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MAGNETIC FIELD MEASUREMENTS AT THE CREIGHTON MINE

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INTRODUCTION

With coordinates 46°30'N latitude, 81°01'W longitude, Sudbury has a terrestrial total magnetic field (see Figure 1) of magnitude 58 kgamma (1 gamma = 1 nT) directed downwards with a dip angle of close to 75 deg. Given the need to provide the lowest magnetic field possible in the SNO detector tank, a survey of magnetic fields at the 6800 ft level in the Creighton Mine was carried out to look for possible changes from field values at the surface, and any anomalies which might be present.

Two instruments were used for the survey. Most measurements were made with a portable fluxgate magnetometer (FM) (Scintrex Model MF-2-100) which can determine vertical component fields 0 - 200 kgamma, with a precision of 5 gamma. Some horizontal field values were also measured with this instrument. A portable proton magnetometer (PM) (E.G.& G. Model G 816) obtained from the INCO Geophysical Exploration group, was also used for some measurements of total field. This instrument is sensitive to interference from AC power lines or other equipment, and measures total field only.

Measurements were made during a mine visit on July 12 at locations including typical surface buildings, outside locations, and sites on the 6800 ft level, particularly at the observatory drift. The effects of steel structures on field values both underground and on the surface were also investigated.

RESULTS

Both instruments were calibrated following standard procedures and gave the following values for the outside field (1.5 m above ground) at several Sudbury locations:

PM instrument 57.5 +/- 0.5 kgamma (total field)
FM instrument 50 +/- 3 kgamma (vertical component)
9 +/- 3 kgamma (horizontal component)

There appears to be about a 10% systematic difference between the total fields measured by both instruments. The dip angle of 80 deg is quite consistent with expected values.

Results of the measurements with both instruments are listed in Tables 1 and 2. Locations on the 6800 ft level are shown on the level map (Figure 2).

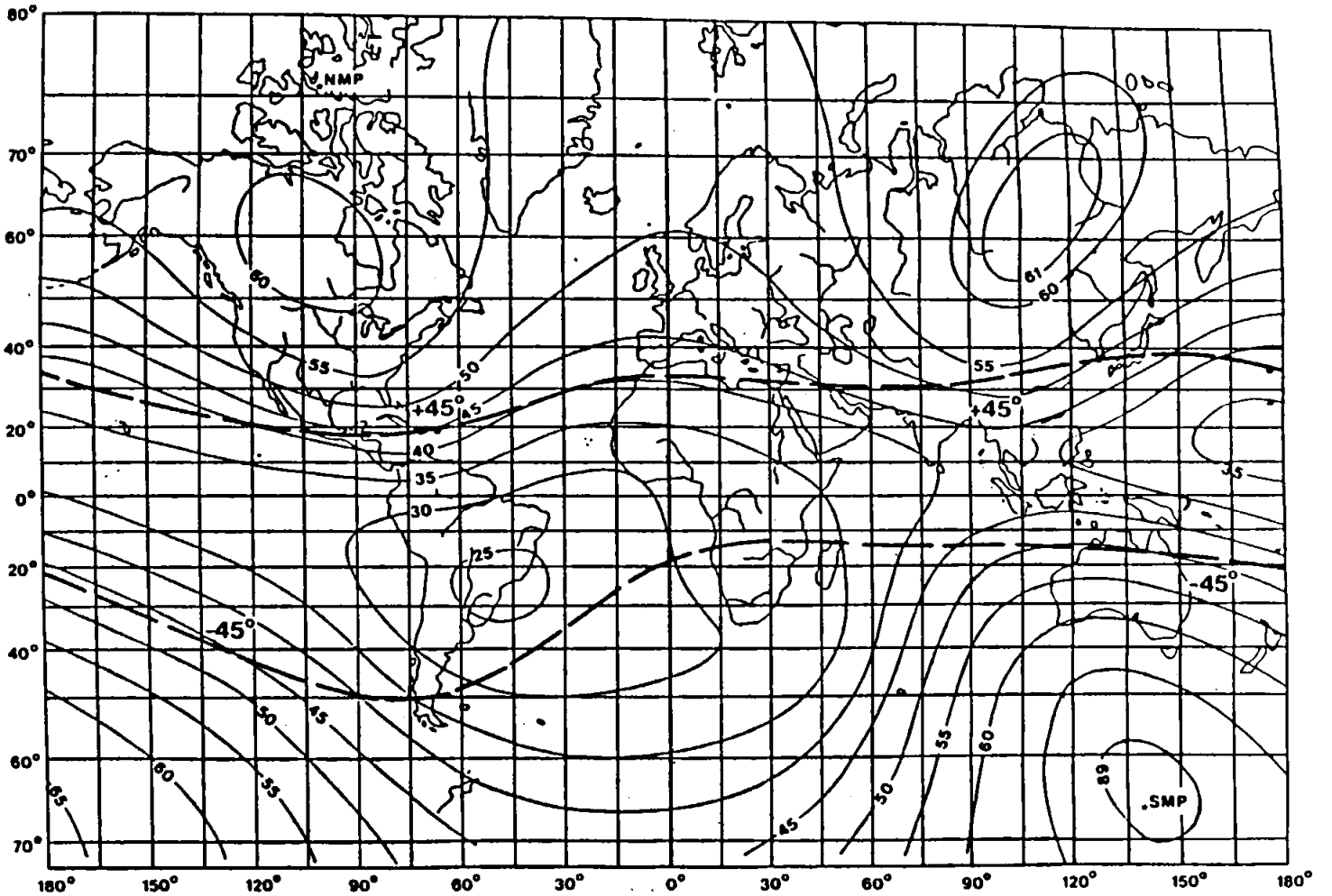

Figure 1
Total magnetic intensity in kilogammas with contours of 45° inclination. In the northern hemisphere, the total field direction is considered to be downwards (positive) and in the southern hemisphere, to be upwards (negative).

Table 1 Magnetic Field Measurements

LOCATION	INSTRUMENT	FIELD (kgamma) V (vert)	H (horiz)	T (total)	NOTES
Creighton Parking Lot	PM	57.5		T	
6800 ft Creighton Mine #9 shaft - 10 m in	PM	55 +/- 5		V	2 m above gnd
	FM	57.5		T	1 m " "
	FM	10		V	20 cm from scoop of tram
	FM	95		V	20 cm from flat car (1.5 x 3 m)
6800 ft LEVEL - site 1 (drift next to SNO)	FM	60 +/- 3		V	1.5 m above gnd
	FM	100		V	5 cm from rail
	PM	56 +/- 2		T	1-3 m above gnd
- site 2	FM	52 +/- 3		V	1 m above gnd
	FM	20 +/- 5		H	see Fig 2 - dir.
(junc. SNO drift)	PM	54 +/- 2		T	2 m " "
	FM	63 +/- 3		V	10 cm from wall (steel mesh)
- site 3 (power centre)	FM	57 +/- 3		V	
	FM	20 +/- 10		V	1 m from 4 ore cars (side)
	FM	100 +/- 20		V	1 m from car end
	FM	55		V	5 m " " "
- site 4 (wash station)	PM	53 +/- 2		T	2 m height
	FM	55 +/- 1		V	across drift
	FM	15 +/- 5		H	see Fig 2 for direction
	FM	65		V	at cross sec J (anomaly)
	FM	25		V	20 cm from scissors lift
- site 5 (ore pass)	FM	55 +/- 1		V	see Table 2 for plate data
	FM	0		V	5 cm from rail
	FM	95 +/- 5		V	5 cm from rail
Fraser Building (L.U.) Laboratory F 541	FM		40 +/-10	V	steel lab benches
	FM		7.5 +/-3	H	(dip angle 80 deg.)
Office F 531	FM		30	V	
			6	H	(approx. mag north)

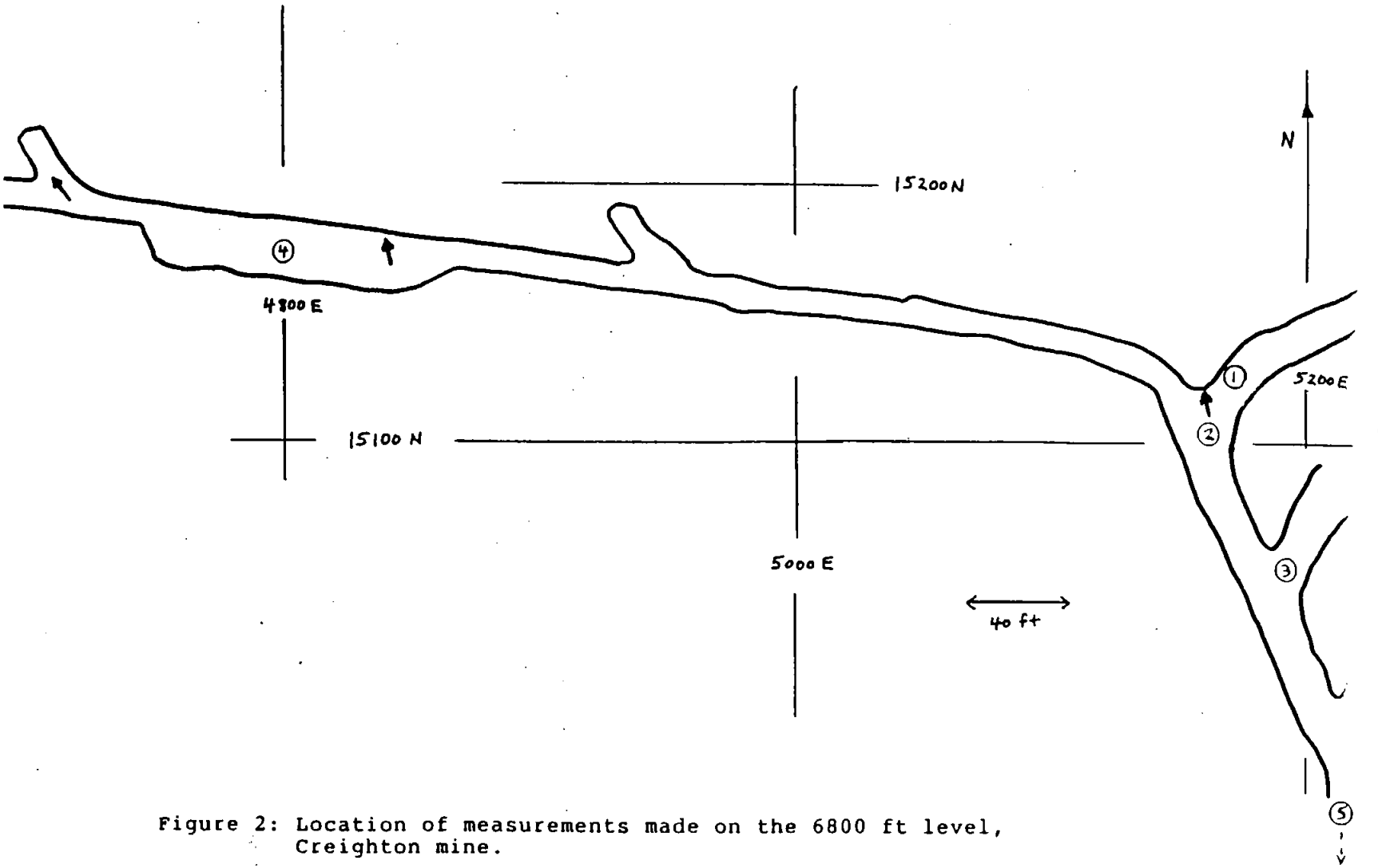

Figure 2: Location of measurements made on the 6800 ft level, Creighton mine.

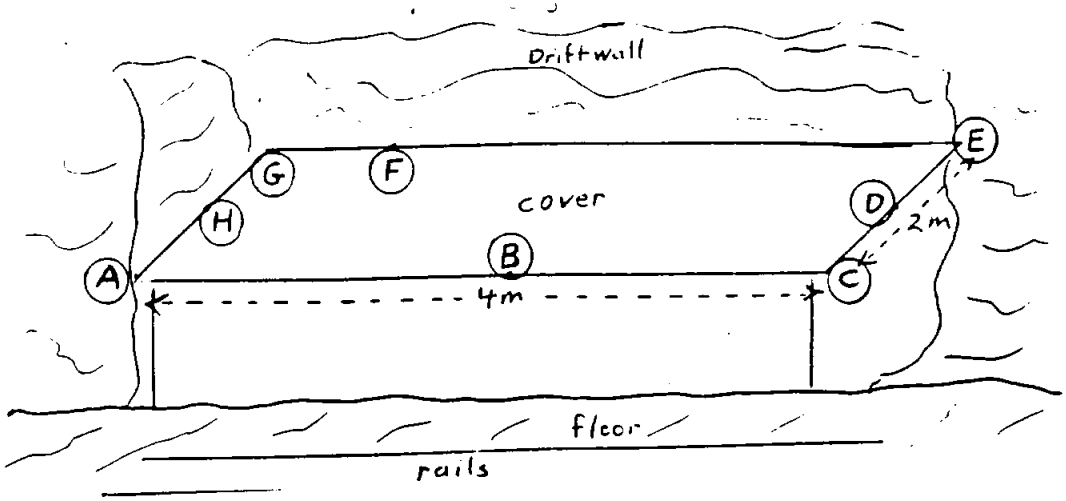

Figure 3: Magnetic field measurement locations - ore pass steel plate cover (6800 ft level, near # 8 shaft)

Table 2 Magnetic Fields near 4 m x 2 m horizontal ore pass cover (site 5) measured with FM (1.5 m above gnd)

Location (see Fig 3)	Distance away from plate edge (m)	Magnetic Field vertical (kgamma)
A	1.0	35
	0.1	90
B	1.0	60
	0.1	46
C	1.0	65
	0.1	72
D	1.0	60
	0.1	50
F	0.1	40
G	1.0	35
H	1.0	28
	0.1	34
D (above	0.1	40
G plate)	0.1	80
H	0.1	52

DISCUSSION & CONCLUSIONS

Clearly, underground data with both instruments is consistent with a vertical field value of 55 +/- 5 kgamma, and a horizontal field value of about 15 kgamma in a direction generally towards magnetic north. Some anomalies of up to 10 kgamma were observed, but field uniformity was generally good.

Near steel objects, variations of field from 0 to 100 kgamma (vertical) were observed. Values measured were consistent with a dipolar field for the (magnetized) object, which cancels or reinforces the earth field depending on orientation.

In a surface building, with steel reinforcing rods and lab equipment, variations in the vertical field were also observed, very similar to those seen underground.

It seems clear that no special conditions for magnetic fields are present underground. To assess the field inside the SNO detector tank, we would recommend measurements near a similar stainless steel tank in some existing installation (water tanks etc.).