HIGH-RESOLUTION REGIONAL AEROMAGNETIC SURVEY - INTERIOR PLATEAU BRITISH COLUMBIA

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INTRODUCTION

Exploration in the Interior Plateau of British Columbia has been inhibited by extensive glacial drift and recent (Miocene) lava flows (Diakow and van der Heyden, 1995). Accordingly, a high-resolution regional aeromagnetic survey was included as part of the Canada - Bristish Columbia Mineral Development Agreement 1991-1995. Additional funding was obtained from the Geological Survey of Canada and the private sector, allowing the survey to be extended to include all of NTS 92N and 93C and parts of 93F, 93G, 93A and 92O quadrants (Figure 1). The survey area includes part of the Coast Mountains in the southwest quadrant. The objectives of the survey were to map faults and boundaries between major lithological units at regional scales and, at larger scales, to help define intrusive and volcanic boundaries, faults and alteration zones. There was concern that the latter objective would require extensive processing to reduce the masking effect of the extensive Miocene cover.

METHODOLOGY

To meet the objective of acquiring a data set suitable for mapping at 1:50 000 scale, east-west flight lines were flown at 800-metre spacing, with north-south control lines at 5-kilometre intervals in a 'smooth-drape' mode, that is on a smooth surface nominally 305 metres above mean terrain clearance but limited by the safe climb and descent capacity of the aircraft. The contract was awarded to Geonex/Aerodat Ltd. in March, 1993, and the survey was flown during the late summer and early fall of 1993, with some reflights in the spring of 1994, from a base at Williams Lake. Geomagnetic diurnal monitors were located at Williams Lake, Anahim Lake and Vanderhoof. Three aircraft were utilized in the survey - a Cessna 404, Cessna 310

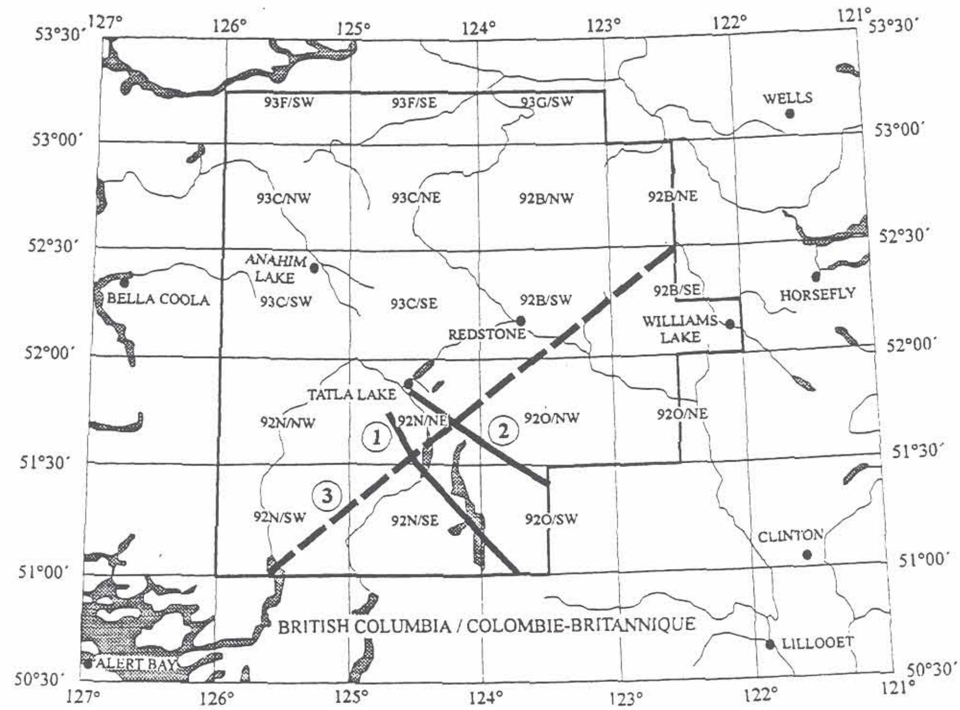

Figure 1. Area covered by high-resolution regional aeromagnetic survey. Approximate locations of 1-Tchaikazan fault, 2-Yalakom fault, 3-possible northeast-trending fault, as interpreted from the aeromagnetic data.

and Rockwell Aerocommander, each equipped with a stinger-mounted 0.005-nanotesla sensitivity split-beam cesium vapour magnetometer, together with radar and barometric altimeters and digital recording systems. Navigation was achieved by Global Positioning System (GPS), with differential corrections applied to determine final XYZ positions accurate to within 25 metres. An initial colour, residual total-field map at a scale of 1:250 000 was released as Geological Survey of Canada Open File 2785 in November, 1994 (GSC, 1994) while 1:100 000 total-field contour maps were released under the same Open File in June, 1995. The digital data are available from the GSC's Geophysical Data Centre (613-995-5326). Although the survey parameters were considered to be appropriate for 1:50 000 mapping, publication was limited to 1:100 000 in order that as much as possible of the available funding could be directed to the acquisition of high-resolution magnetic data. Larger scale maps, enhanced maps and derived products can, however, be obtained for the Geophysical Data Centre and can be generated from the digital data.

PROCESSING AND INTERPRETATION

Routine techniques that have been applied to the data set include: vertical gradient to delineate near-surface vertical contacts; shaded relief (illumination by an artificial light source at arbitrary inclination and declination), to emphasize linears and contacts perpendicular to the direction of the light source; and upward continuation to identify and map the extent of major units and intrusions. The actual interpretation of the original and derived data sets, combined with other available data sets (*i.e.* Radarsat), can often be carried out most effectively by geoscientists most familiar with a specific area. Further analytical interpretation that could be carried out includes modelling of individual profiles or anomalies; however, a careful selection of anomalies and integration of available geological and physical properties (*e.g.*, magnetization) is required for this approach to be effective. More automated procedures such as Euler (Reid *et al.*, 1990) or Werner (Hartman *et al.*, 1971) deconvolution techniques can be used to extract useful information on particular simple-source geometrics such as contacts, dikes and small intrusion on a more routine basis, however the results must be carefully interpreted.

PRELIMINARY RESULTS

The aeromagnetic total field maps and derived products reveal a wealth of information relevant to the structure of the area, a short and incomplete list of which are noted below.

Major fault systems are defined and/or redefined by the aeromagnetic data. Examples are:

- The Yalakom and Tchaikazan faults (Wheeler and McFeely, 1991), which merge on the southwestern boundary of the Tatla Lake Metamorphic Complex 10 to 15 kilometres west of the town of Tatla Lake. This confirms fault relationships shown on new geologic maps of the area (Mustard *et al.*, 1994; Mustard and van der Heyden, 1997, this volume).

  It also appears that the Yalakom fault system continues to the northwest into the Charlotte Lake map area (93C/3), although the structure becomes less well defined and cannot be confidently continued along trend through the entire Charlotte Lake area.
- A lineation, possibly the location of a major fault which can be traced across the survey area from southwest (51°, 125°50'W) to northeast (52°30'N, 122°30'W) (*see* Figure 1 for approximate location). The anomaly also has a signature on the residual gravity map corrected for isostasy (P. Keating, personal communication).

The general trend of magnetic patterns through the central part of the map area, northeast of the Yalakom fault, is north and northwest. This pattern is particularly evident along and parallel to the Fraser fault, which is seen as a dominant magnetic low, and its continuation north-northwest to the northern Fraser Plateau region, evident as parallel patterns of magnetic highs and lows.

Major features evident at the 1:250 000 scale include the Tatla Lake Metamorphic Complex (Mustard and van der Heyden, 1994) and major plutonic complexes of the Mount Waddington (NTS 92N; Tipper, 1969) and the southwest part of the Anahim Lake (NTS 93C) map areas. The latter areas contain complex aeromagnetic patterns, probably reflecting the presence of an intrusive complex comprising plutons of different compositions. Evidence to support this interpretation comes from new mapping and geochronologic studies in parts of these areas (van der Heyden *et al.*, 1994; Mustard *et al.*, 1994; Mustard and van der Heyden, 1997, this volume) and predicts there is similar complexity exists in the rest of the Mount Waddington area, which on regional-scale geologic maps has been shown as a few large plutonic bodies of similar general age (*e.g,* ,Klinaklini pluton of Tipper, 1969).

In addition to the confirmation of the main trends of the Yalakom and Tchaikazan fault systems, major plutonic bodies mapped by Mustard *et al.* (1994), Mustard and van der Heyden (1997, this volume) in NTS 92N/15 and N/14 (east half) are clearly delineated by the aeromagnetic data. The Wilderness Mountain and Klinaklini plutons are well defined, as are the Sapeye Creek pluton and an unnamed large plutonic body at the north end of the Niut Range. New geochronological data for these plutons demonstrate that they are Late Triassic in age rather than Cretaceous, as previously believed, and that the eastern pluton intrudes Middle Triassic volcanic rocks which host several zones of porphyry copper-gold mineralization probably related to pluton intrusion (*e.g.*, New Mac claim group, Mustard *et al.*, 1994). Several smaller aeromagnetic anomalies do not correspond to any mapped plutonic bodies or other indentified features. These may represent unexposed extensions of the known plutonic bodies or small unknown buried plutons.

Anomaly patterns can be identified and used to extend mapped Eocene volcanics on the tectonic assemblage map of Wheeler and McFeely (1991). The broad positive magnetic anomaly, slightly to the northeast of the Clisbako River study area (*ca.* 52°46'N, 124°10'W), is interpreted as the signature of a subvolcanic intrusion or stock underlying an Eocene volcanic centre interpreted by Metcalfe and Hickson (1995). The anomaly lies at the intersection of two linear magnetic discontinuities. The first was identified (P. Read, personal communication, 1995) as cospatial with the Chilcotin fault, whose trace is exposed to the southeast of the Clisbako River area. This anomaly extends northwest across the Clisbako volcanics from approximately 52°30'N, 123°30'W to 53°00'N, 124°15'W. Other magnetic discontinuities in this area are subparallel to the Chilcotin structure.

A second magnetic discontinuity crosses the area trending slighly south of due east, parallel to the trend of the Anahim volcanic belt. The intersection of the two discontinuities occurs at approximately 52°50'N, 124°05'W. If the east-west discontinuity is also interpreted as a significant structure in the basement, the implication is that the location of the Clisbako volcanic centre is controlled by such structures. Also implicit in this a hypothesis is the interpretation that such basement structures, being pre-Eocene, predate the Anahim belt volcanism. This does not disprove a proposed hot-spot origin for the Anahim belt volcanism, but suggests an additional structural control.

The Clisbako River area is also transected by numerous high-frequency north-bending trending anomalies, usually associated with areas underlain by Neogene Chilcotin Group basalts due to the abundance of magnetite in these rocks. The anomalies persist in areas which are not underlain by Chilcotin basalts but where scarcity of outcrop may conceal the presence of dikes. This interpretation does not, however, explain why these anomalies do not cut the large anomaly interpreted as an Eocene stock.

An interesting, and as yet unexplained feature, is the dominant north-westerly trending magnetic low in the southwest part of the study area; over part of the Coast Mountains. It may be the expression of a deeply buried source with reversed magnetization.

At 1:50 000-scale, the new data provide information of the extent and boundary contacts of mapped and possibly unmapped features which may be important loci for mineral deposits. Examples include:

- In the Fawnie Creek area (93F/3) mapped by Diakow and Webster (1994), several known (Wolf, Fawn and Buck) and new (Malaput and Tommy) epithermal occurrences have been explored in Eocene and Jurassic rocks. Mineralization in Jurassic rocks may be related to contacts with the Late Jurassic Capoose batholith exposed in the northern part of the sheet. The aeromagnetic data can play an important role in this area by mapping contact zones between the Jurassic, Cretaceous and Eocene rocks, faults and alteration zones within units, and different phases within the batholith. In some cases, the data could be used to plan more detailed geophysical surveys in areas of particular interest.
- In the Clisbako River area, mapped by Metcalfe and Hickson (1995), magnetic Eocene volcanics, occurring in a possible eroded caldera, host potetially economic epithermal mineralization. Two known deposits, Baez and Clisbako (Metcalfe and Hickson, 1995) occur on the flank of a magnetic anomaly associated with an eroded caldera and an outlier to the southeast, respectively.
- In the Mount Tatlow area (92O/5), the Fish Lake porphyry deposit occurs near the Yalkom fault and on the flank of a major magnetic anomaly associated with mapped Eocene volcanics. The deposit appears to lie on a faulted contact which may act as a conduit for mineralizing fluids. Plouffe (1997, this volume) has also noted the presence of a significant gold anomaly in till which is also located on the flank of an aeromagnetic anomaly in this area.

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