2014

CORDILLERAN TECTONICS WORKSHOP

HOSTED AT UNIVERSITY OF
BRITISH-COLUMBIA-OKANAGAN

Organizers :
Kyle Larson, UBC-Okanagan
Félix Gervais, Polytechnique Montréal

SCHEDULE OF EVENTS

Friday February 21st

7-10 pm	Registration, ICEBREAKER with appetizers and beer. Administration building Room 115.

Saturday February 22nd

8:00-8:55	Registration, poster set-up outside room EME 050, continental breakfast.
9:00-10:15	Oral presentations in room EME 050 followed by questions-discussion
10:15-11:15	Coffee break, poster session, general discussion over posters
11:15-12:15	Oral presentations followed by questions-discussion
12:15-14:00	Lunch (provided)
14:00-15:00	Oral presentations followed by questions-discussion
15:00-16:00	Coffee and poster session
16:00-18:00	Bar munchies, general discussion over posters/maps/field photos

Sunday February 23rd

8:00-9:00	Registration, continental breakfast
9:00-10:15	Oral presentations in room EME 050 followed by questions-discussion
10:15-10:45	Coffee break, poster session
10:45-12:15	Oral presentations followed by questions-discussion and planning for CTW2015
12:15-14:00	Lunch (provided)

TECHNICAL PROGRAM

Saturday February 22nd

8:55	Opening Remarks
9:00	BLUESCHIST FACIES ROCKS IN THE CANADIAN CORDILLERA: A REVIEW Edward Ghent: *University of Calgary, AB*
9:20	TECTONIC IMPLICATIONS OF OCEANIC ASSEMBLAGES FOUND IN SOUTHWEST YUKON Steve Israel[1], Donald C. Murphy[1] and Monica P. Escayola[2] *[1]Yukon Geological Survey; YT [2] Universidad de Buenos Aires, ARG*
9:40	STRUCTURAL AND TECTONIC CONTROL ON MINERALIZATION BY MAGNETITE-DESTRUCTIVE FAULTS IN WESTERN YUKON AND EASTERN ALASKA [1]Matías G. Sánchez, Murray M. Allan, Craig J.R. Hart, Jim K. Mortensen *[1]Mineral Deposit Research Unit, UBC*
10:00	DISCUSSION
10:15	Coffee break, poster session, general discussion over posters
11:15	A POSSIBLE ANCIENT OCEAN CORE COMPLEX IN THE NORTHERN CACHE CREEK TERRANE, BRITISH COLUMBIA AND YUKON? Alexandre Zagorevski; *Geological Survey of Canada, ON*
11:35	"THE SOUTHEAST ZONE (CU-MO) AND DEERHORN (CU-AU) PORPHYRIES; A GENETIC RELATIONSHIP BETWEEN A CALC-ALKALIC AND AN ALKALIC DEPOSIT, WOODJAM PROPERTY, CENTRAL BRITISH COLUMBIA" Irene del Real[1], F. Bouzari, C.J.R. Hart, J.L. Blackwell, A. Rainbow, R. Sherlock *[1]Mineral Deposit Research Unit, UBC, BC*
11:55	Discussion
12:15	Lunch (provided)
14:00	TECTONIC EVOLUTION OF THE CHUGACH-PRINCE WILLIAM TERRANE, ALASKA: CONSTRAINTS FROM SEWARD AND BARANOF ISLAND Garver[1], J.I., Davidson[2], C.M., Frett[2], B.K., Kaminski[1], K., Rick[2], B.J., Riehl[1], M., Roig[3], C.I., and Wackett[4], A.A. *[1]Carleton College, MN; [2]Union College, NY; [3] University of Puerto Rico, Puerto Rico; [4]Trinity University, TX*
14:20	NEW CONSTRAINTS ON THE NATURE AND CORRELATION OF LATE PALEOZOIC - EARLY MESOZOIC ACCRETED TERRANES IN THE NORTHERN U.S. CORDILLERA Mark Schmitz[1], Bryant Ware[1], Kyle Tumpane[1], Gene Kurz[1], C.J. Northrup[1] *Boise State University, ID*

14:40	AN EOCENE TRIGGER FOR EXTENSIVE FELSIC MAGMATISM IN THE CANADIAN CORDILLERA Esther Bordet[1], Mitchell G. Mihalynuk and Craig J.R. Hart *[1]Mineral Deposit Research Unit, UBC, BC*
15:00	Discussion
15:20	Coffee break, poster session
16:00	Bar service and appetizers, poster/maps/field photos session, general discussion over posters

Sunday February 23nd

9:00	DETRITAL ZIRCONS FROM BONNETIA REVEAL A 1.68 – 1.78 GA LOCAL SOURCE OF SEDIMENT IN NORTHWESTERN LAURENTIA [1]Verbaas, J., Nielsen, A., Thorkelson, D.J., Furlanetto, F. Crowley, J., and Gibson, H.D. *Simon Fraser University, BC.*
9:20	STRATIGRAPHIC RELATIONSHIPS BETWEEN THE WINDERMERE SUPERGROUP AND HYLAND GROUP IN THE RACKLA BELT OF EAST-CENTRAL YUKON: IMPLICATIONS FOR THE AGE OF SELWYN BASIN AND FORMATION OF THE LAURENTIAN PASSIVE MARGIN David Moynihan[1], Maurice Colpron[1], Justin Strauss[2], Steve Israel[1] and Grant Abbott[1]: *[1]Yukon Geological Survey,YT; [2]Harvard University, MA*
10:00	Discussion
10:15	Coffee break, poster session
10:45	TRACKING BASEMENT CROSS-STRIKE DISCONTINUITIES BENEATH AN OROGENIC SYSTEM USING GRAVITY DATA LAURENT GODIN[1] & LYAL B. HARRIS[2] *[1] Queen's University, ON; [2] Institut national de la recherche scientifique, QC*
11 :05	PROGRADE AND RETROGRADE ZIRCON GROWTH IN HIGH-PRESSURE MIGMATITIC PELITIC SCHIST OF THE MONASHEE COMPLEX: ASSESSMENT OF THE TI-IN-ZIRCON THERMOMETER Félix Gervais[1] and Jim Crowley[2] *[1]Polytechnique Montreal, QC; [2]Boise State University, ID*
11 :25	Discussion and planning for CTW-2015
12 :00	Lunch (provided)

POSTERS (from Friday 21st to Sunday 23rd)

Tectonometamorphic Discontinuties in the exhumed Himalayan mid-crust
Tyler Ambrose[1], Kyle Larson[1], Carl Guilmette[2] and Heather Buckingham[1]
University of British Columbia, Okanagan, BC; [2]University of Waterloo, ON

Update of the Yukon bedrock geology map
Maurice Colpron; *Yukon Geological Survey, YT*

New constraints on deposition age and provenance of the Monashee cover sequence, southern Canadian Cordillera
Crowley, J.L.[1], Gibson, D.[2], Scammell, R.[3]
[1]Boise State Univ., ID; [2]Simon Fraser Univ., BC; [3]Apache Corp., AB

Geochronology of the Exshaw Formation: correlation with the Hangenberg extinction event
Josh Ekhoff[1], Kathleen Bundy[1], Mark Schmitz[1], Vladimir Davydov[1]
[1]Boise State University , ID

Pluton crystallization and petrogenesis in the Eastern Hindu Kush, NW Pakistan
Shah Faisal[1,2*], Kyle P. Larson[1]
[1] University of British Columbia, Okanagan, [2]National Centre of Excellence in Geology, University of Peshawar, Pakistan

New CA-ID-TIMS maximum age for the 'Sturtian' glaciogenic Pocatello Formation, southeastern Idaho
Vincent Isakson[1], Mark Schmitz, Francis Macdonald, Carol Dehler and Adolph Yonkee
[1]Boise State University, ID

Exhumation of the Chugach-Prince William terrane, Baranof Island, SE Alaska
Kaminski[1], K., Riehl[1], M., Garver[1], J.I., and Davidson[2], C.M.,
[1]Union College; NY; [2]Carleton College, MN

Microscale Strain Partitioning and Differential Quartz Lattice Preferred Orientation Development
Kyle P. Larson[1], Jaida Lamming[2], Shah Faisal[1]
[1] University of British Columbia, Okanagan,BC; [2] University of Saskatchewan, SK

Structural and stratigraphic control of porphyry and related mineralization in the Treaty Glacier – KSM – Brucejack – Stewart trend of western Stikinia
JoAnne Nelson[1] and Jeff Kyba
BC Geolgical Survey

U/PB DATING OF DETRITAL ZIRCON FROM SEWARD TO BARANOF ISLAND PROVIDES DEPOSITIONAL LINKS ACROSS THE CHUGACH-PRINCE WILLIAM TERRANE IN SOUTHEASTERN ALASKA

Rick[1], B.J., Frett[1], B.K., Davidson[1], C.M., and Garver[2], J.I.
[1]Carleton College; MN; [2] Union College, NY

GEOLOGY OF THE DAWSON RANGE AREA OF WESTERN YUKON: A MASKED STRUCTURAL BOUNDARY BETWEEN YUKON TANANA TERRANE AND PARATHOCHTONOUS NA

Jim Ryan, Alex Zagorevski, Nancy Joyce, Charlie Roots, Nathan Hayward, John Chapman
Geological Survey of Canada

UNRAVELLING THE GEOLOGICAL EVOLUTION OF THE RUDDOCK CREEK ZINC-LEAD DEPOSIT: DETAILED MAPPING, STRUCTURAL, PETROLOGICAL AND GEOCHRONOLOGICAL ANALYSES WITHIN THE NORTHERN MONASHEE MOUNTAINS, BRITISH COLUMBIA

Lucia Theny
Simon Fraser University, BC

GEOCHEMISTRY AND GEOCHRONOLOGY OF THE CRAWFISH INLET PLUTON, BARANOF ISLAND, ALASKA

Wackett[1], A.A., Smith[1], D.R., Roig[2], C.I., Cavosie[2], A.J., Davidson[3], C.M., Garver[4], J.I., Valley, J.W.[5]
[1]Trinity University; TX; [2] University of Puerto Rico, PR; [3] Carleton College, MN; [4]Union College, NY [5] Univ. of Wisconsin, WI

CONSTRAINTS ON MAGMATISM AND DEFORMATION IN THE SOUTHERN KOOTENAY ARC: INSIGHT FROM U-PB GEOCHRONOLOGY

Ewan R. Webster[1] and David R.M. Pattison[1]
University of Calgary, AB

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ABSTRACT

(in alphabetical order by first author)

TECTONOMETAMORPHIC DISCONTINUITIES IN THE EXHUMED HIMALAYAN MID-CRUST

Tyler Ambrose[1], Kyle Larson[1], Carl Guilmette[2] and Heather Buckingham[1]
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The Himalayan Metamorphic Core (HMC) is a package of low to high grade metamorphic rock that was buried to mid-crustal levels and subsequently exhumed during the Himalayan orogenesis. Although pressure-temperature-time-deformation discontinuities within the HMC have been identified along the length the orogen, little is known about what exactly they represent (i.e. a thrust-sense fault or a normal-sense fault), when they developed, and their importance to the evolution of the orogen. This study integrates mineral chemistry, phase equilibria modelling, microstructural analyses and geochronology of samples collected across a previously recognized discontinuity in the Kanchenjunga region of far northeastern Nepal. Characterizing such discontinuities within the HMC will allow insight into the processes fundamental to the construction and evolution of the Himalayan mid-crust. Moreover, the advancements made through discoveries in the Himalaya will yield models that can be applied to ancient orogens around the world.

AN EOCENE TRIGGER FOR EXTENSIVE FELSIC MAGMATISM IN THE CANADIAN CORDILLERA

Esther Bordet[1], Mitchell G. Mihalynuk and Craig J.R. Hart
[1]Mineral Deposit Research Unit, UBC, BC

Rapid onset of synchronous, voluminous Eocene volcanism along the North American Cordillera formed a belt up to 500 km wide that extended from present-day southwest Yukon to Idaho. A trigger mechanism of plate tectonic-scale is required, rather than typical continental arc magmatism. Eocene volcanic successions, including those of the dominantly felsic Ootsa Lake Group (OLG) in central BC, were erupted ~200-500 km from the active margin during less than ~10 Myr, and shut down almost as abruptly as they started, along a continental margin that was under extension.

A recently developed plate tectonic model for western North America derived from seismic tomography (Sigloch and Mihalynuk 2013) images a "slab gap" bounded by vertical, sinking slab walls, that formed beneath south-central BC during the Eocene, starting ~55 Ma. Lateral extents of the slab gap approximately correspond to the distribution of the OLG. OLG volcanism was triggered by the cessation of subduction and slab breakoff, which resulted in the influx and juxtapostion of hot asthenospheric mantle against relatively cold, metasomatized mantle wedge. The mantle wedge was forced across a growing slab gap as North America moved westward in advance of the spreading Atlantic, and the detached subducted oceanic lithosphere sank vertically. This likely generated an immediate magmatic response, until thermal reequilibration of the sublithospheric mantle wedge was attained within ~10 Myr (Van de Zedde and Wortel 2001).

Induced melting of the metasomatized asthenospheric mantle wedge resulted in the transfer of heat and magma across the lithosphere. Ponding/intrusion of basaltic melts into the lower crust may have assimilated and thermally weakened it, facilitating extension. Thus, the "volcanic arc" signature of OLG lavas may have been partly inherited from previously formed arc crust (i.e. with supra-subduction zone geochemistry). Extensional deformation generated magma pathways, and extensional basins contributed to the preservation of volcanic deposits erupting above those pathways. Synchronous extension and volcanism favoured effusive outpourings of felsic lavas, rather than voluminous rhyolitic ignimbrites that would tend to form on previously extended crust (Axen et al. 1993).

Previous attempts to explain the widespread Eocene volcanic pulse along the North American Cordillera involved the formation of “slab windows” during the continuous subduction of spreading oceanic ridge(s) beneath the active margin (e.g., Thorkelson and Taylor 1989; Breitsprecher et al. 2003; Haeussler et al. 2003; Madsen et al. 2006). However, the location of subducted ridges is unconstrained because the oceanic crust that would have recorded their passage has been consumed. The proposed slab gap model offers a simpler geometric solution, and is supported by the configuration of relict slabs in the upper mantle. Both types of discontinuities, slab gap and slab window, may trigger widespread and voluminous Eocene volcanism, but their geometries result from different tectonic settings and evolution of the Cordillera.

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Breitsprecher, K., Thorkelson, D.J., Groome, W.G., and Dostal, J. 2003. Geochemical confirmation of the Kula-Farallon slab window in the Pacific Northwest. Geology, 31(4): 351–354.

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Van de Zedde, D.M.A., and Wortel, M.J.R. 2001. Shallow slab detachment as a transient source of heat at midlithospheric depths. Tectonics, 20(6): 868–882.

UPDATE OF THE YUKON BEDROCK GEOLOGY MAP

Maurice Colpron,
Yukon Geological Survey, YT

In the 15 years since the first release of the Yukon Digital Geology (Gordey and Makepeace, 1999, 2001), approximately 25% of the territory has been subject to more detailed bedrock mapping. Major collaborative initiatives such as the Ancient Pacific Margin NATMAP, the Targeted Geoscience Initiatives, and more recently the Geomapping for Energy and Minerals programs of the GSC have added to ongoing detailed mapping efforts by the YGS and resulted in significant improvements to our general understanding of Yukon geology. In order to capture this advance in understanding, the Yukon Geological Survey has begun the process of updating the Yukon Digital Geology with the objective of releasing an updated bedrock geology compilation in 2014. Incremental updates of the GIS dataset are being released as they are completed on the YGS website (www.geology.gov.yk.ca). By the time of the workshop, much of the southern half of Yukon will have been updated; the part of the territory that has seen most of the new detailed mapping. A preliminary version of this map will be displayed next to the original compilation by Gordey and Makepeace (2001) in order to show improvements in the geology.

This update of the Yukon bedrock geology map goes beyond just compiling new bedrock maps. As part of this update, YGS has completely overhauled the geodatabase structure behind the map. This new structure builds on the one developed by Gordey and Makepeace (1999), but expands the stratigraphic and chronostratigraphic attributions in order to facilitate searching of its more than 30,000 polygons. In addition, this restructuring of the digital map will make future updates much easier, such that we hope to integrate future bedrock maps into the Yukon compilation soon after publication. These regular updates will be distributed via the YGS MapMaker Online and the Yukon bedrock geology map will essentially become a “live” map. This update of the Yukon bedrock geology also constitutes the YGS contribution to the GSC-led tri-territorial compilation.

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Gordey, S.P. and Makepeace, A.J., 1999. Yukon digital geology. Geological Survey of Canada, Open File D3826, *also Yukon Geological Survey, Open File 1999-1(D).*

Gordey, S.P. and Makepeace, A.J., 2001. Bedrock geology, Yukon Territory. Geological Survey of Canada, Open File 3754, 1:1 000 000; *also Yukon Geological Survey, Open File 2001-1.*

NEW CONSTRAINTS ON DEPOSITION AGE AND PROVENANCE OF THE MONASHEE COVER SEQUENCE, SOUTHERN CANADIAN CORDILLERA

Crowley, J.L.[1], Gibson, D.[2], Scammell, R.[3]
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The first comprehensive detrital zircon study in the Monashee cover sequence, a seemingly rare succession of metasedimentary rocks that was deposited on 2.1-1.8 Ga basement along the western margin of Laurentia, provides new constraints on deposition age and provenance. Prior age constraints on most of the sequence are equivocal or lacking due to severe Cordilleran tectonism that obliterated sedimentary and volcanic features. Detrital zircon dates and chemistry were obtained from eleven samples from the northern flank of Frenchman Cap dome, where the cover sequence is best preserved and most studied. The sequence is divided into three parts: the "lower part" is mainly quartzite and pelitic schist, the thin "middle part" has marker horizons including carbonatite and Pb-Zn layers, and the "upper part" is similar to the lower, but with more mafic volcanic protoliths.

As expected, 2.6 and 1.9-1.7 Ga zircon comprises the majority of most samples, and some have 1.4-1.0 Ga zircon; these age spectra are Laurentian signatures. Other results are more interesting. Quartzite immediately above basement contains 1.4-1.0 Ga zircon, and thus was not deposited at 1.8 Ga as previously thought. Two samples contain a few percent of 780 Ma zircon that has chemistry and zoning suggestive of an intermediate plutonic source. One sample is in the lower part of the sequence that was intruded by 725 Ma syenitic gneiss, requiring deposition between 780 and 725 Ma. Zircon of 780 Ma age is sparse in western Laurentia, having only been found in a few Neoproterozoic rocks in the western U.S. Provenance is unknown, but we speculate that our 780 Ma zircon may be related to the Gunbarrel mafic dyke swarm; this can be tested by high-precision dating. Several samples in the upper part of the sequence contain 550 Ma zircon, including metaconglomerate with volcanic clasts, which supports previous studies that show the upper part of the sequence is Cambrian or Devonian. The 550 Ma zircon has chemistry suggestive of mafic sources, likely formed during rifting of the Laurentian margin. These age constraints show that just a few hundred metres of the cover sequence could have been deposited at between 730 and 550 Ma. This is the time of deposition of most of the Windermere Supergroup that is up to 9 km thick where it lies immediately above the cover sequence in the hanging wall of the Monashee décollement, an east-directed thrust-sense shear zone. The lack of Windermere in the Monashee cover sequence can be explained in one or more ways: (i) the cover sequence was deposited on the eastern margin of the Windermere basin, then during Cordilleran tectonism the basin was thrusted ca. 150 km northeastward over the cover sequence on the Monashee décollement; (ii) Monashee basement was a structural high during Windermere deposition; and (iii) structural omission during Cordilleran tectonism.

"THE SOUTHEAST ZONE (CU-MO) AND DEERHORN (CU-AU) PORPHYRIES; A GENETIC RELATIONSHIP BETWEEN A CALC-ALKALIC AND AN ALKALIC DEPOSIT, WOODJAM PROPERTY, CENTRAL BRITISH COLUMBIA"

I. del Real[1], F. Bouzari, C.J.R. Hart, J.L. Blackwell, A. Rainbow, R. Sherlock
[1]*Mineral Deposit Research Unit, UBC, BC*

Porphyry Cu±Mo±Au deposits in the Canadian Cordillera are divisable into a pre- to syn- and post-accretion classification. The pre- to syn-accretion porphyry deposits are Late Triassic to Middle Jurassic (216 to 183 Ma) and occur in the Quesnel and Stikine terranes in British Columbia. They are sub-divided into calc-alkalic and alkalic types on the basis of their host rock chemistry and alteration-mineralization styles (McMillan et al., 1995; Lang et al., 1995). These deposits formed during temporally restricted time intervals, some of which may have been controlled by specific tectonic events, possibly genetically linked to subduction-related tectonics processes in discrete island arcs (McMillan et al., 1995). Although the precise tectonic environments of formation are uncertain in many cases, porphyry mineralization is clearly directly associated with specific phases of distinctive intrusive suites that were emplaced during brief time intervals.

The Woodjam district hosts porphyry deposits of Late Triassic to Middle Jurassic age (216 to 183 Ma) in the Quesnel Terrane in central BC. The district hosts several discrete porphyry deposits including the Megabuck (Cu-Au), Deerhorn (Cu-Au), Takom (Cu-Au), Southeast Zone (Cu-Mo) and the recently discovered Three Firs (Cu-Au). These deposits display various styles and assemblages of alteration and mineralization. Whereas the Southeast Zone is has characteristics similar to calc-alkalic porphyry deposits, the nearby Deerhorn is mainly similar to alkalic porphyry intrusions. These differences have resulted in the separation of the Southeast Zone (SEZ) from the Megabuck and Deerhorn deposits as a different mineralization event (Logan et al., 2011). However, similar ages of the host rocks (196.35 ± 0.19 Ma for Deerhorn and 197.48 ± 0.44 Ma for SEZ; Rainbow et al., 2013) and characteristics of alteration and mineralization suggest that deposits within the Woodjam district may be genetically related.

Recent exploration at the Deerhorn Cu-Au deposit has shown two contrasting alteration assemblages of K-feldspar + magnetite, typical of alkalic systems, and illite (± tourmaline) and Mo mineralization typical of calc-alkalic system. The SEZ, located less than 4 km from the Deerhorn deposit, displays some features not typical of calc-alkalic deposits, such as infrequent quartz veining. These observations suggest that temporal and paragenetic relationships between the two deposits may exist, thus providing a unique opportunity to study the relationship between alkalic and calc-alkalic deposits in BC.

The Southeast Zone (SEZ) deposit is hosted in texturally variable quartz monzonite intrusives (Fine, medium and coarse grained) and a K-feldspar porphyry that are inferred to be part of the Takomkane batholith. Alteration is zoned from a K-silicate in the center, which becomes weaker towards the margins and is laterally surrounded by albite alteration at the margins of the deposit, both alterations are overprinted by Chlorite ± epidote ± pyrite and illite alteration (del Real et al., 2012). The Deerhorn deposit is hosted in a series of narrow (<100m) monzonite bodies that have "pencil" geometries and intrude the volcano-sedimentary rocks of the Nicola Group. Alteration is characterized by intense K-silicate in Monzonite A and adjacent volcaniclastics. Monzonite D cuts Monzonite A and displays moderate to weak K-silicate alteration (del Real et al., 2012)

Whole rock geochemistry analysis is being developed currently in order to characterize the host rocks and comprehend the magmatic evolution of the deposits. Preliminary results shows the same geochemical signature for the medium, course and K-spar porphyry in the SEZ, but not for the fine-grained quartz monzonite, which shows a geochemical signature similar to the one observed in Monzonites A and D at the Deerhorn deposit. All intrusive bodies from the SEZ and Deerhorn deposit show depletions in heavy rare earth elements (HREE); this feature is characteristic of calc-alkaline porphyry deposits such as those observed in northern Chile, Arizona or northern Argentina (Richards, 2001). The depletion of HREE might be due to partial melting processes or fractional crystallization of hornblende, titanite, and/or garnet from hydrous magmas due to slab melting in a convergent margin (Richards and Kerrich, 2007), this characteristic of HREE has not been previously recognized in alkaline porphyry deposits in BC.

The whole rock geochemistry characteristics of both deposits point to a calc-alkalic formation environment, but the “pencil” shape intrusive host rock lacking modal quartz observed in the host rocks at Deerhorn is consistent with characteristics of Cu-Au alkalic porphyry systems (Holliday et al., 2002). Therefore, the porphyry copper environment at Woodjam might have been transitional between alkalic to calc alkalic suggesting that SEZ and Deerhorn deposits are genetically related.

Lang et al., 1995 proposed that alkalic magmatism in Quesnelia and Stikinia terranes can be attributed to arc (or interarc) collision events and the cessation of active subduction (i.e., McInnes and Cameron, 1994). This style of magmatism associated with many copper-gold porphyry deposits in the Canadian Cordillera fall in the age range of 210 Ma to 200 Ma, spanning the Triassic/Jurassic boundary (Mortensen et al., 1995). The transitional stage observed in the Woodjam property could represent the starting or ending stage of the tectonic setting proposed by Lang et al., 1995. Future work in the emplacement settings of the Takomkane Batholith will help understand the relationship between the SEZ and Deerhorn deposits.

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GEOCHRONOLOGY OF THE EXSHAW FORMATION: CORRELATION WITH THE HANGENBERG EXTINCTION EVENT

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The Hangenberg mass-extinction event occurred at or just before the boundary between the Devonian and Carboniferous Periods, and is recognized by the common occurrence of black shales associated with marine anoxic environments (Caplan and Bustin, 1999). Biostratigraphy and radiometric dating have been used to globally correlate these end-Devonian black shales; however, much of the biostratigraphic record is sparse and past radiometric ages have not had the resolution necessary to provide clear insight into the causes of the Hangenberg event (Kaufmann, 2006). Here we apply high precision CA-TIMS U-Pb zircon dating methods to volcanic tuffs collected from four locations in the Exshaw Formation (Richards et al., 2002), along the eastern of edge of the Western Cordillera in Alberta, Canada, and compare these results to high-precision ages for the Hangenberg Event (359.3 ± 0.1 Ma) in the type sections of the Rhenish Mountains of Germany.

The Exshaw Formation is divided into lower black shale and upper silty carbonate members; the exact location of the Hangenberg event within the Exshaw is unknown due to the sparse fossil occurrence. Two correlated tuffs exposed in the Jura Creek and Mt. Rundle (Goat Creek) sections, near the main depocenter of the basin, have been dated to 360.0 ± 0.1 Ma. A second overlying tuff at Mt. Rundle dated at 360.4 ± 0.1 Ma constrains the position of the Hangenberg event to the upper portion of the lower black shale member of the Exshaw Formation. Zircon dates of 362.7 ± 0.1 Ma and 363.0 ± 0.1 Ma from the Nordegg and Crowsnest sections, respectively, are significantly older than the Hangenberg Event. These new zircon ages confirm and clarify the presence of unconformities in the these locales, and show that either: a) sustained black shale sedimentation began earlier in the Western Canadian Sedimentary Basin compared to correlative strata in Europe; or b), the Exshaw Formation contains stacked, unconformity bounded discrete black shales that correlate with the Dasberg and Hangenberg events (House, 2002).

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PLUTON CRYSTALLIZATION AND PETROGENESIS IN THE EASTERN HINDU KUSH, NW PAKISTAN

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Laser ablation multicollector inductively coupled plasma-mass spectrometer U-(Th)/Pb geochronology on zircon and monazite was employed to constrain the crystallization ages of plutonic bodies in the Eastern Hindu Kush, NW Pakistan. These new ages have been combined with geochemical analysis to provide insight into the evolution of igneous systematics along the southern margin of Eurasia. Our new age data from the Kafiristan, Tirich Mir, Buni-Zom and Garam Chasma plutonic bodies outline a protracted magmatic history of the area that spans from the Cambrian to the Paleogene (509 ± 3 to 23.70 ± 0.25 Ma). The plutons record a variety of petrogenetic associations variably influenced by within plate, volcanic arc (subduction) and collision tectonic environments recording a prolonged pre-Himalayan orogenic events in the Hindu Kush followed by continued convergence after India-Eurasia collision.

The early plutonism (509 ± 3 Ma) in the eastern Hindu Kush is recorded in the Kafiristan pluton with major and trace element chemistries and rare earth element signatures that are consistent with a crustal source with some mantle-derived contamination, emplaced within plate during post-orogenic extensional environment. The Tirich Mir pluton yields a crystallization age of 126 ± 1 Ma and has geochemical signatures of both S and I-type sources. It likely originated in a compressional continental arc setting associated with subduction under the southern margin of Eurasia. The middle Cretaceous (107 ± 0.43 Ma) Buni-Zom plutonic has a geochemistry characteristic of an I-type source and a subduction related tectonic environment. The Early Miocene (23.70 ± 0.25 Ma) Garam Chasma plutonic body is a S-type body with a geochemical similarity to plutonic bodies generated through crustal thickening in a collisional tectonic regime. The generation of this pluton coincides with widespread melting across the Himalayan arc due to the continued collision between India and Eurasia.

TECTONIC EVOLUTION OF THE CHUGACH-PRINCE WILLIAM TERRANE, ALASKA: CONSTRAINTS FROM SEWARD AND BARANOF ISLAND

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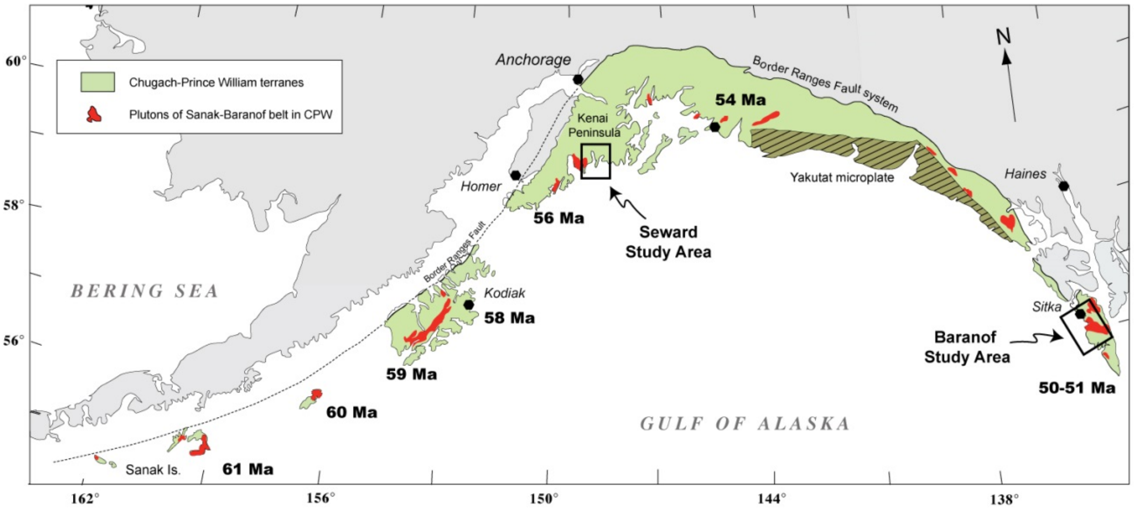
The Chugach-Prince William (CPW) terrane in southern and southeast Alaska is mainly composed of thick imbricated flysch (most are Maastrichtian to Paleocene) intruded by diachronous near-trench plutons of the Sanak-Baranof belt (Paleocene to Eocene). The sequence is interpreted to represent a thick accretionary complex where turbidites from an adjacent arc and metaplutonuc basement were deposited, accreted, buried, and then intruded by plutons over a short period of time. Our research team has been focused on scientific problems that surround the provenance and age of the flysch (Rick et al., this volume), the burial, metamorphic, and cooling history (Kaminski et al., this volume), and the nature of near-trench plutons (Wackett et al., this volume).



The flysch is very thick and compositionally uniform, and volume estimates of several million km^3 suggest that it was fed by a single evolving deeply exhumed source terrain. All sandstones in the belt are dominated by detrital zircons that are close to the age of deposition, and hence it is clear that that source region supported an active and long-lived volcanic arc. The metaplutonic basement that supported this arc is mainly made of rocks that produce Mesozoic zircon (mainly Jurassic), with a minor fraction of Paleozoic (mainly Devonian) and Precambrian grains. Our work builds on a number of previous studies that suggests the most likely candidate source is the Coast Mountains Orogen, which currently represents the spine of the BC Coast Range. Thus a small amount of translation is required to restore it to be adjacent to its likely source.

The Sanak-Baranof belt (SBB) is a series of mainly granodiorite plutons that intrude the CPW along the 2000 km long belt. The oldest plutons are in the west (61-62 Ma on Sanak and the Shumagin Islands) and the youngest plutons are in the east (47-53 Ma on Baranof Island). It has long been inferred that these plutons represent near-trench intrusions related to slab window effects caused by ridge-trench interaction. It has been assumed in the literature that that the adjacent ridge that drove this plutonism was a major plate boundary in the Pacific, and it was either the Pacific-

Kula or the Pacific-Resurrection ridge. The latter boundary requires consideration of a new oceanic plate in the NE pacific, which is not represented by marine magnetic anomalies and would have been wholly subducted by now.

Slabs of ocean crust as tectonic slices in the CPW may represent this offshore ridge. Near Seward Alaska (close to the center of the belt), the CPW terrane has two large ophiolite complexes, the Resurrection Peninsula and Knight Island ophiolites, which have been structurally incorporated into the imbricated flysch. The upper stratigraphy of both ophiolites is distinctive because the pillow basalts are interbedded with clastic sediment that is now thought to be identical to the flysch of the CPW, thus the process that resulted in ophiolite creation must have occurred where turbidites were deposited. The provenance of this interbedded and overlying flysch provides a critical constraint on the age of the ophiolites and the source area that was nearby.

Controversy exists where accretion and intrusion occurred along the North American margin: in one option the accretion and plutonism occurred in the north (Alaska-BC) in relatively close proximity to the present location, and in another option it occurred to the south (BC-WA and all points south) and strike-slip faulting and margin-parallel translation is required to bring these rocks to the north.

Major questions addressed by detrital zircon U/Pb dating are focused on basic questions of the age of the flysch, continuity of accreted belts in the flysch, and the nature of the source rocks revealed in older zircon. Our recent work shows that the clastic cover to the Resurrection ophiolite in the Seward area is definitively Paleocene (~57-60 Ma or younger) and thus allied with the Orca Group, and not the older Valdez Group. On Baranof Island, new detrital zircon dates indicate that what is traditionally viewed as the Baranof Schist appears to be largely Paleocene in age, and not Cretaceous (young belt is 64 to 60 Ma or younger) (see Rick et al., this volume). These findings have important implications as to the timing of deposition, accretion, and intrusion between ~60 and 50 Ma.

The belt has a distinctive thermal history and almost all rocks of the CPW experienced prehnite-pumpellyite or higher metamorphism soon after deposition and accretion. Cooling following this thermal event is mainly about 50 Ma in the western part of the belt, but younger in the east. This cooling pattern is likely related to strike-slip deformation and local plutonism that affects rocks in Prince William Sound and to the east, but not rocks to the west. ZFT dates from the CPW rocks on Baranof Island are relatively uniform and mainly between 30 and 40 Ma, which may indicate detachment and exhumation as strike-slip faults reworked the outer BC margin in the mid Tertiary (Kaminski et al., this volume).

The plutons of the Sanak-Baranof belt punctuate the tectonic processes that built the CPW wedge. The easternmost part of the CPW is intruded by the Crawfish Inlet and allied plutons on Baranof Island. New U/Pb dates across the Crawfish pluton, geochemistry, and oxygen isotopes suggest a more protracted history of intrusion (47-53 Ma) that was driven by at least two distinct types of mantle melts mixing with sedimentary material most likely derived from the accretionary wedge (Wackett et al., this volume).

The history of the CPW undoubtedly involves margin-parallel translation, but the amount of displacement is controversial. In some scenarios, displacements of 1000 km or less are entertained based mainly on potential geologic ties; however, displacement of nearly 3000 km are required if paleomagnetic data and key geological observations are considered. Hence in our analysis of the CPW and SBB plutons we are focused on building an integrated geologic history along the belt where robust data sets can be used to constrain or refute mutually exclusive hypotheses on the origin and original disposition of these rocks.

PROGRADE AND RETROGRADE ZIRCON GROWTH IN HIGH-PRESSURE MIGMATITIC PELITIC SCHIST OF THE MONASHEE COMPLEX: ASSESSMENT OF THE TI-IN-ZIRCON THERMOMETER

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U-Pb ages and trace elements acquired simultaneously on zircon grains from a migmatitic pelitic-schist, collected in the northern part of the Frenchman Cap dome in the Monashee Complex (SE Canadian Cordillera), were linked with results of phase equilibria modeling. Three phases of zircon growth were documented. The first occurred at c. 72 Ma as the rock crossed the muscovite dehydration-melting in the kyanite field at temperatures > 725°C on its prograde path. It produced zircon with a shallow positive slope in high rare-earth elements (HREE) and a moderate Eu anomaly. The second occurred at c. 67 Ma as the rock crossed the biotite dehydration-melting that formed garnet and rutile at temperatures of 800-875°C. It produced zircon depleted in HREE and without Eu anomaly. The third took place at c. 62 Ma as the rock crossed back the latter reaction on the retrograde path and thus consumed garnet and rutile at temperatures > 800°C. It produced zircon similar to the first generation, but also enriched in Nb and Ta released during rutile breakdown. In contrast with the high temperature of zircon growth documented above, Ti-in zircon thermometry yields unrealistically low temperatures between 546 and 612°C, and this despite excellent analytical conditions and without uncertainties in buffering assemblage (rutile and quartz were present throughout). This study, therefore, demonstrate that zircon growth along a prograde path is possible and, moreover, highlights the needs to use extreme caution when interpreting results of zircon thermometry in metamorphic rocks.

BLUESCHIST FACIES ROCKS IN THE CANADIAN CORDILLERA: A REVIEW

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Blueschist facies rocks are considered to be of tectonic importance; they are indicators of subduction-related metamorphism at plate margins. They have also been used to determine the polarity of subduction and are used to set estimates on geothermal gradients attending the metamorphism. These rocks occur at several localities throughout the Canadian Cordillera. These areas include Pinchi Lake, French Range, and the Bridge River complex. Estimation of P-T conditions for blueschist facies rocks is difficult due to the lack of geothermometers and geobarometers. Only limits on P-T conditions can be estimated. These include the equilibria, albite=jadeitic pyroxene + quartz; laumontite=lawsonite + H_2O and calcite = aragonite. Constraints on the P-T trajectory to the surface can be estimated from the survival of metamorphic aragonite, suggesting the temperature never exceeded about 250-350 °C. This suggests a P-T metamorphic gradient of about 10°C km^{-1}. Blueschists at Pinchi Lake are associated with tectonic blocks of eclogite. They contain lawsonite, jadeitic pyroxene +quartz and aragonite. Aragonite occurs in thin marble lenses. Jadeite + quartz replacement of plagioclase in metagreywackes is very similar texturally to that in Franciscan metagreywackes in California. ^{40}Ar/^{39}Ar dates on white micas are 221 to 224 Ma which overlap those in eclogite tectonic blocks. Blueschists from the French Range contain lawsonite and albite, and, with quartz in veins, aegerine-rich clinopyroxene (mole % jadeite=20). Marble lenses contain only calcite suggesting temperatures at ambient pressure were either too high to stabilize aragonite or to preserve aragonite during unroofing. White mica ^{40}Ar/^{39}Ar dates on white micas in the early metamorphic fabric are 174 Ma. Clastics from these rocks are deposited in the early Bajocian (Jurassic) basin at between 171 and 175 Ma. Deformation is constrained by cross-cutting plutons which are at least as old as 172 Ma. This suggests that the blueschist metamorphism and exhumation occurred over <2.5 m.y. Exhumation rates are between 4.4-7.2 mm yr^{-1} (based upon pressures between ~3 to ~4.8 kbar). Blueschists occur in fault-bounded blocks within the Bridge River Complex. Lawsonite and epidote occur with blue amphiboles and clinopyroxene contains up to 55 mol% jadeite. Minimum pressure of metamorphism was about 8 kbar at 200 °C. No aragonite was detected in the metacarbonates. The blueschist metamorphism is dated at 230 Ma. The Bridge River complex contains rocks which are younger than this (middle Late Jurassic) and are as old as Mississippian. The large age range of the complex suggests a long period of subduction and assemblages forming within the accretionary prism and outboard of the subduction zone.

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TRACKING BASEMENT CROSS-STRIKE DISCONTINUITIES BENEATH AN OROGENIC SYSTEM USING GRAVITY DATA

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The internal configuration and processes that govern the rise of orogens such as the Himalayan Mountains and Tibetan Plateau are crucial to understand continental collision zones. However, knowledge of the prior configuration of the colliding plates is equally important, since inherited (pre-orogenic/basement) structures can undeniably influence the development of the orogenic architecture throughout the orogen's cycle of collision and eventual collapse. The Himalaya is the result of the on-going convergence and collision of India and Asia.Three northeast-trending palaeotopographic ridges of faulted Precambrian Indian basement underlie the Ganga basin south of the Himalaya. Our study illustrates a crustal-scale fault origin for these ridges and succeeds in determining how far north beneath the Himalayan system they extend and how they ultimately govern the location of upper crustal faults in southern Tibet. Spectrally filtered EGM2008 Bouguer gravity data and edges in its horizontal gradient at different source depths ('gravity worms') over northern Peninsular India, the Himalaya, and southern Tibet reveal several continuous Himalayan cross-strike discontinuities interpreted to represent crustal faults. Gravity lineaments in Peninsular India coincide with edges of the Precambrian basement ridges and megakinks up to 100 km wide develop in foreland cover sequences between the interpreted basement faults. The interpreted basement faults project northward beneath the Himalayan system and southern Tibet. Our results suggest that several active Himalayan cross-strike faults, such as the ones related to many graben in southern Tibet (Asian plate), are rooted in the underplated Indian lower crust or step en échelon along interpreted basement strike-slip faults. Our interpretation thus suggests that south Tibet graben are spatially related to deep-seated crustal-scale faults rooted in the underplated Indian crust. These major discontinuities have the potential to partition the mountain belt into distinct zones, and could ultimately contribute to lateral variability in tectonic evolution along the orogen's strike.

NEW CA-ID-TIMS MAXIMUM AGE FOR THE ‘STURTIAN’ GLACIOGENIC POCATELLO FORMATION, SOUTHEASTERN IDAHO

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Neoproterozoic glacial successions are recognized worldwide and have been interpreted to record global glaciations as part of the snowball Earth model (e.g., Kirschvink, 1992; Hoffman et al., 1998). A fundamental tenant of the Snowball earth hypothesis is a global synchronicity of glaciogenic deposits. However, the number, timing and ultimate duration of worldwide glacial episodes remain controversial as successions are incomplete and geochronologic constraints are limited.

Glaciogenic strata preserved on multiple continental fragments commonly preserve two stacked sets of diamictite-cap carbonate, indicating at least two periods of glacial deposition (Hoffman et al., 1998). Currently published data establish low latitude Sturtian at ~715-710 Ma (Bowring et al., 2007; Macdonald et al., 2010) and Marinoan at ~640-635 Ma (Hofmann et al., 2004, Condon et al., 2005) glacial events, along with some evidence for a third interval at ~685-655 Ma (Lund et al., 2003; Fanning and Link, 2004). Alternatively, it has been suggested that a long-lived Sturtian glacial epoch existed between ~717-662 Ma followed by a relatively brief interlude before the onset of Marinoan glaciation (Rooney et al., 2014).

The Neoproterozoic rock record of northern Utah and southeastern Idaho provides a thick, well-preserved stratigraphic succession spanning pre-, syn- and post-glacial strata within the Pocatello Formation. Diamictite bearing strata within this formation appear to record two glacial episodes, but lack hard age constraints and their relation to other Neoproterozoic glacial events are uncertain (e.g., Crittenden et al., 1983; Prave, 1999; Lund et al., 2003; Fanning and Link, 2004; Macdonald et al., 2010). Maximum age determination for these diamictite-bearing strata is critical for testing models of Cryogenian glaciation.

We present two new high precision U-Pb chemical abrasion – isotope dilution – thermal ionization mass spectrometry (CA-ID-TIMS) ages of ca. 697 Ma from two rhyolitic, pyroclastic flows directly above the basal Bannock Volcanic member and immediately beneath recognized glaciogenic diamictite strata of the Scout Mountain member within the Pocatello Formation. These dates place upper age constraints on the timing of local ‘Sturtian’ glaciation. This data provides a foundation for further chronostratigraphic studies and may be used to more clearly place the Pocatello Formation in context with other Neoproterozoic glaciation.

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TECTONIC IMPLICATIONS OF OCEANIC ASSEMBLAGES FOUND IN SOUTHWEST YUKON

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Sutures between major tectonic elements in any orogen hold the key to understanding the development of the orogen. Within the North American Cordilleran the location of sutures are easily discernible at the scale of the tectonic assemblage map but are difficult to locate at regional and outcrop scales. To make matters worse, sutures are commonly intruded by igneous rocks, obscured by sedimentary overlap assemblages and/or re-activated along crustal-scale Tertiary structures.

In southwest Yukon, recent mapping has uncovered what may be the remnants of two distinct oceanic assemblages, one of which separated the Intermontane terranes from the ancient Laurentian margin (Slide Mountain terrane) and the other found between the Insular and Intermontane terranes. The Harzburgite Peak-Eikland Mountain oceanic assemblage, comprising chert, argillite and mafic and ultramafic rocks, occurs in a northerly trending belt between rocks of the Selwyn basin assemblage of the Laurentian margin and Yukon-Tanana terrane. Along its western margin (current coordinates), it structurally overlies schist, calc-silicate and metavolcanic rocks of the Upper Devonian Scottie Creek and Triassic(?) Mirror Creek formations of the Selwyn basin assemblage, across a fault and shear zone with west-southwestward vergence. Along its eastern margin, the assemblage structurally overlies rocks of Yukon-Tanana terrane, across a fault of unknown kinematics. We interpret the oceanic assemblage as a portion of the Late Paleozoic Slide Mountain ocean floor/continent-ocean transition zone which was obducted over rocks of the ancient Laurentian margin during the Late Permian-Jurassic accretion and overthrusting of Yukon-Tanana and Slide Mountain terranes onto the Cordilleran margin.

South and east of the Slide Mountain terrane, mafic and ultramafic rocks are found in three spatially separated but possibly correlative occurrences located near the present boundary between the Yukon-Tanana terrane and Insular terranes. The Doghead assemblage, extending northwestwardly from Kluane Lake to the northwest side of the Donjek River on the northeast side of the Denali Fault, occurs primarily as fault-bound bodies of gabbro and ultramafic rock structurally overlying Yukon-Tanana terrane. The southernmost body at Doghead Point on Kluane Lake also structurally overlies the Kluane Schist, a metamorphosed forearc basin assemblage. Extending eastwardly within the Kluane Schist from the Doghead Point body is a discontinuous belt of metre-scale lenses of mafic and ultramafic rock; these lenses are included in the Doghead assemblage, inferred to have been incorporated into the shear zone between the two assemblages. A Latest Triassic and older age of the assemblage is indicated by a U/Pb zircon age from a gabbro pod located within highly deformed harzburgite and dunite at Doghead Point. Preliminary geochemical investigations into the origin of the Doghead assemblage suggest that it is the mafic and ultramafic underpinnings of an intra-oceanic arc. Secondly, the Bear Creek assemblage, also located north of the Denali fault in southwest Yukon but on the other side of the belt of Kluane schist from the Doghead assemblage, is a strongly deformed and metamorphosed sequence of mafic volcanic, ultramafic and lesser metasedimentary rocks of uncertain age. The assemblage is inferred to be structurally overlain on the west by Jura-Cretaceous turbidites of the Dezadeash Formation which depositionally overlies rocks of the Insular terranes (Shakwak suture). Thirdly, the Meade Glacier complex east of Skagway, Alaska comprises an assemblage of undated mafic and ultramafic meta-igneous rocks and Middle to Late Triassic clastic, carbonate and mafic volcanic rocks. The complex is juxtaposed across the Meade Glacier fault with meta-siliciclastic rocks and meta-carbonate in near-physical continuity with those rocks of Yukon-Tanana terrane overthrust by the Doghead assemblage. The lithological similarities, structural positions with respect to Yukon-Tanana terrane and Kluane Schist and ages (where constrained) of these three assemblages are compatible with them being correlative with each other and in turn correlative with the Taku terrane, a package of Late Paleozoic to Triassic mafic volcanic and sedimentary rocks found in southeast Alaska between the Insular and Intermontane terranes.

The boundary between the Insular and Intermontane terranes in southwest Yukon is currently defined by the Denali fault and the Shakwak suture. The Denali cuts across the trends of the Slide Mountain and Doghead-Meade Glacier-Bear Creek assemblages, which converge toward each other between the White and Donjek rivers, as well as the Shakwak suture. As much as 470km of post-Latest Cretaceous right lateral displacement has been proposed for the Denali fault based on the restoration of the MacLaren metamorphic complex-East Susitna batholith with the Kluane Schist-Ruby Range batholith. This restoration places the Insular-Intermontane boundary zone (Shakwak suture) against the Valdez Creek shear zone and the Kluane Schist-Ruby Range batholith-Yukon-Tanana terrane trio against comparable components of the MacLaren Metamorphic Complex and East Susitna batholith. In this particular location, the Insular-Intermontane boundary is not marked by oceanic assemblages as in Yukon; however, these restore further along the Denali across from the Chulitna terrane with a Devonian and older basement of chert, basalt, gabbro and serpentinized ultramafic rocks lithologically similar to Slide Mountain terrane, upper Paleozoic clastic and carbonate rocks and a Triassic volcano-sedimentary succession. Importantly, the Chulitna terrane lies northwest of, and structurally above, a Cretaceous melange unit which lies along the northern boundary of the Insular terrane, possibly continuous with the Valdez Creek shear zone. Similar melange also locally occurs south of rocks of the Laurentian margin on the other side of the Denali fault.

The Denali restoration therefore implies that Laurentia, Slide Mountain and Yukon-Tanana terranes, Kluane Schist and the Late Triassic oceanic terranes (Chulitna, Doghead, Bear Creek, Meade Glacier, Taku) all lay inboard of a Late Cretaceous suture between these terranes and the Insular terrane. In addition, as the Farewell terrane lies to the northwest of the Chulitna terrane, it must also lie on the inboard side of the suture.

The extensive presence of the oceanic assemblages not only in southwest Yukon but in east-central and southeastern Alaska suggests that these assemblages likely represent a major suture between the large composite Insular and Intermontane terranes. It is possible that the two composite terranes were separated by a Triassic intra-oceanic arc that was later obducted onto the Intermontane terranes during the initial accretion of the Insular terranes. Timing of this accretion remains poorly constrained, but had to occur after development of the arc in the Late Triassic and before intrusion of cross-cutting Late Cretaceous igneous bodies. A syn-tectonic ca. 116Ma granitic intrusion found within the Bear Creek assemblage may date the deformation associated with the collision. The presence of Slide Mountain correlative rocks near the outboard margin (present coordinates) of the Intermontane terranes indicates pre-Jurassic structural complexities along the Intermontane/ancestral North America suture. It could be that the present day geometry and spatial location of the Slide Mountain terrane reflects Early Jurassic oroclinal bending or strike-slip duplication of the margin.

EXHUMATION OF THE CHUGACH-PRINCE WILLIAM TERRANE, BARANOF ISLAND, SE ALASKA

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The Chugach-Prince William terrane (CPW) is a forearc accretionary complex in southeastern Alaska composed primarily of Maastrichtian to Paleocene deep-water turbidites and volcaniclastics (Plafker et al., 1994). The easternmost part of the belt is well exposed on Baranof Island, where presumed equivilants are mapped as the Sitka Graywacke and the Baranof Schist, which are separated by plutonic rocks of the Crawfish Inlet pluton. U/Pb ages of detrital zircon constrain the depositional age of the Sitka Graywacke to the Albian and Maastrichtian and this unit experienced prehnite-pumpellyite facies metamorphism (Haeussler et al., 2005). To the south, metasediments of the Baranof Schist are inferred to be the metamorphosed equivilant to the Sitka Graywacke (Loney and others, 1975) and these rocks show regional metamorphism of garnet-biotite grade, and then a local andalusite grade contact metamorphism along the margin of the Crawfish Inlet Pluton. The Sitka Graywacke and Baranof Schist are presumed to have been deposited at approximately the same time, and are perhaps the same rock unit, differing only in metamorphic grade. The Crawfish Pluton has been dated with U-Pb on zircon at 49-51 Ma, only about 10 Myr after deposition of the youngest dated rocks of the Baranof schist. A number of previously published K-Ar and Ar-Ar dates on biotite indicate initial cooling of the pluton occurred at 42-48 Ma (Karl et al., in review). Our work investigates cooling that follows deposition, burial, and intrusion of the Crawfish Inlet pluton.

Zircon fission track cooling ages of the Baranof Schist, the Sitka Graywacke, and the Crawfish Inlet pluton were determined from 14 samples collected from Sitka Sound and Whale Bay on Baranof Island. The results show a remarkable uniformity of cooling in Late Eocene (generally between 32-38 Ma). An important finding is that both the high-grade Baranof Schist and the lower-grade Sitka Graywacke give essentially identical cooling ages in this age range, despite the striking differences in metamorphic grade. Thus these consistent cooling ages across metamorphic grade suggests that rock cooling probably occurred at the same depth and the same rate. Tectonic tilting and exhumation of the high-grade rocks of the Baranof Schist, likely occurred immediately after intrusion of the pluton after 50 Ma, perhaps between 42-48 Ma, as indicated by K-Ar and Ar-Ar dates on biotite. After 42 Ma, both the graywacke and schist cooled uniformly through the Late Eocene, which explains similar cooling ages on either side of the Crawfish Pluton. Cooling in the late Eocene may have been driven by erosional exhumation. Deposition of the upper part of the Kootznahoo Formation (Upper Eocene) has garnet-bearing schist clasts that may represent erosional exhumation of the adjacent Baranof block (Ancuta, 2010). Tilting and cooling of the CPW could be related to strike-slip faulting along the northern Cordilleran margin. The vertical movement related to exhumation of the Baranof Schist might have been driven by a transition to strike-slip deformation, perhaps slip on Border Ranges Fault.

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MICROSCALE STRAIN PARTITIONING AND DIFFERENTIAL QUARTZ LATTICE PREFERRED ORIENTATION DEVELOPMENT

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Micro-spatial quartz c-axis orientation assessment techniques allow the critical assessment of strain partitioning at the thin section scale. A low metamorphic grade quartz-rich specimen from the Chitral region of northwest Pakistan illustrates the potential importance of looking at specimens in such detail. The overall fabric yielded by automated quartz c-axis analysis is consistent with slip along the basal <a> and prism [c] planes. The existence of prism [c] slip, which typically develops during high temperature deformation, in a low grade specimen may be explained by mechanical rotation of small, quartz grains within a mica-rich matrix (e.g. Stallard and Shelly, 1995). The quartz c-axis fabric changes significantly, however, if different grain sizes are separated. The specimen is a quartz-rich phyllite with a few quartz-only lenses. Quartz external to these lenses, disseminated within the phyllite, is typically fine grained (5-15 µm) and forms the dominant c-axis pattern measured as discussed above. The quartz within the lenses comprise two distinct grain sizes: larger grains that average ~ 165 µm and smaller sized grains that average ~80 µm. The two size populations yield different c-axis patterns. The smaller grains within the lenses yield a single girdle dominated by prism <a> and basal <a> slip while the larger grains yield a crossed-girdle pattern with an opening angle that can be used to estimate a deformation temperature of 400 ± 50 ˚C. The difference in patterns and grain size may be reflect a primary, original difference or alternatively it may reflect micro-scale strain partitioning. Quartz grain-size piezometry indicates that the smaller grains would be consistent with a differential stress of 14.4 +3.4/-2.2 MPa while the larger grains would record a differential stress of 8.6 +2.6/-1.5 MPa. Moreover, deformation temperature and differential stress values indicate that the smaller grains may record a strain rate on the order of 10^{-14} to 10^{-15} depending on the calibration used, while the larger grains may record a strain rate on the order of 10^{-16} to 10^{-17}. All of this information and potential evidence of micro-scale strain partitioning extracted from the quartz lenses would have been lost if the bulk fabric from the specimen was taken as representative.

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STRATIGRAPHIC RELATIONSHIPS BETWEEN THE WINDERMERE SUPERGROUP AND HYLAND GROUP IN THE RACKLA BELT OF EAST-CENTRAL YUKON: IMPLICATIONS FOR THE AGE OF SELWYN BASIN AND FORMATION OF THE LAURENTIAN PASSIVE MARGIN

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The northern margin of Selwyn basin is marked by the north-vergent Dawson thrust – a Mesozoic contractional structure that coincides with the position of an antecedent fault that has been periodically active since the Proterozoic. The Dawson thrust separates Neoproterozoic-Cambrian rocks of the Hyland Group (Selwyn basin) from Proterozoic-Paleozoic shelf and slope rocks of the Ogilvie platform (Yukon stable block). However, primary stratigraphic relationships across the basin margin are preserved at the eastern end of the Dawson thrust zone, in an area that is informally known as the Rackla belt.

The Neoproterozoic-early Cambrian Hyland Group, which is the oldest unit in Selwyn basin, includes three formations. The basal Yusezyu Formation comprises a thick sequence of coarse siliciclastic rocks and brown shale. It is overlain by the carbonate Algae Formation, followed by the Narchilla Formation, which is dominated by maroon, green and brown shale. In the Rackla belt, the Algae and Narchilla formations can be traced across and around the eastern end of the Dawson thrust zone, where they overlie the Ediacaran Blueflower Formation of the Windermere Supergroup. This indicates equivalence of the Algae and Narchilla formations (Hyland Group) with the Risky and Ingta formations, which are the youngest units in the Windermere Supergroup. The Blueflower Formation includes a relatively thin (500-600m) upper member that is equivalent with the Yusezyu Formation. The upper Blueflower-Yusezyu clastic wedge thickens into Selwyn basin, where the Yusezyu Formation is estimated to have a stratigraphic thickness of ~ 3km.

The age of the Blueflower Formation is constrained by its position below the Narchilla and Ingta formations, which record the Ediacaran-Cambrian boundary, and by recognition of a large negative carbon isotope anomaly in the underlying Gametrail Formation. $\delta^{13}C_{carb}$ analyses from the Gametrail Formation yield values as low as -13‰ (VPDB) and increase up-section to positive values near the top of the formation. This carbon isotope excursion has been correlated with the global Shuram/Wonoka anomaly, which is documented globally in rocks deposited around 560 Ma. These data indicate deposition of coarse clastic rocks in Selwyn basin during the interval ~560-541 Ma and support a latest Precambrian age for formation of the northern Laurentian passive margin. This is broadly similar to the interpreted age of continental separation in southern British Columbia.

STRUCTURAL AND STRATIGRAPHIC CONTROL OF PORPHYRY AND RELATED MINERALIZATION IN THE TREATY GLACIER – KSM – BRUCEJACK – STEWART TREND OF WESTERN STIKINIA

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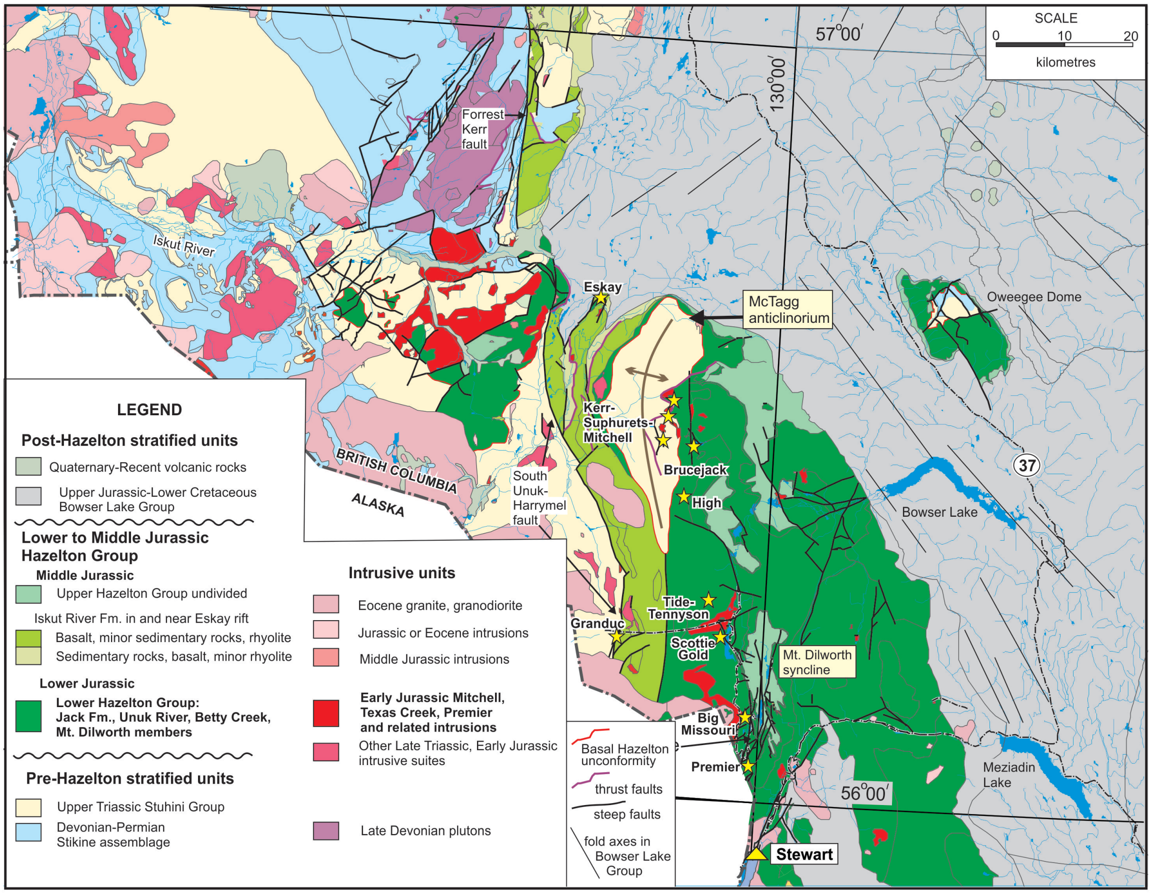
One of the most important mineral trends of northwestern British Columbia extends from near the town of Stewart to the Treaty Glacier, in the western part of the Stikine arc terrane. Major deposits along this trend include Kerr-Sulphurets-Mitchell (KSM), Brucejack, Silbak-Premier, Big Missouri, Scottie Gold and Red Mountain. All are hosted by volcanic and sedimentary of the Hazelton Group (Lower Jurassic) and its subvolcanic feeders (193-195 Ma Premier porphyries near Stewart; Mitchell intrusions at KSM). Although the Hazelton Group is widespread throughout Stikinia, the narrow, consistently NNW-SSE trend of Early Jurassic mineralization along a 60 km strike length suggests structure-controlled magmatic and hydrothermal systems, possibly influenced by basement anisotropies.

The Jack Formation, a unique basal Hazelton unit restricted to the flanks of the McTagg anticlinorium, is characterized by quartz-rich arkoses and polymictic pebble conglomerates with high-level intrusive, felsic volcanic and quartz clasts. Stratigraphic and sedimentologic data from Jack Formation sections are consistent with depositional control by penecontemporaneous, basin-bounding faults and by volcanic centres. The McTagg anticlinorium was probably a topographic high during sedimentation. Initial sedimentation at the Treaty Glacier and Brucejack sections on the eastern side of the anticlinorium is marked by sharpstone conglomerates derived from immediately underlying Stuhini Group basement (Triassic) that may represent mechanical weathering fronts on a gently sloping upland, whereas at the Bruce Glacier section to the west, basal units include isolated remnants of carbonaceous mudstone that are overlain by thick (100 m +) sections of polymictic cobble-boulder conglomerate, which imply abrupt basin deepening and underfilled conditions followed by uplifting, significant relief, and a proximal but integrated drainage system. An overlying predominantly fine-grained clastic section thins eastward from ~ 400 m at the Bruce Glacier section to a maximum of 80 m at the Treaty Glacier section. Local cross beds in mass flow sandstones at the Bruce Glacier section indicate derivation from the east, away from the area now occupied by the McTagg anticlinorium. Sandstone megaclast-bearing olistostromes in equivalent carbonaceous mudstones at the Brucejack section attest to fault-induced uplift and cannibalization of previously deposited Jack Formation sandstones. Andesitic pyroclastic and epiclastic volcaniclastic rocks in the middle of the Jack Formation represent an episode of intense volcanism. Black mudstone intraclasts in the volcaniclastic units indicate that background deep-water sedimentation resumed during intervals of volcanic quiescence. Thick, coarse volcaniclastic sections at the Bruce Glacier and Treaty glacier sections suggest proximity to discrete coeval volcanic centres. In the Iron Cap section, highly altered lower Jack Formation arkosic sandstones and polymictic pebble conglomerates occur as screens within the potassic and phyllic-altered porphyry body, which is overlain by a thin andesitic volcaniclastic blanket and unaltered Jack conglomerates, showing the coeval relationship of sedimentation, intrusion, alteration and local volcanism. At the Bruce Glacier section, the volcaniclastic facies grades back into a mudstone-rich sedimentary section and a return to deep- water sedimentation. In marked contrast, at the Treaty Glacier section to the east, rocks above the volcaniclastic facies indicate shallow-marine sedimentation (basal limestone beds with shelly fauna, sandstones with interference ripples and plant debris, polymodal paleocurrents). Apparently, as with the onset of

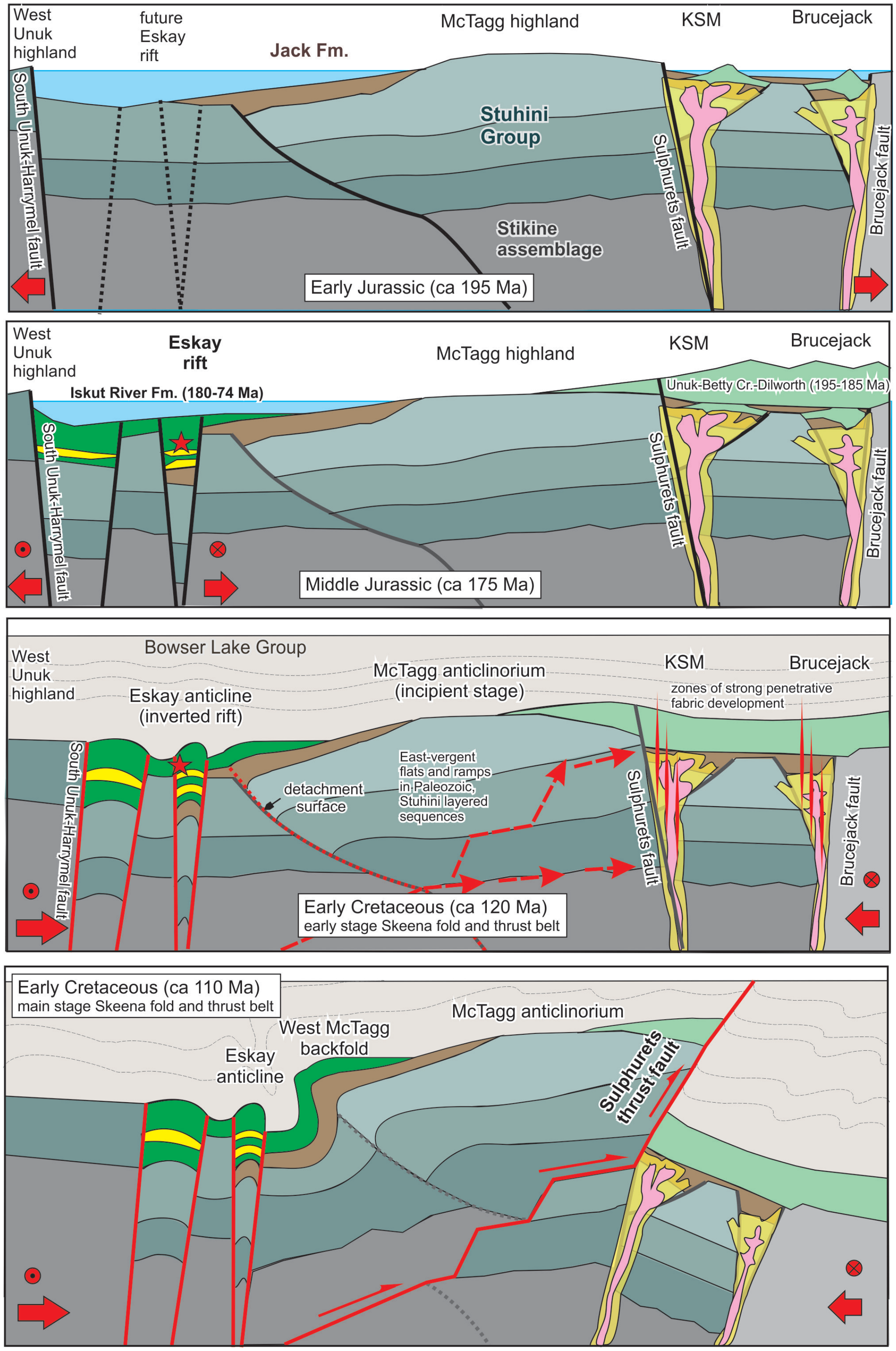
Jack Formation sedimentation, the region on the eastern side of the McTagg anticlinorium was high standing relative to the eastern side.

Integration of facies variations in the Jack Formation with first-order Cretaceous structures leads to a model in which the eastern margin of the McTagg anticlinorium was once a basin-bounding master growth fault. Accordingly, the KSM porphyries and their associated alteration haloes were channeled along this fault, and the Brucejack epithermal system to the east developed adjacent to a complex set of related north-trending and east-trending faults. The Early Jurassic structural regime may have been transtensional or purely extensional. It succeeded an episode of Late Triassic compressional deformation that is expressed as a widespread angluar unconformity at the base of the Hazelton Group, the tectonic cause for which is not known.

The Treaty-Stewart trend is one of a set of northerly mineral belts in northwestern Stikinia, parallel to the mid-Jurassic Eskay rift, the Homestake-Kitsault trend, and major faults that extend as far north as the Stikine River. Their trends are highly anomalous compared to the overall northwesterly Cordilleran structural grain. Because they affect rock assemblages as old as Devonian, they are attributable to the unexposed pre-Devonian basement of Stikinia. In far northwestern Stikinia, Paleozoic Stikine assemblage strata overlie peri-Laurentian, Yukon-Tanana basement. However, Jurassic conglomerate within the Eskay rift in the Anyox area contains detrital zircon populations of 1086-988 Ma and 612-518 Ma (Evenchick and MacNicoll, 2002), which are typical of peri-Baltican terranes. It is thus possible that a cryptic north-trending pre-Devonian suture zone underlies western Stikinia, and that Jurassic structures hosting mineralization are reactivated early Paleozoic faults.



Location of the Treaty-Stewart mineralized trend in northwestern Stikinia. Note northerly trends of mid-Jurassic Eskay rift, defined by extent of Iskut River Formation; and northerly trend of Late Devonian-Early Mississippian plutons.



Inversion of the Sulphurets fault and Eskay rift during Early Cretaceous compressional deformation.

U/PB DATING OF DETRITAL ZIRCON FROM SEWARD TO BARANOF ISLAND PROVIDES DEPOSITIONAL LINKS ACROSS THE CHUGACH-PRINCE WILLIAM TERRANE IN SOUTHEASTERN ALASKA

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The southern Alaskan continental margin is defined by the Chugach-Prince William (CPW) terrane, a deformed ~2200 km long Mesozoic-Tertiary accretionary complex (Plafker et al., 1994). The outboard units of the CPW in the Prince William Sound area are comprised of the Maastrichtian Valdez Formation and Paleocene to Eocene Orca Group, primarily composed of deep-water graywacke turbidites (flysch) and volcanic rocks, including the 57 Ma Resurrection Ophiolite complex (Plafker et al., 1994; Bradley and Miller, 2006). The westernmost unit of the Chugach accretionary complex on southern Baranof Island in southeastern Alaska is the Sitka Graywacke, also composed of deep-water turbidites and its metamorphic equivalent the Baranof Schist. Paleocene to Eocene (60-49 Ma) near-trench plutons of the Sanak-Baranof belt intruded the terrane with a west-to-east migration from 61 Ma in the west to 51-49 Ma in the east (Bradley et al., 2003). Paleomagnetic data from the Resurrection Ophiolite requires that this element of the Prince William terrane formed 13±9° south of its present location, indicating nearly 1000 km of northward displacement (Bol et al., 1992). However, Haeussler et al. (2003) discount the paleomagnetic data and suggest that the Resurrection Ophiolite and Sanak-Baranof plutons were emplaced more or less in place. In this contribution, we present detrital zircon U/Pb ages from the Sitka Graywacke on Baranof Island, and the flysch of the Valdez and Orca groups that lie structurally, and locally stratigraphically, above the Resurrection Ophiolite near Seward. We show that the maximum depositional ages generally young inboard to outboard with some notable discontinuities, and that the youngest (most outboard) rocks of the Sitka Graywacke correlate to the Orca Group in Prince William Sound.

Using U/Pb dating of detrital zircon, previous work has shown that the Sitka Graywacke on Baranof Island just south of Sitka is Upper Cretaceous with an inboard older package of rocks with maximum depositional ages (MDA) of 97, 103, and 105 Ma and a younger outboard package with MDA's of 72, 74, 74, and 74 Ma (Haeussler et al., 2006). Five samples of metamorphosed Sitka Graywacke from our study collected along a SW-NE transect in Whale Bay (~52 km south of Sitka) yield maximum depositional ages of 60, 62, 62, 68, and 75 Ma, younging from inboard to outboard. This result means that a large fraction of the Baranof Schist is stratigraphically equivalent to the Orca Group in Prince William Sound. These new data from Baranof Island show that deposition of the Sitka Graywacke extended into the Paleocene, before being buried and metamorphosed to amphibolite facies (andalusite+garnet) due to the intrusion of the Crawfish Inlet pluton at ~50 Ma (Karl et al., 2014; this study).

Five new samples collected from the flysch of the CPW near Seward, Alaska yield MDA's of 58, 59, 65, 67, and 67 Ma, and thus deposition of rocks was likely coeval with those on Baranof Island. The youngest two samples are from Fox Island in Resurrection Bay and appear to correlate in age with samples reported by Pettiette (2013) from flysch interbedded with pillow basalts of the 57 Ma Resurrection Ophiolite. The other three samples come from adjacent but structurally higher (inboard) positions in the accretionary wedge and have slightly older (65 to 71 Ma) MDA's. Our new U/Pb date on the Aialik Pluton of 56.5±1.0 Ma and the existing constraints on the age of the Resurrection Peninsula Ophiolite (57 Ma, see Pettiette, 2013), would suggest near contemporaneous formation of the ophiolite and intrusion of the pluton. From these data we are left to conclude that either: 1) ophiolite formation, imbrication, and intrusion occurred in less than 1 Myr (at ~57 Ma); or 2) ophiolite formation and pluton intrusion occurred at different parts of the same margin, and were since juxtaposed along unidentified structures. Likewise our new U/Pb ages on detrital zircon from the Baranof Schist are much younger that previously thought, and our data require deposition as late a 60 Ma, and then imbrication and burial occurred in the 10 Myr interval before intrusion of the Crawfish Inlet Pluton at 50 Ma, at depths of 10 to 20 km (Zumsteg et al., 2003).

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GEOLOGY OF THE DAWSON RANGE AREA OF WESTERN YUKON: A MASKED STRUCTURAL BOUNDARY BETWEEN YUKON TANANA TERRANE AND PARATHOCHTONOUS NA

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The Dawson Range is underlain by two basement complexes whose boundary is masked (intruded and overlain) by locally voluminous successor late Triassic to Tertiary plutonic and volcanic rocks. The basement rocks of the Yukon-Tanana terrane (YTT) dominate the northern part of the area, whereas the White River assemblage dominated the southern part of the area. The central core of the map area is transacted by the mid-Cretaceous Whitehorse plutonic suite (hbl-granodiorite of the Dawson Range batholith (DRB) phase, and bt-monzogranite of the Coffee Creek granite (CCg) phase) and it masks a pre-mid Cretaceous, fundamental tectonic boundary in intermontane geology between the two basement assemblages. On the northeast side of the DRB, typical YTT rocks are exposed, comprising a thoroughly deformed and metamorphosed pre-Devonian to Permian basement complex. Pre-Devonian quartzite, psammite, marble and amphibolite (Snowcap assemblage; SCA) form the oldest rocks. The SCA is locally in structural contact with amphibolite that is interpreted as the arc-related Devonian to Mississippian Finlayson assemblage. The SCA and Finlayson assemblage are intruded by Permian granites of the Sulphur Creek suite. Early Mississippian Simpson Range plutonic suite is restricted in the map area to the northwest extremity, and is in thrust contact on top of the Snowcap assemblage and Permian intrusions. Occurrences of the Late Triassic Pyroxene Mountain suite occur only in the hanging wall Simpson Range suite rocks, leading us to conclude that the thrust is post late Triassic. We interpret the Pyroxene Mountain suite as intrusive portions of Stikinian Lewes River arc magmatism. On the south side of the CCg, a deeper thrust of similar scale separates amphibolite facies schist and Permian augen granite from greenschist facies metavolcanic Klondike Schist, indicating that thrusting postdates peak metamorphism. Our work demonstrates that the Permian magmatic portion of YTT is much more widespread than previously known, and extends from the Alaska border in southwest Stewart River map sheet some 180 km to the east-southeast into Carmacks map sheet.

On the southwest side of the DRB, the White River assemblage is dominated by amhibolite facies siliciclastic rocks of the Scottie Creek formation and derived partially melted migmatic paragneiss, that have similar compositional character as the SCA to the northeast. However, these rocks lack Permian intrusions, and are spatially associated with metaplutonic rocks (Baker orthogneiss) and metavolanic rocks (White River formation) that are latest Devonian, and distinctly older than the typical rocks of YTT to the northeast. The southeast domain is intruded by the Late Triassic Snag Creek gabbro suite that is distinct from the Pyroxene Mountain suite on the northeast side of the map area. Along the northern margin of DRB, we have mapped several lozenges of peridotites that we interpret as marking the thrust contact (Moose Creek thrust) between the White River assemblage and typical YTT to the northeast. Snag Creek gabbro is restricted to the White River assemblage, leading us to interpret this thrust as a post-late Triassic fundamental terrane boundary. This boundary appears to have focussed the location of the Whitehorse plutonic suite, as well as the Late Cretaceous Casino suite and Prospector Mountain suite, and their associated intrusion related mineralization. The large scale structures were episodically reactivated and overprinted by mid to late Cretaceous structures that have long strike length, but not necessarily have significant offset (e.g., Big Creek Fault).

STRUCTURAL AND TECTONIC CONTROL ON MINERALIZATION BY MAGNETITE-DESTRUCTIVE FAULTS IN WESTERN YUKON AND EASTERN ALASKA

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Regional-scale magnetite-destructive structures transecting the allochthonous to parautochthonous Intermontane terranes of western Yukon are characterized by northwest-trending and steeply north-east dipping fault systems, whereas eastern Alaska is dominated by a series of northeast-trending and sub-vertical faults. At a local scale, geological, structural and geophysical data support the role of these structures in focusing of orogenic style and magmatic-related mineralization under contractional and strike-slip tectonics, respectively. Orogenic gold mineralization in the Klondike and White Gold districts is closely linked to contractional deformation and to cooling of upper plate rocks in the Middle to Late Jurassic, following accretion and amalgamation of the Intermontane terranes to the Laurentian margin. Orogenic gold mineralization associated with this event formed in a variety of structural settings, including orogen-parallel thrust surfaces, breccias and veins in orogen-perpendicular to oblique transfer faults, and dilational veins hosted in fold-related shear and tensional fractures. This phase of Jurassic northeast-southwest directed contraction was followed by northwest-southeast extension by Early to mid-Cretaceous time and to transtension in the Late Cretaceous. In the Yukon's Dawson Range, mid-Cretaceous epizonal orogenic gold mineralization (Coffee Gold Au system) and early Late Cretaceous porphyry Cu-Au(-Ag-Mo) systems (e.g., Casino, Nucleus, Revenue, Cash) are structurally related to the northwest-trending, dextral strike-slip Big Creek fault, which represents a branch of the Teslin-Thibert-Kutcho fault system of southern Yukon and northern British Columbia. By the latest Cretaceous, defomation is dominated by northeast-trending sinistral strike-slip magnetite-destructive faults (e.g., Pb-Ag veins of the Sixtymile and Fortymile districts of far western Yukon and eastern Alaska). We interpret fault bends, fault relay zones and fault tips, as well as lower-order structures, to favour the formation of mid- to Late Cretaceous magmatic-related mineralization.

NEW CONSTRAINTS ON THE NATURE AND CORRELATION OF LATE PALEOZOIC - EARLY MESOZOIC ACCRETED TERRANES IN THE NORTHERN U.S. CORDILLERA

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The terranes of the Late Paleozoic - Early Mesozoic Blue Mountains province of eastern Oregon and west-central Idaho provide an important link between the geology of the North American Cordillera exposed in Canada and Alaska in the north and Nevada and California in the south. Previous studies in the BMP have identified four first-order tectonic elements outboard of the ancient cratonal margin of North America: the inboard Olds Ferry volcanic arc terrane, the accretionary prism melage Baker terrane, the outboard Wallowa-Seven Devils volcanic arc terrane, and a forearc basin overlap sequence often termed the Izee "terrane".

We present new geologic, geochronologic, and geochemical data from the volcano-sedimentary Huntington Formation of the Olds Ferry arc that place the terrane within a firm temporal and tectonomagmatic context, and establish its identity as a fringing arc terrane along the Triassic to Early Jurassic Cordilleran margin. The Huntington Formation is divided into two unconformity-bounded members: a Norian (*ca* 220 Ma) lower sequence of mafic-intermediate volcanics, massive volcaniclastic breccias and minor carbonates deposited unconformably onto the exhumed 237.7 Ma Brownlee pluton and intruded by the 210.0 Ma Iron Mountain pluton; a Rhaetian through Pleinsbachian (<210 to 187.0 Ma) upper member comprising thick, massive cobble- to boulder-conglomerates, abundant rhyodacite to rhyolite effusive and pyroclastic flows, and distinctive interlayered thin-bedded sandstone turbidites, deposited with angular unconformity across a variety of lower member supracrustal and plutonic rocks. An erosional hiatus and regional tilting produced an angular unconformity separating the Huntington Formation from the basal conglomerate of the late Early to Middle Jurassic Weatherby Formation of the Izee forearc basin transgressive onlap sequence.

Volcanic rocks of the Olds Ferry arc are isotopically enriched relative to depleted mantle and coeval igneous rocks in the outboard Wallowa terrane, and illustrate a temporal evolution to more elevated $^{87}Sr/^{86}Sr$ ratios (0.7036 to 0.7057) and less positive εNd values (+5.4 to +3.1) in the upper member volcanics of the Huntington Formation, suggestive of the involvement of continental-derived material in their petrogenesis. Precambrian xenocrystic zircons in both lower and upper member volcanic rocks provide the most compelling support for the inference that the Olds Ferry terrane was proximal to cratonal North America during much of its history. The tectonostratigraphic architecture of the Olds Ferry terrane allows its robust correlation to other fringing-arc (Eastern Klamaths, Quesnellia, Stikinia) terranes along the U.S. and Canadian Cordillera.

The Izee forearc basin is a volcanic rich sedimentary sequence onlapping the Olds Ferry volcanic arc and Baker accretionary mélange terranes, and comprises the marine flysch Weatherby Formation sub-basin in its eastern extent. New high precision U-Pb zircon ages for of primary pyroclastic turbidite horizons found within the marine flysch provide new constraints on synchronous basin development and volcanic activity in the Olds Ferry arc between 187 and 170 Ma. The youngest primary pyroclastic horizons within the Weatherby Formation are early Middle Jurassic (*Aalenian*), ca 170 Ma. Detrital-zircon analysis of sediments above the youngest primary volcaniclastic horizon indicate reworking of Middle Jurassic zircons and no input of new volcanic material into the basin after about 170 Ma. High precision U-Pb geochronology and structural measurements demonstrate that the Weatherby Formation has been folded into a synformal structure via movement along the east-vergent Connor Creek reverse fault. A 192 Ma welded tuff exposed near the Connor Creek fault is interpreted as a fault-bounded slice of the underlying Huntington Formation riding along a splay of the Connor Creek fault system. The Connor Creek fault is interpreted as a significant contractional structure related to the internal amalgamation of the terranes, but is not a lithosphere scale terrane boundary. Compared with the western Izee basin, the Weatherby Formation lacks *Oxfordian* sediments suggesting the propagation of the Connor Creek fault occurred as early as the Middle Jurassic (*Aalenian*), ca 170 Ma.

"UNRAVELLING THE GEOLOGICAL EVOLUTION OF THE RUDDOCK CREEK ZINC-LEAD DEPOSIT: DETAILED MAPPING, STRUCTURAL, PETROLOGICAL AND GEOCHRONOLOGICAL ANALYSES WITHIN THE NORTHERN MONASHEE MOUNTAINS, BRITISH COLUMBIA"

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The Ruddock Creek zinc-lead deposit contains approximately 10,036,000 tonnes of 8.07% combined zinc and lead (indicated and inferred resource at 4% cut off). The deposit is interpreted to be a sedimentary exhalative deposit (sedex). Historic work dates back to the 1960's and 1970's when the property was explored by Cominco and Falconbridge. Since those early days, Ruddock has seen over 88, 000 metres of drilling, the development of an underground decline, support roadways and a substantial camp built on site. In 2012, Ruddock Creek Mining Company invested in a bulk sample, which was taken from the deposit's main mineralized zone, the E zone. The company has proceeded with metallurgy and acid rock drainage to further support their development of this potential zinc-lead mine in British Columbia.

Despite all the work that has been done in the past, the age of ore genesis and structural control of the deposit still remains unresolved. Through a 'boots on the ground' approach, detailed mapping and sampling were the main focus of field work this past summer. The primary aim of the project is to constrain the timing of ore development, and resolve the long standing question of whether the main structural control of the mineralized horizon is due to faulting, folding or a combination of both. The regional- and property-scale geology has been subjected to amphibolite facies metamorphism and multiple, penetrative deformation events related to a protracted history of Cordilleran orogenesis. To date, the most reliable marker unit is the mineralized horizon, which appears to be closely related to an underlying unit of calcsilicate gneiss.

The Ruddock Creek deposit is hosted in a set of lithologies that capture a very interesting part of the Canadian Cordilleran history. The meta-sediments that host the mineralized horizon, and make up the majority of the regional stratigraphy in the Northern Monashee Mountains belong to the Windermere Supergroup. The Windermere comprises a genetically important set of rocks with regard to the Cordilleran history because it represents the first sediments shed along the length of the western margin of Laurentia, deposited during Neoproterozoic rifting.

During the Neoproterozoic, the tectonic regime was such that the western margin of Laurentia was marked with discrete basins along its length. Development of a basin is the first fundamental step towards creating a sedimentary exhalative deposit. Reactivation of faults along the irregular horst and graben topography provides a conduit for the auriferous hydrothermal fluids which are syn-genetic with sediments. Underlying magmatism provides the essential energy to drive the entire process of forming a sedex. Historically, the Windermere has not been considered as a viable sedex exploration target; however, further to the south, the Monashee Complex is host to three similar "sedex" deposits that have had a variable amount of work done on them, which suggests the Windermere may be a worthwhile exploration target.

DETRITAL ZIRCONS FROM BONNETIA REVEAL A 1.68 – 1.78 GA LOCAL SOURCE OF SEDIMENT IN NORTHWESTERN LAURENTIA

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The Wernecke Breccia is a set of hydrothermal breccias which crosscut the <~ 1.64 Ga Wernecke Supergroup at 1.60 Ga. The Wernecke Supergroup is present in Proterozoic inliers in the Yukon Territory and consists of locally deformed and metamorphosed, fine grained siliciclastic and carbonate rocks. Clasts in the Wernecke Breccia are mainly sourced from the Wernecke Supergroup, however, some of the clasts are lithologically distinct and older than the Wernecke Supergroup and hence are considered exotic. These exotic clasts include igneous and sedimentary varieties and reach sizes of up to 900 x 300 x 30 m. The inferred source for these clasts is a hypothetical terrane called Bonnetia. Bonnetia is considered to have been thrust onto the Laurentian continental margin, shortly before brecciation. Bonnetia was entirely eroded prior to deposition of the Pinguicula Group between 1.4 and 1.0 Ga, except for its clasts in the Wernecke Breccia.

Our understanding of Bonnetia is constrained by field relations, petrology, geochemistry and isotopic ages of the exotic clasts. Results show that Bonnetia contained 1) a widespread mafic to intermediate plutonic complex that was at least in part 1.71 Ga 2) mafic volcanic successions (undated) and intercalated with sedimentary strata. Geochemical analyses on the igneous clasts indicate that Bonnetia formed in a volcanic arc environment possibly modified by a plume, rift or slab window, and was built in part on continental crust.

During the field season of 2012, sedimentary clasts within Wernecke Breccia were tentatively identified as being exotic with respect to the Wernecke Supergroup. One such sample was processed for detrital zircons and results were obtained by laser ablation inductively coupled mass spectrometry. The resulting age pattern shows a large peak at 1.68-1.78 Ga with minor contributions from other Paleoproterozoic and Archean zircons. Many of the younger 1.68-1.78 Ga grains are subhedral, implying minimal transport distances. Local Laurentian sources with populations concentrated in this age-range are unknown. The older zircons, however, were likely derived from the Laurentian craton. Together, these detrital zircon signals suggest that the stratigraphic formation which sourced the exotic sedimentary clasts formed as an overlap assemblage or provenance-linked basin on Bonnetia and/or Laurentia, with sediment supplied from both entities. Additional geochronological analyses are planned in late January and a new and improved dataset obtained by sensitive high resolution ion microprobe will be presented.

GEOCHEMISTRY AND GEOCHRONOLOGY OF THE CRAWFISH INLET PLUTON, BARANOF ISLAND, ALASKA

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The Sanak-Baranof plutonic belt (SBPB) includes a series of biotite tonalite, granodiorite, and granite near-trench plutons that sporadically intrude the Campanian to Eocene Chugach-Prince William terrane (CPW) over 2100 km along the curved southern Alaskan margin (Hudson et al., 1979; Hill et al., 1981; Bradley et al., 1998). SBPB intrusions have been interpreted to be the result of subduction of the Kula-Farallon or Kula-Resurrection spreading ridge at a trench-ridge-trench triple junction (Bradley et al., 2003; Haeussler et al., 2003; Cowan, 2003). Part of the SBPB, the Crawfish Inlet pluton intrudes the Maastrichtian-Paleocene Sitka Graywacke and is exposed on Southern Baranof Island in Southeast Alaska. It has been considered to mark the eastern boundary of the SBPB based on its anomalous forearc location and field relationships (Hudson et al., 1979; Haeussler et al., 2003; Bradley et al., 2003). However, Reifenstuhl (1986) concluded that the Crawfish Inlet pluton is not likely to be a part of the SBPB based on its petrography and major element chemistry. In this study we use petrographic, geochemical, and U/Pb geochronology of zircon to compare the Crawfish Inlet pluton and the Krestof pluton on Baranof Island to other intrusive bodies of the SBPB. Geochemical and oxygen isotope analyses are used in petrogenetic models to evaluate if mixing between accretionary wedge material of the CPW and MORB can explain the chemistry of the Crawfish Inlet and Krestof plutons.

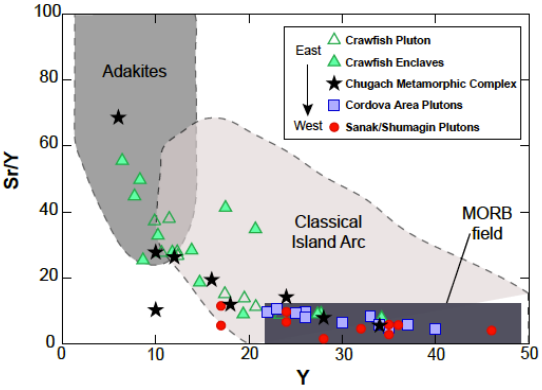

Figure 1: Sr/Y vs. Y for the Crawfish and other SBPB plutons. Cordova pluton: Barker et al. (1992); Sanak/ Shumagin area: Hill et al. (1981); Chugach metamorphic complex: Sisson et al,

Few studies have compared the geochemical signature of plutons across the SBPB. However, Farris and Paterson (2009) found that plutons in the western belt (Sanak/Shumagin Islands and Cordova) exhibit low Sr/Y ratios and LREE enrichment with well-developed Eu anomalies, while those in the eastern belt (Chugach Metamorphic Complex) display higher Sr/Y ratios and less LREE enrichment (Fig. 1). Compositions of granites and mafic enclave samples from the Crawfish Inlet pluton generally exhibit higher Sr/Y (>15) ratios and lower Y compared to plutons lying to the west. Some samples of eastern SBPB plutons plot within the adakite field (Fig. 1), leading workers to conclude that slab melting might be an important process for the formation of some SBPB plutons (Drummond and Defant, 1990; Harris et al., 1996; Farris and

Paterson, 2009). An alternative explanation involves melting of mafic, garnet and/or amphibole-bearing lower crust (e.g., Dawes, 1994; Garrison and Davidson, 2003).

Analyses of $\delta^{18}O$ on zircon, quartz, and magmatic garnet were made by laser fluorination from seven granite samples from the Crawfish Inlet pluton, one from the Krestof pluton, and one from the Aialik pluton of the SBPB collected near Seward, Alaska. Values of $\delta^{18}O$ (Zrc) from the Crawfish and Krestof plutons on Baranof Island in Southeast Alaska range from 6.18‰ to 7.48‰, and 9.62‰ from the Aialik pluton (Fig. 2). All nine zircon samples lie in the "supracrustal" field, as zircons with $\delta^{18}O > 6‰$ are not known from uncontaminated mantle-derived magmas (Valley et al., 2005; Cavosie et al., 2005; Cavosie et al., 2011). A preliminary interpretation of the elevated $\delta^{18}O$ measured in these plutons indicates mixing and equilibration with a crustal component and are consistent with major and trace element geochemical data. Future work will focus on further analysis of $\delta^{18}O$ data with U/Pb ages of the Crawfish Inlet pluton, as well as petrogenetic modeling using the trace element and isotopic compositions of the mafic enclaves and graywacke as endmembers to evaluate their relative roles in the generation of magmas emplaced in the Crawfish Inlet pluton.

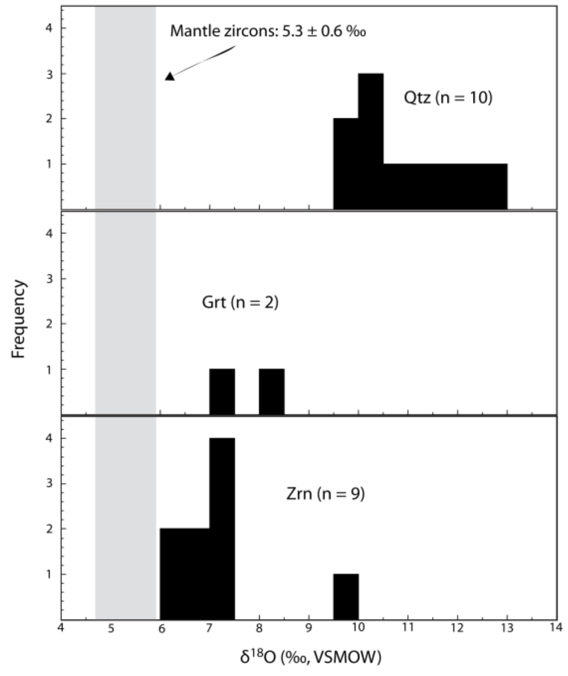

Figure 2: Histogram of oxygen isotope analyses of quartz, garnet and zircon by laser fluorination from Crawfish Inlet and Krestof plutons. The shaded vertical bar indicates range of mantle-equilibrated zircon, 5.3 ± 0.6‰ (2 SD), (Valley et al., 2005).

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CONSTRAINTS ON MAGMATISM AND DEFORMATION IN THE SOUTHERN KOOTENAY ARC: INSIGHT FROM U-PB GEOCHRONOLOGY

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The southeastern Omineca Belt of the Canadian Cordillera is recognized as the hinterland of the orogenic belt and is host to a number of core complexes that comprise the composite Shuswap complex (Monger et al. 1982; Coney and Harms 1984; Simony and Carr 2011; Cubley and Pattison, 2012). On the eastern flank of the Shuswap complex, three tectonic domains meet in the area between Creston and Salmo in southeastern British Columbia: the southern Kootenay Arc, northern extension of the Priest River Complex and western flank of the Purcell Anticlinorium. This area has undergone multiple phases of metamorphism, deformation, and has been intruded by multiple suites of igneous intrusives that extend across southeastern BC. Determining the age of the intrusives provides constraints on the tectonometamorphic evolution of the area.

Five key intrusions of unknown age were selected for this study. One sample from each of the following intrusions was collected for U-Pb zircon analyses and returned the following results; the Porcupine Creek stock (162.6 ±1.3 Ma), Baldy pluton (117.5 ±1.3 Ma), Mount Skelly pluton (108.8 ±1.2 Ma), Summit stock (111.8 ±0.8 Ma) and Emerald stock (101.7 ±2.2 Ma). The new age for the Porcupine Creek stock overlaps with ages obtained by Ghosh (1995a) for the nearby Nelson plutonic suite (172–161 Ma), suggesting it is part of the Nelson suite. The other four U-Pb ages overlap within the age range established for the Bayonne magmatic suite (ca. 115-76 Ma; Logan, 2001), possibly extending the upper limit to 118 Ma.

The new age for the Baldy pluton of 118 Ma provides new constraints on the timing of penetrative fabric development in the Baldy pluton and adjacent metasediments, in the footwall of the Midge Creek fault. The Baldy pluton was likely emplaced during peak penetrative deformation in the Early Cretaceous, but slightly after Barrovian regional metamorphism, implied by the cross-cutting nature of the pluton and metamorphic isograds in the footwall of the fault.

The Mount Skelly pluton is the eastern most phase of the Bayonne batholith. The new age of 108.8 ±1.2 Ma, combined with existing ages of other phases, requires a reinterpretation of the Bayonne batholith. The intrusive rocks that comprise the Bayonne batholith crystallized over an extended period of time, ca. 30 m.y. The plutons have different compositions, structural histories and varying depths of emplacement, confirming the Bayonne batholith is a composite body.

A POSSIBLE ANCIENT OCEAN CORE COMPLEX IN THE NORTHERN CACHE CREEK TERRANE, BRITISH COLUMBIA AND YUKON?

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The northern Cache Creek terrane comprises a thrust stack of chert, limestone, siltstone, basalt, gabbro and ultramafic complexes ranging in age from Mississippian to Triassic. The presence of Tethyan fossils has lead to the suggestion that the Cache Creek terrane represents an accreted oceanic plateau or series of seamounts. The question of emplacement of the exotic Cache Creek terrane inboard of less exotic arc complexes has been integral to development of tectonic models of the Mesozoic Cordillera. In general, it is accepted that the Cache Creek terrane is composite in nature; however, relatively little work has been done to systematically decipher the internal tectonostratigraphy. Previous studies indicate that the Cache Creek terrane includes several unrelated tectonic elements of distinct ages, including a rifted arc complex. This rifted arc complex is best exposed along the western and northern margins of the Cache Creek terrane where it is associated with large peridotite massifs.

Fields studies and geochemical investigations indicate that the ophiolitic mafic-ultramafic complexes along the western and northern margin of the northern Cache Creek terrane did not form in an ocean plateau or seamount setting. Rather geochemical characteristics are most consistent with a supra-subduction zone setting. The general lack of lower and middle crust in most sections and direct contact between supracrustal and mantle sections suggest that the supracrustal rocks were structurally emplaced over mantle along extensional detachments. These detachments occur throughout most of the northen Cache Creek terrane (>300 km). The timing of these detachments is poorly constrained at present; however, Middle Triassic tonalite boulders occur in Middle Triassic Kedahda Formation strata suggesting that the exhumation was broadly syn-volcanic. The overall chert-dominated character of the Kedahda Formation suggests that the rift developed into an oceanic backarc basin. Overall, these data indicate that parts of the northern Cache Creek terrane may have formed in a setting analogous to backarc ocean core complexes such as the Godzilla Megamullion in the Parece Vela backarc basin, western Pacific. Detailed mapping and analysis will be conducted to test this hypothesis in the near future.

CAMPUS MAP - OKANAGAN

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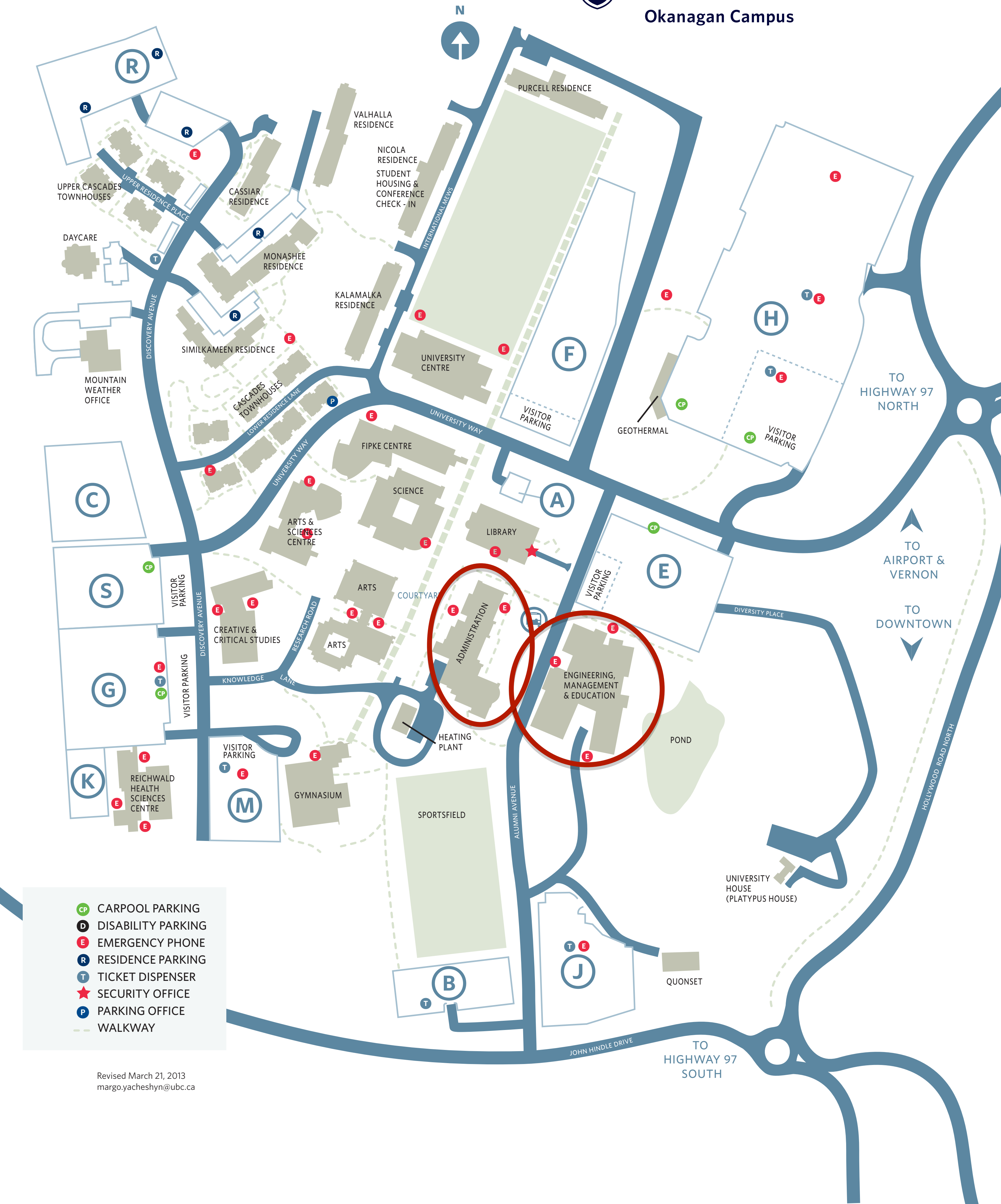

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Gymnasium	3211 Athletics Crt	GYM
Library Building	3287 University Way	LIB
Monashee Residence	1267 Discovery Ave	MON
Mountain Weather Office	1238 Discovery Ave	MWO
Fipke Centre	3247 University Way	FIP
Quonset	1035 Alumni Ave	QUO
Science Building	1177 Research Rd	SCI
Similkameen Residence	1263 Discovery Ave	SIM
Administration Building	1138 Alumni Ave	ADM
University House (Platypus House)	1060 Diversity Pl	UNI
Kalamalka Residence -South Ent	1220 International Mews	KAL
Kalamalka Residence -Main Ent	1240 International Mews	KAL
Kalamalka Residence -North Ent	1260 International Mews	KAL
Valhalla Residence -South Ent	1291 Discovery Ave	VAL
Valhalla Residence -Main Ent	1311 Discovery Ave	VAL
Valhalla Residence -North Ent	1331 Discovery Ave	VAL
Nicola Residence -South Ent	1270 International Mews	NIC
Nicola Residence -Main Ent	1290 International Mews	NIC
Nicola Residence -North Ent	1310 International Mews	NIC
Purcell Residence-Under Const.	1323 International Mews	PUR
Cassiar Residence-Under Const.	1337 Discovery Avenue	CSR
Cascade Residence -Lower -Bldg A	3212 University Way	CAS-A
Cascade Residence -Lower -Bldg B	3200 University Way	CAS-B
Cascade Residence -Lower -Bldg C	3188 University Way	CAS-C
Cascade Residence -Lower -Bldg D	3176 University Way	CAS-D
Cascade Residence -Lower -Bldg E	3174 Lower Residence Ln	CAS-E
Cascade Residence -Lower -Bldg F	3192 Lower Residence Ln	CAS-F
Cascade Residence -Lower -Bldg G	3210 Lower Residence Ln	CAS-G
Cascades Residence -Upper -Bldg H	3153 Upper Residence Pl	CAS-H
Cascades Residence -Upper -Bldg I	3132 Upper Residence Pl	CAS-I
Cascades Residence -Upper -Bldg J	3133 Upper Residence Pl	CAS-J
Cascades Residence -Upper -Bldg K	3152 Upper Residence Pl	CAS-K
Portable A (temporary)	1060 Diversity Pl	PBA
Portable N (temporary)	3177 Athletics Crt	PBN
Quonset	1033 Alumni Ave	

Google

sheraton airport

A. Four Points by **Sheraton** Kelowna **Airport**
5505 Airport Way, Kelowna, BC V4V 2N9
+1 855-900-5505
2 reviews

Prices converted at current exchange - Disclaimer