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ABSTRACTS

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THE EDITORS

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The Zealand Station beryl (Aquamarine) deposit, west-central New Brunswick: mineralogic, geochronologic, and petrogenetic constraints

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The Zealand Station beryl deposit is located 30 km northwest of Fredericton, New Brunswick, along the northeastern cusp of the multiphase Devonian Pokiok Batholith that has been mapped as the Hawkshaw Granite, previously dated at 411 ± 1 Ma by U-Pb titanite. A late-stage, southeast-trending, weakly porphyritic with coarse-grained perthitic feldspar, aplitic to pegmatitic dyke locally contains abundant blue beryl (aquamarine) in the aplitic groundmass. An exposure of the pegmatitic phase, 50 m from the map area, is predominately muscovite, quartz, and orthoclase with granophyric texture containing wolframite. Beryl is also found along quartz-rich veins trending 135°/90° and 010°/75°W and near altered greisen pockets in the host granite that have no predominant orientation.

The host granite and crosscutting dyke have a slightly potassic granitic composition and the $FeO^T/(FeO^T+MgO)$ ratio of the granite indicates that they are predominantly magnesian. Furthermore, the area is approximately calc-alkaline with strong peraluminousity that is enhanced by greisenization. The granite composition partially overlaps those of the aplitic dyke and related phases. Trace-element data have elemental characteristics of S-, fractionated I-, and crustal A-types. In addition, Sm-Nd data indicate that the aplitic dyke is similar to the Pokiok Batholith.

The aplite dyke has been dated at 400.5 ± 1.2 Ma using TIMS U-Pb on magmatic zircon (Memorial University) and at 404 ± 8 Ma using the U-Pb in magmatic monazite by the electron probe microanalysis (EPMA) technique (University of New Brunswick): these ages link the aplitic dyke to the Allandale Granite phase, previously dated at 402 ± 1 Ma by U-Pb monazite, which is the youngest and most evolved phase of the Pokiok Batholith. In addition, two EPMA monazite analyses resulted in an age of 510 ± 20 Ma, indicating a supracrustal xenocrystic origin with an age similar to the Miramichi and St. Croix subzone metasedimentary rocks.

Eight beryl samples were analysed by EPMA from the aplitic dyke, beryl-bearing quartz veins, and greisen pockets. At this deposit, the average H_2O content in the channel site is 1.53 wt.% calculated by $(Na_2O + 1.4829)/1.1771$. The beryl's excess silica concentration is well-fitted into the Al-octahedral site, along with other common constituents including iron that is shown to be predominantly ferric and the dominant chromophore. Compositional zonation is evident in all beryl crystals using backscatter electron imaging, with one sample showing oscillatory zoning.

Amphiboles document processes near the roof of a mafic magma chamber: the Neoproterozoic Greendale Complex, Antigonish Highlands, Nova Scotia

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The ca. 607 Ma Greendale Complex is located between the Hollow and Greendale faults in the Antigonish Highlands, and is a local representative of extensive arc-related magmatism in the Avalon terrane of the Canadian Appalachians. The complex is a roughly semi-circular body with a diameter of ca. 5 km and is composed of steeply dipping, intrusive sheets which define a distinct layering that may be centimetres to metres in width. The complex is heterogeneous with abundant evidence for mixing and mingling between its various components. It contains felsic, intermediate, mafic, and ultramafic compositions. The ultramafic rocks occur as discontinuous sheets and pods which are interpreted as boudins derived from early-formed layers. The felsic rocks occur in veins, as either conjugate sheets or networks and typically terminate in pegmatitic lenses. The mafic or intermediate rocks, which dominate the complex, are composed mainly of amphibole-rich porphyritic gabbro.

Amphibole occurs in all lithologies in the complex. In ultramafic rocks it poikilitically encloses olivine, clinopyroxene, and orthopyroxene. In mafic to intermediate rocks its texture vary from fine stubby phenocrysts to coarse (>10 cm) prismatic crystals growing perpendicular to the bounding walls of the dykes. In felsic rocks, the amphibole is less common (<10%), but generally occurs as prismatic minerals in a quartzofeldspathic matrix. The sensitivity of amphibole chemistry provides detailed information about the conditions of crystallization. Amphibole from the various Greendale Complex lithologies was analysed for major, trace, and rare earth elements by Laser Ablation at Memorial University, Newfoundland. These data provide insights into the crystallization histories near the roof of the pluton and allow the effects of temperature and varying magma composition on amphibole chemistry to be determined.

Lithogeochemical vectors toward gold mineralisation in the Amaranth Vein, Waihi, New Zealand: precision of visual alteration intensity estimates

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The Waihi area of New Zealand, part of the Hauraki Goldfield, is located at the southern end of the Coromandel

Peninsula, on the North Island, and is host to a number of actively mined and currently sub-economic, low-sulphidation epithermal gold- and silver-bearing quartz veins. The Waihi epithermal vein system is the largest of 50 known deposits on the Coromandel Peninsula. Veins in the Waihi area are hosted by Miocene to Pliocene volcanic rocks of andesitic to dacitic composition of the Coromandel Group. Two main units have been defined by previous studies and consist of a subjacent quartz-plagioclase-porphyritic andesite and superjacent plagioclase-porphyritic andesite; the former generally hosts wider and higher grade veins. Much of the area is overlain by younger ignimbrite, tuff, alluvium, and volcanic ash from the currently active Taupo Volcanic Zone to the southwest.

This thesis study focuses on the Amaranth Vein, one of several large, currently sub-economic veins in the Gladstone Hill area. The Amaranth Vein is located within the town of Waihi, several hundred metres to the east of the active Martha open pit mine and a few hundred metres west of the Favona Vein, which is also currently being mined by underground means. Rocks in the Gladstone Hill area are characterised by strong to intense hydrothermal alteration that is manifested in the presence of abundant clay minerals (illite, interlayered illite-smectite, smectite, and chlorite) that have thoroughly replaced phenocrysts and groundmass. Typical alteration zonation consists of an illite-smectite-dominant argillic assemblage of variable intensity nearest to mineralised veins, grading outward into a less-intense propylitic chlorite-calcite-dominated assemblage. Pyrite and quartz are ubiquitous throughout the area and vein calcite, though prevalent in the nearby Martha deposit, is restricted to relatively isolated zones in the Gladstone Hill area.

This thesis aims to quantify alteration intensities, identify alteration zonation, and develop associated geochemical vectors to gold mineralisation that may be used in the Coromandel Group to identify new deposits. Results available to date (visual drill core logs) allow assessment of the precision of visual estimates of alteration intensity. Once lithogeochemical data become available, a more comprehensive assessment of alteration intensity can be undertaken.

Petroleum potential of the Mississippian Banff Formation

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The Mississippian Banff Formation is a carbonate ramp system consisting of carbonate and fine-grained clastic sedimentary rocks. Generally the Banff Formation can be divided into three informal members; the upper and middle carbonate-dominant members and the lower shale member. Detailed study of gamma-ray and sonic logs near the Fort Nelson area (northeastern British Columbia) has enabled subdivisions of carbonate layers within the upper and middle Banff. The five subdivisions were based on gamma-log signatures and are listed as follows; the middle Banff C and E units as well as the upper Banff Markers A and B and the upper Banff Channels.

Two of these five members have good reservoir potential. The Middle Banff C is a nonconventional play interpreted as a shallow, intertidal oolitic grainstone shoal deposit. Porosity levels range from poor to good and are classified as intergranular, forming from dissolution within poorly-connected ooid and pelmatozoan grains. The poor connectivity of these grains results in low permeability values within the Banff C of about 1.10 md. The Upper Banff Channels are also believed to have high reservoir potential as a conventional resource play. These grainstone channels are interpreted as turbidite flows, and have similar attributes to the Yowlumne turbidite deposits in California. Although channel penetrating wells within the study area are limited, the submarine channel deposits with the thickest log responses seem to contain thin net pay intervals. Unrisked reserves evaluations were conducted using SPIES software for both the middle Banff C and the upper Banff Channel reservoirs yielding results of 0.9 and 2.1 BCF OGIP/DSU respectively.

The influence of crustal-scale faults on fluid flow and heat transport

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Crustal-scale faults in the Canadian Cordillera place important controls on fluid flux and the transportation of heat from depth back up to the surface by providing a high permeability conduit to channel fluids. 2D and 3D numerical modeling makes it possible to investigate and simulate the conditions present in these fault zones that may influence the circulation of fluid and heat. By comparing observational data with model output values, it is possible to constrain the parameters present in the subsurface and more accurately predict the distribution of thermal fluids.

The formation and deposition of fluid muds on the Louisiana continental shelf

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The purpose of this work is to identify sedimentary processes that govern formation and deposition of fluid muds on the western Louisiana continental shelf. According to published literature, fluid mud is established when cohesive fine-grained sediments are suspended and transported near the bed in concentrations greater than 10g/l. The conditions

that allow for the formation of fluid mud typically involve a high sediment supply, and trapping of that sediment near a boundary, such as a shoreline. On the Chenier Plain, near the western edge of the Mississippi Delta (Louisiana, USA, and the location of this proposed study), the exact mechanisms and environmental conditions that combine to create conditions ideal for fluid mud formation and accretion remain poorly understood.

A number of studies on the Chenier Plain and other locations worldwide have been conducted to better understand fluid mud dynamics and deposition. In 1989 the AmasSeds project (A Multi-disciplinary Amazon Shelf SEDiment Study) identified fluid mud deposition along the inner and mid-shelf near the Amazon River. During this study, peak deposition rates were related to river discharge. Mud transport seemingly occurred near-bottom rather than at surface. During the later STRATAFORM program, on the Eel River, many of the processes observed were similar to those on the Amazon shelf. It was noted that dense mud flows remained close to the sea bed and that accumulation was related to high sediment discharge and intense wave re-suspensions.

For this study, geological and oceanographic data were collected during three cruises on the Louisiana shelf in February-April of 2007. Data collection has been organized into time series observations, coinciding with different phases of river discharge. During each of these cruises, core samples were retrieved from the seabed along transects perpendicular to the shoreline. From each core, samples for X-radiography and sediment analyses were taken. The X-radiography trays were scanned for density analysis and then X-rayed for stratigraphic interpretation. Sediment samples are being analyzed for grain size and Beryillium-7 content, to relate sediment deposition patterns to patterns of wave action and river flow. It is anticipated that the results of this work will provide some new insights into sedimentary and oceanographic processes governing fluid-mud dynamics.

The origin of glass-coated crustal xenoliths from the Rockeskyllerkopf Volcanic complex, West Eifel, Germany

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The Rockeskyllerkopf volcano in the Quaternary West Eifel Volcanic field is composed of maar, spatter and scoria deposits, and lava flows that erupted at various stages throughout the volcano's history. The xenoliths that occur in the silica-undersaturated nephelinitic and tephritic lavas are clinopyroxenite + peridotite, as well as Devonian sedimentary and lower crustal rocks.

The quartz-rich Devonian sedimentary xenoliths are divided into two categories. The first includes unaltered xenoliths that occur in maar and poorly welded scoria deposits. The second includes glass-coated xenoliths that are found in welded bomb-rich deposits related to a feeder dyke that once it broke through the surface formed a fire fountain-type eruption.

The glass-coated xenoliths range from 1 cm up to 10 cm in diameter. The majority are rounded with some having folded on themselves. The colour of the glass coating varies from green to brown, and is on average less then a millimeter thick, except where the xenoliths are folded, or have drips at their base. In this case the glass coating can be up to 3 mm thick. Scanning electron microscope images show that the xenoliths can be divided into three zones. The first is the glass-coating that contains partly dissolved rounded quartz crystals and quench crystals of alkali feldspar and a few vesicles. The second zone contains more rounded quartz grains and vesicles with less glass. The third and innermost zone is made up of angular to subrounded quartz grains and broken down biotite grains that formed glass + oxides ± alkali feldspar ± cordierite. This zone contains the most vesicles of the three and the least glass. Veins are present in several samples, they run through zones two and three, and they appear to be the source of the glass in the outermost zone.

The glass coating is interpreted to have formed by the breakdown of biotite and reaction of the melt with the quartz grains in the xenolith. This was tested by experiments on similar Devonian sedimentary rock. The rock was heated in a furnace to temperatures between 1001°C and 1276°C for up to 180 minutes. The textures and mineralogy are similar to those observed in the samples from the volcano, supporting the hypothesis for the petrogenesis of these samples.

Comparative analysis of analogue modelling results and seismic profile data from the slope diapiric subprovince II and III of the Scotia margin

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Recent petroleum exploration on the Scotia margin has yielded poor results as new wells drilled into the shallow-water shelf and along the deep-water continental slope struck no economic hydrocarbon deposits. This lack of recent exploration success is likely not indicative of hydrocarbon deficiency, but rather shows that better understanding of the Scotia margin's geological complexity and basin structural evolution is required for future successful exploration. To further our understanding of the Scotia margin, we carried out a comparative analysis

of analogue modeling results and seismic data from the slope diapiric subprovince II and III. Our goal was three fold: to develop a digital seismic database of offshore Nova Scotia at Dalhousie University; to reinterpret available seismic data from the targeted area for future petroleum system modeling and comparison with existing analogue models; and to provide guidance for future analogue experiments simulating the tectono-sedimentary processes in the study area.

We created initial Dalhousie University digital database of high-quality seismic data from offshore Nova Scotia that includes GXT NovaSPAN and Lithoprobe profiles. Four 2D seismic lines from the GXT NovaSPAN survey and one 2D Lithoprobe line were carefully reinterpreted, including picks depicting stratigraphic boundaries and outlines of all salt structures present. A 3D scaled analogue model with a symmetric rift graben structure and thick salt (~2 km when scaled) representing a possible Triassic basement configuration in the Scotia Basin was structurally analyzed and retrodeformed. Salt structures identified in the analogue model were compared to those in the seismic images. Structural restorations of the analogue model through time constrained the evolution of the salt deformation structures and provided insight on the formation mechanism of salt structures within the Scotia Basin. The simplified analogue model setup of the Scotia Basin developed similar salt structures as seen in seismic images, showing that analogue models can provide useful insight into the evolution of passive margin salt basins. Many salt structures were correlated between the model and the seismic images including allochtonous canopy systems and salt nappes, welds resulting from salt withdrawal both in the basement and canopies, and passive diapirs of varying width particularly in the slope regions. Nevertheless, further joint analysis of other Dalhousie Salt Dynamics Group analogue models and available seismic data is necessary for detailed guidance of future analogue experiments.

Inversion of regional gravity and magnetic data from Voisey's Bay

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The purpose of this study is to investigate the regional geology of the main ore bodies over the Voisey's Bay Nickel-Copper-Cobalt deposit in Labrador, Canada. Techniques employed include 3-D inversion of gravity and magnetic data as the primary tool to study the regional geology of Voisey's Bay ore bodies. The deposit is contained in the Nain Plutonic Suite, which is composed of granitic, anorthositic, ferrodioritic, and troctolitic intrusions. The purpose of this study is to interpret magnetic and gravity data to investigate the regional structural geology to aid in the geological model of the formation of the Voisey's Bay ore bodies and to further aid exploration for other ore bodies in the region. By creating shaded relief maps and inverting potential field data from magnetic and gravity data, coupled with limited prior knowledge of the geology of the area, it will be possible to create a geological model of the area in question.

The gravity and magnetic data was collected at Voisey's Bay during ground and airborne surveys. Traditional interpretation techniques will be employed, such as filtering, to investigate regional trends, then 3-D inversion to provide a 3-D model of the sub-surface. Shaded relief map showing the ground magnetic and gravity data can also be created. Inversion programs will be used to create models of the subsurface from this data, where because of the nonuniqueness of potential fields, some information of the surrounding geology can be used to create an appropriate model with more meaningful geological results.

Quantification of subsurface heat storage in the GCM ECHO-g: effects of shallow bottom boundary placement

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Recent studies indicate that shallow bottom boundary conditions (BBCs) used in state-of-the-art GCMs impose an artificial limit to the amount of heat that can be absorbed by the subsurface. Since this is an important issue for determining the energy partitioning among climate model subsystems. To better quantify this effect, the energy accumulation from the ECHO-g soil model is compared to the energy accumulation in a finite difference land-surface model (FDLSM) driven by the ECHO-g based IPCC A2 and B2 future climate simulation. The FDLSM is run with a BBC at the same depth as the ECHO-g soil model (10 m) to verify that the soil models are thermodynamically equivalent. A run with a deep, causally detached BBC is also carried out. Results show that the deep FDLSM run captures several times more energy than the ECHO-g soil model for the time period 1991-2100 CE. The spatial distribution of the FDLSM enhanced heat storage is described. These results suggest that shallow BBCs in GCMs prevent large amounts of heat from being stored in the subsurface and that this effect could be relevant in simulations of future climate change.

Testing the utility of trace element geochemistry of apatite as a petrogenetic indicator

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Apatite, formula $CaPO_4$(F, Cl, OH), is the most common of the phosphate minerals. It is a common accessory mineral in

many igneous and metamorphic rocks. In addition, the structure of apatite allows for a wide range of substitutions, notably of measurable quantities of REEs, U, Y, Sr, Mg, Na, and Mn. Its common occurrence and potential for high variability of trace element chemistry make apatite a good candidate for use as a sensitive petrogenetic indicator.

In order to assess the usefulness of trace elements in apatite as an indicator of petrogenesis, a study of trace element geochemistry of apatite grains from spatially related but lithologically or stratigraphically distinct rocks will be undertaken. The study will consist of three main points: 1) assess the intra-sample variation in trace element chemistry exhibited by samples of apatite standards from Sludyanka, Durango, Kola and others; 2) from felsic tuff horizons from the Dolomites of Northern Italy, assess the variation in trace element chemistry of apatites within each horizon, then assess the variation between separate horizons; determine whether trace element chemistry of apatite can be used to correlate these tuffs between locales; and 3) from the Lyon Mountain gneiss from the Adirondacks, determine if there is a relationship between trace element chemistry of apatite and location within specific zones of alteration or mineralization.

This study will employ CL, BSE, EPMA and LA ICPMS analyses. From the samples to be studied, apatite grains will be picked and mounted in epoxy. A CL map of the mount will be made. BSE photographs of all grains to be analyzed will be taken. The EPMA will be used to measure F, Cl, Mn, P, Ca, Fe, Mg, and Sr. Then the LA ICPMS will be used to measure trace element chemistry. The Ca concentrations derived from the EPMA will be used as an internal standard, to normalize the LA ICPMS counts to concentrations.

Two datasets will be incorporated into this project. Earlier apatite analyses performed by John M. Hanchar in 2002, using the methodology described above, will form the dataset for interpretation of the Italian felsic tuff horizons, and part of the dataset for investigation of variation in the recognized apatite standards. A second dataset will be collected during the Fall of 2007, from apatites from the Lyon Mountain gneiss as well as the Sludyanka standard.

Interpretation of the data will involve constructing plots and performing statistical analysis. X-Y variation diagrams and REE chondrite-normalized plots will be constructed. Type plots discussed in academic literature will be constructed and assessed. Statistical analysis will be employed to quantify the variation observed in trace element concentrations, and to determine if the degree of variation is statistically meaningful.

The final aims of the project are to determine if trace element chemistry of apatite can be used as an indicator of petrogenesis, and if so, what are the best trace element comparisons for distinguishing different suites of apatite. If the results are positive, it could be a powerful tool in the determination of petrogenesis, with applications in stratigraphic correlation and modeling of ore-forming processes.

Geologic, petrologic, and metamorphic history of western Algonquin Park: implications for the tectonic evolution of the western Grenville orogen

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The Central Gneiss Belt of the western Grenville orogen, Ontario, has been interpreted to represent the deep levels of ca. 1000 Ma. Himalayan-scale mountain belt. Within this region, different lithotectonic domains, including the Kiosk and Algonquin domains, preserve different structures and metamorphic assemblages formed during ca. 100 million years of convergence. A field study of the poorly explored Kiosk and Northern Algonquin domains yields a better understanding of the tectonic evolution of the Grenville orogen.

Geological reconnaissance in northwestern Algonquin Provincial Park identifies a widespread, straight, and strongly developed L=S fabric in the Kiosk domain which is not found elsewhere within the Central Gneiss Belt. Field relations show this fabric to be one of the earliest Grenvillian fabrics preserved in the Central Gneiss Belt; neighbouring domains, in contrast, preserve highly contorted flow fabrics. Strong northwest-southeast oriented lineations in the Kiosk domain suggest a thrusting direction consistent with previously proposed tectonic models showing northwest-directed emplacement of thrust sheets during the Grenvillian orogeny. Regional high-grade metamorphism resulting in granulite-facies mineral assemblages is, for the most part, preserved in the Kiosk and Algonquin domains with notable retrogression to amphibolite facies occurring along the northern boundary of the Kiosk domain. Lithologically, the study area is characterized by small, highly deformed metaplutonic bodies set in a matrix of quartzofeldspathic and pelitic gneiss; metaplutonic bodies are chiefly garnet-hornblende metamonzonite, garnet metadiorite, and metasyenite in composition.

Combining structural evolution with metamorphic P-T-t data will lead to a better understanding of how the Grenville orogen was assembled.

An investigation of chemical mobility and variability within a metamict zircon from the Georgeville Granite, Nova Scotia, using ToF-SIMS

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Zircon, a mineral known for its chemical durability, is susceptible to chemical change after structural damage caused

by alpha-decay of U and Th. A metamict zircon from the Georgeville Granite, Nova Scotia, was analyzed by Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) to determine trace element variability between altered regions within a single crystal. Quantitative electron microprobe analysis and textural characteristics revealed in backscatter electron images were used to identify four distinct domains, herein designated A, B, C and D. These domains were separately analyzed using an ION-TOF (GmbH) ToF-SIMS IV instrument housed at Surface Science Western, London, Ontario. The ToF-SIMS technique was used because it can: 1) detect trace elements in the ppb level, 2) analyze a small spot size (<1 μm), and 3) measure a wide range of elements at one time. The main drawback of the ToF-SIMS technique is that it is difficult to quantify the results without a proper standard. However, it is ideal for examining micrometer scale trace element variations within a single zircon crystal such as those in the Georgeville Granite. The analyses indicate that the relative concentrations of most of the trace elements follow the general trend A>B>D. However, Li and K were found to be enriched in domain B and D. Domain C, which has a distinct trace element signature, represents small Th-rich inclusions within domain B. The major and trace element data for domains A, B and C indicate that the magmatic zircon was enriched in high field strength elements (HFSE) such as Ti, Ta, and most REEs. Alteration of this trace element-enriched zircon by hydrothermal fluids resulted in the partial dissolution of domain A and the subsequent precipitation of a trace element depleted zircon at lower temperatures (domains B and D). Some of the trace elements excluded from the reprecipitated zircon were incorporated into Th-silicate inclusions (domain C) that formed within pore spaces in domain B. The variation in trace element content between domains reflects the different conditions of zircon formation and the relative compatibilities of trace elements at these conditions. The observed alteration and chemical mobility of the trace elements within this zircon crystal is especially relevant to durability studies of various wasteforms which are designed to safely store radioactive waste such as weapons grade plutonium.

Improving the efficiency of the Forward Problem Solver for 3D resistivity modeling

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Resistivity imaging is a geophysical method that enables scientists to create computer models of the Earth's subsurface based on calculations of apparent resistivity. Two point electrodes are used to send an artificial current through the ground and voltage is measured at separate points in the vicinity. This measured potential difference, along with the known amount of current injected, is used to calculate the apparent resistivity (or conductivity). When creating a computer model of the Earth based on geophysical data, the "forward problem" and the "inverse problem" are terms applied to the problems being solved to create the model. Typically, the forward problem has to be solved many times by the inverse problem solver, so an efficient algorithm is very important. My honors project will examine and improve upon the current algorithm being used for resistivity survey modeling.

Given an Earth model and a set of measurement locations, the forward problem will find the expected values of the measurements. In the case of a resistivity survey, the earth model is a set of conductance values and the expected values are electric potentials (voltages). To solve this problem, a computer needs to solve a large system of equations in the form of the classic matrix equation: Ax=b, where A is sparse and there are multiple right-hand sides. Because of the sparsity of A, current algorithms solve this problem efficiently using a conjugate gradient algorithm, which provides an iterative solution. However, since there are multiple right-hand sides it would be even more efficient to solve this problem with a direct solver.

I will investigate recently developed solvers, such as those published as part of the PARDISO[1] project, which are efficient for sparse systems that have multiple right-hand sides. This will enable me to find a more efficient algorithm for modeling a resistivity survey. Once I have completed a mathematical analysis proving correctness, I will examine its efficiency with consideration of time and space complexity. I will also implement the algorithm and experimentally test its relative effectiveness.

1. *http://www.pardiso-project.org/index.html*

The Antalya Basin- a study of the sedimentation and structural development in an active convergent plate margin

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The Antalya Basin is situated in the eastern Mediterranean Sea and is bounded by the southern coast of Turkey, the Florence Rise, and the island of Cyprus. The Florence Rise is part of the Cyprus Arc, which is an active convergent plate margin formed by the collision of the African Plate and Aegean-Anatolian Microplate. The purpose of this project is to interpret approximately 200 km of multi-channel seismic reflection data that run across the Antalya Basin which is essentially a deep water sedimentary basin in the fore-arc region of the plate margin. Ultimately the goal is to develop a stronger understanding of the active deformation of the fore-arc region. There are many challenges in collecting, processing, and interpreting the Eastern Mediterranean data. The interpretation will also include the imaging and understanding of salt mobilisation

during basin development, as the salt layers formed during the Messinian play a dominant role in the structural evolution of the Antalya Basin.

The data used in this project consists of 200 km of multichannel seismic data collected in 2001 by a Memorial University research team. The specific lines in this project have been selected so that they complete a section of previously processed and interpreted seismic lines from the same 2001 data set. This reflection data will be analyzed by incorporating a variety of techniques by using the Halliburton Landmark Graphics packages; ProMAX will be used for the processing and the final images will be interpreted using SeisWorks.

The primary goal is to study the relationship of the sedimentation and structure throughout the evolution of a modern fore-arc basin in a convergent plate margin setting; where the convergence vector is rotating relative to the plate boundary. This will require comparing the various pre-arc basins which lie at different locations along the arc from the area of perpendicular convergence, which is this project area, to the area of transform faulting at the eastern end of the Cyprus Arc.

Geology and structural relationships of the Windy-McKinley and Yukon-Tanana terrane boundary, western Yukon

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The northwestern Cordillera of North America comprises several tectonic terranes, defined on the basis of age, lithology, and metamorphic history. Two of these are the Windy-McKinley and Yukon-Tanana terranes, which have an inferred boundary in western Yukon near the Alaska border, approximately located between UTM coordinates 501554, 6941448 and 502122, 6940121. Despite the importance of this boundary to regional tectonic history, no extensive work has been undertaken in the area, primarily as a result of the limited outcrop, and therefore none of the structural relationships are known. The objective of this project is to establish the detailed architecture across the proposed terrane boundary utilizing the few, but good exposures that transect it. The methodology comprises detailed structural and lithological mapping in conjunction with geochronology. The completed mapping shows two distinct lithological packages which is the basis for the current placement of the terrane boundary. The "Yukon-Tanana" units consist of a mafic and ultramafic package with some marble, whereas the "Windy-McKinley" side of the boundary consists of porphyry, a metasedimentary unit, carbonate, and quartz-mica schist. The deformation geometry is fairly consistent in both packages. F_1 and F_2 folding generations are nearly coaxial to each other and trending northwest-southeast. S_1 and S_2 commonly cannot be distinguished from each other on the regional scale and form a composite foliation.

Transposition through isoclinal folding occurs for both generations. F_1 and F_2 fold axes form a small circle around the F_3 axis, which has a general orientation of 22° 211° and is defined by crenulations as well as open folds. S_3 foliation is rare, and where found is a discrete, spaced cleavage. Preliminary microstructural work shows development of complex tectono-metamorphic fabrics that correlate with the macroscopic field observations.

Phosphate deposits in Cambrian rocks of Avalonia in the Saint John, New Brunswick Area: insight into Paleozoic life?

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Unusual black sandstone beds of Cambrian age (~530 to 511 Ma) occur in the Saint John area of southern New Brunswick. These beds are located in the Saint John Group and occur in the upper part of the Glen Falls Formation and the lower part of the overlying Hanford Brook Formation. The dark color of these beds has been attributed to the presence of phosphate minerals and iron chlorite. The presence of phosphorous, an essential nutrient for life, is important in these rocks as they span the time of the early evolution of life. The research of this project focuses on mineralogy, origin, and depositional environment of the black sandstones, as well as their disputed stratigraphic relationships with the overlying and underlying rocks, and the phosphorous cycling that took place during deposition that may have influenced the early evolution of life. No study prior to this has conducted the correlation between the evolution of life in the Saint John group and the appearance of phosphorite.

Phosphorite is defined as a marine sedimentary rock with equal to or greater than 18% P_2O_5. The sedimentary phosphate mineral is francolite, $(Ca_5(PO_4,CO_3)_3F)$. The origin of phosphorite involves phosphorous in particulate organic matter being transferred to sediment, followed by diagenetic degradation and dissolved inorganic phosphorous being released from the organic matter to sedimentary pore waters, causing the precipitation of francolite. This produces phosphorite hardgrounds, as well as individual grains or concretions that become reworked, forming concentrated phosphorite beds. The phosphorite that occurs in the Glen Falls and Hanford Brook formations was probably linked to the sea-level rise at the Cambrian-Precambrian boundary and iron-redox. These events would have allowed for more phosphorous to be available for life forms.

Fifty-two samples were collected from outcrops in and around the Saint John area and stratigraphic sections were logged for each location. The stratigraphic sections are being compared for lateral and stratigraphic variations. Thin sections of samples have been cut and examined for petrographic features using both petrographic and scanning electron microscopy to aid in determining paragenesis. SEM-EDS was used to determine the composition of the phosphorite. Five samples were sent to the Queen's Facility for Isotopic Research where stable isotope compositions for carbon (^{13}C) and oxygen (^{18}O) can be determined through ICP-MS, giving redox potential and temperature of precipitation, respectively. Future work includes further examination of polished thin sections under the scanning electron microscope as well as cathode luminescence to determine paragenesis.

Controls on barium concentration in groundwater

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Groundwaters of the Winnipeg Formation have been found to have barium concentrations in excess of drinking groundwater guidelines over an area of several hundred square kilometers. Water samples are at or near barite saturation; however, sulfate concentrations are exceedingly low. This inequality suggests that either the barium is from a source other than barite or that sulfate is being lost from the groundwater, allowing for a buildup of barium in solution. Sources and controls on barium concentrations are examined in this study.