Levelling of Aeromagnetic Surveys in Canada

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The levelling of aeromagnetic surveys covering Canada has been achieved in two steps. A project was set up to produce a series of 1:1 000 000 aeromagnetic total field colour maps (Teskey *et al.*,1982). To accomplish this, line data from contour maps compiled at 1:63 360 (1 inch to 1 mile) were digitized, gridded and levelled to adjacent surveys. This project began in the late 1970s and lasted about a decade. A continuous, seamless aeromagnetic grid extending from Alberta to the Atlantic Ocean and from the United States border to the Arctic Ocean was created using regional surveys. These surveys were flown at a mean terrain clearance of 305 m (1000 feet) with a line spacing of 815 m (½ mile). Smaller grids using drape-flown surveys from British Columbia and the Yukon Territory were also assembled.

The levelling of individual surveys was performed by first subtracting the International Geomagnetic Reference Field for the year of the survey for each survey grid. Then the difference at the boundary of adjacent surveys was removed using a low-order polynomial. The remaining errors were locally smoothed out where required (Teskey *et al.*,1982). This project required the participation of a number of private companies to digitize flight line contour intercepts. This was accomplished in three years, under the supervision of the Geological Survey of Canada (GSC). The line data were archived on a survey basis, and this accumulated data resulted in the creation of the National Aeromagnetic Data Base.

In 1989 a second phase of the levelling of Canadian aeromagnetic surveys was initiated by the Ontario Geological Survey (OGS) in co-operation with the Geological Survey of Canada. The project consisted in the making of a "Single Master Aeromagnetic Grid for the province of Ontario at a uniform grid spacing of 200 m" (Reford *et al.*, 1990). This required the regridding of the digitized line data to a finer grid cell size and the subsequent transfer of the levelling adjustment which was previously applied to the regional grid in the first phase of the project. The existing 812.8 m cell size grid was re-gridded to match the unlevelled 200 m grid. A Naudy filter was applied to the difference between the two grids to retain only the level adjustments. The grid of the level adjustments was then subtracted from the original unlevelled total field grid. The line data for the digitized surveys were extracted by interpolation from the 200 m levelled grid. The levelling adjustments for the digitally acquired surveys were calculated from the adjustment grid and applied directly to the line data. The project was realized by Paterson Grant & Watson on behalf of the OGS and the GSC. Subsequently, an identical procedure was applied to the aeromagnetic survey data of the Atlantic provinces, Manitoba and Saskatchewan. The procedure was slightly modified for the processing of the surveys for the province of Québec and the Northwest Territories. For these surveys, the levelling adjustment was systematically calculated from the adjustment grid. The adjustment was then applied to the line data, avoiding the regeneration of profile data from the levelled grid.

In the past decade, a series of surveys were flown at constant barometric altitude over the Rocky Mountains. These surveys bridge the gap in the aeromagnetic coverage between the drape-flown surveys on each side of Rocky Mountains. Linking of the drape-flown levelled aeromagnetic grids to the constant altitude aeromagnetic survey grids has been attempted by computational draping of the constant altitude surveys. At first, this was done by means of analytical calculation of a drape surface using the constant altitude surveys and a digital terrain model over mountainous regions. This method introduced noise into the resulting levelled data and was deemed unsuccessful in merging of adjacent surveys. Later, a surface simulating an aircraft flying over this area with a 5% maximum slope (Figure 1) was calculated and used as the drape surface which greatly improved the quality of the merged surveys. The method used for draping is based on a Taylor series expansion of the magnetic field on the measurement surface (Pilkington and Roest, 1992). This approach has been evaluated along with the COMPUDRAPE technique (Paterson *et al.*, 1990) in areas where coincident drape-flown and constant altitude survey data are available. Both computational draping methods compare well to the drape-flown data (Pilkington *et al.*, 1995), validating their use in the levelling of the Rocky Mountain surveys. Figure 2 shows the constant altitude surveys in Alberta and British Columbia that have been draped. The resulting levelled and merged data are shown in Figure 3.

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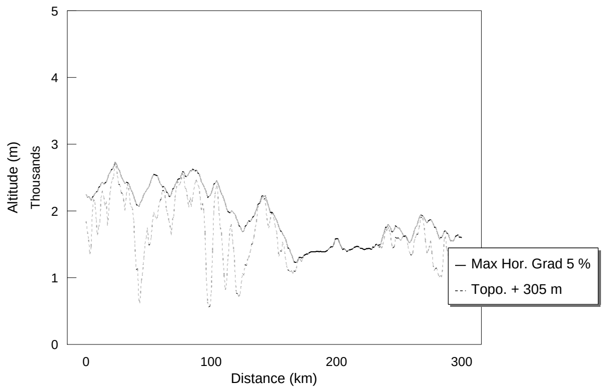

Figure 1: *Relation between draping surfaces. Solid line is the surface specified by adding a constant 300 m flight height to the digitized terrain values. Dashed line shows the modified surface restricted to a maximum 5% horizontal gradient.*

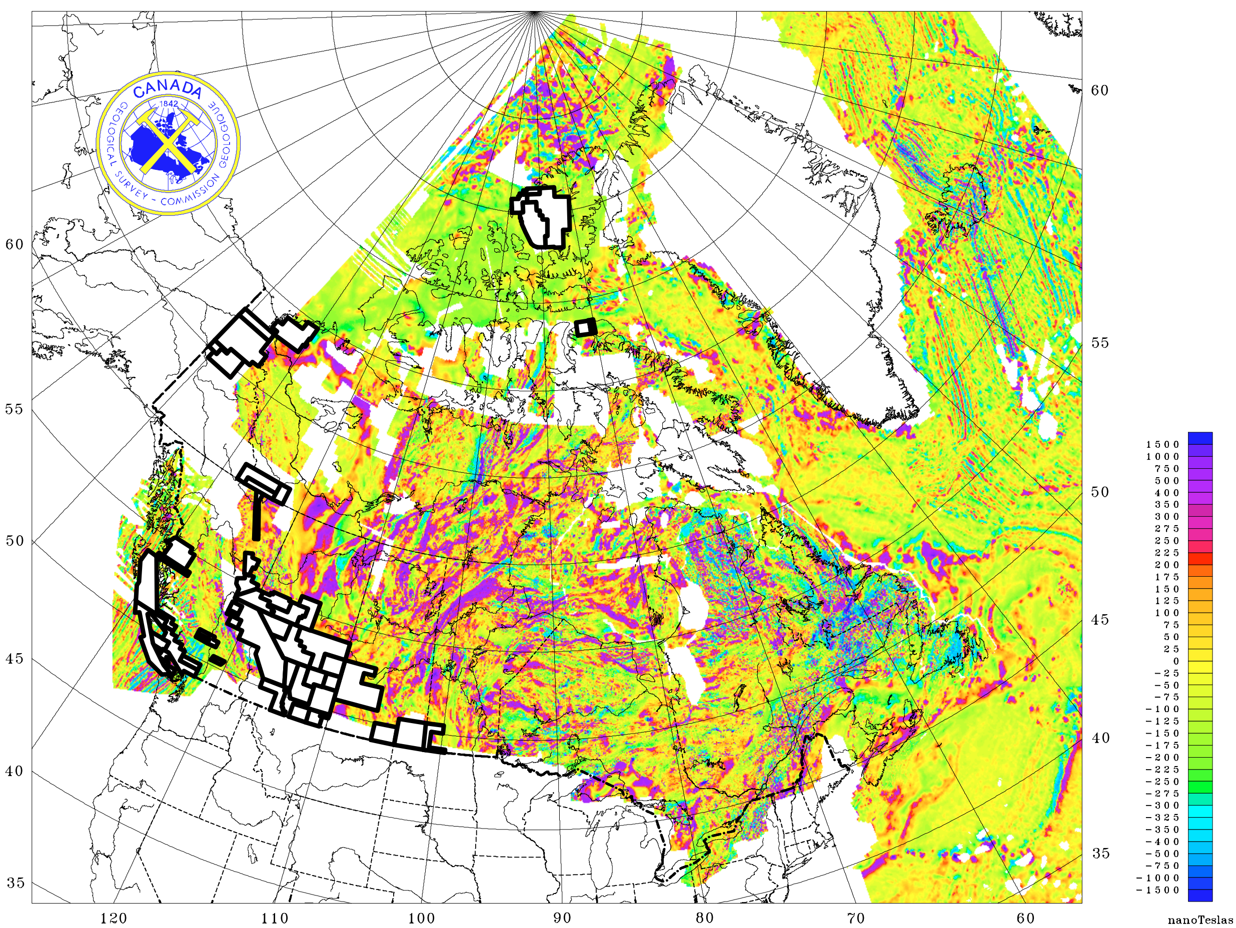

Figure 2: *Location of constant altitude surveys in Alberta and British Columbia that have been computationally draped.*

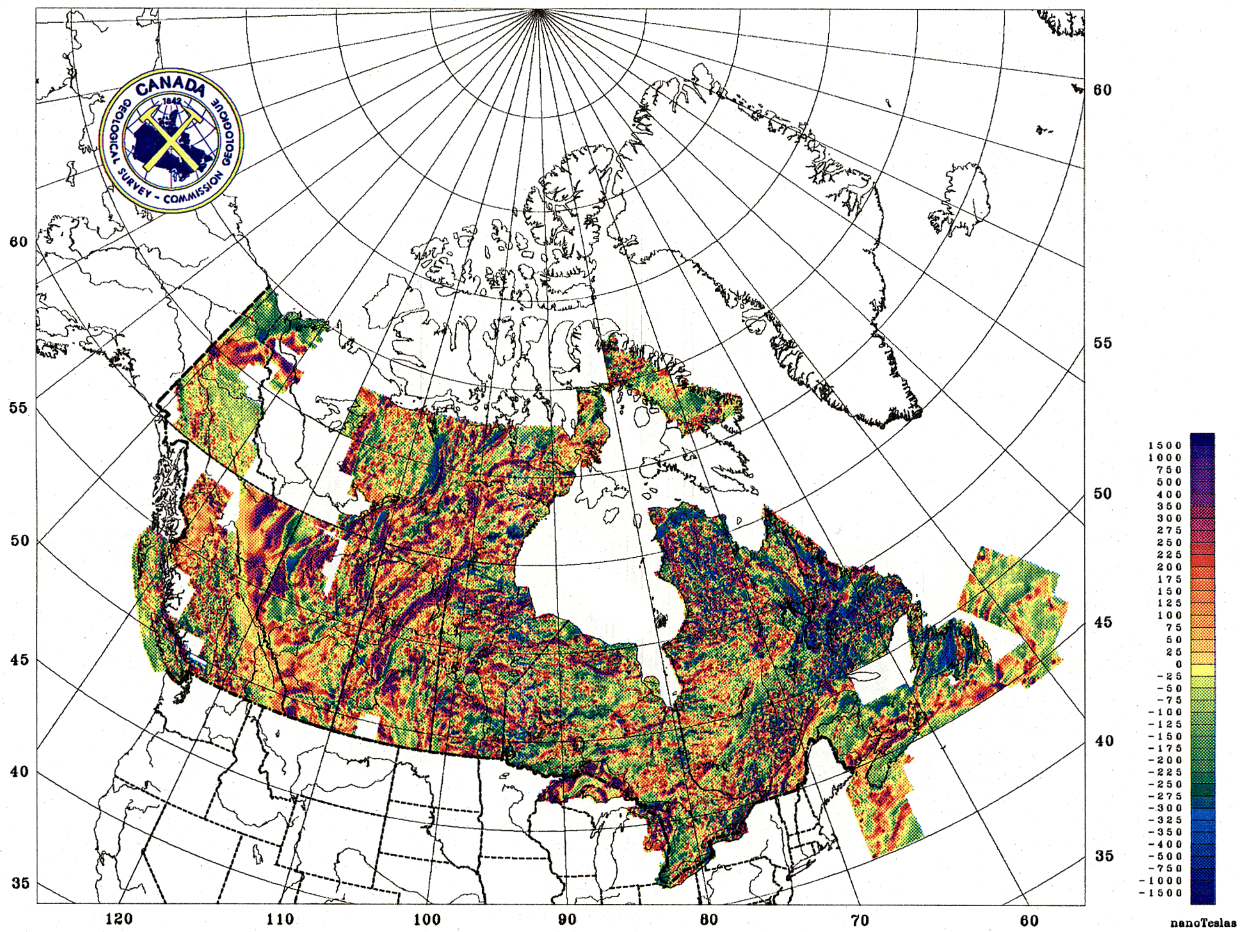

Figure 3: *Current state of the levelled data coverage of Canada.*

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