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STRUCTURE OF THE THOMPSON MINE AND ITS SURROUNDINGS, MANITOBA

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INTRODUCTION

Two block diagrams are presented that illustrate the structure and geological setting of the Early Proterozoic Thompson Ni sulphide ore body. For a recent description of the geology and tectono-metamorphic history of the Thompson Nickel Belt, the reader is referred to Bleeker (1990) and Bleeker and Macek (1988a). A detailed map of the Thompson Open Pit has been published earlier (Bleeker, 1989) and provides details on mesoscopic structures and lithologies comprising the mine sequence.

BLOCK DIAGRAMS

The block diagrams are scaled orthographic projections, in which the observer is looking down 35°, towards almost due north (N002°E). Surface coordinates are northings and eastings of the Thompson Mine grid. To aid in visualization of the attitudes of fold structures, the legend provides examples of projected F_3 fold axes of given orientation, all lying within the macroscopic S_3 axial plane as determined for the Open Pit.

The reference surface shown is an $S_0(S_2)$ foliation surface along the metapelitic schist unit of the Early Proterozoic Ospwagen group cover sequence (Bleeker, 1989). Within the extent of the Thompson ore body, the reference surface follows the ore zone. Beyond the Thompson ore body, sedimentary sulphides (sulphide facies iron formation) in the metapelitic schist unit are followed. Where schist and associated sulphide are lacking, the reference horizon is interpolated between stratigraphically overlying and underlying lithologies.

Data used for the construction are INCO Ltd. exploration drill hole data compiled on "200 scale" (1:2400) drill sections, level maps of T_1 underground mine on the main south plunging F3 hinge, surface mapping of the Thompson Open Pit (Bleeker, 1989) and the regional surface geology as interpreted from scattered outcrops and up-dip projection of exploration drill hole data. Reliability of the data varies considerably and is best for the domain between T1 and T3 headframes. Except for the plunges of the main F3 folds at T_1, plunge attitudes are only moderately constrained; some had to be interpreted.

The first diagram presents the mine structure as a part of the larger doubly plunging Thompson structure. The distribution of ultramafic boudins along the reference horizon is indicated as compiled by INCO geologists on exploration sections and longitudinal projections.

The second diagram shows the southern portion of the structure. It also illustrates the geometry of an ultramafic dike, which occurs in the hanging wall of the mine sequence and is correlated with the Molson dike swarm (Bleeker, 1989).

DESCRIPTION OF FIGURE 1

Although the Ospwagan Group cover sequence has been transposed, the nature of the transposition is such that enveloping surfaces to particular lithostratigraphic units show overall parallelism to each other and to S_0. In spite of polyphase isoclinal folding, the mine sequence has, therefore, preserved much of the original lithostratigraphy. Stratigraphic analysis throughout the Thompson Nickel Belt has shown that detailed correlations can be made (Bleeker and Macek, 1988a). Based on this regional lithostratigraphic analysis , an overall younging direction can be recognized in the mine sequence. The term overall younging direction indicates that only the large scale stratigraphic asymmetry can be used to determine younging. Small scale indicators, if preserved at all, are unreliable due to abundant isoclinal folding unless they are used on a statistical basis.

The overall younging direction across the reference surface is indicated by its patterned top. The upright, doubly plunging fold structures (F_3) are all downward-facing and are developed on the regionally overturned limb of an F_1 nappe. The nappe extends from Moak Lake Mine in the north to Pipe Mine in the south and hosts the Moak, Mystery, Thompson, Birchtree, Pipe I and Pipe II deposits in its sedimentary core.

F_3 refolding of the overturned limb resulted in steeply doubly plunging synforms and antiforms, which follow each other in an en echelon pattern. Besides F_3 folds, a few vertically plunging F_5 folds can be seen in the #2 zone, i.e. the short, vertical limb of the main south plunging F3 antiform. Although mesoscopic interference structures involving F_3 and older F_2 folds are common, only a few macroscopic examples are known and no attempt has been made to incorporate these structures into the diagram. Isoclinal F2 folds are, however, important in the # 1 zone [1], and thickening in their steep, northeasterly plunging hinges appears to control some of the linear ore shoots.

The reference horizon forms several 'zones' corresponding to F_3 fold limbs. Significant Ni mineralization is associated with the # 1, 2 and 3 zones (Thompson Mine terminology) but appears to be absent on the # 4, 5 and 6 zones. The # 4 and 5 zones and the northern parts of the # 1 and 2 zones appear to be devoid of the ultramafic boudins

[1] The #1 zone is the southeastern limb of the structure, i.e. the limb on which the open pit and T3 shaft are situated (see Figure 1).

but barren sedimentary sulphides have been intersected along those parts of the reference horizon. The # 6 zone hosts large ultramafic lenses but appears to be devoid of abundant sedimentary sulphides. The location of the Thompson ore body along the reference horizon seems to correlate therefore with the combined presence of ultramafic boudins and abundant sedimentary sulphides (Bleeker, 1989; Bleeker and Macek, 1988a; Peredery and Geological Staff, 1982).

All ultramafic boudins in the # 1, 2 and 3 zones are probably remnants of a single pre-F_1 ultramafic sill which intruded along the pelitic sediments of the Ospwagan group cover sequence. The ultramafic lenses in the # 6 zone may have been parts of the same sill or parts of satellite sills along the same stratigraphic horizon. The northern part of the # 6 zone can be traced northwards along the east shore of Mystery Lake, where it hosts or stratigraphically underlies one of the bigger ultramafic bodies in the Thompson Nickel Belt.

DESCRIPTION OF FIGURE 2

Figure 2 shows a more detailed view of the southern part of the Thompson structure, using the same reference surface as in Figure 1. In addition, it shows an ultramafic dike which has been mapped in the hanging-wall of the Open Pit (Bleeker, 1989). The subsurface geometry of the dike as shown in Figure 2 is based on tracing this distinctive lithology as it is recorded in "100 scale" exploration sections. The three central lenses, which succeed each other in a probably primary en echelon pattern, are reasonably well constrained. The other two lenses are based on only a few drill sections and are more highly interpretive.

One segment of the ultramafic body transects the gneiss-metasediment contact, thus demonstrating its intrusive nature. Other features such as the en echelon disposition of the lenses and the presence of smaller en echelon offshoots support this.

The dike is of interest because (1) it can be correlated with the 1883 Ma Molson dike swarm (Heaman et al., 1986) and (2) it appears to be post-F_1 in age. The relative age relationship is suggested by only moderate internal strain and the weak boudinage of this body, as compared to much higher strain indicated by the widely separated boudins of the ore-related ultramafic sills (cf. Figure 1 and 2).

Similar relationships have been observed in Pipe II Open Pit (Bleeker and Macek, 1988a and b), and imply that the Molson dike swarm is distinctly younger than, and unrelated to, the ultramafic sills that are associated with the Ni sulphide ore bodies. They further indicate that emplacement of the nappe occurred prior to 1883 Ma and that the Molson swarm cannot be the original rifting swarm (Hubregtse, 1980; Green et al, 1985).

CONCLUSIONS

The Thompson ore body occurs on the regionally overturned limb of an F_1 nappe structure which was emplaced on the Superior plate margin prior to 1882 Ma. All known nickel deposits in the Moak Lake-Pipe Lake section of the Thompson Nickel Belt occur within the metasedimentary core of this nappe.

The nappe is refolded by F_2, F_3, and several subsequent fold generations. No macroscopic examples of unambiguous F2 folds are yet recognized. Nearly upright, tight, doubly plunging F3 folds are dominant throughout the Thompson Nickel Belt, and have transposed previous flat-lying schists and gneisses into their present subvertical attitudes.

The Thompson structure consists of a series of tight F3 folds, causing repetition of the metasedimentary sequence and the potential ore horizon into several subparallel zones. The Thompson ore body occupies only a small domain of the potential ore horizon. Its location correlates with a highly disrupted ultramafic sill and with abundant sedimentary sulphide bands in the metapelitic host rocks.

No indications have been found that the Ni sulphides were mobilized far beyond their original host horizon. The large extent of Ni sulphides along this horizon is a reflection of the stretching of the original ultramafic sill and metasedimentary host rocks on the overturned limb of the F_1 nappe. Whereas the ultramafic sill accommodated the extension by boudinage, the Ni sulphides extended by stretching with the metasedimentary envelope. As a consequence, significant Ni sulphides do not extend beyond the range of major ultramafic boudins.

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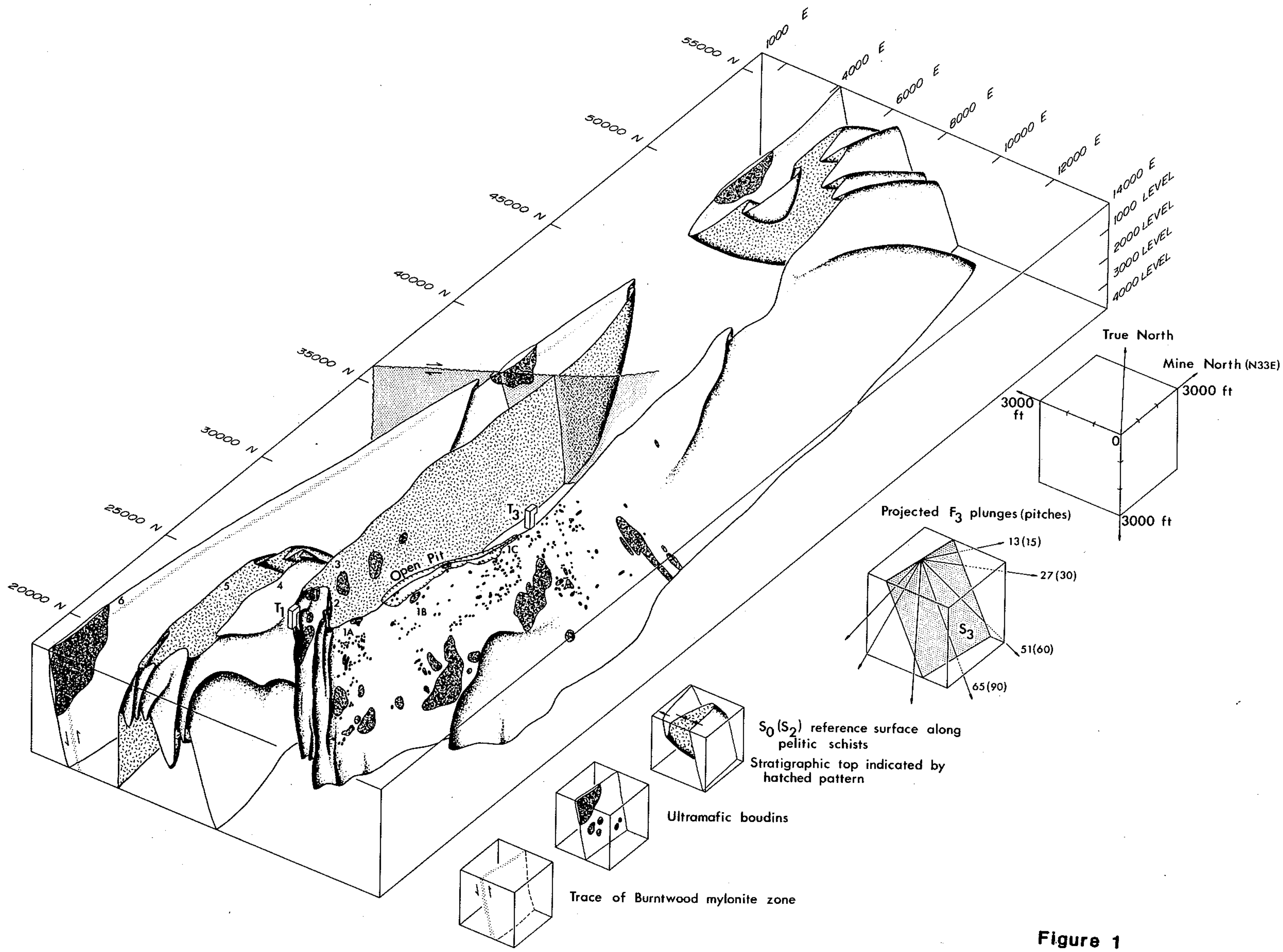
FIGURE CAPTIONS

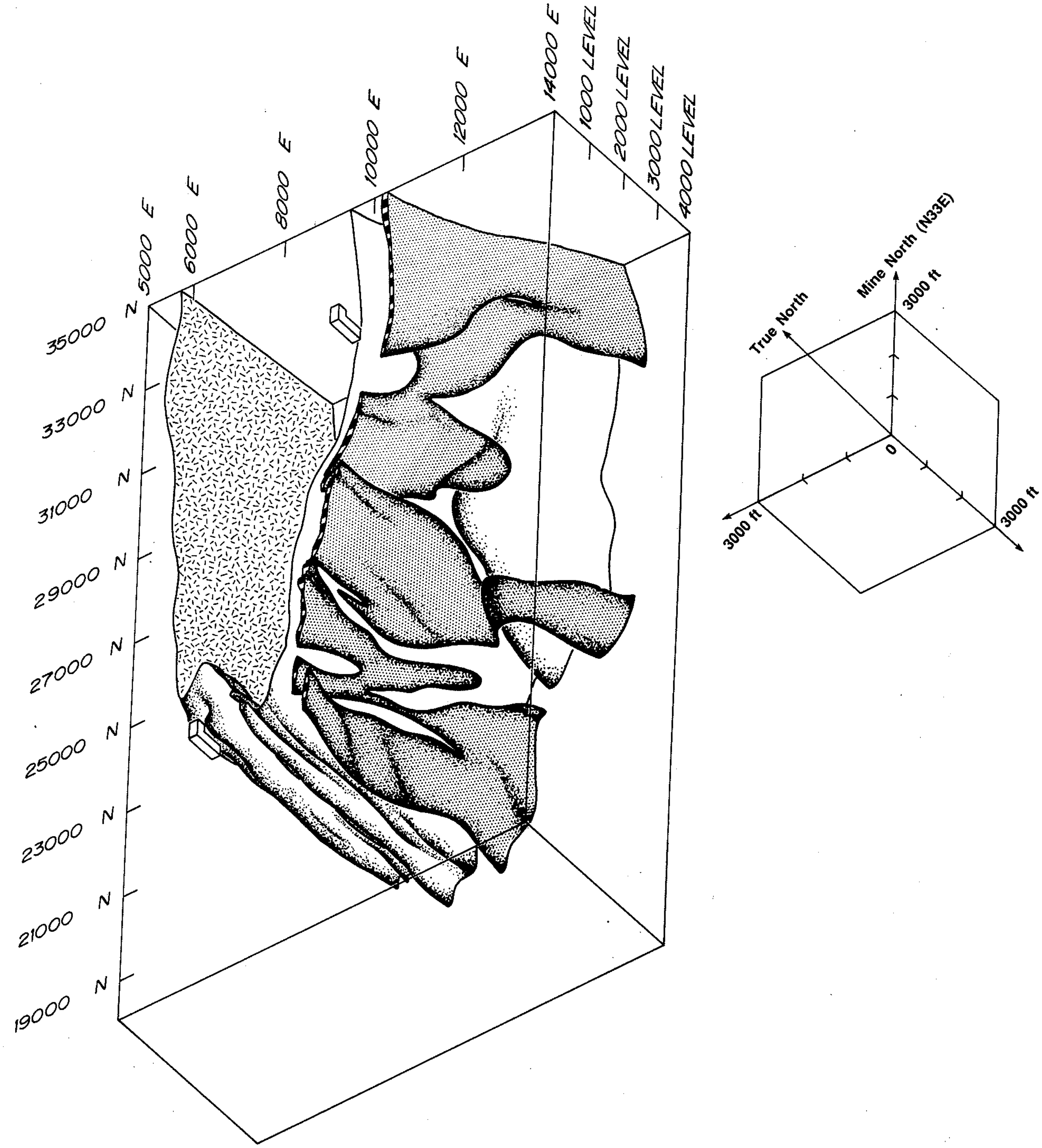
Figure 1: Scaled orthographic block diagram of the Thompson structure. The projected reference surface is an $S_0(S_2)$ foliation surface along the metapelitic schists of the Early Proterozoic Ospwagan group cover sequence. The stratabound Thompson ore body and ultramafic boudins that are interpreted as remnants of the original parent sill are situated along this reference horizon. Stratigraphic facing of the reference surface is indicated by its patterned top. Locations of the T1 and T3 headframes, as well as the Thompson Open Pit, are indicated. Note that the reference surface appears at the surface along several northeast trending 'zones', which correspond with the limbs of the tight upright folds (F_3). These zones are numbered #1 through 6, starting from the southeast. Further explanation is given in the text.

Figure 2: Scaled orthographic block diagram of the southern portion of the Thompson structure, illustrating the geometry of an ultramafic Molson dike in the hanging wall of the # 1 zone. Further explanation is given in the text.



55000 N
50000 N
45000 N
40000 N
35000 N
30000 N
25000 N
20000 N
1000 E
4000 E
6000 E
8000 E
10000 E
12000 E
14000 E
1000 LEVEL
2000 LEVEL
3000 LEVEL
4000 LEVEL
Open Pit
T1
T3
1A
1B
1C
2
3
4
5
6
True North
Mine North (N33E)
3000 ft
3000 ft
3000 ft
0
Projected F3 plunges (pitches)
13(15)
27(30)
51(60)
65(90)
S3
S0 (S2) reference surface along pelitic schists
Stratigraphic top indicated by hatched pattern
Ultramafic boudins
Trace of Burntwood mylonite zone

Figure 1



35000 N
33000 N
31000 N
29000 N
27000 N
25000 N
23000 N
21000 N
19000 N
5000 E
6000 E
8000 E
10000 E
12000 E
14000 E
1000 LEVEL
2000 LEVEL
3000 LEVEL
4000 LEVEL
True North
Mine North (N33E)
3000 ft
3000 ft
3000 ft
0

Figure 2