OPEN FILE

A magnetic susceptibility map has been prepared under contract by Paterson, Grant and Watson Ltd. of Toronto for an area northwest of Timmins, Ontario. The 1:25,000 magnetic susceptibility map was derived from the high resolution aeromagmetic survey data published by the Geological Survey of Canada as Maps 20,005G (NTS 42A/12a), 20,006G (NTS 42A/12h), 20,008G (NTS 42A/11d) and 20,009G (NTS 42A/11e). The map is intended to display the effective volume magnetic susceptibility of the rock formations which produce the magnetic patterns seen on the total field aeromagnetic maps.

Blackline copies of the magnetic susceptibility map together with a three-page description of the technique and a brief discussion of features on the map prepared by Dr. Fraser S. Grant are available from Campbell Quickprint, 85 Sparks Street, Ottawa, K1P 5A7.

NOTES TO ACCOMPANY MAGNETIC SUSCEPTIBILITY CONTOUR MAP

The contours show the volume magnetic susceptibilities (in 10^{-3} e.m.u.) of the rocks which lie at or close to the bedrock surface, as calculated from the aeromagnetic survey data. The model that is assumed for the ground is an array of vertical prisms measuring 0.1 inch by 0.1 inch at the published map scale(approximately 208 feet by 208 feet on the ground) whose tops terminate at the bedrock surface and whose bottoms lie at an indeterminate depth below the bedrock. Each of the prisms has a uniform magnetic susceptibility whose value is calculated directly from the matrix of aeromagnetic intensity values interpolated by computer onto a 0.1 inch x 0.1 inch grid. The calculations are performed by a deconvolution process using the MAGMAP® computer program of Paterson, Grant and Watson Limited.

Prior to making the susceptibility calculations, large-scale regional trends including uncorrected geomagnetic gradients are removed from the data by filtering methods which are based upon the analysis of the spectrum of the total intensity map. This procedure ensures that only those magnetic effects which have a near-surface origin remain in the data, and that the magnetic susceptibility map will relate to the rocks which lie at or close to the bedrock surface. Since most of the area is covered with overburden whose thickness varies between 0 and 200 feet, the bedrock surface has been assumed throughout the calculations to be at an average depth of 100 feet below the ground.

Magnetic susceptibility is a measure of the quantity of magnetic minerals - principally magnetite and maghemite - which the rocks contain. There is a rough proportionality between the volume magnetic susceptibility of a rock and its volume percentage of magnetite or magnetite equivalent, the relationship being approximately as follows:

volume magnetic susceptibility (in e.m.u.) $\doteq$

$2.5 \times 10^{-3} \times$ volume percentage magnetite (or equivalent).

Thus, the magnetic susceptibility contours show the distribution of the accessory minerals magnetite and maghemite in the near-surface rocks. The actual bedrock lithology must be interpreted from these contours.

Certain features in the susceptibility map are distinct enough that they leave little doubt as to their probable geological origin. The long, narrow zones of medium to high susceptibility (up to 3×10^{-3} e.m.u.) which strike in a generally northerly to northwesterly direction through Godfrey, Jamieson, MacDiarmid, and Reid Townships are undoubtedly related to diabase dikes which are known to exist in this region. The localized areas of medium and high susceptibility (up to 10×10^{-3} e.m.u.) in the vicinity of the common junction of Turnbull, Godfrey, Jamieson, and Robb Townships correspond with known outcrops of intrusive gabbro and other ultramafic rocks which are partially serpentized in places. This is also a topographically high region, a fact which may have exaggerated the susceptibility values somewhat. The northeast-striking zones of moderate susceptibility (up to 2×10^{-3} e.m.u.) in Jessop Township are also quite prominent, but the composition of these rocks is not known. Numerous other less well-developed patterns of accessory mineral distribution

throughout the area should prove to be useful in conjunction with drilling and other information for mapping the bedrock geology. Several of the more distinct lineations appear to be interrupted by cross-cutting features, suggesting different ages of intrusion. In some areas, faulting can be inferred from offsets.

The appearance of negative magnetic susceptibility values in the map requires some explanation. Negative susceptibility areas which lie immediately adjacent to moderately or strongly magnetic zones are often caused by "overshoot" in the computer calculations. These are to be regarded as "shadow zones" from which no useable information about rock susceptibilities can be inferred. A zone of negative susceptibility which is not in close proximity to a positive zone may indicate the presence of inversely magnetized rock. This condition is usually caused by factors related to the thermal history of the rock, but it is sometimes also brought about by later chemical alteration. Some negative features can be seen in the east central part of Mac Diarmid Township.

The changes in magnetic susceptibility levels at the borders of intrusive bodies such as dikes and plugs should be quite sharp. Wherever these changes appear to take place gradually, it may be inferred that either the bedrock surface is deeper than has been supposed, or that the intrusion has not reached the bedrock surface. Examples of features which clearly lie at depths which are greater than 100 feet may be found in Mountjoy, Jessop, and Kidd Townships, and in the eastern parts of Jamieson and MacDiarmid Townships.

Mineral zoning patterns or border metamorphism effects that are associated with intrusions are sometimes visible in magnetic susceptibility maps. No examples of these processes are apparent in this survey.

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