Airborne Electromagnetics and Airborne Gravity in the QUEST Project Area, Williams Lake to Mackenzie, British Columbia (parts of NTS 093A, B, G, H, J, K, N, O; 094C, D)

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Introduction

Geoscience BC's QUEST Project (QUesnellia Exploration STrategy) is designed to stimulate mineral exploration in the drift-covered section of the Quesnellia Terrane between Williams Lake and Mackenzie, British Columbia. This is a belt of highly prospective rocks that to date has had little exploration because of the till and lacustrine cover left by retreating glaciers (Logan et al., 2007).

At the northern and southern ends of the QUEST Project area, the Quaternary cover is thinner, and several important deposits have been discovered. At the southern end are the Gibraltar porphyry copper and the Mt. Polley porphyry copper-gold deposits, and at the northern end is the Mt. Milligan copper-gold porphyry deposit. A number of recent mineral discoveries have also been made further north from Mt. Milligan. An extension to the original QUEST survey area has been funded by the Northern Development Initiative Trust, based in Prince George, that will help stimulate further exploration to the northwest.

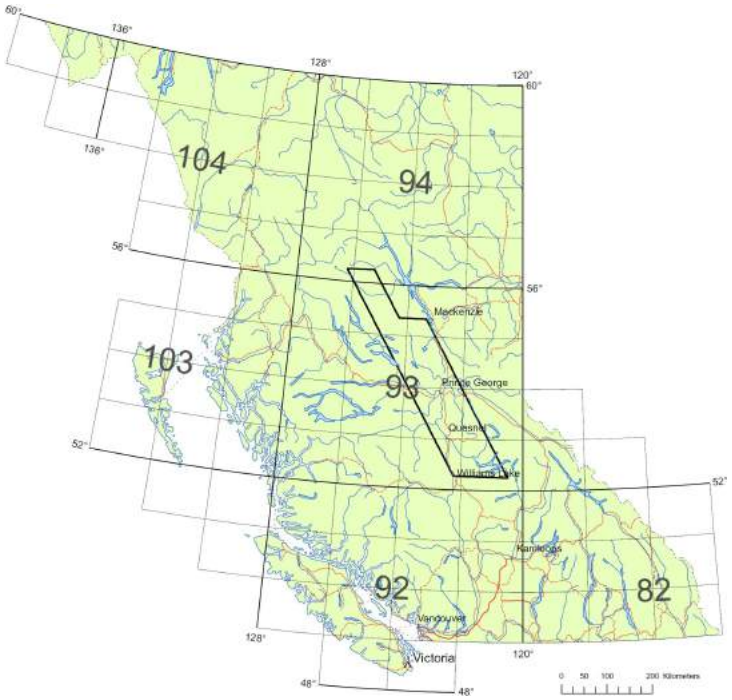

Figure 1. Location of the QUEST Project area, showing the outline of new airborne gravity and electromagnetic surveys being conducted in the QUEST Project. Note that any new deposits found in this area will be close to existing infrastructure.

Geoscience BC's QUEST Project will compile publicly available topographic, watershed, surficial and bedrock geology, geophysical, geochemical, mineral deposit and road access data for an area of approximately 150 000 km^2, centred on Prince George (Figure 1). Geoscience BC is also collecting approximately 2 100 new lake and sediment samples to increase the density of geochemical sampling north and west of Prince George (Jackaman and Balfour, 2008). In addition, new airborne gravity and electromagnetic surveys are being flown to help map the bedrock geology under the glacial drift and to provide a framework for further exploration in this area.

Keywords: *airborne gravity, airborne electromagnetics, regional geophysical surveys, porphyry copper-gold deposits, target generation, Quesnellia Terrane, QUEST Project*.

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Surficial Geology and Regional Geophysics

Figure 2 shows the surface geology of the QUEST Project area, based on the 1:1 000 000 geological map published by the BC Geological Survey (Massey et al., 2005). It can be seen that large areas of this map are pale yellow, which represents the Quaternary cover. Until recently it was thought that the thickness of the glacial overburden would make the exploitation of any new discovery uneconomic. Review of water well data and observations made during recent geological mapping suggests that the Quaternary cover may

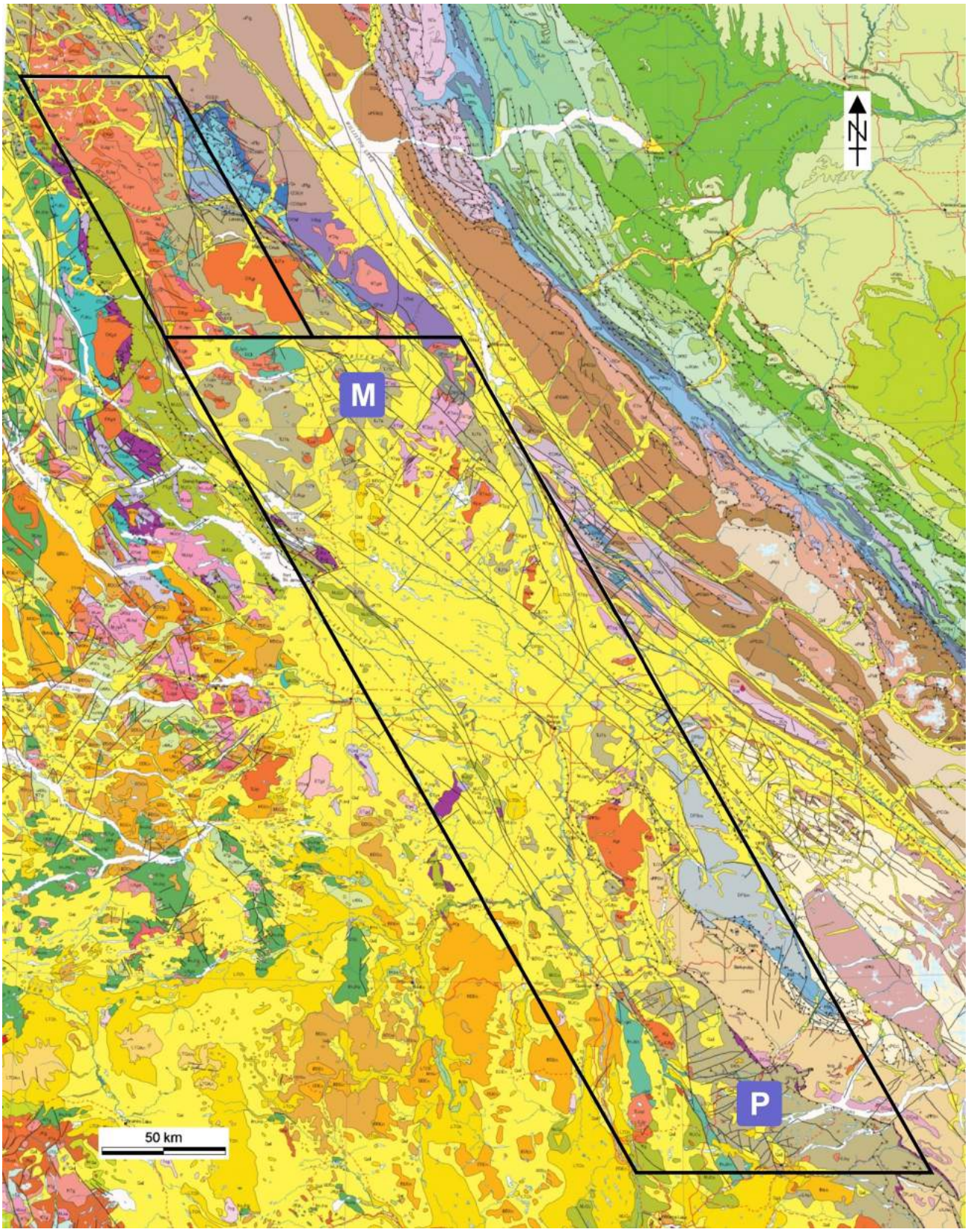

Figure 2. Surficial geological map of the QUEST Project area, showing the outline of the QUEST airborne gravity and electromagnetic surveys. The pale yellow areas represent the Quaternary overburden. Mt. Milligan is marked with an 'M', while Mt. Polley is marked with a 'P'. The smaller block to the northwest outlines the extension to the original QUEST geophysical survey area that was funded by a grant from the Northern Development Initiative Trust.

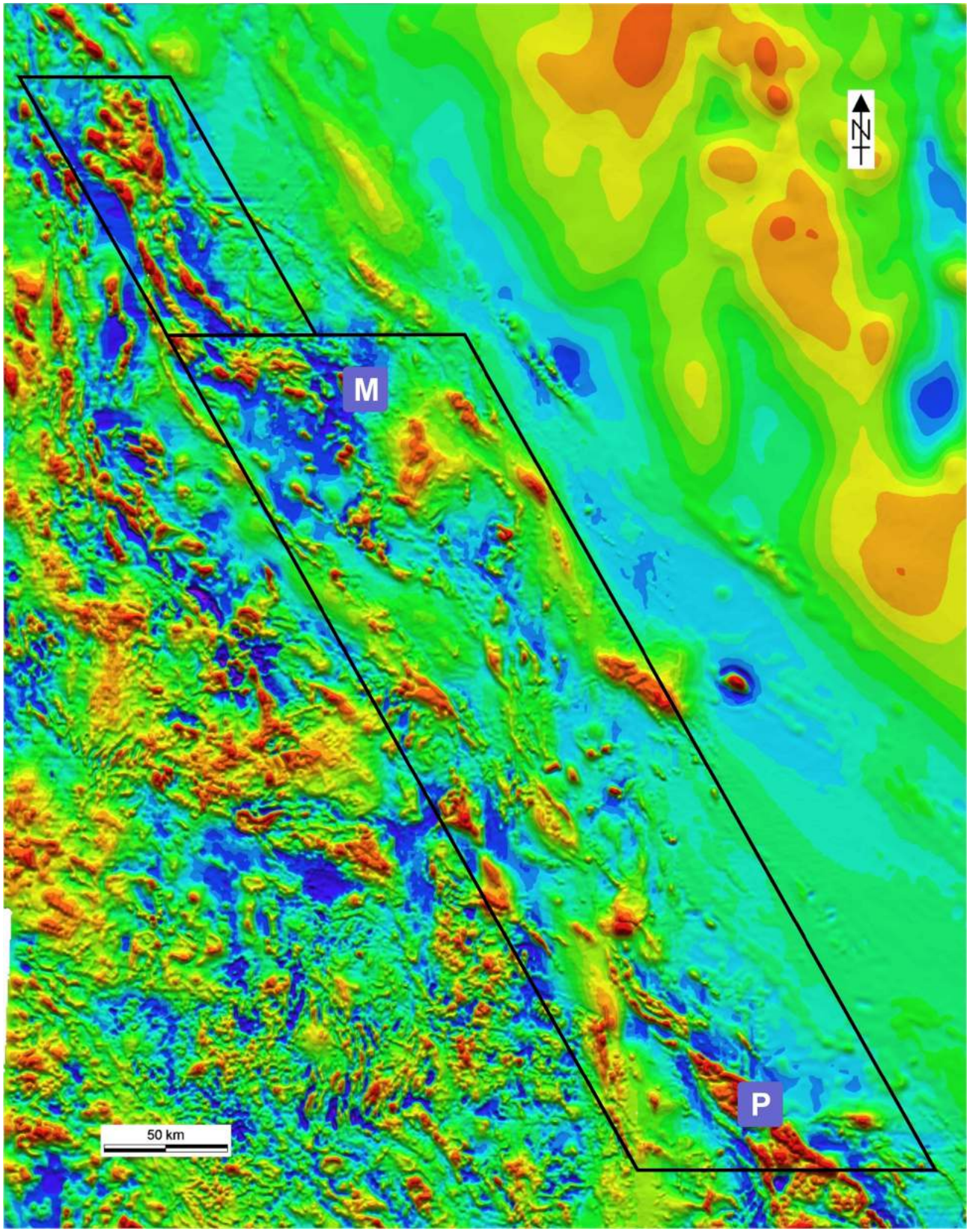

Figure 3. Reduced-to-pole magnetic image of the QUEST Project area, showing the outline of the QUEST airborne gravity and electromagnetic surveys. The grid interval for these data is about 250 m.

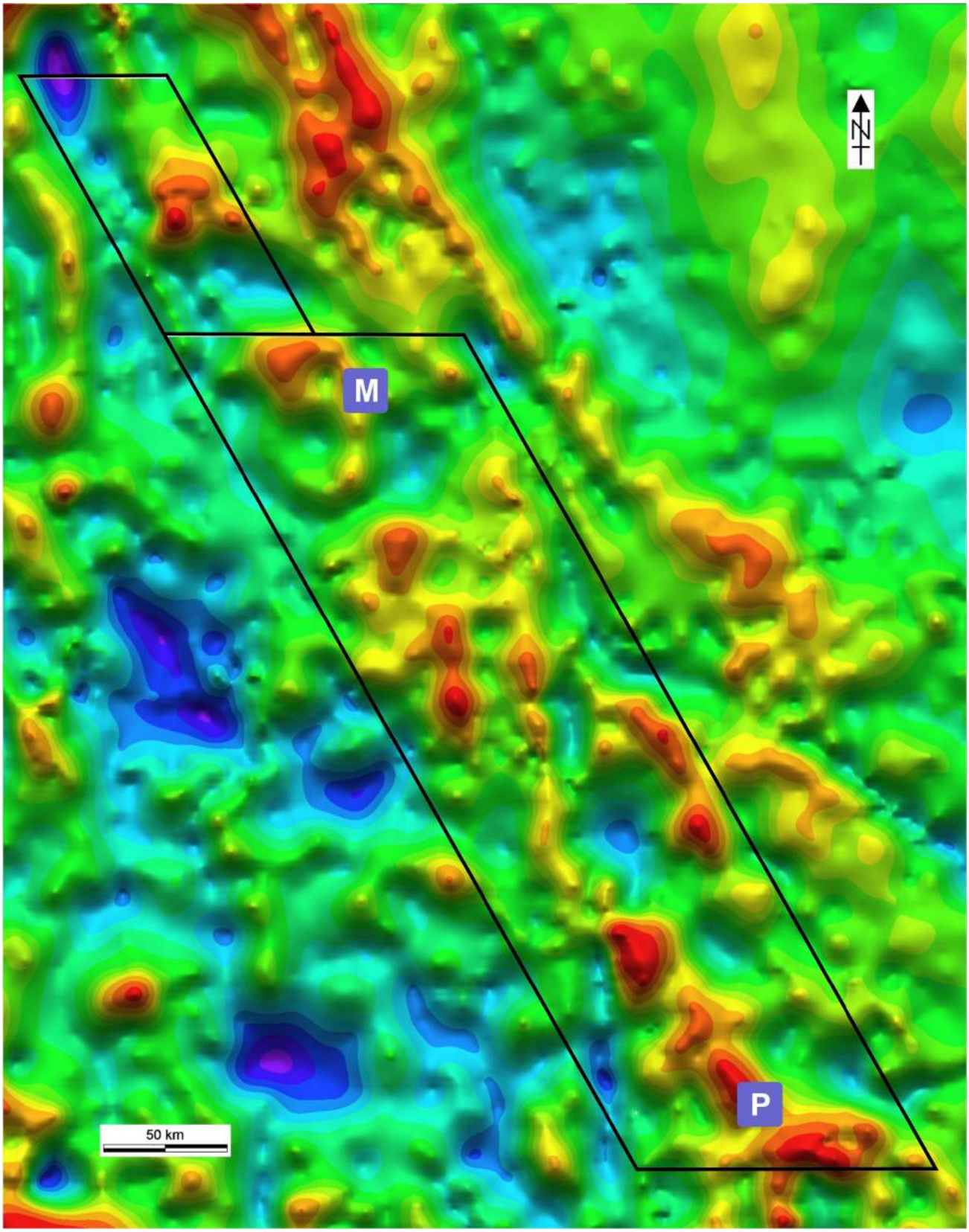

Figure 4. Isostatic residual gravity image of the QUEST Project area, showing the outline of the QUEST airborne gravity and electromagnetic surveys. The grid interval for these data is about 2 500 m.

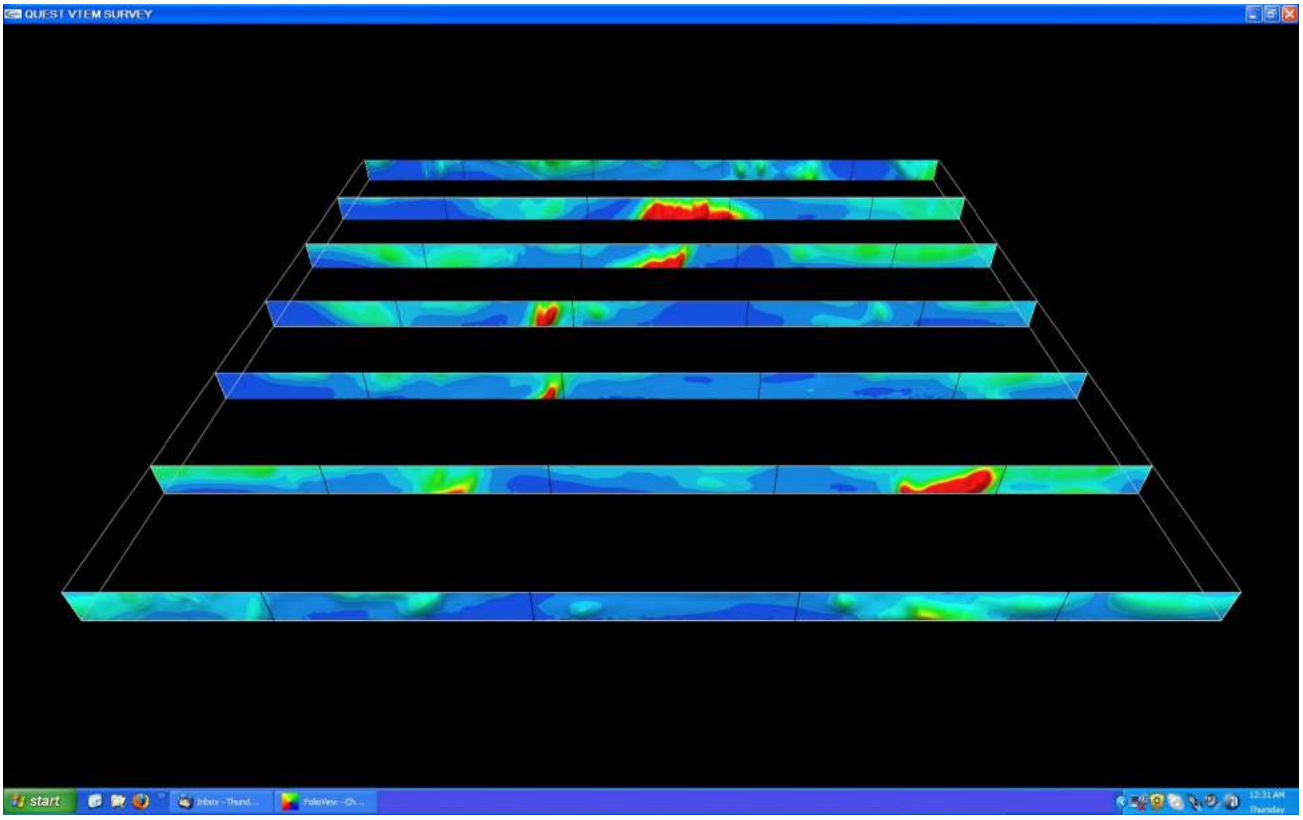

Figure 5. Perspective view of stacked airborne electromagnetic sections from a portion of the QUEST Project area. Resistive areas are shown in blue, while overburden conductors are highlighted in green and probable bedrock conductors, in red. The line spacing between the EM sections is 4000 m. Image produced by BW Mining, Boulder, Colorado.

not be as thick as previously assumed over much of the area (Andrews and Russell, 2008).

Figures 3 and 4 show the existing aeromagnetic and gravity datasets for the QUEST Project area that are available from Natural Resource Canada's Geoscience Data Repository (http://www.gdr.nrcan.gc.ca/). The majority of the magnetic surveys were flown on east-west flight lines at a line spacing of 805 m, which permits the data to be gridded at an interval of 250 m. The gravity readings were collected at an average station spacing of 10 km, which permits the data to be gridded only at a relatively coarse interval of 2 500 m. Nonetheless, both these datasets contain useful information. It can be seen, for example, that Mt. Polley (P) and Mt. Milligan (M) are spatially associated with magnetic and gravity highs, which are related to the Late Triassic and Early Jurassic alkalic intrusions that host these deposits.

New Airborne Geophysical Surveys

Although the existing aeromagnetic dataset could certainly be improved by flying lower and more closely spaced lines, it was felt that the existing data provide an adequate framework for exploration in this area. Geoscience BC's Project Development Team concluded that a greater advantage would be gained from an airborne gravity survey to improve the density of the existing ground stations, and an airborne electromagnetic survey to map conductivity. In combination, these data should complement the existing aeromagnetic dataset.

Figures 1 to 4 show the outline of the two new airborne surveys, which were designed to cover an area of approximately 46 000 km^2 in one field season. The gravity survey will be flown at a line spacing of 2 km to permit gridding the data at 500 m, which should result in a five-fold improvement over the existing data. The electromagnetic survey was flown at a line spacing of 4 km. The two surveys are being flown on matching east-west lines with the hope of mapping cross structures as well as the regional trend of the northwest-trending geology. Every second line will therefore contain both detailed gravity and EM traverses.

The gravity survey is currently in progress, and is being flown with the Sander AIRGrav fixed-wing system. The airborne gravity survey should map the plutons at depth, which are expected to be important controls for any porphyry copper or copper-gold deposits, and differentiate lithologies in the subsurface geology based on their density.

The electromagnetic survey was completed in late October, and was flown with the Geotech VTEM helicopter-borne

system. This electromagnetic system was selected for the QUEST Project as it has the power to penetrate the Quaternary cover, in order to map the basement conductivity and to provide an indication of areas where the cover is thinner and hence of greater possible economic interest to the exploration industry.

The VTEM data are still being processed, but the initial results indicate that the system is seeing through the Quaternary overburden and picking up discrete conductors in the bedrock. Figure 5 shows a perspective view of stacked vertical time sections of the VTEM data for a small portion of the QUEST Project. Areas shown in blue are resistive, while areas shown in green are more conductive and typically represent the glacial till. A number of discrete conductors are shown in red.These are just preliminary sections, designed for quality-control purposes rather than interpretation, and a rigorous inversion of the data will be carried out in due course.

Conclusions

Geoscience BC's QUEST Project was initiated to add to the geoscience knowledge of, and to stimulate exploration interest in, the covered areas of the Quesnel Terrane in central BC. An airborne electromagnetic survey on a 4 km line spacing has been completed and an airborne gravity survey on a 2 km line spacing has been initiated over Geoscience BC's QUEST Project area. The processing of the electromagnetic data is in hand, and the data should be ready for release in January 2008. The airborne gravity survey is still in progress, and the data will be released as soon as possible after the completion of the survey. The new airborne gravity and electromagnetic survey data will complement the existing ground-based gravity data and airborne magnetic data available through NRCan's Geoscience Data Repository. The QUEST geophysical surveys are supported by the new geochemical data being made available as a part of the QUEST Project and by the existing geological, geophysical, remote sensing and topographic data.

Ultimately, QUEST's goal is to stimulate new exploration activity in the area, and to accelerate the rate of new mineral discoveries, hopefully resulting in the development of one or more new mines in the area. The new airborne surveys will complement the existing airborne magnetic information. The airborne geophysics, along with the detailed topography, water well data and ground observations. should provide a powerful data set to map the thickness of the Quaternary. To assist with the identification of economic deposits, an integrated folio of maps representing the multiple layers of exploration data sets will also be produced. In addition, over the coming year, Geoscience BC intends to work with geologists in government, academia and industry to develop revised interpretations of the subcropping geology using the results of the new QUEST geophysics and geochemistry.

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