Atlantic Geology

Atlantic Universities Geological Conference 20: Abstracts (October 23-25, 20)

Volume 44, 2008

URI : https://id.erudit.org/iderudit/ageo44abs03

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Éditeur(s)

Atlantic Geoscience Society

ISSN

0843-5561 (imprimé)
1718-7885 (numérique)

Découvrir la revue

Citer ce document

(2008). Atlantic Universities Geological Conference 20: Abstracts (October 23-25, 20). *Atlantic Geology*, *44*, 141–145.

Atlantic Universities Geological Conference 2008

ABSTRACTS

October 23–25, 2008

CONFERENCE HOSTED BY:
THE BAILEY GEOLOGICAL SOCIETY, UNIVERSITY OF NEW BRUNSWICK,
FREDERICTON, NEW BRUNSWICK

Abstracts from the annual Atlantic Universities Geological Conference (AUGC) are published in Atlantic Geology. Such publication provides a permanent record of the abstracts, and also focuses attention on the excellent quality of the oral presentations and posters at AUGC, and the interesting and varied geoscience that they cover.

THE EDITORS

Atlantic Geology 44, 141–145 (2008)
0843-5561|08|01141–5$1.75|0

Petrology of cuttings from oil wells in the Phetchabun basin, Thailand

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The Phetchabun Basin in central Thailand is one of many Tertiary intermontane basins developed in Southeast Asia in response to the collision of India and. Asia. Wells in the basin produce oil from fractured igneous layers in Oligocene to Pliocene lacustrine sedimentary rocks. This study is part of a larger project to investigate the nature of these igneous bodies, and to determine whether they are intrusive or extrusive, and how they correlate throughout the basin. It focuses on two wells (L44G and L44G-D1) drilled north and east of the current oil-producing areas. Cuttings samples have been obtained from depths between 340 m and 1025 m where igneous units are present. Petrographic study of the samples shows that the host rocks are wacke and laminated siltstone, and that the igneous units are mainly intrusive, except for one amygdaloidal basalt flow. The sedimentary rocks display recrystallized textures and spotting in the vicinity of intrusive units as a result of contact metamorphism. During drilling, a variety of materials including crushed limestone, soda ash (trona), and vegetation such as corn cobs were introduced into the wells to try to prevent oil and water from leaking into fractures. The presence of these foreign materials, including marine fossils such as bryozoans, makes the petrographic work challenging. Preliminary results of this study indicate that the intrusions in the wells are anorthositic and leucogabbroic, in contrast to the more normal gabbroic intrusions in the Na Sanum area to the south and Wichian Buri area to the west. However, based on published reports, similar intrusions may be present in the Bo Rang well to the north.

Provenance of ophiolite to arc transition in the peri-Laurentian realm, central Newfoundland Appalachians

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The Newfoundland Appalachians are a Palaeozoic accretionary orogen. The formation of the Newfoundland Appalachians began with destruction of the Iapetus ocean. The orogen formed by the progressive eastward accretion of arcs and continental fragments to the continent of Laurentia. The closure of the Iapetus Ocean led to the development of the Red Indian Line (CRIL), a major crustal-scale fault, that trends northeast through the Dunnage Zone. The RIL is a major suture zone in the Newfoundland Appalachians because it separates rocks formed on the Laurentian side of the Iapetus ocean from rocks formed on the Gondwanan side. The RIL divides the Dunnage zone into two subzones; Laurentian elements lie to the west of the RIL in the peri-Laurentian Notre Dame subzone, and Gondwanan elements lie to the east in the peri-Gondwanan Exploits subzone.

Samples of a polymictic volcanogenic breccia-conglomerate unit were collected in the Wiley's Brook Area, along the Red Indian Line, in the peri-Laurentian realm of the central Newfoundland Appalachians. The area consists of various island arc and backarc basin complexes. The samples were collected by the Geological Survey of Canada (GSC) through the Targeted Geoscience Initiative (TGI-3) program. The breccia-conglomerate unit locally overlies tholeiitic pillow basalts typical of the Skidder formation and tholeiitic pillow basalts of the Harbour Round formation, and, is also locally overlain by calc-alkaline basalts of the Harbour Round formation. The Skidder and Harbour Round formations are both part of the peri-Laurentian Red Indian Lake Group.

The objective of this project is to identify the sources of the clasts from the breccia-conglomerate unit, and determine the tectonic environment of deposition. Clasts from the breccia-conglomerate unit were selected and analysed for greatest variety on the basis of visual petrography. Twenty-three clasts were analysed by ICP and will be compared to the regional geochemical database to determine the source. U-Pb dating of a sample of zircon grains taken from the clasts and matrix will help to identify the age of clast sources and the maximum age of deposition. Zircon grains were analysed for volcanic ages on the basis of morphology. The youngest population identified will represent the maximum age of deposition of the unit. Provenance of the clasts may help to determine the stratigraphic position of the breccias-conglomerate unit.

Hafnium isotopes as a geochemical tracer in zircon from tonalite plutons from Adamello, northern Italy

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Due to its similarity to Zr in ionic radius, tetravalent charge, and electronic configuration, Hf may substitute in the zircon crystal structure in concentrations up to several weight percent HfO_2. This high concentration of Hf may be used as an isotopic tracer, which in this study will be determined in situ by LA-MC-ICPMS, to better understand the petrogenesis of igneous intrusive suites. This can be done because hafnium is a high field-strength element, relatively immobile, with a low diffusion rate, and as such preserves isotopic information incorporated at the time the zircon crystallized. When incorporated into the crystal structure of zircon, the Hf composition will remain relatively consetant even when exposed to post-emplacement processes such as metamorphism, deformation, and alteration. The rocks that make up the Adamello Batholith in northern Italy have been essentially undisturbed since their post-Alpine Orogeny emplacement, making this region an ideal natural laboratory for studying magmatic pro-

cesses. The geochemical attributes of Hf isotopes in the zircon crystals may provide insights into the magmatic history and emplacement of poly-intrusive tonalitic and related rocks of the Adamello Batholith.

Zircon samples from six tonalitic plutons (one sample per pluton) from the Adamello Batholith were previously dated using secondary ion mass spectrometry (SIMS). The SIMS analyses produced U-Th-Pb zircon rim ages ranging from ~43 Ma to ~33 Ma for samples from southwest to northeast, respectively, across the batholith. Although results from the SIMS analysis agree with geochronological results, zircon grains in some of the samples contain inherited cores (ranging from ~200–2500 Ma which are some of the oldest geological objects thus reported in the Eastern Alps). Furthermore, the SIMS U-Th-Pb results indicated that several individual zircon crystals have varying ages for rims and cores. Three types of core-rim age variations were identified: (1) rims and cores of statistically similar age; (2) rims with slightly older cores; and (3) young rims with significantly older inherited cores. This study is subdivided into three parts, each answering a very specific question regarding age differences of the zircon grains:

1. Determine whether there is a systematic variation in εHf values for the rims of zircons from oldest to youngest plutons. Epsilon hafnium for these plutons may give insight into the origin, evolution, and/or magmatic relationship between the plutonic events.
2. For zircons that show age variations, investigate if there is compositional change of Hf isotopic composition in the rims and cores of these grains and if so, establish a unifying explanation for why this is so.
3. The third question to be addressed is why some zircons show core inheritance (i.e., young rim-very old core) and the nature of the inheritance whereas other zircon crystals from the same rock do not. Using Hf isotope data, it is believed that a concrete explanation will be established.

Chloride in kimberlites? Constraints from diamond oxidation experiments

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Kimberlites are the surface expression of deep-seated magmas derived from the subcontinental mantle. They intrude Precambrian cratons, forming pipe-shaped discordant structures, and erupt explosively at the surface forming pyroclastic deposits and craters. Kimberlites are often classified as ultramafic and alkaline rocks, but their primary composition is poorly constrained due to extensive contamination and secondary alteration. Volatile loss during eruption further compromises the record of volatile species. It is critical to improve constraints on kimberlite composition before we can understand its genesis and make inferences about processes in the mantle source.

A variety of methods are applied to ascertain the fluid composition of kimberlites, including fluid inclusion studies, infrared spectroscopy of olivine, and diamond surface features. Studies of fluid inclusions in a Canadian coated diamond showed high concentrations of Cl (26.6 ± 5.1 wt%). Additionally, high Cl content in a melt inclusion from olivine (18.5 wt%) and groundmass minerals (≥ 8 wt%) in the exceptionally fresh Udachnaya-East kimberlite (Siberia) imply high Cl^- content in kimberlitic melts and fluids. However, studies of diamond surfaces and olivine infrared spectra suggest H_2O-rich kimberlitic fluid compositions. Furthermore, Cl^--bearing minerals are not typically abundant in kimberlites, perhaps due to secondary Cl^- dissolution.

Natural diamond surfaces show a wide variety of different surface forms produced by fluid oxidation during magma ascent. Surface features are fluid composition-dependent, at least in the H_2O-CO_2 system. Hence, establishment of diamond surface forms produced by Cl^--bearing fluids will help further constrain kimberlitic fluid composition. To this end we explore diamond oxidation in the H_2O-Cl^- and CO_2-Cl^- systems at 1300 °C and 1 GPa in the piston-cylinder apparatus. Preliminary results show characteristic forms produced in NaCl-H_2O and KCl-H_2O compositions. Following completion of additional experiments, we will compare our results to diamonds from Lac de Gras kimberlites to constrain fluid composition in these kimberlites.

Character of the mafic trigger of the Kos Plateau Tuff eruption

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The Kos Plateau Tuff (KPT) eruption at 161 ka was the largest explosive Quaternary eruption in the eastern Mediterranean. There has been a discovery of an uplifted beach deposit of abraded pumice cobbles directly overlain by tuff that records the earliest phase of the KPT eruption. The pumice cobbles contain inclusions of basaltic andesite showing chilled lobate margins suggesting co-existence of two magmas. The basaltic andesite is more primitive than any other mafic rock known from the Kos-Nisyros volcanic centre and contains phenocrysts of Fo_{90} olivine, enstatite, and diopside. Groundmass amphibole suggests availability of water in the final stages of magma evolution. The abundant basaltic andesite was presumably the mafic trigger for the KPT eruption.

Host lithologies and ore characterization of the Dumont Sill, Quebec

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The Dumont Sill is a komatiitic Archean copper nickel ore body hosted in a large layered ultramafic sill. This sill is located 25 km west of Amos in the Abitibi greenstone belt of Quebec. The sill is completely owned by the Royal Nickel Corporation (RNC) and their property covers 4,080 hectares. The Dumont Sill is 7.5 km long and averages 700 m thick. The sill itself is thought to contain 5.1 billion tones of nickel (0.25% cutoff). The nickel mineralization is concentrated in the dunite unit. In 1987 platinum was discovered in the eastern sill through a drill program.

The dunite is variably mineralized with pentlandite, heazlewoodite, and awaruite containing nickel and chalcopyrite containing copper. This project is hoping to gain more insight into which lithologies host the different types of ore, as there were two major phases of ore generation: primary magmatic sulphides and secondary ore formed during serpentinization. This project will also try to determine which minerals host the platinum group elements and their concentrations.

This project will use approximately 30 of the samples collected in the summer of 2008 by Dr. E. Burden and possibly some PGE samples supplied by the RNC. Nine field samples from the north section of the sill represent six field stations and thirteen samples from the south of the deposit represent twelve field stations. An additional two samples were taken from a diabase to the south of the sill and five samples were taken from a mafic to ultramafic section to the west of the main deposit; this section appears to be parallel in strike. These samples will be analyzed using a petrographic microscope with polished thin sections and by using a scanning electron microscope, mineral liberation analyzer (SEM-MLA). There will also be access to whole-rock lithogeochemical data for samples collected on and around the Dumont Sill.

By using microscopy, geochemical analysis, and advanced imaging techniques it is hoped that more will be learned about the host lithologies of the Dumont Sill and the character of the ore mineralization.

Mineralogical controls on the distribution of platinum-group elements and gold in the Afton porphyry deposits, Kamloops, British Columbia

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The Afton Cu-Au porphyry system is an unusual alkalic-type porphyry deposit that is highly enriched in the platinum-group elements (PGE) Pd and Pt. The deposit is located 10 km west of Kamloops, B.C., within the Upper Triassic Nicola volcanic group and the associated dioritic to syenitic Iron Mask Batholith. The deposit contains economic amounts of Pd. However, one of the key problems is that, until now, it was believed that the PGE were associated with Cu and Au in the deposit. Consequently, some important mineralogical hosts for discrete PGE phases (pyrite and silicates) were being discarded. The present study is the first attempt to identify the most important mineral carriers for Pd and Pt, the timing of their formation, and their bearing on the overall distribution of Pd and Pt at the deposit scale. This information will lead to a conclusion about the difficulty or ease of extracting the Pd from the bulk ore. Bulk rock analyses show that Cu and Au show no correlation with PGE abundance. The best positive correlations that the PGE show in bulk rock analyses are with Ni and Hg. Inverse correlations between the PGE and Ba, Ti, U, Th, Tl, and Li were also observed. Thus far, quantitative analysis by SEM-EDS has been conducted on a sample of mounted heavy mineral separates from a high grade (>1 ppm Pd) core sample in the deposit, as well as 3 thin sections from 3 different core samples containing very high concentrations of Pd (up to 5 ppm Pd). So far, the SEM-EDS work has identified four platinum-group minerals hosted in both sulphide phases (pyrite and chalcopyrite) as well as alteration silicates: naldretteite (6 grains; Pd_2Sb), isomerteite and mercurian isomerteite (2 grains; $Pd_{11}Sb_2As_2$ or $Pd_{11}[Sb, As, Hg]_4$), mertieite-II (1 grain; $Pd_8[Sb,As]_3$), and kotulskite (1 grain; PdTe). These minerals are associated with the accessory phases electrum (avg. of 62 grains: $Au_{62}Ag_{38}$) gersdorffite (NiAsS), bromargyrite (AgBr), muthmanite (AuAgTe), and REE-rich monazite (avg. La = 6.6 wt%, Ce = 13.1 wt%; Nd = 4.7 wt%). Future work will attempt to constrain the processes that led to Pd introduction into the ore-forming system using the mineralogical and bulk chemical data combined with careful petrographic analysis of the alteration and sulphide assemblages that host the Pd carriers.

The occurrence and significance of quartzine in open spaces in a basaltic flow: Dunn Point Formation, Nova Scotia.

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Irregularly rounded masses of microcrystalline silica were discovered within a large narrow cavity (40 cm in length) in a basaltic flow within the ca. 460 Ma Dunn Point Formation, Arisaig, Nova Scotia. X-ray powder diffraction patterns indicate that the rounded masses consist of low quartz (var. chalcedony) with no trace of the polymorph moganite or opal-CT. This exceptional mineral occurrence offers an opportunity to examine the products of late geothermal fluids and provides insights into the nature and thermal history of the fluid responsible for chalcedony precipitation in the Dunn Point Formation. The chalcedony has a waxy luster, is milky white in colour,

and forms a nearly continuous layer (1 to 3 cm thick) on the walls of the cavity. Observation of thin sections cut perpendicular to the walls of the cavity indicates that the chalcedony comprises two textural types: a fine grained (100 to 400 μm) plumose aggregate and spherulitic masses composed of fibers up to 1 cm in length that overgrow the finer grained material. Individual fibers are elongate parallel to [0001] indicating that the chalcedony is a relatively rare variety known as quartzine. A dark green rind (2 to 3 mm thick) at the contact between the basalt and quartzine is composed almost entirely of crystals of magnetite surrounded by radial aggregates of chamosite.

Quartzine is indicative of precipitation from silica-rich alkaline fluids. The alkaline nature of the late-stage fluids in the Dunn Point Formation is supported by the occurrence of analcime in other nearby cavities in the basalts. The aqueous silica activities for chalcedony as a function of temperature have been calculated using SUPCRT92 software. These data can be combined with geothermometric measurements obtained from chamosite and fluid inclusions to constrain the silica activity in the precursor fluid. The observed textures and environment of deposition indicate two stages of deposition of silica from a highly supersaturated fluid phase in response to pressure release.

Seismic and core stratigraphy of a glaciated lake, Dartmouth Nova Scotia

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Preliminary interpretations of high-resolution seismic data (10 kHz profiler) and six sediment cores (maximum 1.2 m), collected in 2007–2008 from Lake Banook in Dartmouth Nova Scotia, are presented, with objectives for future work. In the 12 m thick sediment column, six seismic facies are defined, mainly according to their acoustic character, including till, two glaci-lacustrine (varved?) units, mass failures, and two Holocene units. Lowstands are also identified from unconformities. These units will be further defined by a detailed seismic interpretation and mapping project. The cores are correlated with the seismic units and consist of thinly laminated glacio-lacustrine mud, locally unconformably overlain by a sequence of soft, dark brown post-glacial mud. Paleoclimate analysis using Thecamoebians is planned.

Mineralogical and chemical characteristics of alteration in the Afton copper-gold porphyry, Kamloops, British Columbia

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The Afton Cu-Au porphyry deposit near Kamloops, B.C., contains high concentrations of platinum-group elements (PGE). PGE mineralization occurs in an unusual alteration zone that developed where a picritic subvolcanic intrusion is in contact with a syenite-monzodiorite stock. The samples examined in this study are from the Afton hypogene zone, and were obtained as part of DRC Resources Corporation's deep drilling program that is exploring the economic potential for underground mining beyond the pit. Preliminary petrographic work on thirteen representative thin sections shows that the syenitic host has undergone significant hydrothermal alteration of varying intensity. The reason for the PGE enrichments in the deposit is still unknown, but is believed to be related to emplacement of the ultramafic subvolcanic intrusion. Analysis of normalized trace element concentrations in 12 mineralized samples has revealed anomalous rare-earth element concentrations. Most notable is a steady increase of the elements Dy, Y, Ho, Er, Tm, Yb, and Lu among the samples. Work in progress will determine if REE abundance correlates with alteration intensity and/or PGE grade. Additionally, the correlation of alteration intensity, REE abundance, and PGE grade with distance from the contact between the picrite and syenite-monzodiorite stock may confirm the picrite as the source of the PGE. The goal of this work is to characterize the gangue mineralogy related to the alteration so that it can be used as an exploration guide for PGE mineralization in porphyry deposits.