Atlin TGI, Part I: An Introduction to the Atlin Targeted Geoscience Initiative

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INTRODUCTION

Placer gold exploration and mining within the Atlin camp has been an economic driving force for the region during much of the last century. However, the area is well endowed with geological environments prospective for other types of mineral deposits. Unfortunately exploration for commodities other than gold has received relatively little attention, in part because the existing regional geological framework for the Atlin area (104N) stems from mapping in the early 1950's, predating the advent of plate tectonic theory (Aitken, 1959).

To help address the disparity between high mineral potential values and low mineral exploration expenditures, a proposal to study the Atlin area was chosen from numerous geoscience proposals from across Canada to receive funding under the Targeted Geoscience Initiative of the Geological Survey of Canada (GSC). The Atlin Targeted Geoscience Initiative is a three-year, multi-disciplinary project aimed at a fundamental revision of the geological and mineral resource knowledgebase for the Atlin area of north-western British Columbia. Principal project components are regional aeromagnetic and geological mapping surveys within the Atlin map area (NTS 104N; Figure 1). Collection of high-resolution aeromagnetic data over the entire project area was initiated in 2000. During 2001, matching funding by the British Columbia Geological Survey(BCGS) permitted systematic bedrock mapping at a 1:50 000 scale in the

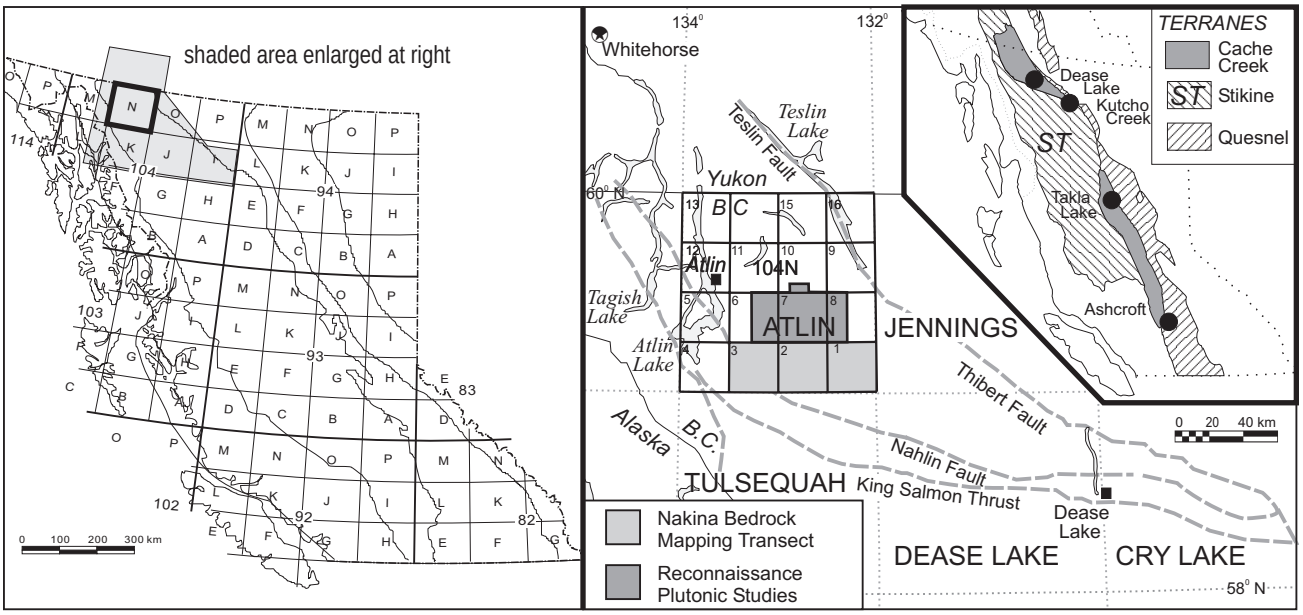

Figure 1. Location of the Atlin Integrated Geoscience Project in northwestern British Columbia. Bold outlined box (104N) shows extent of aeromagnetic survey. Regional geological mapping surveys were conducted over the eastern and central Nakina transect (104N/1 and 2). Reconnaissance plutonic studies covered parts of 104N/6, 7, 8 and 10.

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south-eastern project area (104N/1 and 2), as well as follow-up ground based magnetic and geologic surveys of post-accretionary plutonic bodies. Work conducted in 2001 involves researchers from the University of Victoria (UVic), The University of British Columbia (UBC) and Université Claude Bernard (UCB), Lyon, France. Geological map data collected in 2001 will be enhanced by geochemical, isotopic, and biogeochronological interpretations. Three university thesis studies initiated under the auspices of TGI will evaluate limestone sequence stratigraphy (Y. Merran, UCB), volcanic environments and petrogenesis (J. English, UVic) and tectonic evolution of serpentinite melange belts (F. Devine, UBC). A thesis study on the origin of ultramafites (G. Shellnut, UVic) received logistical support from the Atlin TGI, as did a CO_2 sequestration study (G. Dipple, UBC). *See* Table 1 for a detailed list of Atlin TGI participants and affiliated researchers.

PROJECT TIMELINE AND DELIVERABLES

Addressing Atlin TGI project objectives began early in 2000 with the production of shaded-relief digital elevation

TABLE 1
PRODUCTS PLANNED FOR THE ATLIN TGI

Topic	Person(s)	Affiliation	Product(s)	Status
Regional aeromagnetics	Dumont, R., Coyle, M. and Potvin, J.	GSC Ottawa	16 - 1:50 000 sheets	Complete
Aeromagnetic thematic studies	C. Lowe	GSC	Thematic maps and topical report(s)	Analysis underway
Regional mapping	M. Mihalynuk, S. Johnston, F. Cordey, F. Devine, J. English, Y. Merran, K. Larson	BCGS, UVic, UCB	1:50 000 sheets: 104N/1, 2 and 3	Compilation complete for 104N1&2
Magmatic rocks study	R. Anderson	GSC Vancouver	Input for magnetic modelling, topical report(s)	Samples in preparation
Radiolarian micropaleontology	F. Cordey	UCB	Fossil age database; approximately 80 age determinations	Results from first 24 samples in TGI Part II
Conodont micropaleontology	M. Orchard	GSC Vancouver	Fossil age database; approximately 25 samples in 2001	Sample preparation
Coral paleontology and paleobiogeography	W. Bamber	GSC Calgary	Fossil age database and paleobiogeographical interpretations	Preliminary identifications completed
Fusulinid paleontology and paleobiogeography	L. Rui	Paleontological contractor, Calgary	Fossil age database and paleobiogeographical interpretations	In preparation
Atlin geoscience lecture series	Johnston, S.T., Mihalynuk, M. Lowe, C. and Cordey, F.	UVic, BCGS, GSC, UCB	Four free public lectures in Atlin, summer 2001	Completed
Atlin Geoscape Poster	Anderson and others	GSC Vancouver	Public information in popular wall poster format	Mock-up complete
Petrogenesis of volcanic	J. English	UVic	M.Sc. thesis, presentations and papers	1st paper completed -see Atlin TGI Part III
Carbonate facies	Y. Merran	UCB	M.Sc. thesis, presentations and papers	Samples in preparation
Evolution of serpentinite mélange	F. Devine	UBC	B.Sc. thesis, presentations and paper	Geochronology samples in preparation
Ultramafites of the Cordillera	G. Shellnut	UVic	Ph.D. thesis, presentations and papers	1st paper in preparation for *Yukon Exploration and Geology*
Atlin area geochronology	M. Villeneuve	GSC Ottawa	Geochronological database and topical report(s)	Samples in preparation
CO_2 Sequestering potential of ultramafites	G. Dipple and students	UBC	Reconnaisance in 2001	Samples in preparation
Whitehorse Geoscience Forum presentation	C. Lowe and Mihalynuk, M.	GSC, BCGS	Oral presentations	Delivered
Cordilleran Roundup presentations	C. Lowe and others	GSC and others	Oral presentation (Lowe), 4 poster sessions	In preparation

models from Provincial 1:20 000 scale Terrain and Resource Information Management (TRIM) elevation data. This base was used to produce a colour-enhanced surficial geology map of the Atlin placer district. Existing geoscience information was compiled for the Atlin 1:250 000 sheet, based largely on an extensive compilation effort in the mid-nineties (Mihalynuk *et al*., 1996), but also using additional sources, such as unpublished 1:25 000 scale mapping by Jim Monger (GSC emeritus; cf. Monger, 1975). This new compilation map has been presented draped over the shaded relief elevation model. Also in 2000, a coincident release of reanalysed Regional Stream Sediment geochemical survey pulps by the BCGS (Jackaman *et al.*, 2000) aided in focusing the Atlin project in areas with stream sediment geochemical anomalies.

Approximately 32,000 line kilometres of aeromagnetic data was acquired over the entire project area in 2000 and early 2001. Flight lines were spaced 500 m apart and drape flown at a minimum terrain clearance of 200 m. To assist in interpretations of the airborne data, magnetic susceptibility measurements were made on archival hand samples, mainly from the BCGS rock stores. The aeromagnetic survey results have been published at 1:50 000 scale as a series of sixteen aeromagnetic anomaly maps (Dumont *et al*., 2001a, b, c and 13 others). Summer field programs in 2001 focused on geological mapping of NTS map sheets 104N/1 and 2 and ground investigations of selected magnetic anomalies. A preliminary report of the geological findings can be found in Atlin TGI Parts II and III (Mihalynuk *et al*., this volume; English *et al*., this volume).

Aeromagnetic data will be modeled and a geological map of 104N/1 will be produced for release in early 2002. In the summer of 2002, TGI project plans call for completion of mapping of 104N/2 and /3, and timely publication as Open File maps in early 2003.

AEROMAGNETIC SURVEY RESULTS SUMMARY

A summary of the Atlin aeromagnetic survey results is presented in Lowe and Anderson (2002). Highlights of the new aeromagnetic data set include:

1. Several, small (<5 km) sub-oval, positive and negative magnetic anomalies punctuate the subdued magnetic field that characterizes regions underlain by the Kedahda assemblage (dominated by cherts, argillites, siltstone and limestone) in the central part of the project area. At least two of these anomalies correlate with reported outcrops and subcrops of porphyry intrusions and with known copper mineralization.
2. Several E- to ENE-trending magnetic lineaments are imaged in the new data set. Two are more than 30 km long. They are not explained by known surface geology in the Atlin project area, although ENE-trending faults have been mapped in the Tagish map area farther to the west (Mihalynuk, 1999). These lineaments mark the southern boundary of some of the intrusive bodies and may be related to their emplacement or exhumation; as such they may represent important mineralizing conduits.
3. Crustal-scale faults such as the Nahlin, Llewellyn and Teslin correspond with strong northwest-trending magnetic lineaments. Magnetic lineaments with similar orientations transect the eastern portion of the Surprise Lake batholith and adjacent aureole where no faults have been mapped previously. Veins enriched with magnetite and base metals infill fractures at a number of localities along these lineaments.
4. Plutonic rocks show markedly different magnetic responses: the Fourth of July, Coconino, and Slaughter House intrusions correlate with strong, positive and relatively homogeneous magnetic anomalies; the Surprise Lake Suite of plutons are weakly magnetic; the magnetic fields observed over the Llangorse, Mount McMaster and Chichoida plutons are heterogeneous with distinct zones of positive and negative magnetic anomalies observed within each body.
5. Magnetic anomalies over exposures of the Nahlin ultramafite are the most intense within the map area. Data collected in the southern project area indicate that the body is a relatively shallowly north-dipping slab.

GEOLOGICAL SURVEY RESULTS SUMMARY

Preliminary results from mapping in the Nakina area are detailed in TGI Part II that follows this introduction (Mihalynuk *et al*., 2002). As part of the mapping program, extensive sample suites were collected for petrographic analysis, micro- and macro-paleontology, major and trace element lithogeochemistry, detailed stratigraphy, and isotope geochronology. At this stage, analysis of these samples is incomplete; results will be reported in succeeding papers.

Geological mapping conducted in other parts of the Atlin sheet focused on plutonic rocks with a six day reconnaissance mapping and sampling program over the McMaster and Llangorse plutons, their adjacent thermal aureoles and satellite stocks (cf. Lowe and Anderson, 2002), in part to explain aeromagnetic anomalies. Reconnaissance and detailed mapping of intrusions within the Atlin map area, including the Surprise Lake batholith, will resume during the 2002 field season. Questions addressed will concern the origin, timing and mode of emplacement of the intrusions and why anomalously high Regional Geochemical Survey stream sediment gold values are concentrated in streams draining the plutons and their aureoles.

CO_2 SEQUESTERING IN SERPENTINITE

Quartz-carbonate-mariposite altered serpentinites (listwanites) are widespread in the Atlin area where they have been the focus of lode gold exploration for most of the past century. They represent a geologic storehouse of carbon dioxide sequestered from mineralizing fluids during carbonation of magnesium silicate. They are also possible sinks for atmospheric CO_2, and are under investigation as part of an international effort to reduce greenhouse gases produced by combustion of fossil fuels. Greg Dipple (UBC) joined the Atlin TGI to initiate an NSERC funded study of

CO_2 sequestration in geologic systems. Media under investigation for industrial scale injection of CO_2 are asbestos waste rock piles and *in situ* serpentinite bodies. Critical for the efficacy of *in situ* sequestration are the initial and evolving state of serpentinite reservoir permeability and reaction kinetics as carbonation reactions proceed. Analysis of large-scale fossil CO_2 sequestering systems (listwanites) preserved in the Atlin area should provide insight into these questions. Dipple plans to have two thesis-based projects in place for the 2002 field season.

PUBLIC OUTREACH

Delivery and dissemination of geoscience information to a broad audience is a key objective of the Atlin TGI. To this end a series four free public geoscience lectures were delivered during the field season in Atlin. Continued delivery of project results will be by a combination of public lectures, posters sessions and conventional maps and reports (*see* Table 1). ***Atlin Geoscape***, a wall poster product aimed directly at public education is currently in production (Anderson). A project web site (http://www.pgc.nrcan.gc.ca/atlintgi) presents a project overview, current activities and project news.

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