The Rock Record - November, 2015

Saskatchewan Geological Society
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In This Issue

Saskatchewan Geological Society Luncheon Talk

Wednesday, November 18

The advantages of wide-spectrum geochemical sampling of groundwater: 101 uses beyond 'water quality data'

Stew Hamilton, Ph.D., P.Geo. Ontario Geological Survey
Provincial and Territorial Geologists medalist

NOTE CHANGE OF VENUE:
The Artful Dodger

Lunch: 11:45 a.m.
Meeting talk: 12:15-1:00 p.m.

For lunch the cost is:
Members: $15.00
Student Members: $5.00
Non-Members: $20.00
For those not having lunch the talk is free

RSVP to Jason Cosford at cosford@jdmollard.com
or Monica Cliveti at monica.cliveti@uregina.ca
before 5:00 pm, Monday, November 16, if you are going to have lunch.

DETAILS OF TALK – November 18th

Stewart Hamilton - Bio

Dr. Hamilton has PhD in aqueous geochemistry, a Master's degree in hydrogeology and an undergraduate degree in geology. His career at the Ontario Geological Survey has been split between exploration geochemistry, where he studied the geochemical origins of electrical self-potentials, and hydrogeochemistry, where he has mapped groundwater geochemical regimes throughout most of southern Ontario. He has been with the OGS for over 20 years and is currently Senior Science Leader for Geochemistry. Prior to this, he worked for a consulting firm in Ottawa as a hydrogeologist. Dr. Hamilton is a past Distinguished Lecturer for the Association of Applied Geochemists and is this year's recipient of the Provincial and Territorial Geologist's Medal.

ABSTRACT

The advantages of wide-spectrum geochemical sampling of groundwater: 101 uses beyond 'water quality data'

Groundwater geochemical data are often collected and treated as 'water quality data' and compared against the benchmark of regulatory standards. This is not unreasonable since regional groundwater sampling programs are usually justified on a public health basis. However, this approach ignores the predictive value of appropriately collected aqueous geochemical data. Dissolved constituents never exist in isolation of each other, or of the host formation, and characterizing the aqueous geochemical matrix can reveal important groundwater processes, including those that affect public health. A minimum suite of parameters including the 7 major ions, pH, redox and certain dissolved gases, in addition to any health-related parameters of interest, provides much more information than the sum of their individual contributions.

A wide-spectrum groundwater geochemical sampling program has been completed in southern Ontario at an unmatched scale, density and degree of analytical completeness. 107 Sample attributes and 27 station attributes were characterized for 2300 samples collected at 1850 stations at a uniform sample density across a 96,000 km2 area. This allows the mapping of groundwater geochemical regimes in most of southern Ontario for the first time. Dozens of phenomena and processes have been identified at all scales, many of which were previously unknown. A few examples include: (1) wide regions of biogenic shale gas, (2) a 1400 km2 breathing well zone expelling hypoxic gases, (3) stagnant flow zones hosting Pleistocene waters, (4) provincial-scale patterns in the distribution of tritium in groundwater, (5) regions where iodine in potable water exceeds seawater by many times, (6) decadal-scale trends in aquifer recovery and depletion, (7) the replacement of ancient water in aquifers with modern water due to pumping, (8) provincial-scale regions of natural fluoride hazard (9) areas of systemic bacterial occurrence in aquifers, and (10) widespread, discreet zones of karstic groundwater flow. Most of these discoveries could not have been anticipated when the program began 8 years ago, which demonstrates the efficacy of primary data collection and geological mapping in the support of groundwater studies.

DETAILS OF TALK – November 24th
Venue: Artful Dodger (further details to follow)

GAC Howard Street Robinson Lecturer: Stephen J. Piercey - Bio

Stephen Piercey completed a B.Sc.(Hons.) and M.Sc. from Memorial University of Newfoundland and a Ph.D. from the University of British Columbia. From 2001-2008, he held the positions of Assistant Professor (2001-2004) and Associate Professor (2004-2008) in the Mineral Exploration Research Centre (MERC) and Department of Earth Sciences at Laurentian University. From 2007-2009 he was the principal of SJPGeoConsulting, a St. John's-based consulting firm focused on the application of field and laboratory techniques to mineral exploration and development. Since December 2009 he has been an Associate Professor (2009-2014) and Professor (2014-present) and the NSERC-Altius Industrial Research Chair in the Metallogeny of Ores in Volcanic and Sedimentary Basins in the Department of Earth Sciences at Memorial University. He is also the Technical Leader for Lithogeochemistry for the Canadian Mining Innovation Council Footprints Project.

His research is in the in the application of field methods, lithogeochemistry, and isotopes to understanding mineral deposit genesis and exploration (see Research Interests and Publications) across numerous commodities, deposit types, and jurisdictions. He also has a blog on Economic Geology that covers current research and ideas in Economic Geology, mineral exploration and mining.

ABSTRACT
Zn-rich Volcanogenic Massive Sulphide (VMS) Deposits

Base metal-dominated volcanogenic massive sulfide (VMS) deposits are important global resources of zinc (Zn) with many deposits having Zn as the main commodity of production. Global VMS deposits can be classified into Zn-rich, zinciferous, and anomalous based on global geological resource data. Zinc-rich deposits have Zn >6.1% (geometric mean + one standard deviation) and >1.27Mt of contained Zn (>90th percentile for all deposits globally). Deposits that are high-grade with Zn>6.1% but have <1.27Mt are considered zinciferous, whereas deposits that have high tonnages and >1.27Mt of contained Zn, but low-grades (Zn<6.1%) are considered anomalous deposits. Collectively, these deposits with abundant Zn are collective considered Zn-enriched deposits.

Zinc-enriched deposits are preferentially associated with VMS sub-types that are associated with felsic volcanic rocks and/or sediments (i.e., bimodal felsic, bimodal mafic, and felsic siliciclastic sub-types). All Zn-enriched deposits are preferentially hosted in Phanerozoic sequences, but there are significant deposits found in Archean and Paleoproterozoic rocks. Furthermore, throughout Earth's history Zn-enriched VMS deposits show a distinct secular evolution with peaks in total contained Zn in the late Archean (~2.7 Ga), Paleoproterozoic (~1.9-1.8 Ga), Cambrian-Ordovician (~510-460 Ma), and Devonian-Mississippian (~390-355 Ma), with subsidiary peaks in the Mesoarchean (~3.0 Ga), Neoproterozoic (~0.75 Ga), Mesozoic (~220-200 Ma), and Cenozoic (~110-90 Ma).

The secular distribution of Zn-enriched, and VMS deposits in general, is directly related to accretionary orogenesis and crustal growth processes. In the Precambrian, the abundance of Zn-rich VMS deposits is directly related to crust-forming events, juvenile crustal growth, and supercontinent formation, particularly in the late Archean and the Paleoproterozoic. Phanerozoic Zn-enriched VMS deposits, although associated with accretionary activity, are not directly associated with the terminal phases of supercontinent formation,

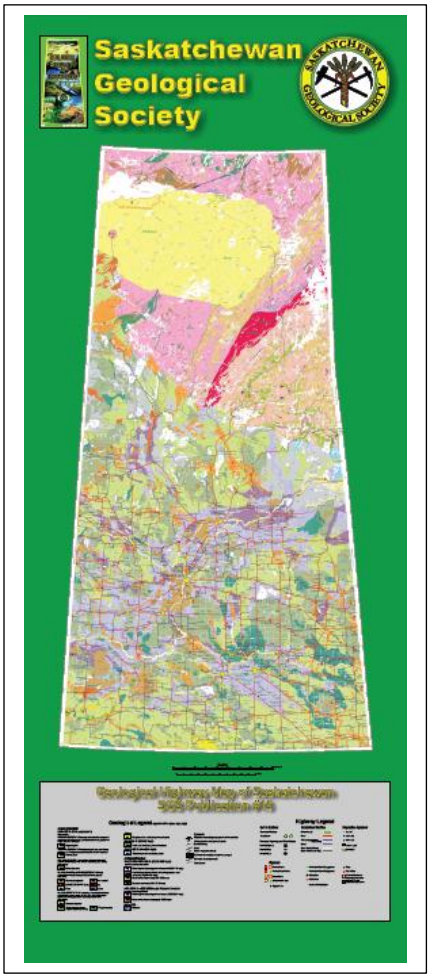
and commonly formed a significant period of time (i.e., commonly >100 m.y.) prior to final supercontinent amalgamation, suggesting that other processes were more important in controlling their temporal distribution. Despite associations with accretionary orogenesis, both Precambrian and Phanerozoic Zn-enriched VMS deposits are associated with extensional geodynamic regimes (e.g., mid-ocean ridges, arc rifts, and back-arc basins).

Other factors that were favorable for the formation and siting of Zn-enriched VMS deposits include: 1) sedimentary rocks in the host stratigraphic succession and anoxic basinal conditions and 2) semi-permeable cap rocks. Sedimentary rocks deposited during reduced marine conditions (i.e., anoxic sediments at the time of VMS formation) can limit the amount of reduced sulphur in the hydrothermal fluids, and pore waters in the sediment can add chloride, both of which help increase the solubility of metals transported in the hydrothermal fluid. More importantly, sedimentary host rock enhances the preservation of VMS deposits, and the formation of large Zn-enriched deposits because they promote subseafloor replacement-style VMS mineralizing processes. Marine basinal anoxic conditions were important for the formation of some Phanerozoic VMS deposits (particularly felsic siliciclastic-types). Anoxic ambient conditions (either local or large-scale) result in a stratified water column with H2S-rich bottom waters that prevented the oxidative weathering of VMS deposits, and also provided additional reduced sulphur to fix metals discharged from hydrothermal vents. The additional H2S present in the water column may have allowed for the more efficient trapping of metals and the formation of larger tonnage Zn-rich VMS deposits (e.g., Brunswick Number 12). The additional reducing conditions also likely prevented the oxidation of deposits, thereby, increasing their preservation potential in the geological record. Cap rocks (e.g., barite, chert, carbonate semi-permeable tuff, shales) that immediately overlie mineralization were critical for increasing the efficiency of zone-refining processes and resulted in abundant Zn-Pb dissolution, re-precipitation and upgrading of Zn grades in deposits leading to high-grade Zn-rich and zinciferous VMS deposits.

Various lines of evidence (e.g., fluid inclusions, metal assemblages, mass balance constraints) suggest that magmatic fluid and metal contributions may have been important in large (e.g., Kidd Creek, Brunswick #12, Neves Corvo) and/or high-grade Zn-rich deposits (e.g., Buchans, Hellyer). None of the evidence uniquely suggests that magmatism contributes Zn to these deposits; however, given their size and/or grade it is conceivable that significant Zn may be derived from magmatic fluids. This question should be at the forefront of research on Zn budgets in VMS deposits in the near future.

President's Blog

Most of you who read this newsletter will know that the Society has pursued the production of a Geological Calendar for the province. The committee has worked hard to come up with a very creative and varied design, lots of different themes, lots of educational components, a bit funny in parts, informative and also visually appealing. The 2016 Geological Calendar of Saskatchewan is now available at a cost of $10, with discounts when you order more than five (5-9 copies for $8; more than 10 for $6 each). It will make a great 'little' stocking stuffer for Christmas! We only printed 1000 copies so make sure to secure your copy as we are sure to run out quickly. It will be for sale at the luncheon talks, at the Geological Open House in Saskatoon and you can also order it by emailing us at Sask.Geol.Soc@hotmail.com. We will require prepayment, if you would like to receive one by mail. To see some of the pages of the calendar and learn more, please visit our website at http://sgshome.ca/products/geological-calendar.



Another product we have been working on is the design of two retractable banners. These will be used at conferences such as the Open House in Saskatoon, where the Society will have a booth. One of the panels will feature the central portion of the Geological Highway Map, the other will feature the varied activities of the Society, in picture and word. And this is what they look like.

In late September, Don Kent led about 18 Society members on a wonderful fieldtrip of the Avonlea Badlands and Claybank icepush features. We also visited the local museum. The weather was more than cooperative on this trip and the badlands presented themselves in wonderful fall colours.

The Saskatchewan Geological Open House is coming up fast and you should plan to attend. Please register at https://openhouse.sgshome.ca/; it's free. The SGS will have a commercial booth at the Open House and we are looking for volunteers to work at the booth; please email me if you are willing to help out! Please also note that there are two short courses scheduled to run in conjunction with the Open House. More details are available below.

Finally, I want to put in a short plug for a fundraiser the DM Kent Geology Student Club is hosting on November 23rd. It will be a Boston Pizza pasta night and there will be good food and good company, and you can help send a student to WIUGC! Please scroll down to find out more details about this event.

NEWS AND EVENTS

Celebrating our Own: Jack Mollard

Many of you will have seen the LeaderPost article a few weeks ago, in which Ashley Martin told Jack Mollard's story. It was a wonderful account of Jack's career and adventures of 70 years of making maps. If you have missed the article I encourage you to follow the link and read it.

What many of you may not know and what I have only learnt recently, is that Jack has made two very significant monetary contributions to both universities in the province. With a gift of $100,000 to the U of S, the school he graduated from in 1945, Jack is giving second-year civil, geological and environmental engineering students the chance to learn more about interpreting geologically significant locations in southern Saskatchewan. The 'Dr. Jack Mollard Sensing the Earth Tour' will allow a large number of students to interact with geology the way it ought to be interacted with: by being out in the field. Jack has made a matching contribution for the same purpose to the Faculty of Engineering and Applied Sciences at the University of Regina.

Short Courses at Saskatchewan Geological Open House in Saskatoon

The full details for these short courses are available at the Open House website. Short Course 1 will be presented by JD Mollard and Associates (2010) Limited and is entitled 'Terrain Analysis for Geoscience Investigations'. Presenters will be Lynden Penner and Jason Cosford. It has attendance limit of 50 and will run pre-conference on Monday November 30, 2015. Cost for the course is $300/person + GST ($15.00).

A post-conference course entitled 'Athabasca Basin Drillcore Workshop' will be hosted by the Saskatchewan Geological Society on Thursday, December 3, 2015. It will be facilitated at the Subsurface Geological Laboratory in Regina. Presenters are Colin Card and Sean Bosman of the Saskatchewan Geological Survey. Cost for this course will be $250/person + GST ($12.50).

SGS Booth at Open House in Saskatoon – Volunteers needed

The SGS Executive is looking for volunteers to work at the booth. The main reason for the booth is to sell the geological calendar, some merchandise, membership renewals and to just promote the activities of the Society. The booth will be open from 5 to 10 pm on Monday, 12 to 7 pm on Tuesday and 12-2 pm on the Wednesday. Please email Ralf.Maxeiner@gov.sk.ca if you are willing to help out.

Geological Calendar – Thank you

By Ralf Maxeiner

I would like to thank all the people who contributed photos to the Geological Calendar. We had many pictures to choose from and the decision which pictures to use was a difficult one. The committee (Ken Ashton, Monica Cliveti, Jason Cosford, Janis Dale, Michelle Hanson, Bernadette Knox and Ralf Maxeiner) worked really well together and it was fun to put it all together. A special thanks to Jason Cosford, who did a fabulous job with the layout of the calendar. Now it is up to the members to reward the committee by purchasing a calendar and promoting it to friends, family and the general public. Please visit the website oto

find out how to obtain your copy. It is also available in Regina at the Royal Saskatchewan Museum and the MacKenzie Art Gallery gift stores.

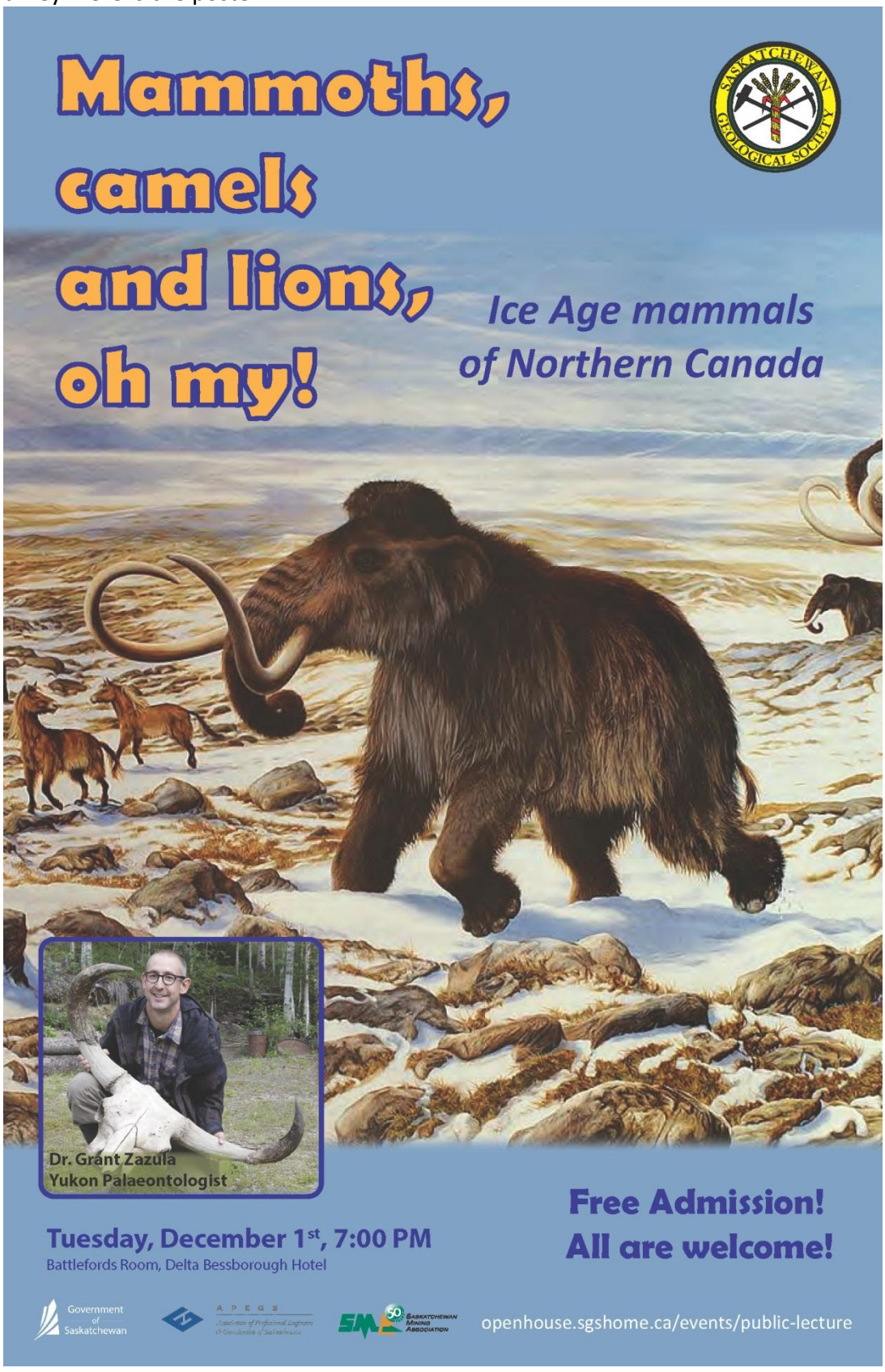
D.M. Kent Club of Geology Boston Pizza Night

By John Kelley

The D.M. Kent Club of Geology is hosting a Boston Pizza Booster Night November 23rd. What does that mean for you? Well, for $20 you can help send 30 students to the Western Inter University Geoscience Conference (WIUGC), and get a great meal to boot. With your choice of pasta or pizza and a Caesar salad, it will be a great meal. All ages are welcome, and we will be drawing raffle prizes all throughout the day. Three seatings are available, (11-5:30, 6-8, 8-9:30), with limited tickets for each seating. To purchase tickets, or ask any questions, you can contact the D.M. Kent club at dmkentclub@gmail.com, or contact John Kelley directly at 306-596-5231. Thank you and we hope to see you there!

Other Upcoming Talks

At the Geological Open House in Saskatoon, this year's public lecture will be by Grant Zazula of the Yukon Geological Survey. Here is the poster:



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