) at McMaster University in Hamilton, Ontario. He married Teresa Lynn (née Joyce) Pemberton on March 4, 1978 in Hamilton, before moving to Athens, Georgia, USA to take up an academic posting at the University of Georgia. George accepted the offer of a position at the University of Georgia in order to work closely with the two most productive sedimentological-ichnological innovators of the seventies – Dr. Robert W. Frey and Dr. James D. Howard. George’s collaboration with those men would profoundly shape the research program that George would develop later in Alberta.

George returned to Canada in 1981 to take up a post at the Alberta Research Council in Edmonton, Alberta. He left the Research Council in 1984 to take the University of Alberta Professor of Stratigraphy position vacated by the retiring Professor Charles Stelck. Charlie would become one of George’s great heroes and mentors, and Stelck’s dedication to good science and excellent teaching had a profound influence on George’s career. George held the position of Associate Professor until 1987, when he was promoted to Professor. During his time as Professor, George held a Canada Tier 1 Research Chair in Petroleum Geology (2002-2009), was elevated to Distinguished University Professor (2009), the highest level the U of A offers to academic faculty, and held the C.R. Stelck Chair in Petroleum Geology from 2013 until his passing.

The Canadian School of Ichnology
During the 1980’s and 1990’s, entirely through George’s efforts (often in collaboration with his colleagues and students), applied ichnology blossomed in Alberta. The WCSB became one of the world’s premier laboratories for developing and refining ichnological models and their applications. Prior to George’s tenure at the University of Alberta, ichnology was rarely employed in facies interpretation. When it was, observations were typically limited to "horizontal burrows" or "vertical burrows". That changed quickly under George’s influence, and today a subsurface study that does not employ ichnology as a tool equal in importance to physical structures would be considered woefully incomplete.

Given the amount of drill core available and the overall interest in understanding stratigraphic and sedimentological complexities in the Western Canadian Sedimentary Basin (WCSB), it is hardly surprising that George turned his attention to significant geological problems revolving around the oil and gas industry — albeit, that was a path he began to follow in the eighties. Among
George’s many, and now widely employed paradigms that were developed in Alberta are:

(1) George pioneered ichnological studies from core datasets. Before George there were no established criteria for the identification of trace fossils, which are inherently 3-dimensional structures, from the 2-dimensional “side views” that core characteristically proffers. The identification of trace fossils in core were beautifully presented in the Bulletin of Canadian Petroleum Geology in 1985 as Biogenic Structures In Outcrops and Cores. Approaches to Ichnology Part 1 (coauthored with George’s hero, Robert Frey). Part 2 was never published and one can only imagine what we missed. In any case, this paper helped industry and academic geologists alike in providing a framework for ichnology in core studies. We still follow the techniques in that paper today.

(2) The brackish-water ichnological model, which was an integration of work conducted on the McMurray Formation, George’s Book Cliffs, Utah experience, and his work in coastal Georgia with Bob Frey. This work is increasingly accepted and is one of the most useful ichnological models that exist today.

(3) The recognition of omission suites and substrate dependent ichnofacies, leading to the wide application of ichnofossils to recognize and interpret (sequence) stratigraphically important surfaces in core datasets. Again, this work was in some ways derivative of George’s sequence stratigraphic work at Exxon, but more importantly was rooted in modern observations of the omission suites that George had studied in Georgia.

(4) The integration of trace fossils with facies models. George became one of the most important and influential workers in the advancement of sedimentary facies models of shallow marine successions throughout the 1980’s and 1990’s. He and his students refined facies models, permitting the identification, detailed characterization, and paleoenvironmental interpretation of offshore, shoreface, delta, bay, and estuary deposits with a level of precision that prior to George’s work was simply not possible.

(5) The application of ichnological analyses to better understand reservoir porosity and permeability distribution. In the later 1990’s, George turned his attention to biogenic influences on reservoir development. His efforts were seminal and we are still building an interpretive framework for the ichnological characterization of reservoirs today.

(6) The expansion and characterization of the ichnofacies concept. George and his students of the “Alberta School of Ichnology” have continued to develop a broad range of ichnological-sedimentological models in a broad range of strata, including delta studies, coarse-grained clastic shorelines, estuaries and bays, and mixed siliciclastic-carbonate shorelines, with the aim of refining and improving the original Selicharian ichnofacies, a framework that was formulated in the 1950’s.

The monumental body of work that George leaves as a legacy to the scientific community is nothing short of stunning. He has received many awards for his insight and efforts, which are recounted below, but in the context of Canadian geoscience, George’s receipt of the Geological Association of Canada’s Logan Medal (The highest award of the Geological Association of Canada is awarded to an individual for sustained distinguished achievement in Canadian Earth Science) in 2013 exemplifies his importance to Canadian geoscience.

The success of George’s work hinged on the recognition that a high-quality sedimentological and ichnological characterization are required together in order to produce an exceptional sedimentary interpretation. Today, an “applied” ichnological characterization of industry drill core has become an almost universally expected aspect of any comprehensive subsurface study. George’s impact can be further seen in universities across Canada, as several centers in Canada now also teach high-level ichnological concepts to undergraduate and graduate students.

The industry that benefitted the most from George's expertise was, of course, the petroleum industry, and it was a mutual benefit: George attracted over $2 million in industry grants over the years, most of which was poured back into student research and support. In his early years in Alberta there was much industry skepticism about whether the study of "worm burrows" was anything more than a purely academic exercise. That perception seemed to change with George’s publication in Science in 1982: "Trace Fossils from the Athabasca Oil Sands, Alberta, Canada", co-authored by Peter Flach and Grant Mossop. The timing was impeccable, since interest in the oil sands was beginning to surge due to the new potential for in-situ recovery offered by SAGD, whose success required detailed facies analysis.

George’s graduate students, as well as the many undergraduate students he mentored, began to be snapped up by the petroleum industry in Canada and around the world. They would spread the gospel of applied ichnology. The feedback for George was a hunger for his short courses, lectures, and core workshops in Calgary, but also in far-flung petroleum centres around the world, which he always accepted if he could. His trace fossil atlas is a well-thumbed fixture in public and private core labs around the globe from Algeria to Venezuela.

George enjoyed the annual conferences of the CSPG and AAPG, and he always tried to attend if his schedule allowed. Conference events gave him a chance to reconnect with ex-students and colleagues who "flocked” around him, all smiles and laughs. Who can forget that distinctive, spontaneous, and infectious laugh?

The Jedi
George was an incredibly kind and devoted mentor. He wove science and life lessons into anecdotes based around his extensive experience teaching short courses around the world, conducting fieldwork, field trips, and core work. He and his students would lunch together daily and within 5 minutes, some question or comment would come that would launch George into an anecdote. There were many stories, but even so they
would repeat, often with increasingly amusing embellishments, over the course of a year. But, we learned the lessons. Lessons of collegiality, loyalty, hard work, having fun and some of the moments of brilliance George had witnessed over the years. He was a teacher in the way that we imagined the ancients taught. In a small circle with oblique lessons of life used as evidence to support specific themes. It was as if he was a mystic, and so those of us mentored by George called him “The Jedi”. Retrospectively, one cannot imagine a better nickname for George. Equal parts philosopher and warrior, kind and fierce, and loyal beyond measure. His lessons are finished now, but not forgotten.

Awards and Recognitions
George Pemberton was elected as a Fellow of the Royal Society of Canada (F.R.S.C.) in 2001. He was recognized for his scientific achievements with numerous national and international awards, including being a Distinguished Fellow of the Geological Association of Canada (1996), American Association of Petroleum Geologists Distinguished Lecturer (1998-1999), recipient of SEPM’s R.C. Moore Medal for contributions in paleontology (2003), the Geological Association of Canada’s Past President’s Medal (Hutchison Medal) (1994), the American Association of Petroleum Geologists’ Grover E. Murray Distinguished Educator Award (2008), the Killam Award for Excellence in Mentoring (2009), the Canadian Society of Petroleum Geology Medal of Merit (2006) for the paper “Classification and characterizations of biogenically enhanced permeability,” the Geological Association of Canada’s Elkanah Billings Medal in Paleontology (2017), the Canadian Society of Petroleum Geologists R.J.W. Douglas Medal for outstanding contributions to sedimentary geology in Canada (2014), Honorary Membership in the Canadian Society of Petroleum Geology (2010), an elected Fellow of the Geological Society of America (2014), and recipient of the Geological Association of Canada’s Logan Medal (that society’s highest honour) (2013). George was to receive SEPM’s Twenhofel Medal (that society’s highest honour) in 2019 for his career contributions to sedimentary geology.

Farewell George
To honour George’s legacy donations can be made by cheque to the International Ichnological Association George Pemberton Scholarship (send to Dr. Gabriela Mángano Dept. Geological Sciences, University of Saskatchewan, 114 Science Place, Saskatoon, SK, S7N 5E2, Canada).

George leaves us with a scientific heritage that is almost unequalled in modern geoscience. We are fortunate to have benefitted from his teaching and to have the opportunity to pass them to the next generations of Canadian Geoscientists. So perhaps the lessons are not complete, but they will be delivered by those who stand on his shoulders and thereby see farther because of George. It is an honour to have learned from such a great, great man. Goodbye, Jedi. ✡
Questions regarding the Twenhofel award:

First and foremost, congratulations on being presented with the Twenhofel award! For those readers who aren’t aware, the award marks a career of excellence in Sedimentary Geology. It is the highest medal of recognition given by the SEPM. 1) Without a doubt an amazing honour, what does being presented with the Twenhofel award mean to you?

I was extremely surprised and humbled by the announcement of the award. To be honest, I never thought myself as being worthy of such an honour, so it is overwhelming that the sedimentary geology community chose to recognize me. The SEPM has always been “my society” and I first joined it in 1976 as a graduate student and have continued to contribute to it in a scientific sense ever since.

2) The list of past recipients is very distinguished to say the least. Does it come as a surprise that an Ichnologist would be chosen for the award?

This comes as a great surprise! I would have suspected that Dolf Seilacher would have been awarded the Twenhofel for his foundational work, but it seems like times are changing and attitudes toward ichnology are shifting. When I started out people thought of ichnology as an anecdotal subject or a hobby. I think that me winning the Twenhofel shows that the science is on strong footing and taking its place as one of the frameworks and fundamental tools of soft rock geology.

3) Looking at the list of recipients, which would you suggest is the most influential (advanced the science) within your generation?

Some of the most influential scientists who have significantly impacted my career, including, Gerry Middleton, Noel James, (Continued on page 12...)

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Bob Weimer, Larry Sloss, Robert Ginsburg, Peter Vail, and Harold Reading have all won this medal. I feel extremely honoured to be in their company.

Questions more on your geological background:

1) What attracted you to the Earth Science discipline, and when did you realize you wanted to focus on the field of Geology? My dad bought me a book called *Under a Lucky Star*, which was an autobiography written by the explorer Roy Chapman Andrews. The adventures of a fossil hunter seemed like it would be a great life and my career path was set in motion at age 11.

2) Who were the influences on your work during your early education/training? Who are your mentors?
During my early education I was very fortunate to have the opportunity to interact with Gerry Middleton at McMaster University. During my PhD I had the pleasure of spending time with Noel James in the field and he provided a great example of what it was to be a gentleman and scholar. Following my graduate training and during my development as an Ichnologist, I was deeply affected through my interactions with Bob Frey and Jim Howard at the University of Georgia. Finally, Charlie Stelck was one of my greatest supporters and an inspiration at the University of Alberta as I developed as an educator and researcher.

3) Is there a seminal experience you feel every Geologist should have in order to call themselves a “Geologist”? Or are there a set of defining characteristics / traits that make a “Geologist”?
This is very difficult to answer, especially considering the field of Geology is so broad, but I can tell you this: as a professor I have seen the light go on in the eyes of graduate students when they realize that they can filter through the chaos to find the important information – that moment when they just get it. Once that happens there is no stopping them. I used to live to see that light - it was the ultimate high!

4) Having worked in many different sedimentary basins across the world, how has this influenced you as a Scientist? Has it changed your perspective on Geology? Was there a “eureka” moment when this happened?
The diversity of locales that I was able to work on throughout my career really reinforced for me that the answers are always coming from the rocks. If you can learn to block out any noise and instead, really focus on reading the rocks and concentrate on what they are telling you, then you simply cannot go too far wrong. Every basin and every section will be unique but it is learning to recognize trends and patterns that will lead to any breakthroughs. The biochemist and Nobel laureate Albert Szent-Györgyi once said “research is to see what everyone else has seen, and to think what nobody else has thought”. This statement really resonates, since in science, I’m not sure there are real “Eureka” moments. I think good research is all about hard work. In order to be prepared for any perceived breakthrough, you need to have truly invested in understanding the background and context for the problem at hand. You need to spend time reading papers, looking at the rocks, and try to find a framework for scientific investigation that you truly believe in. Any romantic notion of the “eureka” moment is built from a foundation of hard work. That doesn’t make it any less satisfying when you begin to see an answer or a new theoretical framework coalesce. Above all else, science and discovery are thrilling.

5) Having seen so many geological wonders in the world, what is your favourite? The first time I stepped off the helicopter at the Steepbank River and saw the McMurray Formation oilfield in outcrop. It was a magnificent site.

Questions focused on career development and advice for Geologists (new or seasoned):

1) Having taught countless undergraduate students and supervised over 75 graduate students throughout your career, do you see any trends (comments on technology, student aptitude, or teaching methods) within the University? In your opinion, is this changing the science?
Teaching methods and the graduate student experience has changed radically throughout my career. It used to be that all of the computers were desktops and were
physically located in the lab, so the students gathered there to get their work done; they exchanged ideas, discussed things over lunch, helped one another, developed new ideas, and slowly learned to think like geologists. Nowadays, people have their own laptops and that kind of synergy has regrettably died in most cases. Students get isolated and do not seem to get what I called the "graduate experience." Another trend is the departure of looking at actual rocks. Employers want instant maps; correlations built using logs and reservoir models. But unless these pieces of information are tied to the actual rock, they have limited value. How are you supposed to understand and develop the reservoir if you don’t do the hard work to understand the rock? It may see like you are saving money by bypassing the core or outcrop work, but if the trend would shift to investing in these analyses and data up front, I think a lot more value would be created.

2) If you could offer some advice to those just starting their career (be it within Academia or Industry), do you have some key messages or "pearls of wisdom" you’d like to offer?

If I could offer a few words of advice to young geologists, it would be to embrace field work and first principles. Do not forget that the actual rock is the best dataset we have as geologists. Our profession deals with the earth and the old adage “The best geologists are the ones who have seen the most rocks” is true. There is no substitute for experience and the thrill of new discovery is only one core box or one outcrop away. Always remember the reservoir is the rock - not a squiggly line on a piece of paper. If you understand the rock, you will understand the reservoir. I take great inspiration from a phrase commonly used by the late sedimentologist Gerry Friedman: Saxa Loquentur or "Rocks Speak". It is our job to learn their language and listen to what they are telling us.

3) You approach the science of Geology from a more philosophical angle, with many of your students learning about “Pemberton’s Laws of Stratigraphy.” When did you develop these?

I developed the Laws over 20 years teaching Stratigraphy. Eventually, I would even do a lecture on them for my 4th year Sedimentology as well as graduate classes. I thought that they would stay as an anecdote within the classroom and that would be it, but Matt Hall wanted me to publish them in 52 Things you Should Know About Geology (Able Geoscience Library), which felt like a good opportunity to reach a few more folks. But, the Laws are in constant flux and throughout the years I have ended up with 32 of them that I believe are important for any young geologist to take into consideration.

I also like to start each lecture or talk with a quote that I call the “Thought of the Day.” I try and find "thoughts" from diverse sources throughout science and philosophy, which I hope can either inspire or make my students take some time to think. I have always felt that one of the roles of a professor is to make students step out of their comfort zone and look at a variety of subjects. Part of the University experience is a degree of scholarship and critical thinking and the point is not simply rote memorization. I like to bring this scholarship to my classes and it seems to be something that the students enjoy.

4) Can you describe some defining moments, or favourite projects over your career? One that you are most proud of or one that you still can look back on and smile?

I generally remember my defining moments and favourite projects as those that challenged me to alter my thinking. The first time I truly knew I had found my calling was during the Facies Models course I took at McMaster University, which was taught by Gerry Middleton, Roger Walker, and Frank Beales. The debate and discussion in that class really fostered my critical thinking ability and challenged me to question scientific authorities. Outside of the classroom, I remember special moments out in the field; especially the work I did looking at sections in Labrador with Noel James, sessions with Roger Walker on the Cardium formation, a day on the Tocito Sandstone (San Juan Basin) with John Van Wagoner, and certainly my first trips out to Sapelo Island, Georgia with Bob Frey and Jim Howard as well as to the Athabasca oil sands with Grant Mossop. Alternatively, sometimes you can read a paper or a book and your thinking is forever altered. The first time I read the translation of Wilhelm Schäfer’s book “Ecology and Palaeoecology of Marine Environments” and Derek Ager’s “The Nature of the Stratigraphic Record” I was changed as a geologist.

I hope that it’s clear that these defining moments were almost always dependent upon my interactions with remarkable individuals who also happened to be outstanding geologists. In terms of influence, I think many of my ideas on Ichnology and Ichnological Principles were shaped by my friendship and working relationship with the late Bob Frey at the University of Georgia. This was a defining relationship in my life and career. I have also had the pleasure of working with many outstanding folks in the oil patch and I think some of my favourite moments would be from my first trip to Russia with John Dolson and I always look back with fondness on a day at the core shed in India with Keith Shanley, where everything just clicked. All that said, I think some of the greatest moments of my career have come from my students. I am very proud of my work as an educator and it has been an honour to watch so many students blossom and become trusted peers. Finally, one of my most cherished experiences as a parent and a geologist has been the opportunity to publish, discuss science, and work on projects with my daughter, Dr. Erin Pemberton.

Questions centered on more general / personal items:

1) Tell us something about the personal side of George Pemberton. What are your interests outside of the University?

My family means everything to me. My eldest daughter Sarah is the light of my life. She is the kindest person that I have ever known. She is my faithful companion at the Edmonton Oilers and Eskimos games - we have season tickets to both and never miss a game! My middle daughter, Erin, earned her PhD in Sedimentology/Stratigraphy (family business!) and works at ConocoPhillips in Houston, Texas. She is very adept at integrating different types of data at different scales and is constantly absorbing new techniques. I am proud that Erin is an out-of-the-box thinker and very novel in the way she works through complex problems. It is this type of thinking that advances our science and makes breakthroughs. I often have to reassure her that being called "crazy" is a compliment. In my experience, (Continued on page 14...)
this just means the other people haven’t put the pieces together yet. It has been a real highlight to be able to “talk rocks” and science with her. My youngest son Joshua also earned his PhD in Cell Biology and currently works as a Postdoctoral Fellow at the National Institutes of Health just outside of Washington, D.C. He is one of the hardest working researchers I have ever known and is not afraid to do the hard work that will solve most problems. Most researchers just want to know the answer and very few want to understand the answer - Josh is definitely the latter. My beautiful wife, Teresa, is the person most responsible for the children’s development and for that I can never re-pay her. Teresa also has always put up with my quirks, and believe me there are many, and she has always allowed me to be who I am and loved me without reservation. Finally, I was lucky to have great parents, George and Ethel, who taught me to believe in myself and to always be my own man. I hope that I have lived up to their expectations.

2) Historical geology has been a side passion of yours, are you currently working on any projects (a book of stories about old graduate students… how they’ve contributed to your life…or not)?

Since I stopped taking on new graduate students, I have been working on a series of papers directed at young ichnologists to give them an appreciation for the history of the science and an understanding of the founders who helped to create this discipline.

3) When people think of George Pemberton, what do you want them to say, or in other words, what do you want your “legacy” to be?

From a scientific standpoint, I would want to be remembered as someone who had a love for the Earth Sciences and was committed to sharing that passion with others. Nothing is more satisfying than scientific discovery with mentors and friends. Our profession fosters it through the comradery of fieldwork, discussion, and time in the core shed. Please remember that we should all embrace this type of open dialog and continue to question the scientific dogma.

My seminal contributions to modern sedimentary geology began in the late 1980s, when I began to integrate essential elements of ichnology into clastic sedimentology as well as genetic stratigraphy and then applied this knowledge to petroleum exploration. This conceptual framework has since been implemented in 104 production geology projects for 80 oil companies working in 35 geological provinces. It really does feel very good to know that on almost every modern core description there is an “ichnology” or “bioturbation” column and geoscientists are using trace fossils and ichnofacies to better understand their rocks and make better predictions. I was laughed out of almost every major company when I told them that understanding worm burrows could help them find oil; now, ichnological analysis is an integral part of most of our day-to-day project work. I’d like to think that my work has played an important role in that and I feel very fortunate that I have been able to find research angles that contribute to science, education, and industry. The trifecta!

I also suffer no delusions and realize that the real reason I have been successful as a researcher is because of the talented group of graduate students that I have had the privilege to supervise over the years. The list of exceptional trainees I have had the pleasure to work with has grown to 60 current or former M.Sc. students as well as 28 Ph.D. students and post-doctoral fellows. During the course of an academic career, complacency can take hold and many times it is an inquisitive graduate student who can lift you out of it and inspire you to new heights. There have been times in my career when my graduate students have taught me more than I have taught them. I want to thank these 88 outstanding individuals for all their hard work and dedication. They have all made me a better person and a better geologist! I am proud to say that my relationships with many of them have evolved from one of teacher through to colleague and, I hope, trusted friend. Their achievements give me great satisfaction and they continually do me proud and remind me why I chose to be a Professor. I like to think that I helped to lay the foundation for their development and that they will continue to push the science forward and surpass what I could contribute. ✩
PEMBERTON'S LAWS OF STRATIGRAPHY

"As a Professor, I am often asked to give advice to students who are going into the petroleum business- so I came up with 32 laws that I believe all geologists need to keep in mind.

I hope they make young geologists think.”
-Dr. S. George Pemberton

1. I generally start all my classes with the Chinese symbol for Chaos and the saying: “Before there is understanding there must be chaos”. I tell students to fully embrace this concept because they must sift through a lot of material that at first they find confusing. If they are willing to embrace this chaotic mess slowly it starts to make sense and they will be able to master more abstract aspects of the material. It takes hard work and the only way you can accomplish this is if you sit down and work through the material until it isn’t overwhelming any longer.

2. Geology is simple: You have a stratigraphic framework, the mineralogy and paleontology of the stratigraphic framework and the structural deformation of the stratigraphic framework. Everything must be related to the stratigraphic framework or it has limited value.

3. You can’t model nature. There are just too many variables. (If you are going to try, know you will be wrong but you had better include your expert geologic knowledge and not simply rely on an algorithm).

4. You can make a model based on your observations. Never let a model dictate your observations.

5. There are no unique indicators in Geology. As soon as you adapt the “this” means “that” philosophy you have lost the war.

6. The best geologists are the ones who have seen the most rocks. In geology there is no substitute for experience, so seek it out. When you first start your career it’s up to you to find your own mentors, then keep your mouth shut and your mind open.

7. Geology is not an exact science- it is an interpretive science. Do not be afraid to make an interpretation. Remember though that interpretations evolve and change as more data comes to the table do not be afraid to adapt to those changes.

8. Just because it’s published does not mean that it is right. Pretty diagrams do not equate to good science.

9. The only facies models that have ever worked are turbidites and the point bar because they can be interpreted hydrodynamically.

10. Although the rock record is static it is representative of dynamic processes. It is our job to unravel those processes. We see a mudrock as a static object and give it one interpretation but it may represent a dynamic history. The mudrock may have been originally deposited in a salt marsh where it was buried and dewatered then erosionaly exhumed in the beach where it is modified, buried and partially lithified. We as geologists need to be able to interpret this complex history.

11. The rock record is more gap than record.

12. Stratigraphy is synergistic and it incorporates all aspects of geology. This is especially true when doing subsurface geology. Petroleum geologists must be eclectic and be able to understand and integrate a wide variety of data sets.

13. Every day in geologic time is unique onto itself because the position of the continents is slightly different and will never be exactly the same again.

14. The rare event is more commonly preserved; the rock record is a series of catastrophes. This is especially true when dealing with clastic systems.

15. The deliberate search for the subtle stratigraphic trap requires geologic expertise. At exploration scale many large stratigraphic reservoirs can be overlooked on seismic and the geologist must rely on core for reliable interpretations.

16. A surface is not a surface unless it can be mapped.

17. Exploration is finding the anomalies and figuring them out. There are two types of geologists, one sees something odd and shrugs their shoulders and continues on. I want them to work for my competition. The other sees the same thing and asks why and tries to figure it out. I want that geologist working for my company.

18. No geophysical log actually measures grain size.

19. The reservoir is the rock not a squiggly line on paper. If you understand the rock you will understand the reservoir. I take great inspiration from a phrase commonly used by the late Gerry Friedman: saxa loquuntur or ‘rocks speak’. It is our job to learn their language and listen to what they are telling us.

20. Always key geophysical data/logs to core then use that to interpret wells with no core.

21. A seismic section is not a cross section of the rocks.

22. You need acoustic impedance to get a signal.

23. One man’s signal is another man’s noise.

24. The best interpreters are the ones with the most vivid imagination. This pertains to both geology and geophysics. Look to people like Robert Weimer and Henry Posamentier for inspiration.

(Continued on page 16...)
(Continued from page 15...)

25. Contouring is the greatest skill you can develop. Our business is dictated by maps, know how to draw them by hand.

26. A computer map is a mathematical expression, not a map. Most mapping software does not put geology into how the contour is drawn; your geological bias is what you get paid for.

27. All companies have the same toys (software, hardware etc.) what will separate companies are the people who manipulate those toys. Arnold Bouma summed this up very succinctly when he stated “There are still discoveries to be made, but it won’t be the computer that tells us what it all means. For that, we always have to go back to the rock to find what we can do with it and what it means. And for that, the geologist who can explore and observe and think is still the most important thing.”

28. Not everything is allogenic. All sharp base sandstones are not forced regressions and not all channels are incised valleys. Many systems contain autogenic elements that rely on in local changes in sediment supply, local tectonic events, and so on to initiate local changes in relative sea level.

29. There is no such thing as a finished map it should be in a fluid state of constant revision.

30. Beware the geologist with the same interpretation for everything. This means that they are either pushing a particular model or that they have only worked in one type of system and their bias is pushing their interpretation. You must be open to following the direction that the rocks are taking you.

31. Do not worry if anyone calls you crazy. That’s how you know you are on to something, that’s how paradigms are shifted and breakthroughs are made.

32. Perhaps the most important law is “Do Not Contract Petroleum Disease”. This is when you get that high paying job with all the perks and toys and forget to do your homework. Don’t lose sight of the fact that you are a professional that needs to continue to learn and develop your craft. If not, when the next downturn comes (and believe me there will be a next downturn) you will be the first one out the door.

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DECEMBER 11th, 2018

Wine & Appetizers 10:30-11:30
Technical Luncheon 11:30 - 1:00

LUNCHEON SPEAKER
Paul MacKay

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UPCOMING EVENTS

Petroleum systems and fluid migration in Devonian reservoirs, Kaybob Alberta

SPEAKER
Mathew Fay, Shell Canada Inc.

Time: 11:30 am doors open
Date: November 20, 2018
Location: Marriot Hotel, Kensington Ballroom
110 9 Ave SE, Calgary AB T2G 5A6

CSPG member ticket price: $44.50+gst
Non-member ticket price: $55+gst
Please note: The cut-off for ticket sales is 1:00pm, five business days before the event. November 13, 2018.

ABSTRACT
The close vertical proximity of conventional and unconventional Devonian-aged reservoirs in the Kaybob region of central Alberta makes this an interesting study area to understand seal capacity and geochemical stratification. This presentation will discuss how produced fluid sample geochemistry can be used to understand how fluids are generated and migrated in the region, and how the local geology impacts these processes in Devonian strata. In addition, subtle changes in formation isochore thickness related to deep structures, and formation pressure data, are also useful when trying to understand the fluid migration in the Kaybob area.

The prolific Duvernay Formation (Upper Devonian Woodbend Group) thickness ranges from 45 to 60 m and present day total organic carbon (TOC) contents ranging from 1 to 6 wt% (Figure 1). There may also be minor hydrocarbon source potential in the underlying Majeau Lake Fm that has TOC ranging less than 1 wt%. In the Kaybob area, the Duvernay Formation is a Type II organic rich, highly siliciclastic mudstone, that is variably interbedded with silty and carbonate rich intervals. The aerial extent of the Duvernay source rock is 130,000 km² (Preston et al., 2016) and has generated an enormous volume of oil and gas. The 2016 Alberta Energy Regulator best estimate of the total remaining unrisked contingent resources in the Duvernay is 1676 MMboe (354 MMboe proved reserves) which equates to about 350 to 540 trillion cubic feet of natural gas, 7 to 16 billion bbl of natural gas liquids, and 44 to 81 billion bbl of oil (Preston et al., 2016). These hydrocarbons have migrated large distances into numerous reservoirs including the Leduc Formation carbonate buildups of the Rimby-Meadowbrook trend, Simonette, Windfall, and other Devonian aged reservoirs (e.g. Switzer et al., 1994; Allan and Creaney, 1991, Fowler et al., 2001).

One of the interesting geochemical novelties of the Kaybob area is that the Duvernay is a sweet, clastic source rock that is surrounded by sour Devonian gas and oil reservoirs with high H2S concentrations ranging from 1 to 30 mol%. For example, the prolific ‘North’ and ‘South’ Kaybob Swan Hills Formation oil and gas reservoirs respectively (Krouse et al, 1988) have been produced for decades. The Duvernay mudstone has generated sweet petroleum fluids with < 0.2 wt% sulfur, that is consistent with a clastic Type II kerogen with abundant free iron. Figure 1 shows a north to south cross section based on gamma, resistivity and sonic logs of the Duvernay and Majeau Lake mudstones underlain by the Beaverhill Lake Group (BHL) that includes the upper Waterways Member argillaceous carbonate mudstones and the Swan Hills Member carbonate platform and reef buildups. The Duvernay Formation is overlain by the Ireton Fm. calcareous mudstones shale seal, with a thickness ranging from 160 to 330 m in the Kaybob area, that was deposited as regional scale prograding clinoforms (Stoakes, 1980). The Ireton is an excellent regional seal from the Duvernay, that separate the overlying Nisku and Wabamun carbonates that also contain sour H2S gas and HS- water ranging from 1 to 30 mol% H2S concentration (IHS, 2017).

Figure 1 illustrates how the upper Ireton and lower Waterways seal thicknesses surrounding the Duvernay source rock change through the region. This seal
thinning in some areas the Duvernay represent a risk for Duvernay horizontal wells to connect with to sour gas fluids in the Swan Hills, Nisku or Wabamun reservoirs. For example, Chalmers (2016) showed that some Duvernay horizontal wells are seeing breakthrough with up to 0.7 mol% H2S concentrations reported (IHS, 2017). This was interpreted as a downward hydraulic fracture connection to sour fluids in the Beaverhill Lake Group, and in some areas a lateral connection to the Leduc Formation. Based on Chalmers (2016) analysis, an adequate lower seal thickness of Waterways shale, necessary to reduce H2S concentrations to 0 ppm in Duvernay horizontal wells, appears to be 40 to 60 m.

**BIOGRAPHY**

Mathew Fay has worked for 6 years at Shell Canada, both as a Senior Production Geologist for the Fox Creek Duvernay Asset, and currently as Senior Geochemist for Canada. Overall, he has 15 years of industry experience in petroleum exploration and development of both unconventional and conventional resources. Mathew holds a Ph.D. from the University of Calgary related to organic & aqueous geochemistry of petroleum biodegradation, a B.Tech. in Environmental Engineering from BCIT, and a B.Sc. in Geology from UBC.

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**DigitCore Library and CoreSearch Databases Merged**

DigitCore Library acquired the www.CoreSearch.ca database on May 31st, 2018. DigitCore Library now has depth-registered core images for ~9,000 wells in Western Canada and keeps expanding coverage every month. 24-7 online access to the DigitCore Library and CoreSearch.ca is by annual subscription for companies, organizations, and individuals. DigitCore also offers its clients high-resolution photography of core for wells not already in the Library. Contact us to find out how you can get this work done for free.

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UPCOMING EVENT

GEOWOMEN LUNCHEON TALK

Oil & Gas Careers; Where Does a Geoscientist Fit In?

SPEAKERS
Maren Blair, P.Geol, Senior Geologist, Sproule
Rochelle Longval, G.I.T, Resource Development, Cenovus Energy
Tiffiny Yaxley, Senior Account Manager, Canadian Discovery Ltd.
Krista Beavis, P.Geol, Reservoir Geologist, Alberta Energy Regulator

Time: 12:00 p.m.
Date: November 15, 2018
Location: geoLOGIC Classroom (2nd Floor), Aquitaine Tower, 540-5th Ave SW, Calgary, AB

Everyone is welcome! This event is free to attend, and no registration is required.

ABSTRACT
What are the career paths available to a geoscientist in the Petroleum Industry? What skill sets are required and how might the path look along the way?

Moderated by:
Alexandria Shrake, P.Geoph, Co-Founder & President of ENERGYminute Education Foundation, Strategy and Planning Analyst at Chevron Canada Resources

BIOGRAPHIES:
Maren Blair:
Maren has a B.Sc. from the University of Alberta in geology (2002). After completing her degree Maren worked for Schlumberger Canada from 2002 until 2005 in the Wireline Evaluation Services division. From 2005 until present Maren has worked for Sproule as a geologist focusing mainly on independent reserves certifications and reservoir characterization projects in Western Canada. Maren is currently serving as the Canada Region President of the American Association of Petroleum Geologists (AAPG).

Rochelle Longval:
Rochelle Longval's passion for geology is more than a passion - it's her life. After all, her name means “little rock.” Ever since she was little, Rochelle had a love for science and the outdoors. She's now working as an Exploration Geologist (GIT) for Cenovus Energy - with expertise in acquisition and divestiture evaluations, including risk assessment and making recommendations for future value add opportunities. She uses her own experiences to inspire the next generation of geologists. In addition to helping shape young minds, Longval is dedicated to advancing women like herself in the energy industry. She initiated the Geoscience Women's Group for the Canadian Society of Petroleum Geologists. This past year she was a Young Women in Energy Award Recipient and continues to be an advocate for women in geology.

Tiffiny Yaxley:
Tiffiny graduated with a BSc in Geology from the University of Alberta in 2006. After a number of years working technical roles in the oil and gas industry she moved into sales. In 2011 she took on a technical sales role and ended up finding her strength and enthusiasm for work there more than ever. In sales she discovered her passion for presenting, human interaction and helping others. She has 7 years of experience in a technical sales, 4 of which in a leadership position.

Krista Beavis:
Krista Beavis is currently working with a multi-disciplinary team to better understand how current subsurface energy development can be used to understand potential future surface expression at the Alberta Energy Regulator. She is passionate about true collaboration to achieve positive outcomes for the province. Krista graduated from the University of Calgary with a BSc, in Geology, and Applied & Environmental Geology in 2007. She has since worked in multiple sectors of the industry in Alberta, from exploration to remediation, and currently regulation. Krista is registered as a Professional Geologist with APEGA, and holds memberships with CSPG and CSUR. In her time away from the office, Krista enjoys traveling, cooking and baking, hiking, knitting, gardening, and adventures with her puppy.

Alexandria Shrake:
Alex is an Analyst with Chevron Canada Resources working on the Strategy and Planning Team. Alex has a BSc in Geophysics from the University of Calgary (2012), and six years of experience working in in Horn River, Liard, and Kaybob Duvernay with Chevron. Alex is a fellow of Action Canada and the Public Policy Forum, a policy think tank to encourage inter-provincial collaboration, perspective, and policy recommendations on Canada’s energy future. As a member of the Canadian Society of Exploration Geophysicists (CSEG), Alex has spent the past 5 years working across the country with students and the public and won volunteer of the year 2016. The last two years, Alex has spent building ENERGYminute - a non-profit education foundation that has recently qualified for charitable status. ENERGYminute's purpose is to foster energy literacy in Canada for less polarizing dialog and curate inquiry based learning studies for students K-12. ✦
Structurally influenced plays and trends in the WCSB

SPEAKER
Marian J. Warren, Jenner
GeoConsulting Inc.

Time: 12:00 pm
Date: Thursday, November 22, 2018
Location: geoLOGIC Classroom (2nd Floor), Aquitaine Tower, 540-5th Avenue S.W.

ABSTRACT
Exploration and development in the Plains portion of the WCSB have focussed traditionally on stratigraphic plays, with emphasis on sedimentological and stratigraphic data and interpretation. Pursuit of structural plays in the foreland basin has been limited mainly to the Foothills fold-thrust belt immediately to the west. As production from long-exploited stratigraphic plays has matured in the foreland basin, new successes in conventional and unconventional reservoirs have have become increasingly dependent on understanding the nature and distribution of sometimes subtle structural elements in the foreland basin.

Several unconventional and conventional play case studies highlight the value of understanding structural influence in new foreland basin play exploration and development. Example types include:

- Identifying subtle structural control on intersecting depositional facies belts, diagenetic pathways and potential trapping trends in Mississippian middle Banff Fm. helped high-grade prospective areas and make a significant discovery. Success involved a combination of reactivated basement structural trends, and Mississippian syn-depositional and Cretaceous post-depositional extensional faults.
- Recognizing syn-depositional extensional fault control of local paleodrainages and reservoir/seal distribution in the Lower Cretaceous Mannville Gp. lead to local exploration success and useful regional application.
- Emerging awareness of compressional reactivation of earlier extensional faults in the basin offers opportunities both for conventional trapping and locally enhanced fracturing in unconventional plays.
- Highlighting published relationships between basement-rooted faults and heterogeneities in basin-centred gas production in Cretaceous intervals in the USA serves as analogy for considering similar relationships in the WCSB.

Synthesis of structural influences in the WCSB includes preliminary discussion of geographic distribution of different types of structural elements in the basin.

BIOGRAPHY
Marian Warren completed a PhD at Queen’s University, Canada. She subsequently worked at EnCana Corporation in Calgary for 11 years in roles as geologist, seismic interpreter and structural specialist for both domestic and international projects. As a result of successful WCSB projects at EnCana, she was a co-recipient of the CSPG Medal of Merit, winner of the AAPG Matson Award and served as an AAPG Distinguished Lecturer.

Marian became an independent consultant in 2008, with focus on exploration projects worldwide in structurally complex settings, and on developing and presenting industry training courses and field trips. She was also an Associate of Rock Deformation Research in the UK and US from 2009-2014.

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.
INTERNATIONAL DIVISION TALK

Use of Regional Multi-Beam Surveys and Piston Coring in the Exploration of Deep-water Frontier Basins

SPEAKER
Marty Wittstrom | Oil & Gas Investments Group LLC

Time: 12:00 pm
Date: Wednesday, November 14, 2018
Location: CNOC-Nexen Annex Theatre, Plus 15 level, 801-7th Ave SW, Calgary

ABSTRACT
Recent exploration discoveries in the deep-waters of offshore French Guiana and Brazil's Ceará and Sergipe deep-water basins have tested the applicability of West Africa exploration analogs to exploration concepts for the Atlantic Equatorial Margin of South America. These initial successes are encouraging, but the number and expanse of the numerous under-explored basins along Brazil's extensive coastline present significant challenges for optimized exploration programs.

Analysis of regional surveys using high-resolution multi-beam scanning and precision-guided piston coring of suspected seepage anomalies is proving to be a robust and cost-effective methodology for guiding regional exploration programs in a highly competitive exploration market. Such scanning and coring campaigns are providing key insights into the presence, type, and extent of petroleum systems in these under-explored frontier areas. The results of basin-wide surveys programs can not only confirm hydrocarbon generation and type, but also guide the optimized use of subsequent, more costly technologies, used to further identify and risk areas at the prospect level.

Multiple deep-water exploration play concepts are available in these under-explored frontier areas that have the same syn-rift lacustrine sediments, post-rift marine environments and turbidite reservoirs as recent discoveries. This paper examines these frontier basins, the likely play concepts present, and the prioritization of each with respect to exploration potential and hydrocarbon sourcing, as indicated by the physical presence of hydrocarbon seepage on the ocean floor.

BIOGRAPHY
Marty Wittstrom is the President of Oil & Gas Investments Group LLC (OGG), which has upstream and downstream investments in South America, particularly Brazil. He is also a Director at the Canadian Global Exploration Forum, Canada's only registered organization that serves and promotes Canadian international E&P and service companies. Prior to OGG Marty was General Manager of the South America Business Unit for Niko Resources, Ltd., and VP International Exploration for Reliance Industries in Mumbai, India. Marty also enjoyed a 26-year career with Chevron in positions of increasing responsibility for North American and international assets having large exploration and field development projects. In addition to his technical and business successes, Marty has also served on key corporate and industry committees, including Chevron's Corporation Reserves Advisory Committee, Strategic Staffing and Strategic R&D Committees, and the Canadian Association of Petroleum Producers East Coast Advisory Committee.

Marty has written and presented extensively on exploration plays, reservoir management, business optimization, and technology applications. He has been a thought leader in exploration and reservoir management, and has developed Centers of Excellence for reservoir characterization, exploration portfolio analysis and G&G training. Marty has served in numerous industry and non-profit organization roles including the AAPG National Convention Technical Committee; the SPE Permian Basin Chapter Enhanced Recovery Conference Technical Committee; the Board of Directors for the Permian Basin Graduate Center; and conference session chairmanships for AAPG, SPE, and the CIPC.

Marty earned a bachelor’s degree in geology from Western State College of Colorado, and his master’s degree in geology from the Colorado School of Mines. Marty is a registered professional geologist, AAG Certified Petroleum Geologist and has been an Active Member of AAPG since 1978.
DIVISION TALKS

INTERNATIONAL DIVISION TALK

Geology of the Scottish Highlands, Scotland

SPEAKER
Rida Aslam | Chemostrat Canada Ltd.

Time: 12:00 pm
Date: Wednesday, December 12, 2018
Location: Buzzards Restaurant and Bar, 140 10 Ave SW, Calgary AB

ABSTRACT
Scotland is well-known among Geoscientists due to its unique geological history and is also the birthplace of some of the world’s most famous Geologists, such as James Hutton (founder of “modern geology”) and Charles Lyell (author of “Principles of Geology”). To learn more about some of the famous geological sites in Scotland, Rida went on a self-guided geological tour in May 2018 around the Scottish Highlands, exploring remote and sparsely populated Geoparks and well-studied geological sites. The presentation will take you through a virtual tour around the Highlands while briefly exploring the geology of Glencoe, Isle of Skye, North West Highlands Geopark, and Lochaber Geopark.

The Scottish Highlands are a region in north west Scotland that comprise of rugged mountains, lakes, hidden beaches, and forests. One of the most renowned sites in the Highlands is Knockan Crag, where thrust tectonics were first understood due to recognition of the famous Moine thrust, leaving many well-respected Geologists of the time puzzled. The thrust was recognized in 1860’s by field work conducted by Peach and Horne over a span of 14 years. It was discovered that the older Moine schist of 1 Ga were forced over top of the younger 500 Ma old Durness limestone. We will also explore the oldest 3 Ga Lewisian Gneiss basement rocks of Scotland, exposed as a major unconformity overlain by Torridonian sandstones at many localities.

A virtual journey through Isle of Skye will take you along columnar basalt cliffs, Jurassic dinosaur footprints, and Tertiary volcanic rock pinnacles.

BIOGRAPHY
Rida Aslam has been working with Chemostrat for the past 3 years as a Geologist (I.T.), gaining experience in local and international projects. Her work is primarily focused on understanding the geochemistry and building a chemostratigraphic correlation framework of the conventional and unconventional plays, using X-Ray Fluorescence (XRF) and Fourier Transform Infrared Spectroscopy (FTIR), while continuing to develop her skills as a Geologist. Her previous experience includes working as a student at the Geological Survey of Canada throughout university, and as a summer student at Nexen. She got her B.Sc. in Geology from Mount Royal University in 2015 and is an active member of CSPG and APEGA.
Advantages of Real-Time Methane to Pentane Gas Detection and Gas Ratios Data

SPEAKER
Gunn | NOV Wellbore Technologies

Time: 12:00 pm
Date: Wednesday, November 14, 2018
Location: geoLOGIC Classroom (2nd Floor), Aquitaine Tower, 540-5th Avenue S.W.

ABSTRACT
Technical advancements in gas detection technology now provides the capability of isolating methane, ethane, propane, isomer & normal butane, and isomer & normal pentane, much quicker and process the data in several gas ratio formulas in real-time while drilling. This data provides many benefits including eliminating missed gas data due to fast ROP, an increase in gas data samples points per time intervals, and real-time hydrocarbon characterization while drilling. Additional data benefits also include identifying oil and water contact points, the ability to provide real-time gas ratio profiles to assist Geosteering as well as geological and completions engineering teams on frac stage placement. It provides further stable calibration, nondestructive sample collection for Isotube sampling and is economically more efficient compared to Gas Chromatograph (GC) and mud logger options.

Gas detection technology has advanced from the GC to new spectral sensing devices such as the Fourier Transform Infrared Spectrometers. The FTIR Spectral Analyzer provides a much quicker sampling time and additional sample points per GC sample intervals resulting in more gas data points per GC sample and eliminating missed gas peaks. The gas sample does not physically interact with the FTIR Spectral Analyzer thus ensuring the FTIR Analyzer calibration accuracy will not deteriorate over time and require calibration offset adjustments or complete recalibrations. The continuous flow gas sample through the FTIR Spectral Analyzer is not destroyed in the gas sensing process and can be collected for Isotube sampling to be qualified to FTIR gas data.

Wetness, Balance, Character, and Pixler Ratios are processed in real-time and exported to any Electronic Drilling Recorder (EDR) communicating with the Wellsite Information Transfer Specification (WITS) protocol every second to provide real-time Gas Ratio data to the rigsite and operators geological team. With this data, the Geosteering teams can adjust the direction of the well path to optimize ideal hydrocarbon state to maximize target hydrocarbon pay zone. Post-well evaluation of Gas Ratio Analysis data can assist geological and completions engineering teams in the placement of frac stages to maximize target hydrocarbon production.

BIOGRAPHY
Scott Gunn, Sales Representative for MD Totco Geological Services, is the subject matter expert on the Gas Watch Analyzer. Scott works directly with Geological clients to generate consistent geological gas data that provides solutions to understanding their reservoirs and optimizing their results. Previously, Scott served as an Instrumentation Engineering Technologist in the Canadian Airforce for 10 years before attending SAIT for Instrumentation Technology. Starting as a Gas Detection Field Technician, Scott then was President and founder of Wellsite Gas Detection Inc. and Geological Rentals & Services Inc. both of which sold to National Oilwell Varco. Scott has several gas detection patents in several countries, awarded for new infrared gas detection inventions.

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The Burgess Shale: A guide’s perspective

In addition to the main presentation by Annie McIntosh, David Moore will provide a brief presentation.

SPEAKER
David Moore, Burgess Shale Guide, M.Sc., The University of Calgary

Time: 7:30 pm
Date: November 16, 2018
Location: Mount Royal University, Room B108

ABSTRACT
Field BC is the jumping off point for a palaeontological pilgrimage for anyone fascinated by the history of early animal life on this planet. For over one hundred years the Burgess Shale has provided a rare and spectacular glimpse into the world as it was during Cambrian time. Accompanying people from all over the world on this adventure is a great honour and I have been very fortunate to have the privilege for almost twenty-five years. What makes this remote mountainside in Yoho National Park so special? Few places on Earth have had as significant and lasting an impact on our understanding of our place in the history of animal life. I will share some of my experiences taking people to this iconic World Heritage Site.

BIOGRAPHY:
David Moore studied Geology at the University of Calgary and received his MSc. in 2002. He started guiding to the Burgess Shale as an Undergraduate in the early 1990s. David has worked in the energy industry for over twenty years. His passions lie in teaching, the history of early animal life, and the mountains. Currently David spends most of the off-season taking care of his young children.

DIVISION INFORMATION:
This event is presented jointly by the Alberta Palaeontological Society, the Department of Earth and Environmental Sciences at Mount Royal University, and the Palaeontology Division of the Canadian Society of Petroleum Geologists. For details or to present a talk in the future, please contact CSPG Palaeontology Division Chair Jon Noad at jonnoad@hotmail.com or APS Coordinator Harold Whittaker at 403-286-0349 or contact programs1@albertapaleo.org. Visit the APS website for confirmation of event times and upcoming speakers: http://www.albertapaleo.org/.

CORE CONFERENCE
16-17 May 2019 • AER Core Research Centre • Calgary, AB
Celebrating 50 Years

The spring of 2019 will be the 50th year of the CSPG Core Conference, and we strive to continue the long held tradition of being the highlight ‘post-event’ of GeoConvention. It is with great honor that we look to celebrate the last 50 years in Canadian Oil and Gas by highlighting how reservoirs have changed across time; ‘The Reservoirs Through Time’.

ABSTRACT SUBMISSION NOW OPEN
REGISTRATION OPEN DECEMBER 3rd
DIVISION TALKS

ALBERTA PALAEONTOLOGICAL SOCIETY DIVISION TALK

Using modern bird claws to investigate the lifestyles of extinct birds

SPEAKER
Annie P. McIntosh, Ph.D. Student, University of Alberta

Time: 7:00 pm
Date: Monday, November 19, 2018
Location: Mount Royal University, Room B108

ABSTRACT
Modern birds evolved from theropod dinosaurs in the Late Jurassic period (around 150 million years ago). Today, birds are the most diverse four-legged vertebrates, comprising about 10,000 living species. Birds occupy many different niches and show great variety in behavior and lifestyle. This diversity in lifestyle is directly related to diversity in form and function and the morphology of an animal can tell us a lot about its behavior. This study sought to determine if the morphology of the claw on the foot in modern birds was correlated to their behavior and ecological niche. The shape of the claw was compared across 128 specimens of bird, comprising 104 living species and one extinct species. By observing clusters of specimens with similar claw shapes, it was found that birds with broadly similar ecological niches were distinguishable based on overall claw morphology. This result was then used to investigate the possible behavior of an extinct bird species, Confuciusornis sanctus, by analyzing the morphology of its claw.

Confuciusornis sanctus is an Early Cretaceous bird from the Liaoning Province of northeastern China. Although much work has been published on this species, details of its habitat and behavior remained unclear. The morphology of the claw of C. sanctus indicates that it likely had a mainly arboreal lifestyle, spending most of its time climbing and perching in trees. By integrating this information with other evidence, we can make better inferences about the lifestyle of C. sanctus. This study shows that morphology and behavior in modern birds can be used to study that in extinct birds and can help us more accurately determine their likely ecological niches.

BIOGRAPHY:
Annie P. McIntosh is a Ph.D. student in palaeontology in the Biological Sciences Department at the University of Alberta. She completed her Bachelor of Science in biological sciences at Northern Arizona University in May 2012. Between May 2012 and August 2013, she taught a summer high school course in palaeontology and geology at the University of Chicago and volunteered as a docent and fossil preparator at the Field Museum. In August 2013 she began the Master’s program at DePaul University in Chicago. Early in her Master’s program, she published two papers on Cretaceous marine vertebrate fauna of the Western Interior Seaway before beginning her thesis project. Her research focused on how the morphology of the claw of modern birds could be correlated to variations in their behavior, and how this can be used to make inferences about the lifestyles of extinct birds. In August 2017, she completed her Master’s thesis and moved from Chicago to Edmonton to begin a Ph.D. program at the University of Alberta. She has been a student and research assistant with Dr. Philip Currie since September 2017. Her current research focuses on the biomechanics of the hindlimb in extinct birds and theropod dinosaurs, specifically as related to the evolution of flight.

DIVISION INFORMATION:
This event is presented jointly by the Alberta Palaeontological Society, the Department of Earth and Environmental Sciences at Mount Royal University, and the Palaeontology Division of the Canadian Society of Petroleum Geologists. For details or to present a talk in the future, please contact CSPG Palaeontology Division Chair Jon Noad at jonnoad@hotmail.com or APS Coordinator Harold Whittaker at 403-286-0349 or contact programs1@albertapaleo.org. Visit the APS website for confirmation of event times and upcoming speakers: http://www.albertapaleo.org/.

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Fracture characterization and vugular porosity distribution in Devonian carbonates using image logs and core data

SPEAKERS
Peter Fermor

Time: 12:00 pm
Date: Thursday, November 1st 2018
Location: Schlumberger Palliser One Building
200, 125 - 9th Ave SE, Calgary

ABSTRACT
The structure and topography of the Rocky Mountain front straddling the International Boundary is dominated by the Lewis thrust sheet. Its outstanding topographic feature is Chief Mountain in northernmost Montana, about 10 km south of the border. Chief Mountain stands as an isolated mass of mid-Proterozoic carbonates of the Belt- Purcell Supergroup (approx. 1.45 Ga), rising 1400m above the adjacent plains with near vertical faces rising 450 metres to the summit ridge.

Despite its prominence and frequent illustration in geological textbooks, there is no definitive description of the geology of Chief Mountain and its surroundings. The existing descriptions and mapping are either incomplete, vague, or inconsistent and are often erroneous. However the spectacular exposure and distinct, colourful Proterozoic stratigraphy permit detailed structural and stratigraphic analysis.

Chief Mountain is one of at least five klippen extending back along a ridge to the main mountain front at Gable Mountain. All are composed of mid-Proterozoic carbonates of the Waterton and Altyn Formations, thrust an estimated 100 km northeast over upper Cretaceous strata. These erosional remnants, and adjacent cliff faces along the main mountain front, display one of the most spectacular duplex structures in the Rockies, up to 250m thick, involving scores of fault slices. This duplex is sandwiched between the Lewis thrust as the floor, and the broadly folded Yellow Mt. thrust as the roof.

The contrast between the near chaos within the duplex structure and the smoothness of the roof and floor thrusts leads us to questions about the mechanism and sequence of duplex development.

Excellent quality Google Earth images combined with the spectacular exposure and distinctive stratigraphic colouration permit us to take a birds-eye geological tour of the area in Google Earth.

BIOGRAPHY
Peter is a retired structural geologist who has 35 years of experience in the petroleum industry with Shell, Encana and Devon. He holds a masters in geology from Queen’s University, Kingston, Ontario.

Fig. 1. Dr. Bob McMechan stands on Proterozoic carbonate talus on the north side of the Papoose klippe, with the Ninaki (left) and Chief Mountain klippen in the background. Cretaceous strata are exposed on the far side of the saddle below the Ninaki.
Summer has come and gone, with Stampede, vacations, camps, and smoke in the rearview mirror (hopefully!). It is now time for us to look to the future, to events still to come in the last months of 2018, and to whatever excitement may be in store for us in 2019.

The spring of 2019 will be especially exciting, as this year’s Core Conference Committee will be celebrating a milestone. It is the 50th year of the CSPG Core Conference! Our goal continues to be to make the CSPG Core conference the highlight ‘post-event’ of GeoConvention, gathering the Geoscience community together, challenging our interpretations, and growing our insight within our industry. Through this conference, many geologists have postulated and discussed over the rocks, whether a pinnacle reef, a tight sand, nano-darcy shale or bituminous reservoir, ideas and thoughts showcased at the CSPG Core Conference have always left a lasting impact. So it is with great honor that we look to celebrate the last 50 years in Canadian Oil and Gas by highlighting how reservoirs have changed across time; ‘The Reservoirs Through Time’.

The first Core conference was held at the world class AER facility in 1969, that’s two generations of upturns and downturns. 1969 was the year oil was discovered in both the U.K and Norwegian sectors of the North Sea. Just a few short years after the first commercial production of the largest oil resource in the world, the Oil Sands in Fort McMurray, AB, began.

The committee is looking to all geologists to submit an abstract or idea that would complement the overall theme of our reservoirs through time. We encourage those who may be working on reservoirs (old and new) to present your ideas in a more casual environment, and perhaps highlight how the marriage of technology has unlocked hidden potential or breathed new life into what had been forgotten. Re-examining previous core presentations, showcasing the classic reservoirs of our history that established our resource, impact and footprint in the WCSB and across the globe.

Wondering what your core display could showcase? Find a list of ideas below:

- Geology – stratigraphy, sedimentology, diagenesis, fracturing, petrography
- Geophysics – seismic prospecting, structural analysis, microseismic
- Petrophysics – log analysis, rock properties
- Geochemistry – source rocks, maturity, TOC
- Geomechanics – rock characteristics, fracability
- Drilling & Completions – frac design, horizontal drilling, pad drilling
- Reservoir Engineering – flow analysis, reserve analysis
- Laboratory Methods – porosity, permeability, special analyses

We would like to thank all the men and woman who have made the past 50 years of geoscience in Canada such an amazing technical field, and look forward to the next 50 years of innovation and ideas.

Those interested are required to submit a brief abstract summarizing their core display between October 19th, 2018 and January 18th, 2019. You will be notified of acceptance the week of February 1st, following which time you will be asked to submit a more detailed extended abstract. Accepted presenters must also be prepared to display a section of core on 1 or 2 tables, posters (four 4’ by 8’ boards are provided for each display), and give a 15-20 minute PowerPoint presentation of their work. If this is something you are keen to do, please submit your initial abstract to CoreConference@cspg.org

Thank you for your consideration, and please don’t hesitate to contact us with any questions.

Your 2019 CSPG Core Conference Organizing Committee
Christa Williams – Trident Exploration
Tom Plumridge – Rife Resources
Carson Renaud – Crescent Point
Liese McLaren – Independent Consultant
Kelsea Pedersen – Cenovus Energy
Brent Kuntz – Cenovus Energy
Candace Jones – CSPG
Events Coordinator

Registration opening December 3rd, 2018!
On August 9th, 32 students and young professionals, led by Kevin Root and John Weissenberger from Gran Tierra went on a one day field trip. The students and YGPs were taken to examine Devonian, Mississippian and Cretaceous strata at Jura Creek and Seebe Dam. These strata both conventional and unconventional reservoirs in the subsurface of Western Canada Sedimentary. The first stop was at Seebe Dam to observe Tertiary thrust structures at Mount Yamnuska and in the front Ranges to west. The following three stops were along Jura creek where the Wabamun deposition and Exshaw type section were discussed. ✨

John Weissenberger speaking to the field trip attendees
Photo Taken By: Jane Marzetti

All the attendees and field trip leaders Kevin Root and John Weissenberger
Photo Taken By: Jane Marzetti
The 29th Annual CSPG Mixed Golf tournament was held 24 August under smoke obscured skies, at least until the rain hit at 9:45 am. Unfortunately, even though the radar was showing a clearing, with the cold wind and soaked participants the decision was made to call the tournament part way through and go with a 9 hole score to determine the winners. We are pleased to report on an increase in participation, but regret the fact that while we had over 20 days of hot, dry weather on the days preceding our tournament, it could not stay around for a nice day for the CSPG golfers!

The 96 CSPG members, sponsors and guests who managed to driver their golf balls through the driving rain and wind did manage to turn in score cards to the Lynx Ridge pro-shop, who managed to calculate the golf teams performances over a 9 hole match. This was tricky given how every team started on a different hole, but needless to say, we did declare the eventual winners. The team low net trophy and tournament winner was the team of Tiffiny Yaxley, Jessica Beal, Angela Galipeault and Jacey Neuman.

We recognize how our great sponsors came through for this year, and we appreciate each and every one of them. The on-course beverage cart was sponsored by geoLOGIC Systems, who provided much appreciated drinks and food throughout the course. All teams enjoyed a hot breakfast provided by, used golf carts sponsored by Chinook Consulting Services, and benefited from visiting hospitality tents and skill/challenge contests provided by the ProGEO beat the hack (Scott Thain) on hole #5, AGAT Laboratories Hole-in-One contest on #17 and the BrokerLink meet and greet on hole #10. Prize holes were additionally sponsored by Belloy Petroleum Consulting, Birchcliff Energy and MJ Systems. We certainly appreciated the prize donations of two sets of clubs and two putters by Typhoon Energy (Foon Der), the wine, golf balls and caps/shirts/touques by Stirling Merchant Capital (William Sattlegger), the emergency car kits and golf balls donated by Hawk Machine Works (David Clyde), the wine donated by Sylvan Safety Services (Stacey Rosentreter), the shirts from McLeay Geological Consultants (Jerry Babiuk), Radium Golf for 4 from Trimble Engineering Associates (Randy Smith), the coffee mugs/hats and notebooks from Rockhound Advisory Corp (Tyler Toltan-Ropchan), the coffee mugs from Canadian Discovery (Tiffiny Yaxley) and the always popular Belloy Petroleum Consultants (Brian Fyke) cooler filled with beer.

During the delicious banquet carved beef dinner, the pictures taken by GeoLOGIC were shown on the large screen for all to enjoy. Belloy Petroleum’s weekend survival kit of a cooler filled with beer was won by Thomas Weedmark, and Michelle Thoms and Kevin Webb won the golf club sets donated by Typhoon Energy. In the end, the members, guests, sponsor players and representatives enjoyed a great day catching up with colleagues, making new friends, and succeeded in delivering $1500 to support the educational and outreach activities of the CSPG.

I would like to thank the many sponsors, golfers, and the greens-keeping, pro shop and catering team at Lynx Ridge Golf course and especially the fine organizing committee of co-chair Brenda Pearson (registration), Norm Hopkins (trophies), Jeff Boissonneault (sponsorship & signage), Tiffiny Yaxley (sponsorship) and our CSPG office support from Kristy Casebeer. A big thank you to the geoLOGIC team and to ProGEO Consultants for all the pictures taken at the event. Hopefully, by the time
this is published, all the pictures taken by various groups will be on the CSPG website.

Attending members and sponsors overwhelmingly expressed their enthusiastic support for continuation of the event, and we will plan for the tournament in 2019. We look forward to your attendance at next year’s tournament tentatively set for Friday, 23 August 2019 as we celebrate the 30th Annual tournament.

2018 Low Gross Team

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

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The brand spanking, fully lithified 2019 CSPG Geological Calendar is about to slam some serious geological pizzazz (noun, informal: an attractive combination of vitality and glamour.) into your hands and ocular outlets.

The 2019 installment highlights many new fresh images from the four corners of the globe submitted by our society’s shutterbugs. A total of 111 submitted entries competed for the 12 months that will grace your home or office for the upcoming year.

The 2019 Calendar showcases a wide range of rock textures and the full gambit of rock types – somewhat unusual in the calendar for the last number of years. The cover photo by Rob Galant (voted Best Photo), highlights Kilt Rock on the Isle of Skye in Scotland. It shows amazing scale with ancient and modern contrasts and a couple of sheep and climbers thrown in for scale. Allan Phillips won the subcategory (Best Core Photo) award for his picture of Silurian Salina B Salt taken near Windsor, Ontario. The Calendar also highlights recent ongoing modern volcanism as seen in Daniela Waldbott von Bassenheim’s photo taken in Hawai’i Volcanoes National Park. Bringing things closer to home in our own backyard, Rares Bistran captured a classic image of Mount Assiniboine. The photos in the calendar this year truly bring you on a trip around the globe without leaving your office.

As always, I would like to thank Dr. Clint Tippett for his time spent on the judging committee with the selection of this year’s winners and his omnipresent role in the editing of geological descriptions. Emma MacPherson, our Publications Coordinator, is always hard at work orchestrating this project, working on finding our generous sponsors, with printers and on all logistics.

The Committee and the CSPG would like to thank all the members that took the time to contribute their photos to the 2019 contest. The continuously high caliber calendar that we can produce would not be possible without your dedicated submission efforts.

(Although I have to say I am always worried in mid-August when there are only a few entries, and then like a great migration, they all pile in in the last two weeks – perhaps I should extend the deadline; I think procrastination would still win.)

Enjoy your 2019 CSPG Calendar and have an engaging and prosperous year ahead!
GEOLOGY IN YOUR NEIGHBORHOOD
by Dr. Clint Tippett, President – C.S.P.G.

This feature is dedicated to Dr. Bill Ayrton who introduced many of us to the wonders of downtown Calgary geology through his popular walking tours. Who would have thought that there was so much excellent geology at our fingertips and that we could learn new lessons every day by paying attention to the walls and floors of the buildings that we frequented?

Thanks to Dr. Jon Noad for pursuing our original quiz and for taking a stab at the answers.

**Picture 1**
This fossiliferous rock is Ordovician Tyndall Limestone quarried in Tyndall, Manitoba. Stratigraphically this is from the Selkirk Member of the Red River Formation. The dominant fossil above the granite ledge and approx. 18 cm across at the base is Receptaculites. The matrix of the rock is heavily mottled by the trace fossil Thalassinoides, produced by an unknown organism. This picture was taken on the north-facing outside wall of the Utilities and Telephone Building at 119 – 6 Ave. SW which was built in 1929. The surfaces of these blocks have been etched by weakly acidic rainwater revealing internal textures, a phenomenon that correlates with the ages of such buildings.

**Picture 2**
This ammonite fossil, with a center approx. 4 cm across, occurs head-height in the west-facing outside wall of Artigiano’s Bistro in Centrium Place at 332 – 6 Ave. SW. The tan mottled limestone slabs contain at least 8 other ammonites. An interesting feature is that many of these fossils have an obvious core in which the chambers may be filled with calcite spar. The outer whorls are less visible as the thin shell walls have been breached and the chambers filled with matrix sediment. The age of the rock is not known but could reasonably be Jurassic.

**Picture 3**
This stone arch is one of a set of six that were built in front of the south entrance of the Energy, Environment, Experiential Learning Building, home of the Department of Geosciences, at the University of Calgary, just south of 32 Ave. NW. The arches or folds contain rusty quartzite at the base, light-coloured Ordovician Tyndall limestone in the middle and a cap of black Rundle Stone (Triassic Sulphur Mountain Formation) with a final layer of white sandstone. If the basal clastic layer could be correlated with the Cambrian Gog Group and the upper sandstone with the Cretaceous Cardium Formation, then the sequencing of these layers is in correct stratigraphic order. In addition, the fold axes are oriented north-south consistent with an origin related to Cordilleran compression. The fold segments are also offset from each other, a pattern that could be akin to the lateral tears found in some thrust sheets. This is the kind of public art that we need!

(Continued on page 34...)
(Continued from page 33...)

**Picture 4**
This bronze plaque was embedded in the floor of the Westjet domestic pier at the Calgary Airport. The scene depicted is from Turner Valley and includes drilling rigs dating back to the Dingman #1 discovery well in 1914 and its offsets. Recent scouting has found that this plaque and others of fossils have unfortunately been removed.

**Picture 5**
This picture is of an oilfield safety sign depicting the end of an arm of an oilfield pumpjack (or nodding donkey) seeming to strike a bystander. Such equipment is vital for oil recovery but does have risks for the unwary. The shot was taken in the outside equipment park at the Leduc #1 Energy Discovery Centre just south of Devon, Alberta.

**Picture 6**
The dominant object in this picture is a pisolith, approx. 3 cm across, found in a cross-bedded, bioclastic, calcarenite matrix. Pisoliths are accretionary grains formed during sediment movement and in this case the large grain appears to have been broken. Fossils include gastropods and pelecypods. Some shelter porosity can be observed. These rocks form cladding slabs that can be found on the north side of the Calgary City Centre Building at 215 – 2 St. SW.

4. Location and historical significance.

5. Type of equipment and industrial significance.

6. Location, type of rock and origin of large grain.
**Picture 7**

This is a picture of travertine, a building stone commonly used in both inside and outside applications. In this case the site is within Fifth Avenue Place at 237 – 4 Ave, SW and just east of the floor 3-23 elevators in the internal corridor. Travertine is a very young form of limestone and is created by precipitation from calcium carbonate-rich thermal springs. Significant porosity occurs within its algal layering and in fossomoldic cavities related to reeds that grew in the depositional ponds. Up until recently, most quarrying took place in Italy. In most cases the layering in travertine is fairly planar but in some situations, as in this picture, biogenic structures do occur. Here we see a buildup approx. 30 cm across at the base and 20 cm high that is draped with the algal layering. Interestingly a smaller positive feature continued to propagate upwards from the crest of this structure. The occurrence of this in Fifth Avenue Place is fitting as the building was formerly known as Esso Plaza and was home to Imperial Oil for many years. In 1947 that company discovered the Leduc Oil Field whose structure bears strong similarities to this biogenic buildup in the travertine.

**Picture 8**

This large building block is from the Paleocene Paskapoo Formation that forms the bedrock to Calgary. In the late 1800’s and early 1900’s large quarries surrounded the city. This sandstone contains large crossbeds that have been interpreted to form the lower parts of point bar deposits in this fluvial formation. This picture was taken at First Baptist Church at 1331 – 4 St. SW looking east. This building stone was used extensively in Calgary and other examples abound. Indeed Calgary’s nickname for many years was “Sandstone City” for this reason.

(Continued on page 36...)
(Continued from page 35...)

**Picture 9**
Trick question. This is a pseudo-rock created for decorative purposes. It contains fragments up to 15 cm across of strongly laminated calcitic deposits set in a matrix of their crushed equivalent. This stone forms the floors and walls of the lobby of Hanover Place at 101 – 6 Ave. SW.

**Picture 10**
This massive grey, partially dolomitized limestone, full of whitish patches, is a piece of the Late Devonian Cairn Formation of the Fairholme Group. This monolith was brought to the Geological Survey of Canada’s Institute of Sedimentary and Petroleum Geology at 3303 – 33 St. NW from Grassi Lakes, just west of Canmore Alberta and was installed with explanatory plaques just outside its entrance. The rock fabric is dominated by large stromatoporoids that have been partially leached out with some late calcite filling. This has created tremendous vuggy porosity. The matrix contains stringy amphipora and is also of good reservoir quality where it has been transformed to dolomite. Pronounced fracturing crosscuts the strata adding to their permeability. This unit is significant because it correlates with the Leduc Formation in the subsurface that is the primary reservoir in many of Alberta’s conventional oil and gas pools.
**Picture 11**

This igneous rock texture is visible in the west outside wall of the BP Centre at 240 – 4 Ave. SW. The dark object has a long axis of approx. 6 cm. It is termed a “xenolith” with “xeno” meaning “foreign” and would be interpreted as a piece of the wall rock into which this granitic magma intruded. To be fair, this could be validated by chemical analysis as this rock might also be an early precipitant from the magma with a composition not the same as the parent magma due to the processes of differential crystallization. If that were true it would be an “autolith” with “auto” meaning “self”. The matrix of this rock is dominated by pink potassium feldspar crystals with smaller white zoned plagioclase, grey quartz and black biotite. The size of these crystals is controlled by many factors including the kinetics of crystallization, nucleation and saturation along with fluctuations in pressure, temperature and the nature of accompanying fluids.

**Picture 12**

This very red mudstone has been used as one of the internal decorative lithologies in the BP Centre at 240 – 4 Ave. SW, on both the main and Plus-15 levels. With few exceptions, this is one of the most fascinating sedimentary rocks that can be viewed in Calgary. There are numerous thin walled ammonites like the one in this picture. Their internal chambers may have a crystalline infilling with the outer ones generally breached and sediment-filled. The rock has been transected by several generations of fractures. The early ones were accompanied by hydrothermal fluids that have percolated into the sediments and altered them in a zonal fashion adjacent to the fractures. A late generation of fractures have locally brecciated the rock as they crosscut all earlier features. The age and source of this building stone are not known but a guess of Mesozoic or Tertiary from somewhere in the Alpine chain might be close to the mark. The sediments were undoubtable of deep marine origin in a starved shale-dominated setting into which deceased ammonites plummeted and were preserved. ♦
# MARCH 21st, 2019 - DAY 1 SCHEDULE

<table>
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<th>Time</th>
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<tbody>
<tr>
<td>8:00</td>
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<td><strong>Welcome &amp; Introductions</strong></td>
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<tr>
<td>8:05</td>
<td>Stan Stancliffe</td>
<td>Optimising the collection of core and chips to obtain the maximum data from new scanning and imaging technologies</td>
<td>Oil Sands; Geochemistry/ Petrophysics/ Geomechanics</td>
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<tr>
<td>8:30</td>
<td>Thomas Weedmark</td>
<td>Incorporation of XRF Data in rock analysis workflow: Applications to oil sands</td>
<td>Oil sands; Geochemistry</td>
</tr>
<tr>
<td>8:55</td>
<td>Graham Spray</td>
<td>TBD</td>
<td>Oil sands; Geochemistry/ Petrophysics</td>
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<tr>
<td>9:20</td>
<td>Michele Speta</td>
<td>Hyperspectral applications in the oil sands</td>
<td>Oil sands</td>
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<tr>
<td>9:45</td>
<td></td>
<td><strong>BREAK</strong></td>
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<tr>
<td>10:10</td>
<td>Liz Percak-Dennett</td>
<td>Subsurface DNA diagnostics as a novel data source for reservoir characterization</td>
<td>Tight Rocks; Geochemistry</td>
</tr>
<tr>
<td>10:35</td>
<td>Omid Ardakani</td>
<td>Hydrocarbon resources geochemical screening: Data quality control</td>
<td>Tight Rocks; Geochemistry</td>
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<tr>
<td>11:00</td>
<td>Gonzalo Zambrano</td>
<td>State of the art of geomechanical triaxial test at the millimetre core scale to examine scale influence of hydro-geomechanical and multiphase properties changes of Shales</td>
<td>Tight Rocks; Geomechanics</td>
</tr>
<tr>
<td>11:25</td>
<td>Marc Bustin</td>
<td>Mechanical characterization for tight rocks at micro/nano-scales using nanoindentation technique</td>
<td>Tight Rocks; Geomechanics</td>
</tr>
<tr>
<td>11:55</td>
<td>Dan Agar</td>
<td>Digital rock characterization of tight rocks</td>
<td>Tight Rocks; Petrophysics</td>
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<tr>
<td>12:20</td>
<td></td>
<td><strong>LUNCH</strong></td>
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<tr>
<td>1:20</td>
<td>Hanford Deglint</td>
<td>Micro-scale characterization of wettability in tight rocks</td>
<td>Tight Rocks; Petrophysics</td>
</tr>
<tr>
<td>1:45</td>
<td>Charles Song</td>
<td>Best practices for advanced core/cutting analysis: Implications for evaluation of enhanced oil recovery in tight reservoirs</td>
<td>Tight Rocks; Petrophysics</td>
</tr>
<tr>
<td>2:10</td>
<td>Amin Ghanizadeh</td>
<td>Relative Permeability of Tight Rocks: Examples from the Montney and Duvernay Formations (Canada)</td>
<td>Tight Rocks; Petrophysics</td>
</tr>
<tr>
<td>2:35</td>
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<td><strong>BREAK</strong></td>
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<tr>
<td>3:00</td>
<td>Andreas Busch</td>
<td>Understanding pore structure, pore orientation and fluid saturation in mudrocks using small angle scattering</td>
<td>Tight Rocks; Petrophysics</td>
</tr>
<tr>
<td>3:25</td>
<td>Bernard M. Krooss</td>
<td>Gas storage and transport properties of tight rocks: Impact of fluid-dynamics, rock-mechanics and water saturation</td>
<td>Tight Rocks; Petrophysics</td>
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<tr>
<td>3:55</td>
<td>Kevin Parks</td>
<td>TBD</td>
<td>Governmental Regulations</td>
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<tr>
<td>4:20</td>
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<td><strong>Closing Remarks</strong></td>
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<tr>
<td>4:25 - 6:25</td>
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<td><strong>ICEBREAKER - Sponsored by AGAT Laboratories</strong></td>
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## MARCH 22nd, 2019 - DAY 2 SCHEDULE

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<tbody>
<tr>
<td>8:30</td>
<td>Welcome &amp; Introductions</td>
<td></td>
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</table>
| 8:35  | Amin Ghanizadeh  
University of Calgary | Integrating Advanced Core Analysis with Lithological Controls on Hydrocarbon Storage and Transport in the Montney Formation: An Integrated Core/Log Analysis | Oil Sands; Geochemistry/ Petrophysics/ Geomechanics |
| 9:00  | Mason MacKay  
University of Calgary | Integrating Geomechanical Characterization of Tight Rocks: Examples from the Duvernay Formation (Canada) | Oil Sands; Geochemistry                  |
| 9:25  | Henry Portilla  
University of Calgary | Geological Controls on Hydrocarbon Generation and Production in the Duvernay Formation: An Integrated Log and Core Analysis Approach | Oil Sands; Geochemistry/ Petrophysics     |
| 9:50  | Bruce James  
Suncor Energy | TBD                                                                               | Oil sands                                 |
| 10:15 | BREAK                                     |                                                                                   |                                            |
| 10:45 | Rick Chalaturnyk  
University of Alberta | TBD                                                                               | Tight Rocks; Geochemistry                 |
| 11:10 | Carolyn Currie  
Core Laboratories | TBD                                                                               | Tight Rocks; Geochemistry                 |
| 11:35 | Marc Enter  
SGS | TBD                                                                               | Tight Rocks; Geomechanics                |
| 12:00 | LUNCH                                     |                                                                                   |                                            |
| 1:00  | Panel Discussion                          |                                                                                   |                                            |
| 1:30  | Closing Remarks                           |                                                                                   |                                            |
| 1:35-3:00 | Core Viewing/Networking                  |                                                                                   |                                            |

### POSTERS

- **Ron Spencer**  
  XRF Solutions  
  Mineralogy of unconventional reservoirs: Comparison of rock analyses from different analytical techniques  
  Tight Rocks; Geochemistry

- **Scott McKean & Mason Mackay**  
  University of Calgary  
  Geomechanical characterization of tight rocks using multistage triaxial testing and ultrasonic pulse transmission technique  
  Tight Rocks; Geomechanics

- **Dan Agar & Joe Ramoin**  
  Core Laboratories  
  Best practices for routine core analysis in the Montney Formation  
  Tight Rocks; Petrophysics
STUDENTS!

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<th>Scholarship/Award</th>
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<tr>
<td>Regional Graduate Student Scholarships</td>
<td>($2,500 x 4)</td>
<td>January 18, 2019</td>
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<tr>
<td>Undergraduate Student Awards</td>
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<td>January 18, 2019</td>
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<tr>
<td>Student Event Grants</td>
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