

GAC-MAC: FIELD GUIDE SUMMARY

Kingston 2017: GAC-MAC Joint Annual Meeting Field Trips

Dawn A. Kellett¹ and Laurent Godin²

¹*Geological Survey of Canada*

1 Challenger Drive, Dartmouth, Nova Scotia, Canada

E-mail: dawn.kellett@canada.ca

²*Department of Geological Sciences and Geological Engineering*

Queen's University, Kingston, Ontario, K7L 3N6, Canada

E-mail: godinl@queensu.ca

BACK TO WHERE IT BEGAN

The Department of Geological Sciences and Geological Engineering of Queen's University, in Kingston, Ontario, will host the 2017 Annual meeting of the GAC-MAC. The meeting will coincide with the 175th anniversary of the founding of the Geological Survey of Canada, which was established by the legislature of the Province of Canada in 1842, in Kingston, and with Canada's 150th anniversary celebrations. The local geology surrounding Kingston, commonly called the Limestone City, does not disappoint and multiple field trips associated with the meeting will take advantage of its unique location. Kingston is located at the eastern end of Lake Ontario, where the St. Lawrence River begins, draining the waters of the Great Lakes into the Gulf of St. Lawrence. The transition from lake to river occurs east of Kingston Harbour, where the nearly flat-lying Early Paleozoic limestone, rimming the eastern Lake Ontario basin, border against a NW-SE trending, low ridge of Grenvillian Precambrian basement rocks, locally known as the Frontenac Arch, which connects the southeastern Ontario part of the Canadian Shield with the Adirondack Massif of northern New York State. The crystalline basement rocks form a resistant ridge over which the St. Lawrence River flows northeastward from Lake Ontario, creating the 'Thousand Islands,' a well-known tourist and cottage region along the international border that now also includes a National Park.

The 2017 Kingston GAC-MAC meeting will provide seven field trip opportunities that span from Proterozoic geology to the present, and cover a wide range of Earth Sciences sub-disciplines, from geomorphology to hydrology, from Quaternary geology to metallogeny, and from tectonics to sedimentology. Trips range in length from one to five days, as homegrown as



Figure 1. Highly deformed tonalitic gneiss cross-cut by pegmatite dykes in the Grenville Province north of Kingston (Photo: Laurent Godin).

a day trip touring the local geology highlights of Kingston's environs, and as far-a-field as a five day transect traversing the accreted terranes of the Newfoundland Appalachians.

The one-day 'Bedrock to Beaches' field trip will take participants from Kingston to Prince Edward County and back. Along the way, participants will track one billion years of evolution of the Kingston region. They will contemplate metasedimentary rocks that were heated, squeezed, and intruded by granite ca. 1170 million years ago, sandstone deposited by rivers and wind ca. 490 million years ago, limestone and shale deposited in tropical seawater ca. 455 million years ago, faults that displaced the limestone perhaps 176 million years ago, drumlins shaped by a continental ice-sheet about 20,000 years ago, a shoreline created by a giant proglacial lake ca. 13,200 years ago, and a thin soil full of frost-heaved limestone nodules that nowadays nourishes many of the best vineyards in 'the County.'

Another one-day trip will explore local shallow neritic marine carbonate rocks on a tropical Ordovician Earth. Shallow water marine carbonate rocks are beautifully exposed in the Kingston area and many buildings in 'the limestone city' are made of these rocks. The easily accessible outcrops have been little altered since they were deposited ca. 450 million years ago and the components are easily visible making aspects of sedimentology, paleoecology, and diagenesis understandable to everyone. The carbonate rocks are world famous in this regard and have been studied for more than 150 years. The field excursion will visit sections exhibiting a range of paleoenvironments with plenty of time for illustration and discussion. Paleooceanography will range from arid tidal flats, through the paleothermocline, into interpreted cool water outer ramp storm and slope deposits. Fossils range from scarce to profuse reflecting changes in paleoseawater salinity and bottom paleotemperature. This trip has been used for many decades as a



Figure 2. Paleozoic boulder conglomerate unconformably resting on Grenvillian quartzite (Photo: Doug Archibald).

teaching tool for Queen's undergraduates and will be designed for participants who are neophytes, those who want to know more about carbonate rocks or those who are fascinated by this period in deep time. Travel will be by bus and ferry, with perhaps a libation stop.

Located adjacent to Highway 7, the Maberly shear zone is one of the most accessible structural features in the Grenville Orogen. It is also one of the oldest (*circa* 1162 Ma) and represents the boundary between the Composite Arc and the Frontenac–Adirondack belts. Beginning and ending in Kingston, this one-day trip will highlight the results of recent research along this boundary by the Ontario Geological Survey. The field trip will examine key outcrop exposures providing evidence of the tectonic, magmatic and metamorphic history of this boundary, including stops in the Sharbot Lake domain, Frontenac terrane, and the shear zone itself. Field trip discussions will focus on styles of metamorphism, magmatism, and metasomatism, complementing both the session on the *Metamorphic Architecture of Orogenic Belts* and the post-meeting trip on the *Tectonic and metamorphic architecture of the northeastern Composite Arc Belt and the Central Metasedimentary Belt boundary tectonic zone, Grenville Orogen*.

New modelling of the Laurentide Ice Sheet reveals the presence of more than 100 fast flowing ice streams. GAC–MAC 2017 will offer a three-day field trip travelling through the superbly exposed glacially-streamlined ‘hard’ and ‘soft’ beds of the former Ontario Ice Stream in southern Ontario and upper New York State. Participants on this trip will examine rock drumlins and mega-grooved limestone surfaces of the ‘hard bed’ seen immediately south of the border of the Canadian Shield and the down-glacier change to classic ‘drift’ drumlins composed of sediment of the ice stream’s ‘soft bed.’ Participants will review variations in drumlin morphology using new imagery such as LiDAR, together with the stratigraphy where exposed along the Lake Ontario shoreline. The field trip will foster field discussion of the role of fast flowing ice streams in the subglacial evolution of rock and sediment bedforms in general, the relationship with landforms such as eskers and moraines, and implications for mineral exploration projects.



Figure 3. Precambrian–Paleozoic angular unconformity exposed in the Kingston area. The Grenvillian quartzite below is cross-cut by an offset mafic dyke, overlain by flat-lying Middle Ordovician limestone (Photo: Doug Archibald).

Another field trip will examine surficial processes in southern Ontario through a hydrogeology lens. This trip will traverse the Canadian Shield and Paleozoic geology of the eastern Lake Ontario Basin to highlight its contrasting style of erosion and sedimentation. The tour will review field evidence of the influence of bedrock lithology and structural control on micro/macro scales of erosional and depositional regimes. From the eroded shield and limestone terrains near Kingston, the tour will complete a loop to the northwest to the thick sediment terrain of the Peterborough drumlin field with its associated tunnel valleys and eskers. Sedimentary deposits, landforms and landscape architecture are integrated into regional conceptual models relevant to groundwater supply and management in the transitional sediment setting (thin to thick) of eastern Ontario.

What better way to follow through on the discussions from the theme session on the *Metamorphic Architecture of Orogenic Belts* than to examine a major tectonic boundary in the Grenville Orogen less than two hours drive from Kingston? This three-day field trip will begin and end in Kingston, and will highlight the results of detailed mapping, new airborne geophysical surveys, and geochemical and geochronological studies conducted by the Ontario Geological Survey between 2011 and 2015 along the northeastern part of the Composite Arc Belt and its boundary with the Central Gneiss Belt in Ontario. The field trip will examine key outcrops providing evidence of the tectonic, magmatic and metamorphic history of this notable area in terms of understanding the linkage between the gneisses of the Laurentian Margin (infrastructure) to the northwest and the Composite Arc Belt (both the suprastructure and the Ottawa orogenic lid) to the southeast. A key goal of the trip will be to foster field discussions on topics including its complex thrusting history, the recognition of ca. 1150 Ma metamorphism and magmatism in parts of the area, and the history of syenite magmatism, metasomatism, and rare element mineralization between 1080 and 1030 Ma.

The Newfoundland Appalachians trans-island field trip will take participants to some of the best-preserved ophiolites, mélanges and island arc terranes in the Appalachian mountain

belt. Crossing several suture zones, including the main Iapetus suture, participants will explore the tectono-stratigraphy of the various oceanic and micro-continental terranes and their complex tectonic interactions during successive accretion to a progressively expanding composite Laurentia from the Early Ordovician to Devonian. The trip will take participants from Stephenville to Gander, showing spectacular geology framed by the beauty and ruggedness of Newfoundland.

We do hope this menu of field trips will appeal to the broad geoscientific community and that you will visit Kingston for GAC-MAC 2017. See you next spring! Further information can be found at: <http://www.kingstongacmac.ca/>.



GAC-MAC 2017
Kingston, Ontario

BACK TO WHERE IT BEGAN



The 2017 Annual meeting of the GAC/MAC in Kingston will coincide with the 175th anniversary of the founding of the GSC in Kingston. The Geological Survey of Canada, Canada's oldest scientific agency, was established by the legislature of the Province of Canada in 1842, in Kingston, Canada West.

The Department of Geological Sciences & Geological Engineering at Queen's and the GSC will be hosting this celebratory event at Queen's University May 14-18, 2017.

www.kingstongacmac.ca

See the website for further information on the program and events

