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Geochemistry of Mesozoic intrusions, Quesnel terrane, south-central British Columbia: preliminary results
Géochimie des intrusions mésozoïques, terrain de Quesnel, Colombie Britannique centre-sud: resultats preliminaires

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PROJECT OVERVIEW

SCIENTIFIC MOTIVATION

Mesozoic igneous rocks of the Quesnel terrane in southern British Columbia are associated with accretionary tectonism in the Canadian Cordillera (eg. Monger et al., 1982). Compositions of specific temporal suites record variations in source or process through time as each arc system evolves, collides, and equilibrates as part of a new, thickened crust. Specifically, these changes in source or process are dependent on the state of the subducting slab throughout the life-cycle of a specific arc. The slab states are: 1) incipient subduction (no slab at asthenospheric depths, and simple compression to slab underplating at lithospheric depths); 2) steady-state subduction (continuous slab from trench to at least the 410 km discontinuity); and 3) boudinaging and foundering of slab following a collision event (slab removal at lithospheric depths, with delayed presence at asthenospheric depths). Mantle types associated with the three slab states are: 1) non-metasomatized asthenospheric mantle overlain by lithospheric mantle with composition inherited from a pre-convergence tectonic state (e.g. harzburgitic of formerly divergent margins); 2) metasomatized asthenospheric mantle wedge with depleted (lherzolitic) lithospheric mantle; and 3) possible addition of sub-slab asthenospheric (fertile) mantle, facilitated by removal of the slab barrier. Crustal inputs include assimilation by mantle-derived magma ascent as the arc evolves, to crustal anatexis following collision. These variations in available sources with respect to both mantle reservoirs and crustal responses should be recognizable in the geochemistry and the Rb-Sr, Sm-Nd, Pb-Pb, and Lu-Hf isotopic compositions of the rocks.

TARGETED LITHOLOGIES

One tectonic cycle is represented by Late Triassic to Middle Jurassic igneous rocks of the southern Quesnel terrane, which have been targeted for geochemical and Rb-Sr, Sm-Nd, Pb-Pb and Lu-Hf isotopic analysis. We present compositional fingerprinting for intrusions of this age range from the Similkameen-Kamloops regions, British Columbia. These samples represent the southerly subset of 57 new geochemical samples collected in 2006, which include rocks of similar ages from the Thuya and Takomkane batholiths. The new isotopic compositions, and the Hf and Pb isotopes in particular, will be used to re-evaluate whether pre-collision (>185 Ma) Quesnellian arc rocks were emplaced in the presence or absence of radiogenic (Precambrian) crust, which has implications for the relationship of the Quesnel terrane to ancestral North America.

ECONOMIC APPLICATIONS

It is anticipated that with further study, the geochemistry of the sampled suites, and especially the Rb-Sr, Sm-Nd, Pb-Pb and Lu-Hf isotopic systematics, may correlate with the predicted variations in slab dynamics at depth through one or more cycles of arc development, evolution and accretion. In turn, changes in magma source over the course of this tectonic cycle may in part account for observed trends in porphyry-mineralization style and commodity. With some exceptions, notably including the Late Triassic calc-alkaline Highland Valley Deposit, the broad mineralization trends that have been observed for the Quesnel terrane are: 1) alkalic Cu-Au +/-Ag porphyry mineralization is typically hosted in latest Triassic intrusions; 2) calc-alkaline Cu +/- Au +/-Mo porphyry mineralization is commonly hosted in Early Jurassic intrusions; and 3) low-F Mo-type porphyry mineralization is hosted by Middle Jurassic and younger intrusions (eg. Anderson, 1985; Woodsworth et al., 1991; McMillan et al., 1995).

THIS POSTER PRESENTS:

This poster presents ***preliminary results of the 1st year of sample collection and analysis of a multi-year project.*** Approximately 40% of the 2006 sample set, consisting of samples from the TGI-3 sample area and funded by the Geological Survey of Canada (blue triangles, Fig. 3), have been processed. In-progress analyses include the Pb-Pb isotopic compositions for the TGI-3 area samples, and rare-earth element and isotopic analysis from the the beetle infestation zone (BIZ) (yellow triangles, Fig. 3).

The focus of this poster is to provide compositional fingerprinting of 3 temporal suites of porphyry intrusions in the TGI-3 area. The compositional ranges provided include the Rb-Sr, Sm-Nd, and Lu-Hf isotopic systems and rare-earth element abundances.

Petrologic and tectonic implications will follow in subsequent years of the project, pending finalization of analytical geochemistry.

MAJOR MESOZOIC PORPHYRY DEPOSITS OF THE CANADIAN CORDILLERA

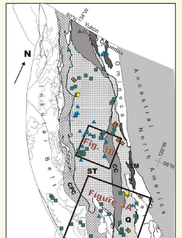


Figure 1. Major terranes of the Coast and Intermontane belts, and distribution of major Triassic to mid-Cretaceous porphyry-style deposits in the Canadian Cordillera. Deposit information from MINFILE (1986) and Cordillera-Age (2006; Nielsen et al., 2006), terrane polygons from NeoFocus (2006).

CHARACTERIZATION OF INTRUSIVE SUITES:

Geochemical sampling was conducted for 4 "time-slices" of Mesozoic magmatism from the Quesnel and Stikine terranes. Sample locations are shown at Figure 4A and 4B. Preliminary results are available for the 3 oldest time-slices:

1) ***Iatest Triassic alkaline Cu-Au porphyry*** mineralized microcrystalline stocks and plutons
2) ***earliest Jurassic calc-alkaline, barren to Cu±Mo±Au porphyry*** mineralized biotite-hornblende granodiorite batholiths
3) ***mid(?) Jurassic barren calc-alkaline*** post-collisionary granites

Detailed descriptions and major element plots are provided in Breitsprecher et al. (2007) (BCGS Fieldwork 2006). Salient lithologic or compositional aspects are noted below.

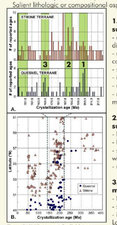


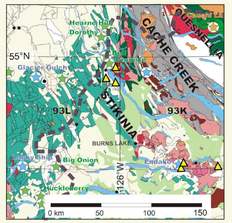
Figure 2. A) Histogram of available age determinations for igneous rocks of the Quesnel and Stikine terranes. Data from Cordillera-Age database (Nielsen et al., 2006), accurate time slices targeted for geochronology in this study. B) Latitudinal distribution of igneous rocks of the Quesnel and Stikine terranes. Sources: BCAge 2004 (Breitsprecher and Mortensen, 2004), query criteria = Arenal, U-Pb, crystallization

1. Latest Triassic (202 ±6/4 Ma): alkalic 'monzodiorite–diorite' suite
- alkaline Cu-Au-Ag-type porphyry deposits (Copper Mountain, Allison Lake (East), Cherry Creek (Iron))
- microcrystalline; exhibit varying degrees of potassic alteration and typically contain abundant hornblende needles
- silica-undersaturated (normative olivine) calc-alkaline monzodiorites
- intermediate but tightly restricted range in MgO (0.49–.51)
- metaluminous and potassic (Na_2O < K_2O; ~2 wt%)
- magnetic susceptibility (ms) varies widely from weakly magnetic (ms = +4) to magnetic (ms = +25)

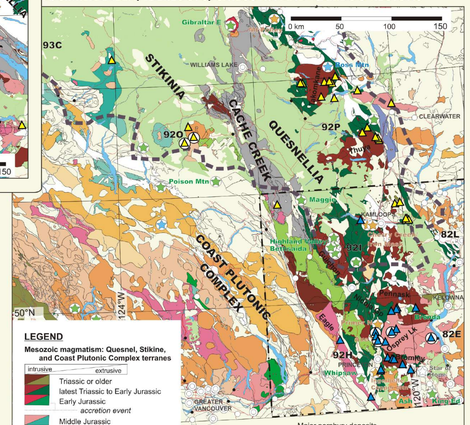
2. Early Jurassic (190±4 Ma): 'hornblende–biotite granodiorite' suite
- large (>900 km²) intrusive bodies
- hornblende and biotite-bearing (to 15 vol%) granodiorite
- silica-oversaturated (normative quartz 15-25%), metaluminous and potassic, with whole-rock MgO ranging from 0.43 to 0.53
- relatively restricted magnetic susceptibility readings (ms = +7 to +9)

3. Middle(?) Jurassic (170±4 Ma): 'K-feldspar megacrystic monzogranite' suite
- K-feldspar megacrystic monzogranite to granodiorite
- samples are calc-alkaline, metaluminous to peraluminous (Osprey Lk core)
- intermediate MgO similar to previous suites (0.47-.48), except at Osprey Lake pluton core (0.25-0.34)
- moderately magnetic (ms = +6 to +15)
- Cahill Creek satellite stock sample is lithologically and compositionally indistinguishable from samples of the Early Jurassic suite (U-Pb age = 168.8±9.3 Ma; Ray and Dawson, 1994) .

B. NECHAKO AREA:



GEOLOGY, PORPHYRY DEPOSITS AND SAMPLE LOCATIONS: A. SIMILKAMEEN, KAMLOOPS, CHILCOTIN AND CARIBOO REGIONS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93C
Gibraltar
WILLIAMS LAKE
STIKINIA
CACHE CREEK
QUESNELLIA
Mount Polley
920
92P
CLEARWATER
Poison Mtn
Mount Polley
Mount Polley
Maggie
KAMLOOPS
Highland Valley Bethlehem
COAST PLUTONIC COMPLEX
82L
Guichon Creek
Logan Lake
Highland Valley
Copper Mountain
Iona
Kwinitsa
Ajax
Kamloops Lake
Whiptail
Afton
Pinaleno
Pinaleno
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