2010 Ground Magnetometer Survey 2

On

Everton Recources Inc.'s

Shoal Lake Property – North Machin Option

Kenora Mining Division

Shoal Lake, Echo Bay, Showshoe Bay, and Glass Townships

NTS 52 E / 10 and 52 E / 11

April 16, 2010

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1.0 Summary

Clark Exploration Consulting was contracted in March, 2010 to cut 12.5 line-kilometers of geophysical grid and conduct a 50m line-spaced ground magnetometer survey. This ground magnetometer survey directly adjoins the previous magnetometer survey conducted by Clark Exploration Consulting over a portion of Shoal Lake – report dated March 17, 2010. A total of 12.5 line-km of cesium ground magnetometer were performed from April 6, 2010 to March 12, 2010. The focus of the exploration was on the ground portion of an area of the Shoal Lake Deformation Zone (SLDZ) where a large flexure occurs. Observable in airborne magnetics, this flexure was mapped in 1990 as an east-west trending dextral shear zone containing 4 gold occurrences within 1500 meters of strike length. The ground magnetometer survey was designed to test the detailed geophysical response in the area of the flexure to try and pickup features that may not have been realized in the airborne survey.

The survey was done on ground by a geophysical technician wearing a Geometrics G-859 'back-pack' cesium-vapour magnetometer. A Geometrics G-856AX proton precession magnetometer was used as a base station for measuring and correction for diurnal variation. Post-processing and gridding was then carried out on the data.

Features that would be interpreted as structures representing second-order splays and zones of dilation were not recognized. Ground magnetics should be obtained for lines with bad data. All data should be stitched to the existing grid to help visualize the relationship to the gold showings.

2.0 Introduction

Clark Exploration Consulting was contracted in March, 2010 to cut 12.5 line-kilometers of geophysical grid and conduct a 50m line-spaced ground magnetometer survey. This ground magnetometer survey directly adjoins the previous magnetometer survey conducted by Clark Exploration Consulting over a portion of Shoal Lake – report dated March 17, 2010. A total of 12.5 line-km of cesium ground magnetometer were performed from April 7, 2010 to March 11, 2010.

3.0 Property Description

The Shoal Lake Property (hereafter referred to simply as "the Property") consists of 149 Mining Dispositions (patents / leases) totaling 2612 hectares (Table 1) and 44 Mining Claims totaling 6157 hectares located in Shoal Lake, Echo Bay, Showshoe Bay, and Glass Townships in the Kenora Mining Division (Table 2, Figures 1 and 2). The Property is a large land package consisting of option agreements between many different parties. The land package shown below (in both tables and figures) is the current extent of all contiguous options in the area.

The claim on which the ground magnetometer survey was performed (K3019219) is currently under option from Machin Mines (via John Scott Roberts). Figure 3 is a detailed map showing the location and extent of the claim.

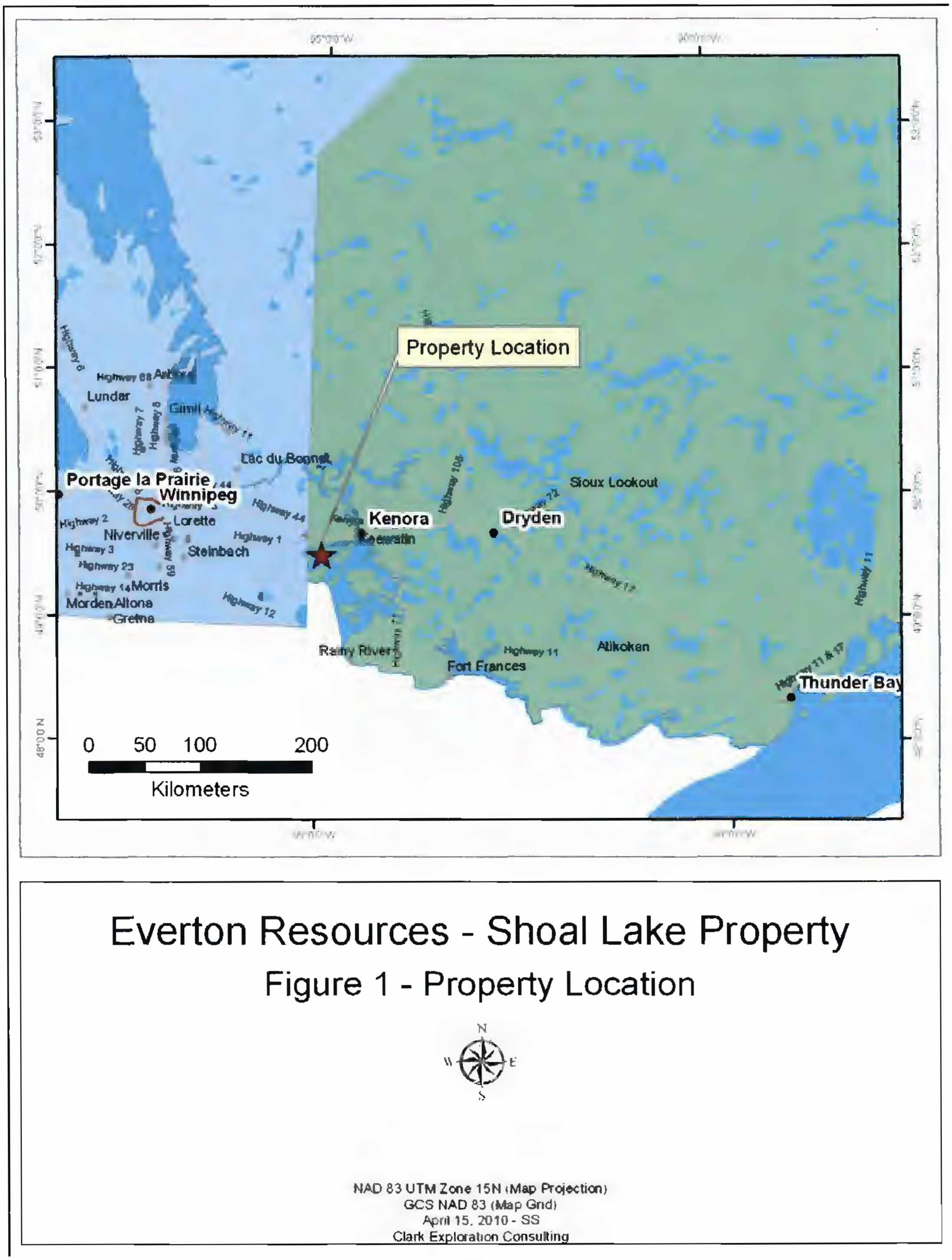

Figure 1: Property location.

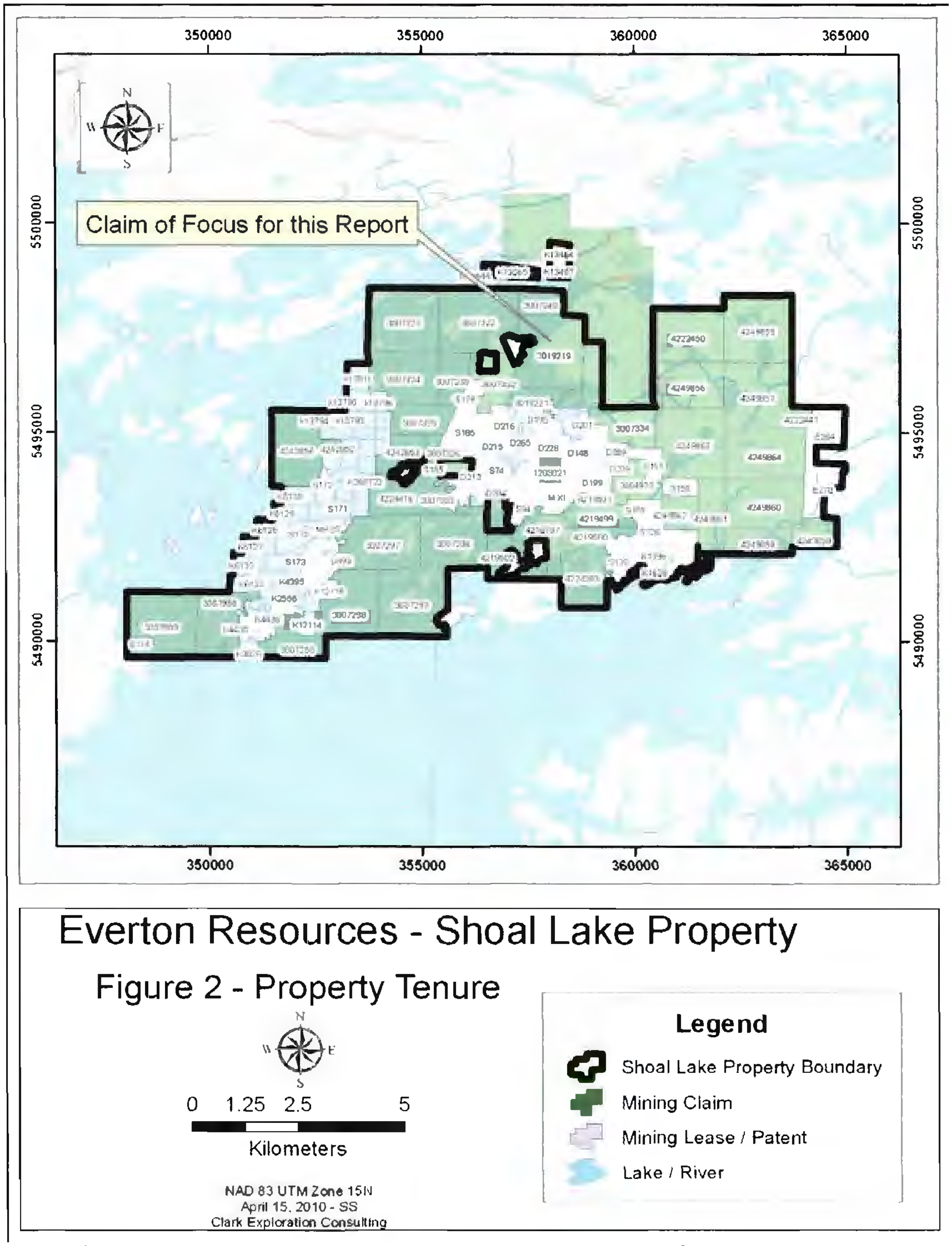

Figure 2: Property tenure with text box arrow showing location of claims where the ground magnetometer was performed and focus of this report.

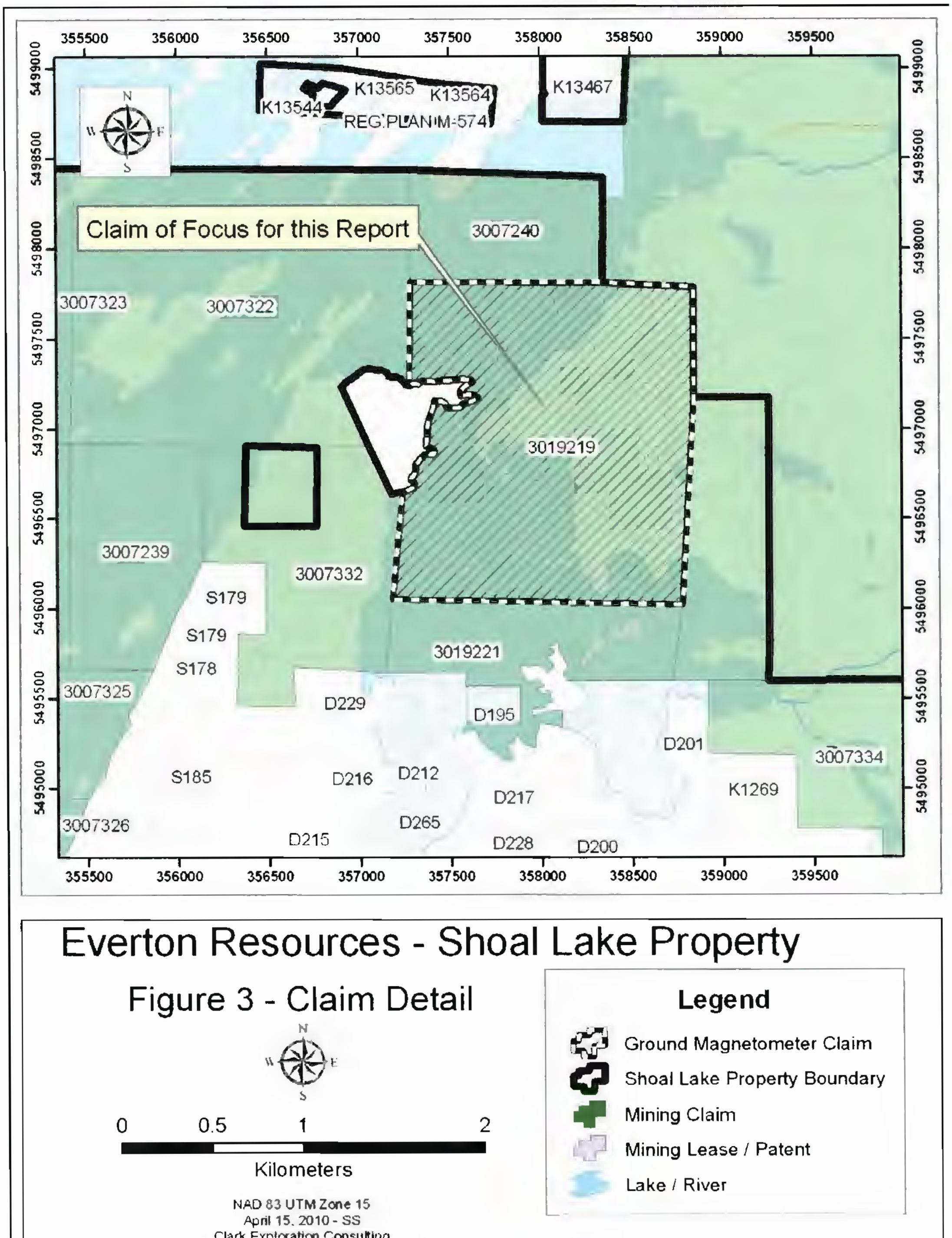

Figure 3: Claims on which ground magnetometer survey was performed.

Table 1: MNDM Dispositions contained within Everton's Property.

MNDM Disposition Name	(continued)	(continued)	(continued)
D147	K1328	K268732	REG.PLAN M-574
D148	K1329	K268733	S105
D195	K1330	K2689	S109
D199	K1332	K2690	S120
D200	K1333	K2691	S124 NORTH PART
D201	K1334	K2758	S124 SOUTH PART
D202	K1335	K2759	S126
D203	K1345	K2938	S150
D204	K13464	K2978	S151
D212	K13467	K2979	S170
D213	K13544	K3014	S171
D214	K13564	K3015	S172
D215	K13565	K3018	S173
D216	k13791	K3019	S174
D217	k13792	K3026	S178
D228	k13793	K3028	S179
D228	k13794	K3029	S179
D229	k13795	K3055	S185
D233	k13796	K3056	S185
D239	k13797	K3057	S74
D265	K13802	K3058	S94
D389	k13811	K3834	S97
D493	K1395	K4395	
E264	K1396	K4396	
E270	K1627	K4431	
J.E.S.100	K1628	K4432	
J.E.S.101	K2284	K4433	
J.E.S.102	K2374 MLO	K4435	
J.E.S.103	K2458	K4436	
J.E.S.104	K2459	K6127	
J.E.S.105	K2460	K6128	
J.E.S.96	K2461	K6129	
J.E.S.97	K2462	K6130	
J.E.S.98	K2554	K6131	
J.E.S.99	K2555	K6132	
J.O.189	K2556	K6133	
K12113	K268722	K932	
K12114	K268723	M.XI	
K12115	K268724	MCA11	
K12116	K268725	MH22	
K12117	K268726	MH23	
K12118	K268727	MH24	
K12119	K268728	MH24	
K12120	K268729	MH25	
K1269	K268730	MH58	
K1317	K268731	MH59	

Table 2: Shoal Lake Property claims.

Owner	Township/ Area	Claim Number	Recording Date	Claim Due Date	Status	Percent Option	Work Required	Total Applied	Total Reserve
Everton Resources Inc.	GLASS	4249859	2009-Oct-22	2011-Oct-22	A	100%	$2,400	$0	$0
Everton Resources Inc.	GLASS	4249860	2009-Oct-22	2011-Oct-22	A	100%	$6,000	$0	$0
Everton Resources Inc.	GLASS	4249861	2009-Oct-22	2011-Oct-22	A	100%	$2,800	$0	$0
Everton Resources Inc.	GLASS	4249862	2009-Oct-22	2011-Oct-22	A	100%	$2,000	$0	$0
Everton Resources Inc.	GLASS	4249863	2009-Oct-22	2011-Oct-22	A	100%	$6,000	$0	$0
Everton Resources Inc.	GLASS	4249864	2009-Oct-22	2011-Oct-22	A	100%	$6,000	$0	$0
Everton Resources Inc.	SHOAL LAKE	4222441	2009-Oct-22	2011-Oct-22	A	100%	$1,200	$0	$0
Everton Resources Inc.	SHOAL LAKE	4249858	2009-Oct-22	2011-Oct-22	A	100%	$2,000	$0	$0
Everton Resources Inc.	SNOWSHOE BAY (SHOAL LAKE)	4224416	2008-Dec-12	2010-Dec-12	A	100%	$2,400	$0	$0
Halo Resources Ltd.	GLASS	3007239	2003-Nov-06	2010-May-06	A	100%	$331	$9,669	$0
Halo Resources Ltd.	GLASS	3007240	2003-Nov-06	2010-Nov-06	A	100%	$2,400	$12,000	$0
Halo Resources Ltd.	GLASS	3007296	2003-Nov-06	2010-May-06	A	100%	$4,800	$19,200	$0
Halo Resources Ltd.	GLASS	3007297	2003-Nov-06	2010-May-06	A	100%	$5,600	$22,400	$0
Halo Resources Ltd.	GLASS	3007299	2003-Nov-06	2010-May-06	A	100%	$6,400	$25,600	$0
Halo Resources Ltd.	GLASS	3007303	2003-Nov-06	2010-May-06	A	100%	$2,000	$8,000	$0
Halo Resources Ltd.	GLASS	3007322	2003-Nov-06	2010-May-06	A	100%	$6,000	$24,000	$0
Halo Resources Ltd.	GLASS	3007323	2003-Nov-06	2010-May-06	A	100%	$6,400	$25,600	$0
Halo Resources Ltd.	GLASS	3007324	2003-Nov-06	2010-May-06	A	100%	$4,400	$17,600	$0
Halo Resources Ltd.	GLASS	3007325	2003-Nov-06	2010-May-06	A	100%	$3,200	$12,800	$0
Halo Resources Ltd.	GLASS	3007326	2003-Nov-06	2013-Nov-06	A	100%	$800	$6,400	$2,164
Halo Resources Ltd.	GLASS	3007332	2003-Nov-06	2010-May-06	A	100%	$2,400	$9,600	$0
Halo Resources Ltd.	GLASS	3007333	2003-Nov-06	2010-May-06	A	100%	$1,471	$8,529	$0
Halo Resources Ltd.	GLASS	3007334	2003-Nov-06	2010-May-06	A	100%	$3,200	$12,800	$0
Halo Resources Ltd.	GLASS	4222450	2009-Nov-16	2011-Nov-16	A	100%	$4,800	$0	$0
Halo Resources Ltd.	GLASS	4249855	2009-Nov-06	2011-Nov-06	A	100%	$6,400	$0	$0
Halo Resources Ltd.	GLASS	4249856	2009-Nov-06	2011-Nov-06	A	100%	$4,800	$0	$0
Halo Resources Ltd.	GLASS	4249857	2009-Nov-06	2011-Nov-06	A	100%	$6,400	$0	$0

Owner	Township/ Area	Claim Number	Recording Date	Claim Due Date	Status	Percent Option	Work Required	Total Applied	Total Reserve
Halo Resources Ltd.	SNOWSHOE BAY (SHOAL LAKE)	3007250	2003-Nov-06	2010-May-06	A	100%	$2,800	$11,200	$0
Halo Resources Ltd.	SNOWSHOE BAY (SHOAL LAKE)	3007298	2003-Nov-06	2010-May-06	A	100%	$5,200	$20,800	$0
Halo Resources Ltd.	SNOWSHOE BAY (SHOAL LAKE)	3007988	2005-Dec-20	2010-Mar-22	A	100%	$8,800	$4,400	$0
Halo Resources Ltd.	SNOWSHOE BAY (SHOAL LAKE)	3007989	2005-Dec-20	2010-Mar-22	A	100%	$12,800	$6,400	$0
Halo Resources Ltd.	SNOWSHOE BAY (SHOAL LAKE)	4242852	2009-Jun-18	2011-Jun-18	A	100%	$400	$0	$0
Halo Resources Ltd.	SNOWSHOE BAY (SHOAL LAKE)	4242853	2009-Jun-18	2011-Jun-18	A	100%	$2,400	$0	$0
Halo Resources Ltd.	SNOWSHOE BAY (SHOAL LAKE)	4242856	2009-Jun-18	2011-Jun-18	A	100%	$4,800	$0	$0
Machin Mines Ltd.	GLASS	3004923	2003-Feb-03	2010-May-18	A	100%	$3,500	$8,500	$0
Machin Mines Ltd.	GLASS	4210797	2007-Apr-10	2010-Mar-22	A	100%	$3,200	$0	$0
Machin Mines Ltd.	GLASS	4219500	2008-Apr-21	2010-Apr-21	A	100%	$1,600	$0	$0
Machin Mines Ltd.	GLASS	4219501	2008-Apr-21	2010-Apr-21	A	100%	$400	$0	$0
Machin Mines Ltd.	SHOAL LAKE	1203021	2001-Oct-05	2010-Mar-31	A	100%	$1,600	$4,000	$0
Machin Mines Ltd.	SHOAL LAKE	4219502	2008-Oct-17	2010-Oct-17	A	100%	$3,200	$0	$0
Machin Mines Ltd.	SHOAL LAKE	4224383	2008-Oct-17	2010-Oct-17	A	100%	$4,800	$0	$0
Roberts, John Scott	GLASS	3019219	2006-Sep-19	2010-May-18	A	100%	$6,400	$0	$0
Roberts, John Scott	GLASS	3019221	2006-Sep-19	2010-May-18	A	100%	$2,000	$0	$0
Roberts, John Scott	GLASS	4219499	2008-Jan-23	2010-May-18	A	100%	$1,600	$0	$0

3.1 Location and Access

The Shoal Lake Property is located about 40 km west-southwest of Kenora, Ontario, which has a population of approximately 16,500. Kenora has a small airport that is serviced by daily with flights from Winnipeg and Thunder Bay. From Kenora, the Property is accessed is by driving approximately twenty-seven kilometres west of the city limits along Highway 17 and then south on Rush Bay road for approximately twenty-three kilometers to the boat launch at Clytie Bay. From there the Property can be accessed partially by land and the remainder by boat. The Property may also be reached by float equipped aircraft.

4.0 Regional Geology

The Lake of the Woods – Shoal Lake area is situated within the western portion of the Wabigoon Subprovince, and is comprised of metamorphosed Archean volcanic and sedimentary rocks which have been intruded by granitoid rocks. Some of the granitic intrusions attain batholithic dimensions, causing segmentation of the volcanic and sedimentary rocks into individual belts. The Wabigoon Subprovince is bounded to the north by the English River Subprovince, a gneissic terrain, and to the south by the Quetico Subprovince.

The margins of the Subprovinces are generally east-west, and characteristically have major breaks or fault zones developed along them. Within the central portions of these belts, as in the Shoal Lake Area, high strain zones occur around margins and between the granitic complexes. These high strain zones are favourable structural sites for gold deposits. The property described in this report is transected by a major northeast trending high strain zone which is situated between the Canoe Lake and Snowshoe Bay granitic complexes. Numerous past and future gold mines are present within this regime.

Very coarse generalized regional geology can be found in Figure 4. Geology in Figure 4 from the Ontario Geological Survey's Miscellaneous Release of Data 126-Rev.

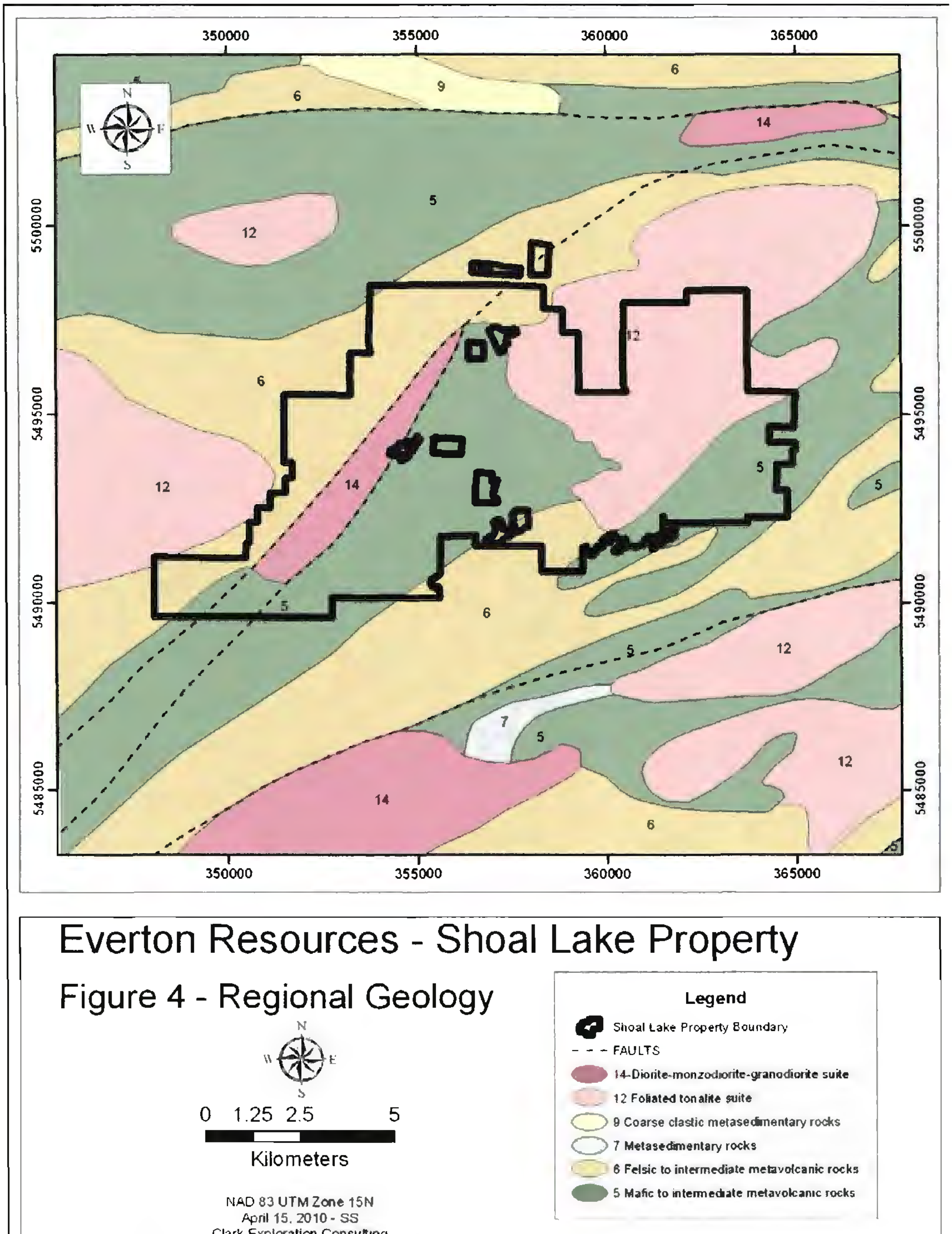

Figure 4: Coarse regional geology from MRD 126-Rev.

4.1 Property Geology

The following is taken from Smith (1986). Detailed regional geology is shown in Figure 5. No lithological legend is provided as these are raw images of maps M2069 and M2422 from the Ontario Geological Survey and one is referred back to them for reference. The eastern portion of the property has also been left off as the map area truncates before this boundary so there exists no data from these two map sets.

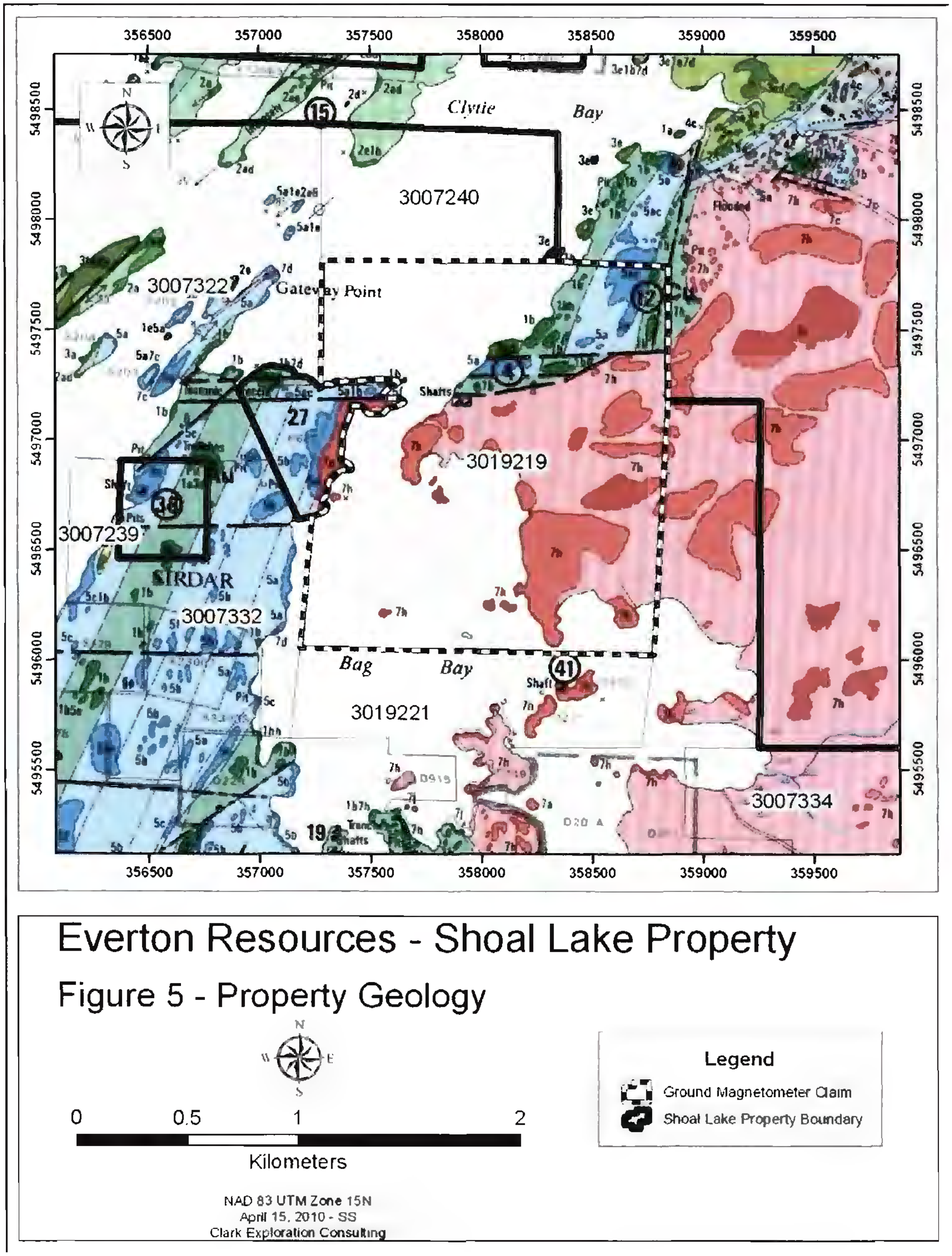

Figure 5: Detailed property geology.

"STRATIGRAPHY

Massive to pillowed feldspar-phyric basalt flows, characterized by subhedral to euhedral feldspar phenocrysts up to 5 cm in diameter, are the oldest rocks of the lower mafic-ultramafic series and act as a marker horizon. Overlying this unit are massive and pillowed aphyric basalts. Komatiitic basalt flows and ultramafic flows and/or sills overlie the aphyric basalt. A second feldspar-phyric basaltic marker unit overlies the komatiitic sequence. The nature of the feldspar phenocrysts is similar to that of the lower porphyritic unit; however, there are no pillows and the abundance and size of feldspar crystals decrease westward. Contacts are poorly exposed and it is not clear whether this unit was intrusive or extrusive. Massive and pillowed aphyric basalt overlies this second porphyritic unit to the northwest and becomes progressively more schistose in that direction.

The calc-alkaline series occupies much of the western portion of the northern Shoal Lake area. This series is characterized by dacite tuffs and tuff breccias, intercalated with andesitic tuffs and flows, basaltic tuffs and flows, reworked tuffaceous sedimentary rocks and chemical sedimentary rocks. No distinct marker units have been identified in this series. The contacts and bedding relationships are dominantly northeast trending, becoming gradually more east-northeast trending towards the west. Stratigraphic tops,determined from sedimentary rocks and pillowed basalts, are consistent with the northwest-facing, homoclinal succession observed in the lower mafic-ultramafic series.

INTRUSIVE ROCKS

A major northeast-trending, elongate diorite to quartz diorite intrusion, the Stevens Island Complex, intrudes the lower mafic-ultramafic series. The southern margin is gently curved and cuts both feldspar-phyric and aphyric basaltic flows. The southeast portion of the intrusion is characterized by medium-grained diorite with local mafic and ultramafic volcanic xenoliths and patches of primary hornblende. In places, intercalated mafic to felsic flow layers occur proximal to, and trend parallel to, the southeast contact. This layering is characterized by numerous small flow folds. No strongly defined metamorphic aureole or chill margin has been observed along the southern and eastern portion of the intrusion. To the west, the diorite is in contact with an anorthositic phase which grades northwestward into biotite quartz diorite, and in places alaskite. This apparent northwestward differentiation is consistent with the facing directions observed in the host volcanic rocks, suggesting that the intrusion may be a sill emplaced prior to the tilting of the volcanic sequence.

Several smaller, stratabound, northeast-trending felsite sills intrude the lower maficultramafic series in the northeast portion of the northern Shoal Lake area.

Two syn- to post-tectonic granitoid bodies intrude the volcanic succession. The Canoe Lake quartz diorite stock intrudes the lower mafic-ultramafic series approximately six kilometres northeast of the Shoal Lake West Project. Much of the stock is devoid of any foliation; however, a weak foliation is developed within the margin of the intrusion and several faults which have developed in the volcanics have been traced into the margin of the intrusion. The Snowshoe Bay Batholith intrudes the volcanic succession approximately one kilometre west of the Shoal Lake West Project and extends west into Manitoba. This medium-grained granodiorite intrusion is fairly homogeneous, although grain size and colour variations occur. A weak foliation or gneissosity is developed proximal and subparallel to the margins of the intrusion. This foliation appears to trend into the regional foliation, indicating that the intrusion may be syntectonic.

Quartz porphyry, quartz-feldspar porphyry and felsite dikes occur throughout the area and have been observed in a variety of crosscutting relationships. Lamprophyre dikes have been observed to cut across all lithologies, but were not recognized in either of the late intrusions.

STRUCTURE

Foliations in the Shoal Lake area tend to diverge about diapiric intrusions and form several distinctive zones of high strain. All recognized foliations are interpreted to have developed during the D2 event.

The Crowduck Lake – Witch Bay Shear Zone is a major east-trending zone of high strain tangential to the Canoe Lake Stock, Viola Lake Stock and the eastern lobe of the Dryberry Batholith. Relative horizontal movement is interpreted to be dextral. The orientation of the fabrics and the dextral sense of shear are consistent with a regional, northwesterly compression (Schwertner et al., 1979). To the south of the Crowduck Lake – Witch Bay Shear Zone, a shadow zone, in which little strain is observed, is indicated on the southwestern flank of the Canoe Lake Stock.

Several narrow, northeast-trending high strain zones occur between the Snowshoe Bay Batholith and the Canoe Lake Stock. These are developed within and along the margins of the Stevens Island Complex and trend subparallel to the intrusion boundaries. These zones of high strain define three shear zones, with similar orientations and character which suggest that each is a component of a larger deformation zone referred to as the Shoal Lake Deformation Zone. The westernmost of these shear zones contains the Duport mineralized zones and has been termed the Duport Deformation Zone. The central and eastern zones are termed the

Stevens Island Deformation Zone and Sirdar Deformation Zone, respectively (Smith, 1985).

The Duport Deformation Zone traces the contact between the lower mafic-ultramafic series and the upper felsic-intermediate series. Stratigraphic units, traceable within both the felsic-intermediate series and lower mafic-ultramafic series, are folded, truncated and deformed within the shear zone. The foliation in the Duport Deformation Zone is subvertical and trends subparallel to zone boundaries. The foliation is penetrative and is oblique or perpendicular to bedding.

Both the Stevens Island Deformation Zone and Sirdar Deformation Zone are similar to the Duport Deformation Zone. They are developed within and along the eastern margin of the Stevens Island Complex and are characterized by a strong foliation and grain size reduction. Feldspar porphyry, quartz feldspar porphyry and lamprophyre dikes are offset and truncated and in places have been deformed into fish-shaped bodies. Steep, west dipping, C and S fabrics are evident on vertical exposures and record reverse movement similar to the Duport Deformation Zone. Mineral stretching lineations pitch vertically. Pillows, where observed, are highly stretched, while quartz veins and felsic dikes are locally boudinaged.

All of the main shear zones within the northeast-trending Shoal Lake Deformation Zone indicate substantial subvertical, west-side-up movement. In places a minor sinistral component is also indicated.

METAMORPHISM

Greenschist facies metamorphic rocks are found throughout the area, characterized by a mineral assemblage of albite, epidote, chlorite, actinolite and sphene, locally with carbonate, brown biotite, quartz and sericite. An amphibolite facies metamorphic assemblage, characterized by hornblende, andesine and epidote, with or without brown biotite, garnet and anthophyllite, surrounds the felsic stocks and batholiths."

5.0 Exploration History

The exploration history of the Property is discussed at length in the 43-101 provided to Everton Resources in July of 2009 (written in November of 2008 and subsequently re-addressed) by Scott Wilson RPA Inc. This 43-101 focuses on the Shoal Lake West portion of the property which encompasses the Duport Mine. The Mikado and Cedar Island mines which are assumed to make up a Shoal Lake East property of which there exists no 43-101 are therefore lacking in detail with regard to exploration history.

The following is taken verbatim from Valliant and Chamois (2008) of Scott Wilson RPA.

"Activities began on the Shoal Lake West property as early as 1897.

From 1897 to 1900, Cameron Island Mining explored four quartz veins on Cameron Island. Work included extensive surface stripping, a 6.1 m (20 ft.) open cut on the No. 1vein, a 9.1 m (30 ft.) open cut on the No. 2 vein, a 40.2 m (132 ft.) inclined shaft, test pits on the No. 3 and No. 4 veins, and a 20.1 m (66 ft.) adit on the eastern shore of the island to intersect the No. 1 and No. 2 veins.

From 1903 to 1904, a ten-stamp mill was constructed.

From 1910 to 1912, Cameron Island Syndicate dewatered the shaft and resumed underground work. A mill run was made, but details are unavailable. In 1915, Cameron Island Syndicate extended the lateral workings to 148.7 m (488 ft.) on the 20.4 (67 ft.)and 38.7 m (127 ft.) levels. A small stope on the second level was worked to a height of 6.1 m (20 ft.). A five-ton mill run graded 0.48 oz/ton Au and 1.2 oz/ton Ag.

From 1933 to 1936, Duport Mining drilled several holes from surface, dewatered the shaft and sank a 74.7 m (245 ft.) inclined winze from the second level. Additional levels were driven at 68.3 m (224 ft.) and 112.5 m (369 ft.) depth. Lateral development totaled 713.5 m (2,341 ft.), with 25.3 m (83 ft.) of raising and some stoping on the second level. Duport Mining produced 1,100 tonnes of material, grading 115 g/t Au, which was shipped to smelters at Tacoma, Washington, and Flin Flon, Manitoba, for processing during the period 1934-1936.

From 1950 to 1951, Matachewan completed an electromagnetic survey, 8,773 m of surface and underground drilling, and 360 m (1,180 ft.) of trenching. The shaft was dewatered and 9.8 m (32 ft.) of raising was completed on the second level.

From 1965 to 1967, Westfield extended the known gold-bearing zones both laterally and vertically by completing 3,516 m of surface diamond drilling.

CPM carried out an initial program of exploration in 1973 consisting of dewatering the shaft and taking bulk samples from the second level.

In 1982, Selco optioned the property and completed airborne and ground geophysical surveys, as well as 9,373 m of drilling.

From 1983 to 1985, Union Carbide optioned the property and completed drilling and underground exploration from a new 1,185 m underground decline driven fromStevens Island. The decline intersected the mineralized zones on the 99.1 m (325 ft.),134.1 m (440 ft.) and 158.5 m (520 ft.) levels. Drifting was done to the north and south on the East and the Main zones on the 99.1 m (325 ft.) level and on the Main Zone on the 158.5 m (520 ft.) level. Bulk and channel samples were taken from all levels. The program confirmed the presence of a mineral resource and led to the extension of known geological structures along strike to the northeast and southwest.

CPM continued underground development on the property during 1986 and 1987 with a program to further define the extent of the gold-bearing horizon. The program included extending the existing decline to a vertical depth of 200 m and diamond drilling, to establish continuity of the gold-bearing horizon to 500 m below surface. Three raises were driven in mineralized material and a 90-tonne bulk sample was mined and shipped to Lakefield Research, Lakefield, Ontario, for pilot plant metallurgical testing. Based on the resultant resource estimate and metallurgical work, CPM commissioned Wright Engineers Ltd. (Wright) to conduct a feasibility study in 1988.

During the time the Wright study was being prepared, CPM commenced the formalpermitting process. The most important aspect of the potential environmental impact of proposed mine development was its location on Shoal Lake. Shoal Lake is the source of drinking water for the city of Winnipeg, Manitoba, and is also the location of two First Nations communities and a number of seasonal cottages. CPM recognized very early during its ownership of the property that environmental concerns regarding development and operation of the property were important.

Between 1979 and 1988, CPM collected baseline environmental data and commissioned Agra Earth & Environmental Ltd. to study the issues and prepare an environmental impact study. The design for plant andinfrastructure was intended to mitigate any environmental effects of the operation.

Despite the fact that the technical aspects of the environmental management plan were relatively straightforward, the property received considerable scrutiny from the local cottagers and, eventually, the city of Winnipeg and the province of Manitoba. The public perceptions were such that in 1989 the Ontario permitting process was stopped and the property was designated for review under the Canadian Environmental Assessment Act.

From 1989 to 1993, essentially no activity took place on any aspect of the property.

From 1988 to 1990, Exploration Brex Inc. (Brex) completed preliminary geological and geophysical surveys on a 40-claim property located immediately east and northeast of Stevens Island, culminating in a four hole drill program totalling 672 m. Brex's property is now incorporated within the Shoal Lake West property. A 68.4 km linekilometre grid was established and surveyed with ground magnetics and VLF-EM.

Geological mapping and sampling of the islands resulted in a number of surface showings generally consisting of narrow quartz vein related mineralization within the Stevens Island Deformation Zone. Grab samples from these showings are reported to have assayed up to 87.45 g/t Au. A boulder of massive arsenopyrite from Seahorse Island yielded 6.62 g/t Au. Holes SL-89-02 and SL-90-4, drilled 115 apart and immediatelynorth of Stevens Island, intersected significant mineralization consisting of pyrite,chalcopyrite and arsenopyrite bearing quartz veining within talc-chlorite schist. SL-89-02intersected values of 8.30 g/t Au across 2.95 m (167.94 m to 170.89 m), 6.45 g/t Au across 1.05 m (186.70 m to 187.75 m), and 12.66 g/t Au across 1.85 m (190.42 m to 192.27 m) (Yeomans, 1989). Hole SL-90-04 intersected 4.00 g/t Au across 3.24 m (36.49m to 39.73 m) (Yeomans, 1990).

Commencing in 1993, CPM reactivated the environmental aspects of the property with the objective of restarting the approval process. As a first step, the property development plan was significantly revised from the Wright study in that all processing was moved to a location outside the Shoal Lake watershed. Ore was to be mined on Stevens Island and hauled by truck to the proposed plant site approximately 10 km away on the mainland. Two processing options were considered – production of concentrate at the plant followed by gold recovery at Placer Dome's Campbell Mine in Red Lake, and production of gold at the plant. The former option had the advantage of eliminating the use of cyanide in the Shoal Lake area. No physical or technical work was carried out on the property during this time other than environmental baseline work and minor fieldwork in support of the revised property development plan.

During this time, CPM re-established a working relationship with the two First Nations on Shoal Lake. An extensive program of community relations was carried out including workshops and public consultation sessions in the communities. Impact and Benefit Agreements were signed with both communities. CPM also implemented a buyout program with affected cottagers on Shoal Lake. Outside the area, CPM carried out extensive consultations with key officials at the city of Winnipeg, the provinces of Manitoba and Ontario, and the federal government in order to describe the revised project and to establish the process for formal environmental approval.

In 1996, after acquiring CPM, ROM updated the CPM work and initiated an internal feasibility study based on CPM's revised development plan. Instead of using theCampbell Red Lake option, concentrate was to be railed to the ROM plant in Timmins, Ontario, where it would be treated using a bio-oxidation process. ROM did not carry out any physical work on the site other than a limited diamond drilling program during 1996-1997. The logs corresponding to ROM's drilling are not available.

In 2005, Halo initiated a comprehensive exploration program consisting of ground and airborne geophysics and diamond drilling. From February 18 to March 28, 2005, Halo completed a total of 70 line kilometres of ground magnetometer surveying over three grids in order to gain geological and structural information for the purpose of locating drill holes. The grids were located i) north of Stevens Island (North Grid), ii) over the southern portion of Stevens Island (East Grid), and iii) over the western portion of Dominique Island (South Grid).

Halo's North Grid covered a portion of the area of the 1988 Brex survey. The survey was successful in delineating contacts between contrasting lithologies in areas of known gold mineralization. The survey, however, did not include the area of the Duport deposit itself and the coverage was insufficient to cover potential targets north of Stevens Island and in the vicinity of Dominique Island.

From August 15 to September 2, 2005, Fugro Airborne Surveys (Fugro) completed 2,743 line kilometres of combined magnetic and electromagnetic helicopter-borne survey under contract to Halo. The survey was flown at 50 m and 100 m line spacings using Fugro's DIGHEM multi-coil, multi-frequency electromagnetic system and a highsensitivity cesium magnetometer. The objective was to identify altered shear zones containing sulphides related to fault structures, intrusive bodies, and competency contrasts between lithologies.

Several magnetic signatures similar to those observed at the Duport deposit were defined. The contoured magnetic data outlined a predominantly north-northeast fabric to the structural and lithological components of the Shoal Lake greenstone assemblage. Distinctive lenticular to elongate magnetic lows striking north-northeast across the centre of the survey area were interpreted to reflect either felsic lithologies in the core of the assemblage or a thick pile of dominantly metasedimentary rocks. A series of ovoid or annular features were interpreted to represent folded and faulted metavolcanic rocks. Three northeast to north-northeast trending deformation zones were interpreted. A considerable number of weak to moderate conductive features were defined in the electromagnetic data, most displaying north-northeast orientations parallel to the regional fabric.

Fifteen targets consisting of conductive features within a one kilometre wide band north-northeast and south-southwest of the Duport deposit were identified for follow-up. These targets have yet to be drill tested.

During the winter of 2005, Halo completed a 23-hole, 7,054 m drilling program from the ice on Shoal Lake. The holes were drilled perpendicular to the strike of the mineralized zones at dips varying from -45° to -67°. Two holes (2005-1 and 2005-2) were drilled to confirm historical resources. Nineteen holes (2005-3 to 2005-19 and 2005-21 to 2005-23) were drilled on a 30 m to 100 m spacing over a strike extension of approximately one kilometre to test the downward and/or southern extension of historical resources. One hole (2005-20) was drilled to test for possible mineralization in a structural feature indicated by the ground magnetic survey. The program confirmed the presence of high-grade gold mineralization as reported in previous studies and confirmed the extension of gold structures along strike and down dip from previous resources, albeit mainly at sub-economic grades."

6.0 2010 Ground Magnetometer Survey

Clark Exploration Consulting was contracted in March, 2010 to cut 12.5 line-kilometers of geophysical grid and conduct a 50m line-spaced ground magnetometer survey. This ground magnetometer survey directly adjoins the previous magnetometer survey conducted by Clark Exploration Consulting over a portion of Shoal Lake – report dated March 17, 2010. A total of 12.5 line-km of cesium ground magnetometer were performed from April 7, 2010 to March 11, 2010. Figure 6 shows the actual cut gridlines for the survey along with claim boundaries. Claim K3019219 contained the entirety of the completed survey. Figure 7 shows the cut gridlines in relation to the previous ground magnetometer survey done on the property while the lake was still frozen. This survey is contained in a report by the same authors dated March 17, 2010.

The focus of the exploration was on an area of the Shoal Lake Deformation Zone (SLDZ) where a large flexure occurs. Observable in airborne magnetics, this flexure was mapped in 1990 as an east-west trending shear zone containing 4 gold occurrences within 1500 meters of strike. The original ground magnetometer survey was designed to test the detailed geophysical response in the area of the flexure to try and pickup features that may not have been realized in the airborne survey. Because of lake conditions, assessment filing time constraints, and line-cutting requirements, the survey was split into two portions – one dated March 17, 2010 which was done on the lake while still frozen and this survey.

For the purpose of this survey, the Property was accessed for line-cutting by snowmobile across the lake from March 1st to March 13th. Due to the warmer than usual conditions in March, the lake was unsafe to travel over during the ground magnetometer survey and the grid was accessed by parking at the Clytie Bay boat launch and walking to the end of the quad trail (both shown in Figure 8) and then roughly 1.5 kilometers through the bush to the beginning of the grid. Due to the terrain around Shoal Lake and the stream between Canoe Lake and Clytie Bay both being impassable the quad trail access had to be used.

The survey was done on ground by a geophysical technician wearing a Geometrics G-859 'back-pack' cesium-vapour magnetometer over the course of 7 days (April 6th to April 12th). A Geometrics G-856AX proton precession magnetometer was used as a base station for measuring and correction for diurnal variation. A Geometrics G-856AX proton precession magnetometer was used as a base station for measuring and correction for diurnal variation. Both the magnetometer and base station were rented from Kivi Geoscience of Thunder Bay, Ontario. An overview of each device is provided below, and details on both of the instruments and their specifications are provided in Appendices A (G-856AX) and B (G-859) in the form of manuals. Figures 9 and 10 are images showing the Total Field and 1st Vertical Derivative grids obtained in the survey.

Post-processing and gridding was carried out by consulting geophysisict Monika Sumara and Geosoft grids of Total Field Magnetics and First Vertical Derivative are included as maps in Appendix C of this report.

During post-processing of the data, it was determined that the data for two lines in the survey was corrupt. This data needs to be reaquired and reinterpreted, but cannot be done at this point in time due to assessment time constraints.

6.1 General Device Specifications

G-856AX

The G-856 provides a reliable, low cost solution for a variety of magnetic search and mapping applications. Single key stroke operation means the G-856AX can be operated by non-technical field personnel or used in teaching environments. The G-856AX uses the well proven proton precession technology, allowing accurate measurements to be made with virtually no dependence upon variables such as sensor orientation, temperature, or location. The unit provides a repeatable absolute total field magnetic reading, traceable to the National Bureau of Standards.

Applications:

The principle application for the G-856AX is as a base station system for monitoring and recording of the Earth's diurnal magnetic field variation. These base station measurements are downloaded into MagMap2000 for automatic correction of G-865AX, G-858 or airborne survey data. Base station accessories available for use with the G-856 include external power cable and base station tripod kit.

The G-856AX is also used in mapping geological structures, for mineral exploration, magnetic search for industrial, environmental or archaeological targets. The optional gradiometer attachment gives greater resolution and noise immunity for conducting searches in industrial or high cultural noise environments. Simple operation, large digital data storage capability, and the inclusion of MagMap2000 data transfer and editing software provides a system well suited for both teaching and survey applications.

A thoroughly well proven design (over 2,500 units sold), excellent performance and the lowest price professional system are key features of the G-856AX. Combined with the ease of use, user friendly download/editing software, and readily available commercial contouring programs, the G-856AX represents a complete magnetic surveying package generating high quality data for budget conscious users.

Specifications:

- Resolution: 0.1 nT
- Accuracy : 0.5 nT
- Clock: Julian date, accuracy 5 sec per month.
- Tuning: Auto or manual, range 20,000 to 90,000 nT
- Gradient Tolerance: 1000 nT/meter
- Cycle time:3 sec to 999 sec standard , can be manually selected as fast as 1.5 sec cycle time.
- Read: Manual, or auto cycle for base station use.
- Memory: 5700 field or 12500 base station readings
- Display: Six digit display of field/time, three digit auxiliary display of line number, day
- Digital Output: RS-232, 9600 baud.
- Input: Will accept external cycle command.
- Physical Console: 7 × 10.5 × 3.5 inches, (18 × 27 × 9 cm) 6 lbs (2.7 kg)
- Sensor: 3.5 × 5 inches (9 × 13 cm) 4 lbs (1.8 kg
- Environmental: Meets specifications within 0 to 40 C
  Will operate satisfactorily from -20 to 50 C
- Power: Rechargeable, magnetically compensated Gel-Cel batteries

<u>G-859</u>

A Professional Magnetic Mapping System For Minerals, Petroleum and Geologic Surveys

- Excellent Performance: Low Noise/High Sensitivity, best in the industry – 0.008nT/Hz RMS – and world-wide operation
- Very Fast – Log mag and GPS at up to 5 samples per second for economic large area surveys at high sample density
- Integrated GPS/Backpack – Includes non-magnetic backpack and Novatel™ WAAS / EGNOS ready GPS
- Low AC Field Interference – Best in the industry for rejecting AC power line grid noise (50/60 Hz)
- Easy-to-use – Simple setup and rapid in-field map generation with free MagMap2000™ software

- Reliability – Our Cesium sensors never need calibration or factory realignment. Designed for extreme ruggedness and reliability.
- Designed for large surveys mining/oil/gas – This versatile tool is specially designed for large area surveys with 8 hr data storage capacity and two 6 hr battery packs

This new low-cost Cesium vapor magnetometer system offers the mining/oil/gas survey companies the best total field magnetic survey tool available. Based on our industry standard G-858 MagMapper system, the G-859 incorporates all of the reliability and proven performance in a lightweight survey package with integrated WAAS/EGNOS enabled Novatel™ GPS.

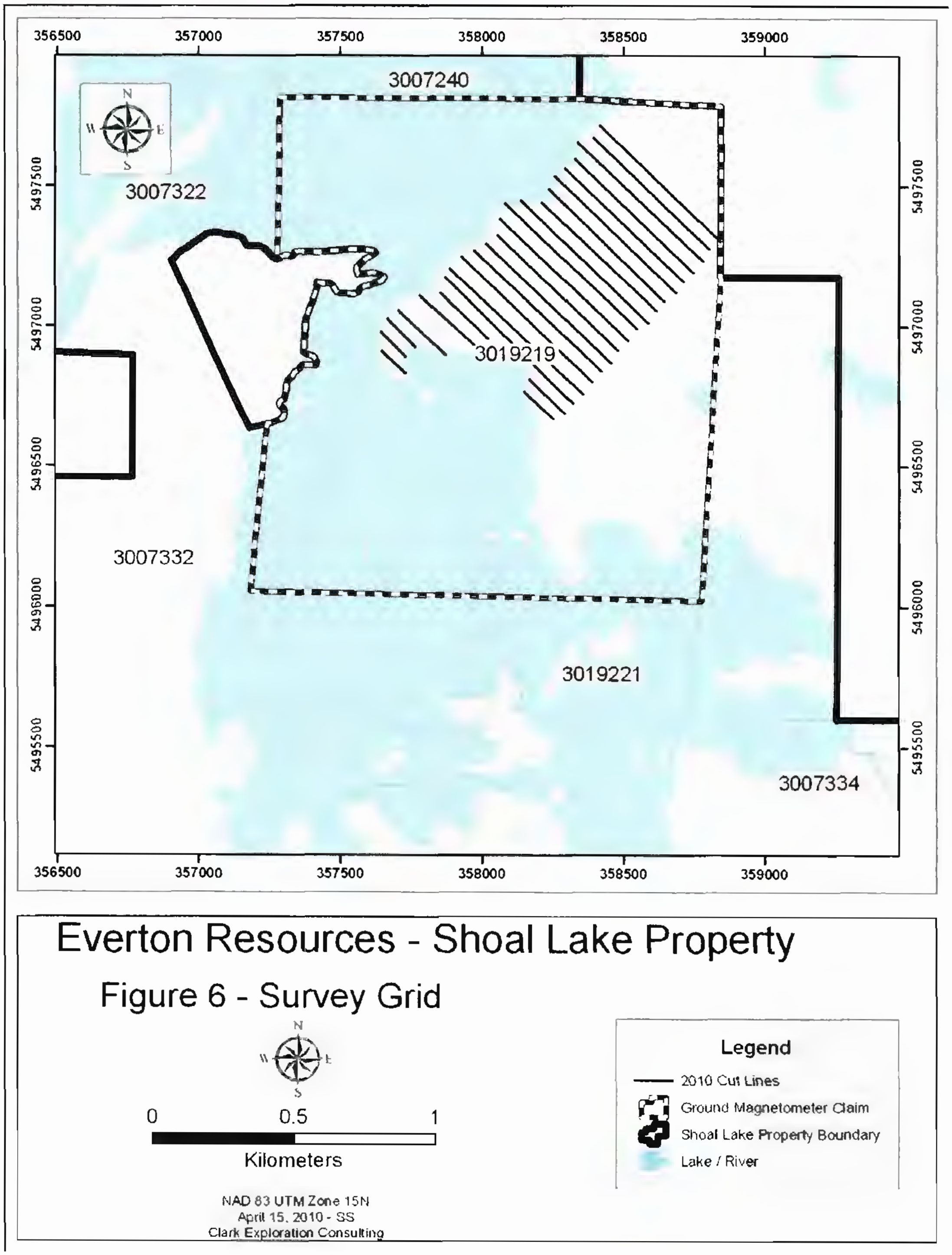

Figure 6: Ground magnetometer survey grid.

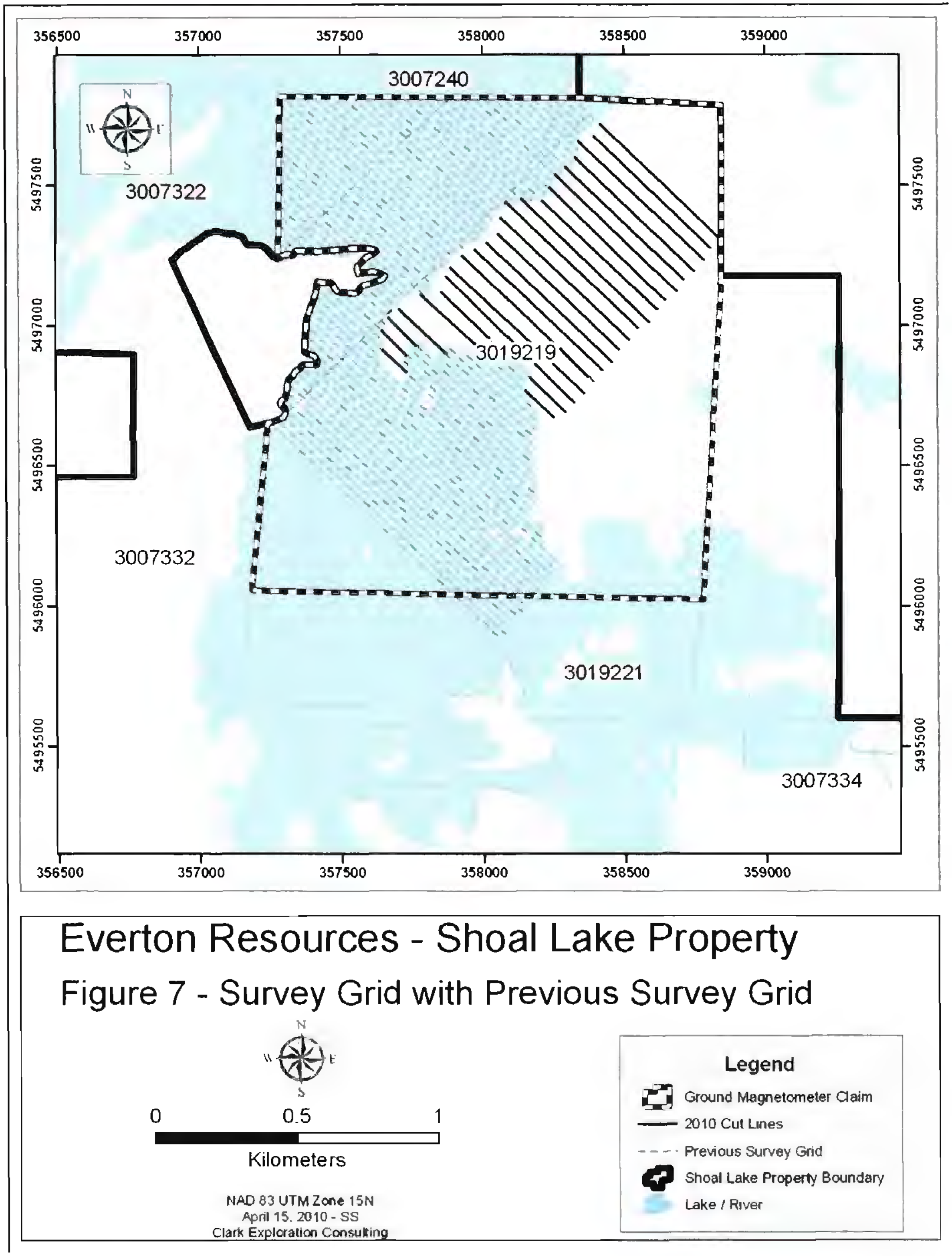

Figure 7: Survey grid with previous lake mag survey grid shown.

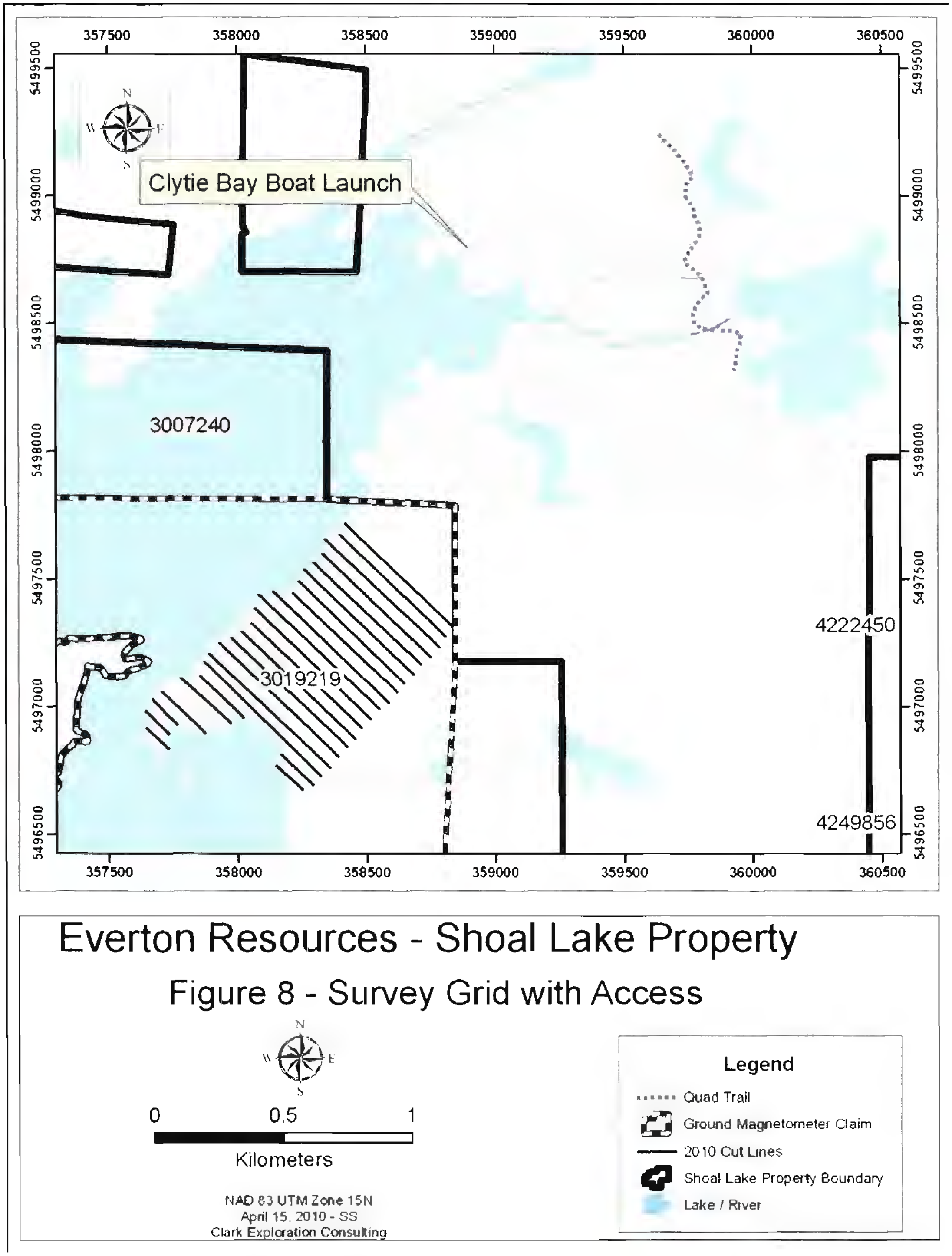

Figure 8: Survey grid location in relation to both the Clytie Bay boad launch and quad trail.

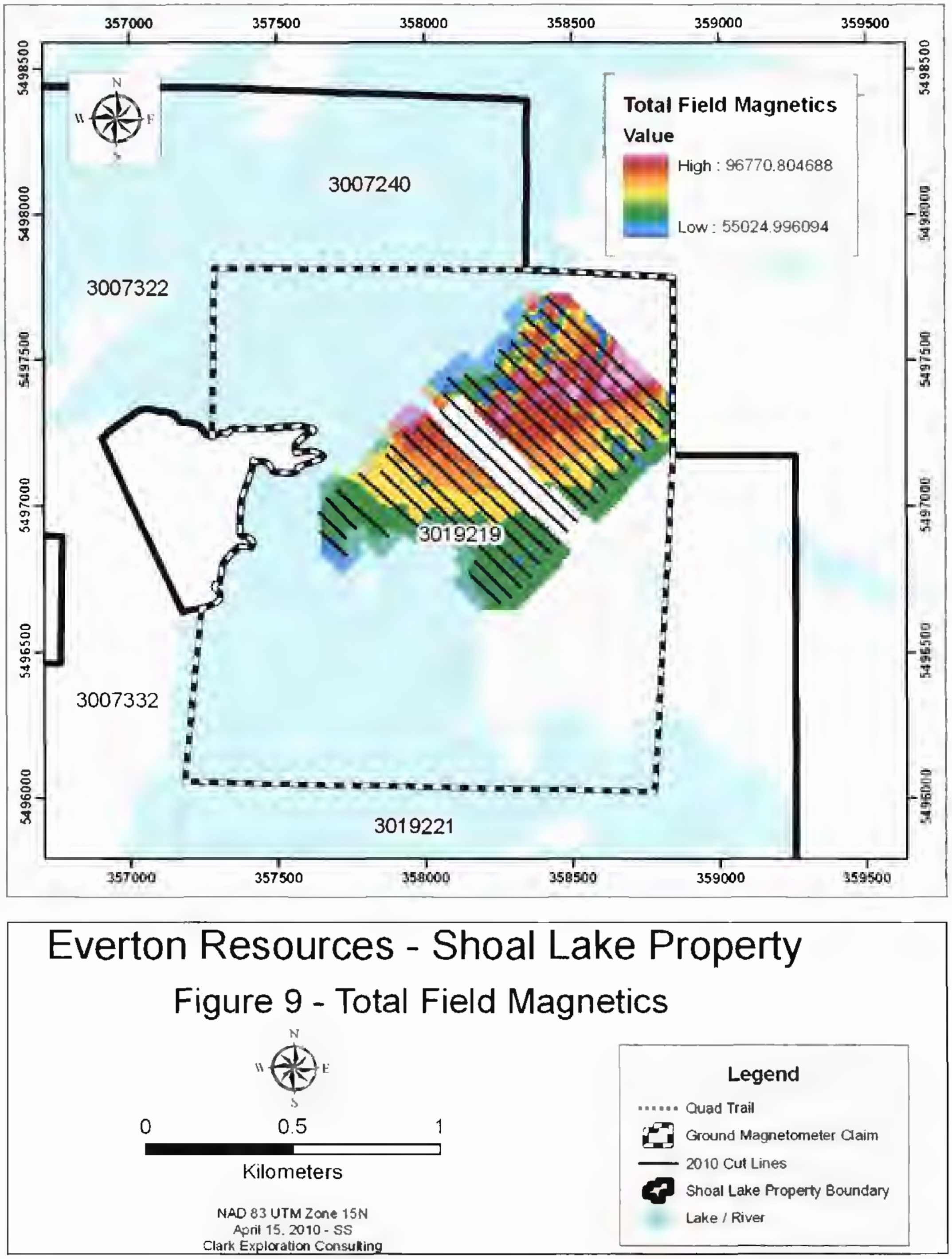

Figure 9: Total field magnetics.

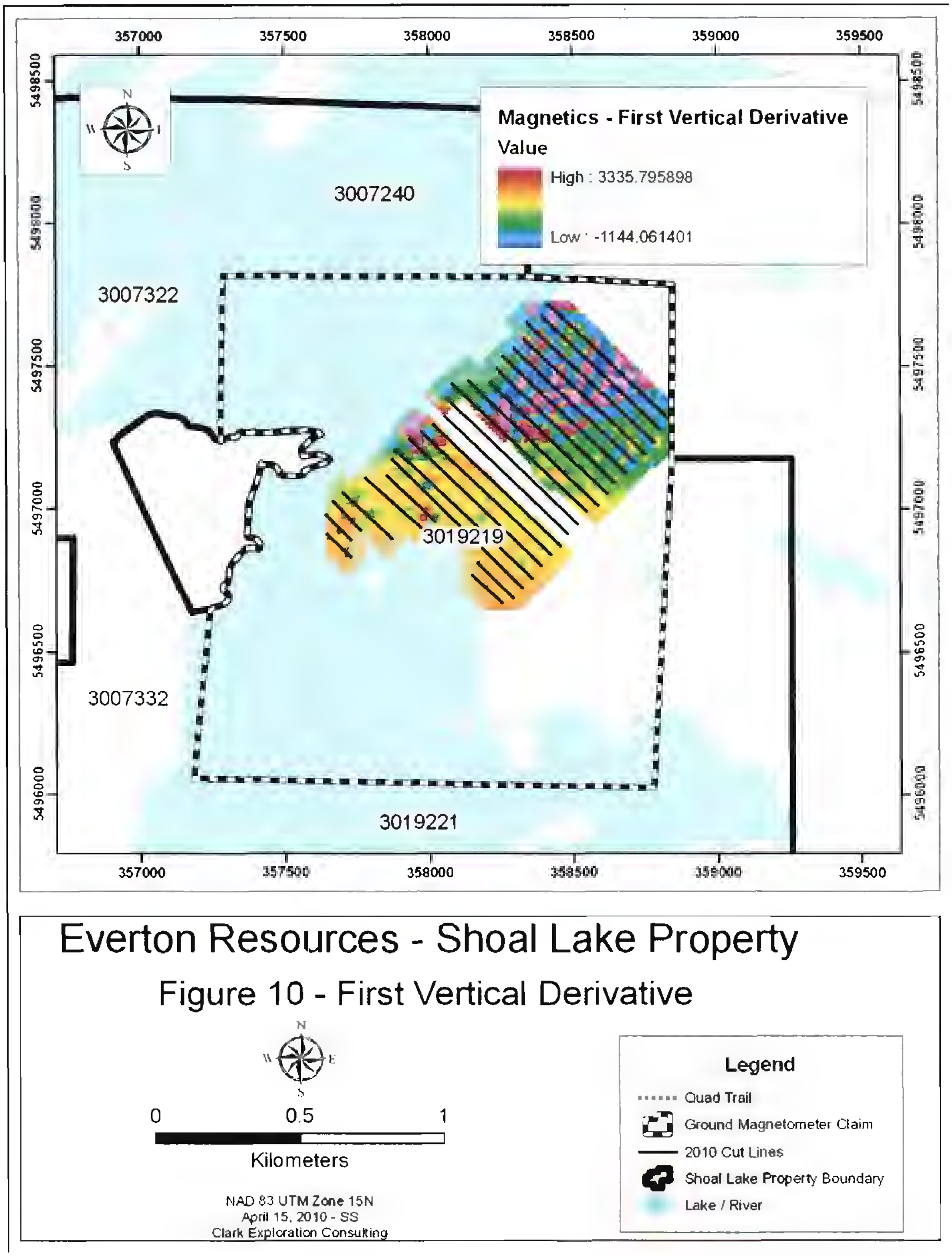

Figure 10: First vertical derivative.

7.0 Conclusions and Recommendations

Features that would be interpreted as structures representing second-order splays and zones of dilation were not recognized. Ground magnetics should be obtained for lines with bad data. All data should be stitched to the existing grid to help visualize the relationship to the gold showings.

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Yeomans, W.C., 1990: Results of a Drilling Program. 162278 Canada Inc. Option, Shoal Lake Property (Ewart Township, Kenora District). Private report for Exploration Brex Inc.

Appendices

Appendix A

G-856 Manual

G-856 Memory-MagTM

Proton Precession Magnetometer

OPERATOR'S MANUAL

P/N 18101-02

GEOMETRICS, INC.
2190 Fortune Drive, San Jose, CA 95131
Phone: (408) 954-0522
Fax: (408) 954-0902
Eml: sales@mail.geometrics.com
Web: www.geometrics.com

DECLARATION OF CONFORMITY

We, Geometrics, Inc.
Geometrics Europe
2190 Fortune Drive
San Jose, CA 95131 USA
phone: (408) 954-0522
fax: (408) 954-0902

declare under our sole responsibility that our portable magnetometers, models G-856, and G-856G to which this declaration relates are in conformity with the following standards:

EN 55022: 1995, EN50082-2: 1995, ENV 50140: 1994, ENV 50141: 1994,
EN 61000-4-2: 1995, EN 61000-444: 1995

per the provision of the **Electromagnetic Compatibility Directive** ***89/336/EEC*** of May 1989 as Amended by ***92/31/EEC*** of 28 April 1992 and ***93/68-EEC, Article 5*** of 22 July 1993.

The Technical documentation required by Annex IV(3) of the Low Voltage Directive is maintained by Christopher Leech of Geometrics Europe (address below).

The authorized representative located within the Community is:

Geometrics Europe
Christopher Leech
Manor Farm Cottage
Galley Lane
Great Brickhill
Bucks. MK17 9AB, U.K. ph: +44 1525 261874. FAX: +44 1525 261867

Mark Prouty, President
Geometrics, Inc.
San Jose, CA, USA

TECHNICAL MEMO

NOTE TO NEW G-856AX USERS

The G-856AX Portable Proton Precession Magnetometer is a versatile rugged tool for locating buried ferromagnetic targets. However, the device has some limitations when used in **high magnetic field gradients** or near power lines which generate **electromagnetic field interference.**

If the signal-to-noise ratio is low (due to gradients or rapidly changing fields due to proximity to large steel objects like a car or AC Powerline) the G-856AX Magnetometer will respond with 5 quick beeps just prior to the display of the data. Also, the "tenths" of gammas digit will be truncated (missing) under these conditions. ***This is an indication of an error condition usually attributable to high gradients or AC interference.*** Here are some techniques that can be employed to maximize the performance of the magnetometer:

1) Make sure that the magnetometer is properly tuned and that you are getting maximum tuning signal values. See the section on tuning the magnetometer (page 9).

2) Remove the magnetometer from the area where it is getting "high gradient" beeps and see if it performs correctly. If so, **remove the rear cover and turn Switch 3 "Short Count Gate" to the "ON" position** and try it again in the problem area. This switch causes the magnetometer to generate 0.2 gamma data compared to 0.1 gamma data, but in high gradients, this slight change is of no importance. However, it will also improve the signal-to-noise ratio by keeping the read cycle to the early "strong" portion of the signal generation. See page 37 for more discussion.

3) If you still get the occasional beep, you can strengthen the signal further by increasing the polarize time. This is done by turning **Switch 1 (Long Pol) to the "ON" position.** However, this has the adverse side effect of increasing the cycle time and draining the batteries more rapidly. See page 37.

4) If you are still getting errors, we suggest that you try raising the sensor to a higher altitude, thus moving it to a lower gradient area. Make sure the sensor is properly oriented (north).

5) Make sure the batteries are fresh and that the cable is not damaged or "open". If problems persist, please contact Customer Service at (408) 954-0522 or support@mail.geometrics.com

G-856 Front Panel Keys

CLEAR

Clears a key stroke or key stroke sequence.

SHIFT

Accesses the numbers on the keys rather then the function.

ENTER

Designates the end of a key sequence and transfers command to system. Also increments memory location displayed during recall operations (see RECALL).

OUTPUT

Begins automatic output of data to external device.

AUTO

Starts and stops automatic recording mode. Sets interval for automatic recording

ERASE

Erases a reading, the last group of readings, or the whole memory. (Must depress twice).

FIELD

Used during memory recall to recover the field reading after TIME has been depressed.

TIME

Accesses the real time clock. Also displays the time at which readings were taken.

TUNE

Displays and/or sets the tuning. Provides display of the signal strength received from last reading

RECALL

Accesses the memory. Also decrements the memory location displayed

STORE

Stores reading in memory

READ

Takes a measure of the magnetic field.

G-856 Front Panel Displays

FIELD/TIME

Displays the magnetic field or the time

STATION/DAY

Displays the station number, also the Julian Day, or the line number. Also displays signal strength, tuning and battery voltage.

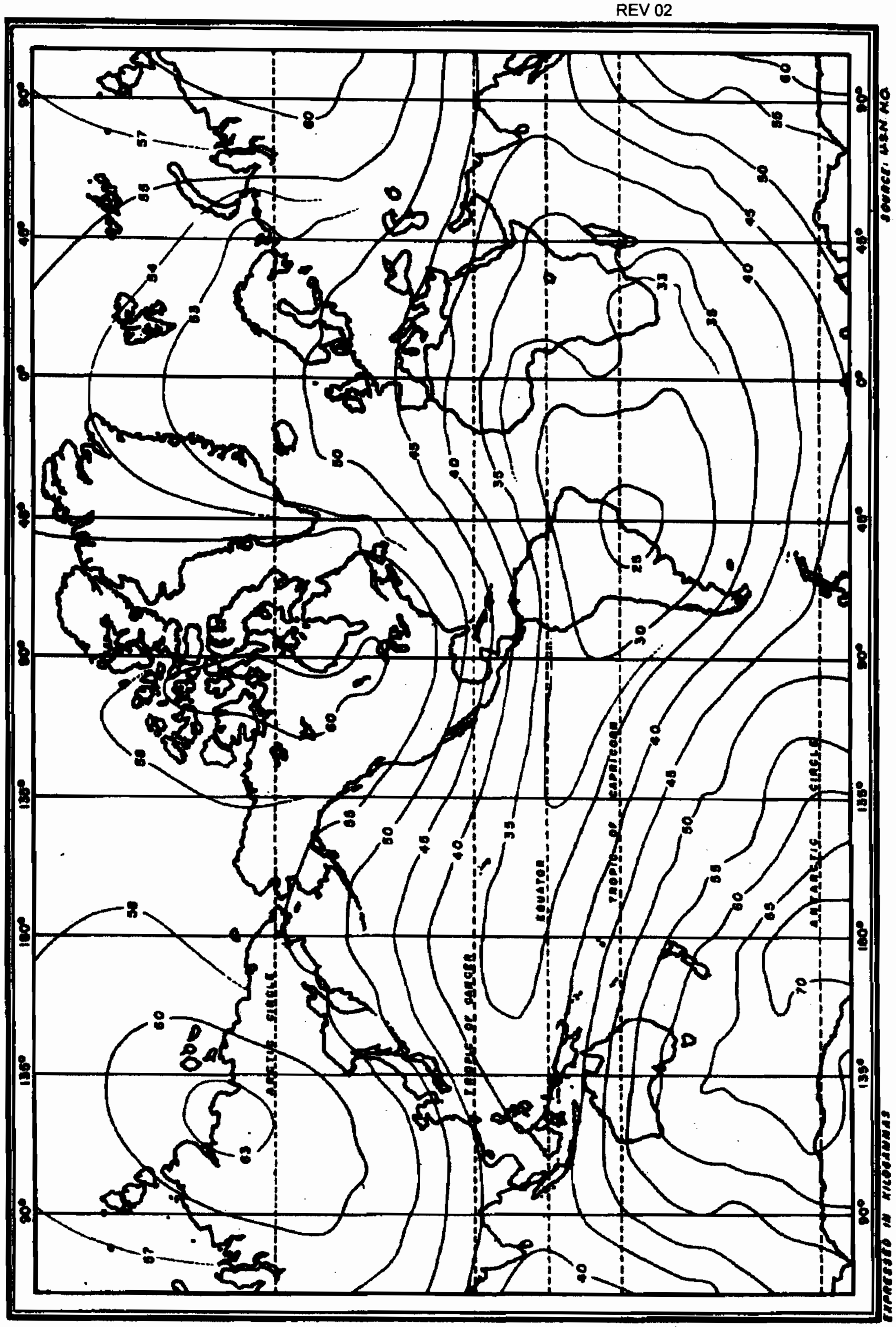

ARCTIC CIRCLE
TROPIC OF CANCER
EQUATOR
TROPIC OF CAPRICORN
ANTARCTIC CIRCLE
SOURCE: U.S.N. H.O.
EXPRESSED IN KILOGAMMAS

Table of Contents

Preface

What is a Magnetometer?

A magnetometer is an instrument for measuring the intensity of the earth's magnetic field. Most rocks contain some magnetite, the most common magnetic mineral, and therefore produce some disturbances in the local magnetic field. Soils and many man made objects such as pottery and pipes can have magnetic properties detectable by the magnetometer.

Through interpretation of magnetometer readings, assumptions can be made about what exists beneath the surface, whether it is a pipeline, an ancient urn, a piece of ordnance, a particular mineral, or geologic structure. The interpretation of magnetic data received from a magnetometer is sometimes a difficult task, made even more complex by constant changes in the earth's overall magnetic field, the size and distance of objects from the magnetometer, the amount of magnetic material the object contains, and the susceptibility of the object to absorb magnetism from other sources. On the other hand, many applications may require only simple interpretations of anomalies.

The proton precession magnetometer is one of the principal instruments for magnetic studies because it combines high accuracy and ease of use. The Applications Manual for Portable Magnetometers, supplied with this instrument and available for download from our website includes general information on the use of magnetometers. It should be studied as a companion to this volume, which deals specifically with the G-856AX Memory Mag™ Proton Precession Magnetometer.

The G-856

The G-856 is a portable, man-carried magnetometer/gradiometer and a "base station" magnetometer. As a hand-carried instrument, it features simple, push button operation and a built-in digital memory which stores over 5000 readings. This relieves the user of the need to physically write down the data in the field, eliminates transcription errors and most importantly, allows the use computers to automatically record and process the data from the magnetic survey. A number of programs are supplied by Geometrics at no cost to help the user interpret the data (see and download MagMap2000 and MagPick from our website www.geometrics.com).

The G-856 Memory-Mag magnetometer will also record automatically at regular intervals, so it can be left unattended to monitor diurnal changes in the earth's magnetic field. These readings (up to 12,500) are used to correct simultaneous field measurements for high accuracy surveys. Here again, the data may be fed directly into a computer so that the field data taken with an identical G-856 or G-858 MagMapper™ may be automatically corrected. The time-of-day is recorded with each reading taken in either mode from a built-in digital clock.

All operations are controlled from a weatherproof membrane switch front panel. The sequence of operations was carefully designed to be very simple to operate and yet flexible. Erasing the memory requires a fail-safe sequence to protect the data, except for the most recent reading which can be easily deleted and replaced if desired.

A single connector is used for the sensor and data output. The output format is in the universal RS-232, understood by computers. Interface software for downloading, profiling and gridding/contouring of data is supplied at no charge (MagMap2000).

Physically, the G-856 is compact and lightweight. It is weather proof and operates over a wide temperature range. It is powered by nine D-cell batteries, sufficient for about 3000 readings, or an internal rechargeable lead acid gel cell battery (camcorder type).

An internal programming switch allows modification of the cycle times to ensure that the G-856 works properly near the magnetic equator and in high gradients where other models may operate only marginally or fail to obtain reliable data.

Above all, the G-856 is a high-precision magnetometer, the result of many years experience in the manufacture of similar instruments. The operation of the instrument is controlled by a microprocessor and the control program may be changed at any time for product improvement or other considerations. In that event, you may find variations between this manual and the operation of your actual instrument operation. Such variations will have no adverse effect and should be recognizable as you familiarize yourself with operation.

Use of the G-856AX as a Gradiometer

A separate addendum has been added to the rear of this manual that describes the use of the G-856 as a Vertical Gradiometer. The gradiometer provides increased detection and enhancement of anomalies due to objects at a distance of up to 5 times the separation of the sensors. It also inherently removes diurnal variations due to the solar flux of charged particles interacting with the Earth's magnetic field.

Contents of this Manual

This manual presents the operating instructions for the G-856. Included are step-by-step instructions on how to:

*operate the magnetometer

*use the special features in surveying

*retrieve data

*maintain the magnetometer

Clarification of Terms

The terms used to describe the actions of the operator or functions of the magnetometer may be new to some users. For example, the areas or buttons, on the front panel will be called "keys". The words "sampling", "cycling", and "taking a reading" are all synonymous, and "mode" is used to refer to different parts of the magnetometer's operation, its different capabilities. The G-856 has two parts of operation--auto (automatic) mode and survey mode (regular field operation where the operator pushes buttons to take a reading).

There are two functions on most keys. When accessing the numbers on the keys, the magnetometer is said to be in numeric mode. When using a key to exercise a command (e.g. TUNE), the magnetometer is said to be in the command mode.

Chapter 1

Initial Set-up

This part of the manual contains information operation of the G-856 and use of its accessories. There is a separate addendum at the end of this manual which describes the use of the G-856 as a gradiometer or two sensor system.

The G-856 comes packed in a strong ABS plastic suitcase, with compartments for its accessories. It contains:

*the G-856 magnetometer

*a sensor

*a collapsible aluminum staff

*a signal cable

*a chest harness

*two sets of 9 D-cell batteries (or 2 rechargeable lead acid battery packs)

*G-856 Operator's Manual

*Application Manual for Portable Magnetometers

*MagMap2000 Software and Manual

*RS232 Data Output Cable

A. System Checkout

This procedure is to check the magnetometer's operation and to familiarize you with the system. Note that the magnetometer will produce incorrect readings indoors or where magnetic interference (from buildings, power lines, vehicles, etc.) is present.

1) Assemble the staff by inserting each section into the next and twisting to lock them together.
2) *Fill the sensor with fluid if shipped empty. Shake the sensor to determine if fluid is installed. A sloshing sound indicates proper filling (some air space is proper for expansion, see instructions on page 27.)
3) Mount the sensor (the white cylindrical object on the staff by screwing the staff into the threaded sensor mount. You'll notice there are two ways the sensor can be mounted, either on its end or horizontally. Mount it vertically now. We will discuss the horizontal method (also called saddle-mount) in Chapter 2. As an alternative, the sensor and magnetometer may be carried in the chest harness.
4) Using the signal cable, connect the sensor to the magnetometer.
5) Depress READ. The displays will light, turn off, then light again for 5 seconds. If the displays did not light, see the maintenance and Troubleshooting section in Chapter 4.

B. Operation Procedure

This section will show you how to take a reading, store it, and recall it from memory. After you've seen the general way in which the G-856 functions, the next section will begin the step-by-step instructions on operation.

The G-856 is really quite simple to operate. Most of the controls will not be used during the course of a normal survey and much of the sequence is automatic. The READ and STORE sequence is all you usually need.

To take a reading of the magnetic field, store it, and recall it from memory will require the use of, three keys.

READ 9	STORE 8	RECALL 7
(1)	(2)	(3)

1. When you depress READ, the displays will light briefly with the battery voltage, for example:

batt	FIELD/TIME
11 . 7	STATION/DAY

2. Then, the battery voltage will go out. After a short interval, the FIELD/TIME display will light with a 5 or 6 digit number, for example:

67584 . 2	FIELD/TIME

   This is the magnetic field reading in gammas.

3. At the same time the magnetic field lights in the FIELD/TIME display, another number appears in the STATION/DAY display, for example:

0	STATION/DAY

   This is the station number. Both displays will stay lit for about 5 seconds, then go out.

4. To store the reading in memory, depress STORE while the displays are still lit. If the displays go out before you depress STORE the reading will be lost and the ERROR message will come on. After you depress STORE the display will go out.

5. To recall the reading from memory, depress

RECALL 7

The FIELD/TIME display will light with the field reading and the STATION/DAY display will light with the station number that was stored with it.

In summary,	by depressing READ	you've taken a reading of the magnetic field
	by depressing STORE in memory	you've stored that reading
	by depressing RECALL from memory	you've recalled the reading

The next section provides instructions on every phase of operation. Each part of operation is presented in the order in which it would normally be done in actual use.

C. Actual Use

This section includes operational instructions. Notice that the operational procedures are divided into nine parts, and they are listed below in the order in which they appear in the manual.

Overview:

1. Clearing a Key Sequence
2. Setting the Clock
3. Using the Line Number Marker
4. Tuning the Magnetometer
5. Taking and Storing a Reading
6. Recalling from Memory
   a. Recalling from Memory - last reading
   b. Recalling from Memory - particular reading
   c. Recalling from Memory - second half of memory line
7. Erasing Data
   a. Erasing data - last reading
   b. Erasing data - last group
   c. Erasing data - entire memory.

8. Setting Auto Mode

   a. Displaying the last field reading taken

   b. Accessing real time

   c. Shutting off Auto Mode

9. Retrieving Data

Expanded Explanation:

1. Clearing a key stroke or key stroke sequence
   Depress

   [CLEAR]

   (A) When you depress CLEAR the displays will go blank and any key stroke(s) will be "erased."

2. Setting the Clock (Julian date/time)

	AUTO	TIME	SHIFT	
then	(day) +	(day) +	(day) +	
then	(hour) +	(hour) +	(min.) +	(min.) +
then	ENTER			

There are a number of features of the internal clock, and they are discussed in several places in this manual. It is especially important to set the clock properly when doing diurnal corrections. The survey maps and the base station mag clocks must be synchronized. A brief description of the key sequence involved in setting the clock includes:

- Check the clock to see if it needs setting.
- Select a time in the near future when you will start the G-856 clock.

- Shift into AUTO mode (the clock can only be set if AUTO is pressed before TIME).

- Depress TIME, SHIFT, and then numbers for the day, hour, and minutes.

- Wait for real time to match your preset time, and press ENTER to synchronize the G-856 clock.

Start by determining if the clock needs setting. Depress TIME. The time will light in the displays. Hour, minutes, and seconds will light in the FIELD/TIME display. The seconds will be running. Another number will light STATION/DAY display. Compare this indicated time to your watch, time standard, or your base station instrument and decide whether you need to set the clock. The display will go blank automatically in 5 seconds; to speed the process, depress CLEAR. If you decide that you need to set the clock, go through the following sequence.

- Depress [AUTO]

- Depress [TIME]

The displays will light with the current time setting. The STATION/DAY display will show the Julian Date. To change it, determine the time at which you will start the clock, and key in the numbers as follows.

- Depress [SHIFT] to access the numbers on the keys
  When you do this the lower display will show:

  _ _ _ STATION/DAY

- Depress:
  [(day) +] [(day) +] [(day) +]

Numbers for the Julian day, for example, April 13 is day number 103. As you do this, the STATION/DAY display will fill with the new setting. If you don't wish to change the day of-the-year value, just re-enter the old number.

- Next, depress:

  [(hour) +] [(hour) +] [(min.) +] [(min.) +]

Numbers for the hours and minutes. As you do this, the FIELD/TIME display will fill with numbers.

- Clock Set At the instant the display matches your time standard depresseuter. When you do this the new Setting will be entered and the display will go blank.

You can check that the time is correct by depressing TIME. The displays will light with the newly set time. The seconds will be running.

Note that the old clock keeps running inside the G-856 until you press ENTER. If you make a mistake in the sequence, just press CLEAR and you will have the old time restored.

ENTER can also be used after the Julian Date is keyed in so you can change that number without resetting the clock. In other words, you are free to use the Julian Date as another variable like the Line Number but remember that in auto cycle this number increments every 24 hours; (see section III).

Notice that depressing SHIFT accesses the numbers that are on the bottom portion of the key. This is different than most other keyboards, where SHIFT will access what is on the top portion of the key.

3. Setting the Line Number (Survey Mode)

In surveying, you will want to use a special designation called the line number to help you in recording your position (see Chapter 2, Mobile Survey Operation, for further details). When in Survey Mode, this 3 digit number appears in the STATION/DAY display when TIME is depressed. (Note: When in AUTO Mode, the three digit number appearing when TIME is depressed is the Julian day of the year).

Both the current line number setting and the Julian day are recorded for each reading taken, although both are not available for viewing on the displays. (If the reading is taken in survey mode, the line number is displayed when TIME is depressed; if the reading was taken in auto mode, the Julian day is displayed when TIME is depressed). The data file of the G-856, however, provides all the information: the line number, the time and Julian day, the field reading, and the station number. (See Chapter 3 for a more thorough discussion).

Be sure you are not in auto mode when setting the line number.

To change the line number:

- Depress TIME

The FIELD/TIME display will light with the real time and the STATION/DAY display will light with the current line number.

- Depress SHIFT to access the numbers on the keys. When you do this the STATION/DAY display will show

- - -	STATION/DAY

Now key in the new line number. As you do this, the display will fill.

- Depress ENTER

The display will blank and the new line number will be stored with the next field readings. To verify proper entry, press TIME.

4. Tuning the Magnetometer:

The magnetometer needs to be tuned for the same reason that a radio requires tuning, to achieve the best signal strength. The tuning procedure is a-matter of matching the circuits response to the intensity of the actual field value.

Usually, fairly accurate readings can be obtained by merely entering a number within 3,000nt of the actual field reading. Each time a new survey is started precise tuning should be adequate to obtain the maximum signal.

If you do not know the approximate magnetic field for your area, locate your position on the world magnetic map in the front of this manual. The map will provide you with the approximate field for your location.

The magnetometer may be tuned to 3-digit resolution (e.g. 57.4 kilo-gammas) but internally it selects from 256 possible steps. This allows you to tune the magnetometer very precisely which will result in less scatter and more accurate readings. Approximate tuning will be adequate for most surveys.

Remember--the following sequence only works if the magnetometer is functioning properly. You will need to be outdoors, away from power lines and large metal objects.

To tune:

- Use the world magnetic map to determine the normal field for the area being surveyed.
- Tune the magnetometer to three digit accuracy, (540 is 54,000 gammas).
- Take a reading.
- Retune to match the reading obtained.

You will depress:

TUNE SHIFT
(1)

\+ \+
(2)

ENTER
(3)

READE
(4)

TUNE
(5)

a. Depress TUNE TUNE

- When TUNE is depressed, a number will appear in the display.

5 1 0 0 0 . 6	FIELD/TIME
7 5	STATION/DAY

- This is the signal strength, a number ranging from 0.0 to 9.9 which describes the strength of the signal received on the previous measurement.

After the signal strength goes out, the current tuning value will appear in the displays.

tunE	FIELD/TIME
51 0	STATION/DAY

This number should be read as 51,000 gammas. The tuning range is between 20,000 and 90,000 gammas.

b. Next, decide if the present tuning value is valid. If it needs to be changed you will need to enter in numbers for whatever the new tuning value should be.

- Depress SHIFT to access the numbers or the keys.
- Depress numbers for the new tuning value, for example:

5	6

(56,000 gammas). Zeros will be entered for any space on the display not given a number.

- Depress ENTER When ENTER is depressed the new tuning value will be activated. The displays will go blank. You will want to check the tuning by taking a reading.
- Depress READ

- You will want to check the signal strength achieved at the new tuning value. Depress TUNE

The displays will again light with a signal intensity number, for example,

51 6	FIELD/TIME
8.5	STATION/DAY

- If this is satisfactory signal strength, you will begin your survey. If you need to increase the signal strength, you will want to be more precise in the tuning value entered. You might want to take a reading and enter in the first three digits of that reading for the tuning value. Some trial and error is usually required to receive the maximum signal strength possible. In general, maximum signal strength is received when the tuning value matches that of the field. Signal strength length levels of — to — are typical and provide good constant results.

5. Taking and Storing a Reading

This part of operation was explained in the section called OPERATION PROCEDURE. Briefly, the keys depressed to take and store a reading are

READ STORE

The next operational procedure, Recalling from Memory, expands on the use of the RECALL key to access the memory.

6. Recalling from Memory

A good way to understand the memory is to think of the data as being in a "stack" of lines, each line being made up of 2 parts. One part is the FIELD READING and STATION NUMBER, the other part is the TIME and LINE NUMBER or DAY. The line number will appear if the reading was taken in survey mode. You will see the Julian Day if the reading had been taken in AUTO mode.

The memory is accessed by depressing RECALL. When you do this the first half of the last ("top") line in the memory stack will light in the display. See Figure 1

Figure 1 Memory Stack

If you depress RECALL, the last line stored in memory lights in the display.

	(field)	(station)	(time)	(line no.)
This reading lights in display	67856.8	009	12.32.55	10
	68645.5	008	12.32.30	10
	68857.4	007	12.32.00	10
	68682.9	006	12.32.54	10
	68432.8	005	12.32.20	10
	68845.7	004	12.31.59	10
	68723.8	003	12.31.37	10
	68245.6	002	12.31.02	10
	68290.0	001	12.30.45	10

If you depress RECALL again, the memory decrements again, and the next reading will be displayed. See Figure 2.

Figure 2

Decrementing the Memory Stack

	(field)	(station no.)	(time)	(line .no.)
	67856.8	009	12.32.55	10
This reading lights in display →	68645.5	008	12.32.30	10
	68857.4	007	12.32.00	10
	68682.9	006	12.32.54	10
	68432.8	005	12.32.20	10
	68845.7	004	12.31.59	10
	68723.8	003	12.31.37	10
	68245.6	002	12.31.02	10
	68290.0	001	12.30.45	10

Depressing RECALL will continue to decrement the memory and each reading down the line will be displayed. Depressing ENTER will increment the memory.

In a large stack of data, it is not necessary to keep depressing RECALL or ENTER until the desired reading is found. In cases where you wish to look at the 5th reading or the 65th reading, the memory will respond if you depress:

[RECALL] [SHIFT]
(1)

[(station)+] [(station)+] [(station)+]
(2)

[ENTER]
(3)

Examples:

Depress

RECALL	SHIFT

to access the memory and the numbers on the keys.

Depress the numbers of the station number you wish to look at, for example 3, 5, 6. As you depress these numbers, the display will fill.

Depress

ENTER

The STATION/DAY display will read 356 and the FIELD/TIME display will light with the field reading taken at that station.

Accessing the other half of the memory line (the time and line number) requires depressing the TIME key while the first half of the memory line is being displayed. For instance, let's say you recall station number 555 from memory. (Depress RECALL, SHIFT, 5, 5, 5, ENTER). The field reading along with the number 555 will light in the displays. See Figure 3.

Figure 3

Display of First Half of Memory Line

	(field)	(station no.)	(time)	(line no.)
The first half of	68856.8	558	13.32.55	10
this reading lights	68845.5	557	13.32.30	10
in display	68857.4	556	13.32.00	10
→	68882.9	555	13.32.54	10
	68832.8	554	13.32.20	10
	68845.7	553	13.31.59	10
	68823.8	552	13.31.37	10
	68845.6	551	13.31.02	10
	68890.0	550	13.30.45	10

While the reading and station number are displayed, depress TIME, and the second half of the line, which consists of the time the reading was taken and the line number marker (or Julian Day, if the reading was taken in AUTO mode) will be displayed. See Figure 4.

Figure 4

Display of Second Half of Memory Line

(field)	(station no.)	(time)	(line no.)	
67856.8	009	13.32.55	10	
68645.5	008	13.32.30	10	
68857.4	007	13.32.00	10	
68682.9	006	13.32.54	10	
68432.8	005	13.32.20	10	
68845.7	004	13.31.59	10	Depressing
68723.8	003	13.31.37	10	TIME displays
68245.6	002	13.31.02	10	this half of
68290.0	001	13.30.45	10	the line.

Remember that when viewing the second half of the memory line, the time that's displayed is an historical record--the time at which the reading was taken. This is different than real time which is displayed with the seconds running.

While you are in the second half of the memory line, you can decrement or increment also, just by depressing RECALL or ENTER. To get the first half of the memory line back, depress FIELD.

With the concept of the memory stack in mind, the following directions on using the RECALL key will be clear.

a. Recalling from Memory--last reading
Depress

ENTER
(1)

The last magnetic field reading in memory will be displayed in the FIELD/TIME display, and its station number will appear in the STATION/DAY display.

b. Recalling from Memory--particular reading in mid-stack

Depress RECALL SHIFT

(station)+ (station)+ (station)+

ENTER

To access the memory and the numbers on the keys.
Depress numbers for the station number you wish to view, for example, 1, 2, 3.

Example:

Depress ENTER

The STATION/DAY display will light with 123 and the FIELD/TIME display will light with the magnetic field reading taken at that station. (If you need to recall a four digit station number, simply enter in 4 digits. The STATION/DAY display will flash with the first digit, blank, then flash with the next three least significant digits.)

NOTE: You cannot reach a memory location without data in it. If you don't have 123 readings stored, the stack will go to the highest valid number. You can also find the highest number by pushing READ.

c. Recalling from Memory--second half of memory line

Part of recalling data from memory has been performed by depressing RECALL, the station number and ENTER. However, that key sequence only gets you the first half of the memory line. To see the time at which that reading was taken, and also the other 3 digit number stored with it, depress TIME

TIME must be depressed while the field reading is still being displayed. The FIELD/TIME display will then light with the hour, minutes, and seconds at which the reading was taken and the STATION/DAY display will light with the line number marker (or Julian Day if the reading had been taken in auto mode. See Setting the Clock and Setting the Line Number (Survey Mode).

Any time you depress TIME when no field reading is being displayed, the real time will be displayed with the seconds running. This is how you can be sure of keeping historical time and real time separate. Real time seconds run. Historical time seconds do not.

Once you get the second half of the memory line, that half of the data will be displayed. You can increment and decrement in the second half just as you would in the first half, by depressing ENTER and RECALL respectively.

When you want to return to the first half of the memory line:
Depress FIELD

The FIELD/TIME display will revert back with the field reading, and the STATION/DAY display will show the station number. The instrument will also return to the first half or the memory line if you take a reading.

7. Erasing Data

The G-856 will allow you to erase the last reading, a last group of readings, for example from 356 on, or the entire memory.

a. Erasing Data - last reading
Procedure

READ	RECALL	ERASE	ERASE

Depress READ

The READ key will move the memory stack to the position of the last reading taken.

Depress RECALL

The last reading taken will appear in the displays.
While the displays are still lit with that reading:

Depress ERASE **twice**

The displays will go blank and the last reading will be erased from memory. ERASE must be depressed twice in order for the reading to be erased. This is a data protection feature. If ERASE is accidentally pressed, depress CLEAR, or any other key, to abort the erase operation.

b. Erasing Data - last group

To erase the last group of readings, first determine at what station number you wish to begin the erasure. All data will be erased from that station number to the last reading stored in memory

RECALL	SHIFT		
(station)+	(station)+	(station)+	(Enter Station Numbers)
ENTER	ERASE	ERASE	

Depress RECALL to access the memory and depress

SHIFT to access the numbers on the keys.

Depress numbers for the station number at which you wish to begin the erasure, for example 7,4,8.

Depress ENTER The displays will light with the station number 748 and the field reading taken at that station. While the displays are still lit with that reading, Depress [ERASE] [ERASE] The displays will go blank and all data from 748 to the last reading will be erased from memory. ERASE must be depressed twice for the data to be erased.

c. Erasing Data - entire memory

To completely clear the memory of information, you need to enter_in the first station number (0) and depress
[ERASE] twice

Depress:

RECALL (1)	SHIFT (2)
0 (3)	
ENTER (4)	
ERASE (5)	ERASE (6)

Depress [RECALL] to access the memory and depress [SHIFT] to access the numbers on the keys.

Depress 0, which is the first station number in memory.

Depress [ENTER] The displays will light with 0 and the field reading taken at that station. While the displays are still lit,

Depress [ERASE] [ERASE] The display will go blank and the entire memory will be cleared of information.

8. Setting Auto Mode

Auto Mode allows the magnetometer to take readings automatically at a specified interval. When the magnetometer is "cycling" automatically, it is usually stationary and is then called a base station. It's purpose is to record readings of the earth's diurnal field that can then be compared with the survey magnetometer's readings. In this way, a more accurate picture of the magnetic subsurface can be obtained.

The G-856 is able to store about 12,700 readings in the auto mode compared to the 5000 readings it stores in survey mode. The reason is that the time interval at which readings are stored is fixed, and so the specific time that each reading is taken can be automatically calculated when retrieving data. Since these items don't need to take up memory space, the memory for magnetic field data becomes larger in auto mode, (but notice that no information is lost). In auto mode, the Memory-Mag magnetometer can record as much as one reading every minute for over 40 hours.

In auto mode, when viewing the second half of the memory line, the three digit number displayed in the STATION/DAY display increments at 24:00 midnight. This number should be set to represent the Julian (numerical) Day of the year. (Refer to Figure 5).

You'll recall that this differs from how the magnetometer functions under regular survey conditions. In survey mode, the three digit number doesn't increment automatically because it is most often used as a line number marker.

Figure 5

Display Differences in Auto and Survey Mode

	Memory Stack		
Field	Sta. #	Time	Day
56890	347	12.19.20	112
5679000	348	12.20.20	112

AUTO MODE

	Memory Stack		
Field	Sta. #	Time	Line
56780	176	12.19.20	100
567980	117	12.20.00	200

SURVEY MODE

The following instructions assume that the clock has already been set (see Setting the Clock). Setting AUTO mode requires selecting the sample interval at which the magnetometer will take samples. The procedure is as follows:

Procedure:

Depress [AUTO] [SHIFT]

(1)

[(seconds)+] [(seconds)+] [(seconds)+]

(2)

[ENTER]

(3)

Example:

Depress [AUTO]

The displays will light with a number.

[AUTO] FIELD/TIME

[1 20] STATION/DAY

This is the current sample interval in seconds. If you like that setting, you can just depress ENTER [step (c)], and the magnetometer will begin taking readings every 120 seconds. If you need to change that sample interval, depress SHIFT to access the numbers or the keys. The displays will show spaces.

Next, depress numbers for the new sample interval, for example, 60 seconds. The display will fill with those numbers. Before 5 seconds lapse, Depress ENTER If ENTER is not depressed within 5 seconds the setting will clear. When you depress ENTER, the instrument will start taking and storing readings automatically.

There is a setting on the internal Option Switch that allows the displays to be turned off in Auto Mode to save battery power. See Using the Programming Switch in Chapter 4. If this switch is used, the displays will light with each sample for 5 minutes, then shut down. You can enable the displays again for 5 minutes by depressing any key.

a. To read the memory during AUTO mode, you depress RECALL and FIELD or TIME as desired. The Julian day will be displayed with TIME.

b. To access the real time.

Depress [TIME]

The FIELD/TIME display will light with the real time and the STATION/DAY display will light with the line number. If you press AUTO first, then TIME, the Julian day will come on. Look for the seconds to tick to verify correct time.

c. To shut off Auto Mode

Depress [AUTO] [CLEAR]

The displays will blank and Auto Mode will shut off.

When the cycle time is short, the above operations (8 a, b, c) will be slightly delayed because the instrument and displays will be busy taking readings. For instance, to shut off auto mode you will have to hold AUTO down for one complete cycle, then hold [CLEAR] down for one complete cycle.

As explained in the section Recalling from Memory, you may recall a 4 digit station number simply by depressing 4 digits. The STATION/DAY display will flash briefly with the most significant digit, followed by the three least significant digits. The FIELD/TIME display will flash with the magnetic field reading taken at that station.

NOTE:. There are 4 key sequences that will produce an ERROR message in auto mode. They are:

1. Depressing the [OUTPUT] key.
2. Depressing the [READ] key.
3. Depressing the [STORE] key.
4. Attempting to change the sample interval while the magnetometer is automatically cycling. You must shut down auto mode to change the sample interval.

9. Retrieving Data

Data can be retrieved both manually (See Chapter 3) and automatically.

To begin automatic retrieval of data, connect the G-856 to an auxiliary piece of equipment (computer, printer, magnetic tape recorder, or another magnetometer) using the optional RS-232 interconnect cable:

Depress [OUTPUT] [ENTER]

The information stored in memory, beginning with the first station number, will be automatically transmitted. The station number will flash so you can monitor progress. To interrupt (stop) the process, press CLEAR. The data will remain in the memory until you erase it.

You may begin automatic retrieval at any station number. The key sequence to begin transmitting data from station number 123 would be:

Depress [OUTPUT]

Depress [SHIFT]

Depress the desired numbers, for example [1, 2, 3]

Depress [ENTER]

The G-856 will begin transmitting data at the designated station number.

Summary

This chapter has presented the steps needed to operate the G-856. As a further aid, a short reference section summarizing this information is presented in the appendix. Chapter 2 discusses the features and performance of the G-856 in special survey situations. The chapter begins with instructions on connecting the sensor; proceeds with information sensor orientation, positioning, and repeatability; continues with a section on the magnetic environment, and ends by discussing some possible techniques that might be used in data collection.

Chapter 2

Field Operation

This chapter will discuss the features and performance of the Memory-Mag magnetometer in regard to actual survey use. Included here is information on sensor attachment and discussion of sensor orientation and positioning in relation to the repeatability of the instrument's readings. Discussed also are testing for magnetic noise and some particular features concerning the use of the magnetometer as both a base station and also a survey unit.

A. Sensor Attachment

Inside the sensor case are coils of wire submerged in a hydrocarbon fluid, in this case, Shell SOL-71 Mineral Spirits. The following section presents proper mounting procedures for the sensor.

1. Check for sensor fluid volume by shaking and listening for a "sloshing" sound. The fluid should sound like it's about 1 cm. from the top of the sensor. If you need to add fluid:

   A. Remove the blue cap plug on the sensor.

   B. Fill with fluid (see below) to within 1 cm. from the top.
   The following is Acceptable Fluids list that may be used in the G-856:

   Acceptable Fluids for Proton Magnetometers

   Preferred fluid: Shell SOL-71 (Shell Oil Co.)

   Acceptable Fluids:

   1. Charcoal Lighter Fluid (Kingsford, Wizard, etc.)
   2. n-Decane (chemical supply houses, oil refineries)
   3. ISOPAR-G (Exxon Oil Co.)
   4. Odorless Mineral Spirits (Naptha)
   5. Mineral Spirits (Naptha)
   6. Kerosene Lamp Oil
   7. Kerosene
   8. Mineral Oil (Medicinal grade)
   9. Diesel fuel
   10. Camp Stove Fuel
   11. White Gas
   12. Unleaded Gas

Items 11 through 12 have a very low flash point and should be used with extra caution. Although any petroleum product must be handled carefully.

There are several alcohols which will produce an acceptable signal, but will tend to absorb water. This will degrade the performance of the sensor over time. These alcohols should be replaced as soon as possible with a fluid from the above list. The preferred fluids are Shell SOL-71 and items 1 through 6.

Usable Alcohols:

1. Ethanol (grain alcohol) at least 190 proof.
2. Methanol (wood alcohol)
3. Denatured Alcohol (Ethanol made poisonous)

All of these fluids must be as clean as possible to ensure that no water or rust is contaminating them.

C. Replace plug.
Using Teflon Tape to prevent leakage

2. Attach the signal cable to the sensor.

3. Attach the sensor to the staff and assemble the sections.

B. <u>Sensor Orientation</u>

The sensor is marked with an arrow and the letter "N". During operation this arrow should be roughly pointed either north or south. Aligning the sensor this way will place the coil axis perpendicular to the Earth's field and produce an optimum signal. Aligning the arrow east or west will cause reduced signal amplitude.

As surveys approach low magnetic latitudes where the field dip is less than 40° and the field value generally below 40,000 gammas, (such as near the magnetic equator where the field is close to horizontal) the sensor should be mounted horizontally (saddlemount) on the staff. In this manner the sensor coils will be properly oriented for maximum signal. Because less signal produced at the low field strength areas, it is more important that the tuning is peaked for maximum. See page 3 for hints on increasing signal to noise ratio.

C. **Sensor Position/Repeatibilty**

Sensor position, in this case meaning the exact and consistent placing of the sensor, is very important to the repeatability of the system. Repeat ability means getting the same count for several readings taken consecutively when the sensor is not moved. This relationship between sensor position and repeatability becomes more and more critical as portable magnetometers increase in sensitivity. The following instances are of particular concem: areas of high gradients, areas where the diumal field is changing rapidly, and areas where magnetic dust is present. It's because of these instances that a 0.1 gamma magnetometer may not repeat as consistently as a 1 gamma unit. To illustrate, consider the following comparisons:

HIGH GRADIENTS: In an area of I sq. meter where the magnetic field varies by several tenths of a gamma every 15 centimeters, a 1 gamma magnetometer will not be affected by moving the sensor slightly, or even moving it as much as 30 or 40 cm.

However, given those same conditions, the repeatability of a 0.1 gamma magnetometer will be affected, and possibly quite noticeably by moving the sensor as little as a few centimeters.

RAPID DIURNAL CHANGES: Consider also that even if the sensor is held perfectly still, a 0.1 gamma magnetometer will pick up subtle changes in the diurnal field that a 1 gamma magnetometer would never detect. This is of particular concern during high sunspot activity.

MAGNETIC DUST: Added to this is the possibility that the sensor itself may be magnetically contaminated due to an inclusion or surface adherence. This may affect data greatly if the sensor is rotated or the orientation continually changed.

OPERATOR CONTAMINATION: A key, ring, knife, or other magnetic object carried by the survey operator can also become a source of errors in the magnetic data. In addition, steel-clad batteries, if installed in the instrument, will almost certainly cause a field error at the sensor.

As a note to the above, there may be other complications to repeatability. One is electrical noise in the system that may produce variations on the order of 0.1 gamma. Another possibility is the statistically random count of proton precession by the system. Again, a comparison between a 1.0 gamma magnetometer and a 0.1 gamma magnetometer is needed to make the point.

To explain further, the G-856 operates by counting the frequency of spinning protons in the sensor (for more information see Applications Manual for Portable Magnetometers). The length of, or the amount of time involved in this count, affects repeatability in a very subtle way. For instance, in a 1 gamma magnetometer, given a normal 3 second cycle time, a certain number of protons will be available for the count. Take as an example the field value of 53795.2. The 1 gamma magnetometer will round that count to 53795. The next count is 53795.3. Again the magnetometer rounds to 53795. In a 0.1 gamma magnetometer, however, that count will be more accurate; the magnetometer reports the counts as 53795.2 and 53795.3 respectively. Of course, this accuracy lessens the repeatability.

D. **Truncating Digits on the Display**

In areas of very high gradients, often times the environment does not permit the magnetometer to capture an accurate count. This happens because the sensor signal collapses, or dies, before the count time has ended, creating an inaccurate picture of the field. The operator will recognize the symptoms of high gradients by noting truncated digits on the display and a series of 5 quick beeps. When the signal has collapsed too soon, the magnetometer will drop the least significant digit and leave an incomplete reading on the display.

Depending on the resolution you need, this is most likely not a problem. If the cause is high gradients, there is no need for 0.1 gamma resolution. A similar effect may be observed in very low fields. You can usually improve the signal strength by shortening the count time and/or lengthening the polarization time. See Using the Programming Switch in Chapter 4.

E. **Magnetic Environment**

In surveying, it's important that magnetic field readings be as true as possible and not be affected by articles of clothing and personal accessories. Jewelry, keys, watches, belt buckles, pocket knives, zippers, etc. can affect the total magnetic field reading. Objects suspected to be magnetic may be checked in the following manner:

1. Mount the sensor on the staff, place the suspected article far away from the sensor, and take several readings. Each reading should repeat to ±1 gamma. (For details see Sensor Position/Repeatability on-the previous page.)

2. Place the suspected article fairly close to the sensor, and again note the readings.

3. Remove the article and again take several readings to check for a diurnal shift in the earth's field. If a shift is present, repeat the test.

4. If no diurnal shift is present, you can assume that the article is magnetic if the first group and the second group of readings varied by more than 1 gamma.

If the article is highly magnetic, or if the sensor is inside or near a building or vehicle, the proton precession signal will be lost, giving completely erratic readings (and 5 quick beeps).

The magnetometer can not reliably be operated in areas that are known sources of radio frequency energy, where power line noise (transformers) is present, in buildings, or near highly magnetic objects. The sensor should always be placed on the staff above the ground, or in the "backpack". The sensor will NOT operate properly when placed directly on the ground.

F. **Magnetic Surveys**

1. SURVEY OPERATION

During survey operation and after the instrument is tuned to the local field intensity (refer to Chapter 1), the operator need only depress the READ key to observe the reading, and if the reading is acceptable, the STORE key. If the reading is in question, for example a sudden shift of several hundred gammas, another reading should be taken.

2. DATA PROCESSING

For downloading and processing of G856 data see the MagMap 2000 manual. Also available for sonce body modeling is our analysis program MagPick, both available from our website. www.geometrics.com.

Note: MagMap 2000 program will automatically do diurnal correction if both survey and base titles are downloaded into the program. It is important that the clocks and days be synchronized prior to data recording.

Chapter 3

Data Retrieval

This chapter explains manual transcription of data for use if no PC computer is available. It also explains the process of using other instruments to retrieve data collected by the G-856 Memory-Mag magnetometer, presenting the possibilities that can be achieved. Some computer knowledge is helpful in performing automatic retrieval of data. Nevertheless, even a novice will be able to print the magnetic field reading, the time each reading was taken, the line number, and the station number. We recommend that you use MagMap2000 as your primary download and processing software program.

Before beginning retrieval of data, be sure to check that the batteries are holding a sufficient charge well above 7.5 volts. Failure to do this could result in incorrect or incomplete data. A simple test of the battery voltage is to press READ when the sensor is not attached. A voltage of 9.0 volts or greater should be noted before beginning retrieval.

A. **Manual Transcription**

To manually retrieve data, find the first reading In the survey (often 000) from your field notes or by iteration (see Recalling from Memory). After the first reading is found and data written down, depress ENTER to increment the magnetometer as many times as needed to see and hand record all the data.

If you are retrieving data from a base station, you will be looking for a specific time rather than a station number. Start with a guess and iterate until you find the precise time.

Assume that you have completed a field survey which took four hours and that at the same time had a base station operating from one hour before to 20 minutes after the survey, taking readings at I0 second intervals. You have made a list of the field data including the time of each reading, and the first reading was recorded at 13:04:27. When the base station READ button is pushed, the STATION/DAY display flashes 1, followed by 919, so you know that your first survey reading is about one hour after the start of your five hour and twenty minute record containing 1919 readings.

Pick reading 300 as a first guess and press: RECALL, SHIFT, 3, 0, 0, ENTER, TIME. The display will light with the Julian Date and a time, for example 12:50:02. This first guess was too early, so try 400 next: SHIFT, 4, 0, 0 ENTER. Notice that you do not need to press TIME again once you. are in the Time display mode. This time the display reads 13:07:42, a little too late. When you repeat the guess at 390, you get 13:05:02, a fairly close number. Now push RECALL over and over, getting a sequence of numbers: 13.04.52, 13.04.42, 13.04.32, 13.04.22. The last number is close enough. If your last guess had been just a little early, you could have advanced by pushing ENTER to increment the stack pointer.

Once you have the desired time In the window, push FIELD, which returns the magnetic field reading to the display. That becomes your baseline for diurnal correction of the survey data. Note that an automated diurnal correction process is included in MagMap2000 program described in separate documentation.

B. Use with a Computer

The G-856AX was designed to be used with a computer for fast and accurate download and analysis of the data. Geometrics has spent man-years developing and upgrading our magnetometer interface software. Currently we are supplying MagMap2000 for use on IBM PC compatible computers running Windows 98, 98SE, NT, ME, 2000 and XP operating systems. We will of course keep the software up to date on whatever current operating system is being used.

MagMap offers a huge advantage when performing routine download, profiling, contouring and diurnal correction of magnetometer using a basestation. The software has a special section designed especially for 856 interface and data handling. We strongly recommend that the MagMap software be used for the data download and initial processing. The latest version can be downloaded free of charge from our website www.geometrics.com. The complete operating manual is included in the software as a Adobe PDF document under Help. Download the free Adobe Acrobat Reader from www.adobe.com.

While we recommend that you spend the time to review the MagMap documentation, here are some of the things you can do with the software:

1. Download the 856 memory using a RS-232 interface at 9600 baud. This takes about 10 minutes for a full memory land survey (5700 readings) or about 20 minutes for a full memory base station survey (12,500 readings). Downloads can be for single sensor, dual sensor (gradiometer) or base station configurations.

2. Define the Grid and interpolate all data. MagMap allows the user to define the spacing between discrete readings and between survey lines. Then the program assigns a position to each reading creating a uniform grid. Positions are editable in individual or line mode. Later this ASCII (Text) file of the position, mag reading and time can be exported to other popular analysis programs such as our free MagPick program, Geosoft or Surfer gridding and contouring analysis packages.

3. Search the data for spikes or erroneous readings and remove them.

4. Flag anomalies in the profile data that are associated with targets of interest (archeological, environmental, utility, ordnance, geological, etc.) and plot the flags on the position map showing where they are located on the survey grid.

5. Create maps of the data in 2-D or 3-D mode with multiple color or shaded relief contours. The Flags discussed in item 4 above are also reproduced on the 2-D and 3-D maps allowing the user to define the large position.

6. Export the data for additional analysis. Please review our stellar MagPick Processing Software package on our web site. Note that this allows the user to estimate the target position, depth and size as well as make impressive contour maps. Use of this software will take some effort on the part of the computer operator, but the results are well worth the effort.

Please contact Customer Service (support@mail.geometrics.com) or Sales (sales@mail.geometrics.com) for additional support in using the 856 with computers.

Chapter 4

Supplemental Information

A. **Instrument Storage**

After use: Disconnect the sensor cable from the magnetometer.

Store all the components in the shipping container to prevent magnetic contamination.

If the magnetometer system will be stored foe a long time, remove the batteries to prevent electrolytic leakage or corrosion of the contacts. DO NOT REMOVE THE LITHIUM BATTERY which is soldered into the circuit board.

The recommended storage temperature for maximum battery life is 40°F (4°C). If you wish to store batteries for a long time, do so in your refrigerator. In addition, wrapping the cells in a plastic bag will prevent moisture formation while in the cold. These batteries should be allowed to warm up in the bag before being used.

B. **Batteries**

There are three kinds of batteries in the G-856 Memory-Mag™ magnetometer. Basic operation is powered by 9 D-cell batteries or by optional rechargeable gel cell battery pack. The clock and memory are powered by a lithium battery installed on the digital circuit board when the main batteries are disconnected or removed.

C. **D-cell Battery Types**

When the magnetometer is used as a base station, alkaline D-cell batteries will work satisfactorily. Figure 6 compares the expected number of readings possible for different battery types. Note that an optional external sensor power cable is available for base station use that allows the user to connect a 12v car battery to power the system. A typical fully charged car battery will last many days powering the 856 in base mode.

When the sensor is mounted on the staff, only cardboard or plastic jacket batteries should be used. If steel jacketed batteries (carbon zinc or alkaline) are used in the console during survey operation a directional dependent shift of several gammas will occur and will bias the measurement.

The optional internal gel cell battery pack is non-magnetic.

Figure 6

Number of Readings per Battery Type

Battery Type	Brand Name	Readings at 25°C	Readings at 0°C	Jacket type
Alkaline	Burgess, Eveready Duracell	6,000	4,000	Steel
Standard Carbon-Zinc (flashlight)	Burgess, Eveready Ray-O-Vac	1,500	700	Cardboard
Premium Carbon-Zinc	Eveready #1250*	3,000	1,700	Cardboard
Internal Gel Cell	Power Sonic*	Full Memory 12000	Full Memory 12000	Plastic

Figure 6 is based upon one reading every 30 seconds, using the 3 second cycle time setting (see Switch Options following). Faster sampling rates will yield fewer readings, especially at lower temperatures. Photoflash and "Energizers" are not designed for this type of application, but may be used until proper batteries are available. It should be noted that battery capacity decreases rapidly below 0°C to only a few hundred readings at -20°C. These battery types will recover, however, when warmed above 0°C. (see D-cell Battery Low Temperature Operation.)

D. **D-cell Battery Voltage Indicator**

After READ is depressed and before a reading of the magnetic field comes up on the FIELD/TIME display, a number indicating battery voltage appears. The indicator will display BATT and some number up to 19.9. This number is the actual battery voltage. Because the measurement of this voltage occurs during the polarize cycle of the magnetometer, the battery voltage indicator reports the amount of charge left in the batteries when they are under load.

It is possible that you may want to use an auxiliary power source with the G-856, which is why the indicator will read up to 19.9. When using just the internal D-cell batteries, however, the maximum voltage will read around 13.5 volts. When the indicator reads 8.2 volts the magnetometer will stop polarizing, and the batteries should be replaced. The "Low Batt" message will be displayed.

If you continue to use batteries that have discharged below 8.2 volts, the magnetometer may not respond to keyboard commands. Also, complete and accurate data cannot be ensured of you begin retrieving data when the batteries are not holding a sufficient charge. See Chapter 3, Data Retrieval for details.

*Available from Geometrics

E. **Low Temperature Operation**

At temperatures below 0°, battery life decreases rapidly. At -20°C, for example, operation may be limited to only 100 readings per set of batteries. At these lower temperatures, an optional Battery Belt (P/N 16069-01) or rechargeable gel cell battery pack (p/n) should be used, or the console may be held close to the operator's person, under warm clothing.

F. **D-cell Battery Replacement**

1. Unsnap and remove instrument cover.

2. Replace batteries matching the polarity markings on the battery holders.

3. Replace instrument cover. Be sure the instrument is seated all the way down in the case before trying to snap on the clops. Do not use the clips to force the unit into the case. Forcing them could cause breakage.

G. **Lithium or Keep Alive Battery**

In addition to the 9 D-cell batteries used to power the magnetometer in normal operation, there is an AA-size lithium battery, called the "keep alive" battery, used to power the clock and keep data in memory should the D-cells fail or be removed. The lithium cell should be changed about every 6-10 years. It is soldered into and underneath the top circuit board and should be replaced in the same manner. Be sure all data is removed from memory and recorded before the lithium battery is unsoldered from the circuit board.

H. **Lithium or Keep Alive Battery Replacement**

1. Unclip the cover and slide it off the circuit boards.

2. Remove the four screws holding the circuit boards together. As you separate the boards, unplug the cables noting their positioning as you do so. Lay the top circuit board down so the battery can be easily removed.

3. Unsolder the battery wires and wipe any debris from the battery area. Clear the plate through holes.

4. Check the polarity, then thread the lead wires on the new battery through the holes in the board.

5. Measure the current drain form the battery if possible. Drain should not exceed 50 micro amps.

   WARNING: Shorting the lithium battery will result in blowing an internal battery fuse and could result in over heating and possible explosion. Be sure the battery lead wires do not meet.

6. Turn the board over and solder the lead wires to the pads. Trim off any extra wire. Connection is made with wires running through the center of the board.

7. Replace the circuit boards, cables, screws and cover.

The clock will have to be reset after the battery is in place.

I. Maintenance and Troubleshooting

POSSIBLE SURVEY DIFFICULTIES

Survey Difficulty	Probable Cause	Corrective Action
Low Signal Amplitude (Display indicates less than 4 volts)	1. Magnetometer out of tune.	1. Retune magnetometer.
	2. Very high gradients.	2. Move out of the area or try switching to a short count.
	3. Broken sensor cable.	3. Replace or fix cable.
	4. Loss of sensor fluid.	4. Fill sensor with Shell SOL-71 to about 1/2 cm from the top.
	5. Sensor coil axis parallel to field.	5. Align sensor North-.South or in the saddlemount position.
Field display shows truncated digits (poor signal to noise ratio) and 5 beeps heard when reading taken	1. 50-60 Hz interference.	1. Move away from interference.
	2. Microphonics.	2. Avoid vibration mechanical shock to sensor while surveying.
	3. Broken sensor cable.	3. Replace or fix cable.
	4. High gradients.	4. See Erratic Readout.
	5. Generally weak signal.	5. Lengthen polarize time.
Erratic Readout	1. Magnetic storm or micropulsations.	1. Try later, especially at night.
	2. High geomagnetic gradient.	2. Hold sensor perfectly still. Try shortened count.
	3. Magnetic objects on operator.	3. Remove iron objects from pockets, belt, etc.
	4. Magnetic dirt on sensor.	4. Scrub or scrape magnetic particles off sensor.
	5. Review causes under "field display shows truncated digits.	
	6. Low battery voltage.	6. Replace batteries.
Displays do not light	1. Poor battery contact.	1. Check for loose batteries. Bend out contacts and clean.
	2. Low battery voltage	2. Remove batteries, then repress reset switch (SW2).
	3. Internal memory error.	3. Replace batteries.
No reading on STATION/DAY display	1. Interboard cable not connected.	1. Check cable for proper connection.

Low Battery Voltage Indication	1. Low voltage.	1. Replace batteries.
Display reads "ERROR".	1. STORE depressed when no reading lit on the display.	1. Take new reading, depress STORE before displays go out.
	2. FIELD depressed when depressing TIME did not precede it.	2. FIELD reading already displayed. The FIELD key is used to return to the first half of memory line. See Chapter 1, "Recalling from Memory".
	3. Incorrect or invalid key or key sequence depressed.	3. Consult Chapter 1. Depress key sequence again.
Display reads "data Err"	1. Internal memory error	1. Print out or transcribe all stored data, then depress ERASE ERASE.
	2. Power removed while instrument was in operating mode.	2. Dump stored data into recording device, then press ERASE ERASE.
	3. Power interrupt during AUTO cycle or OUTPUT.	3. Remove batteries. Press the INTERNAL RESET button on CPU board 16635-01. Install batteries. Set clock.
	4. Lithium battery malfunction.	4. Measure lithium battery voltage. If voltage is less than 3.2V, replace. (See page 30.)
	5. Control board.	5. Return board (P/N 16621).
Display reads FULL	1. Memory capacity is full of data.	1. Transcribe and erase some data to create memory space.
Console will not tune	1. Poor signal-to-noise ratio. See display reads truncated digits.	
	2. Low battery voltage.	2. Replace batteries.
Err message when tuning	1. Disable Autotune function.	1. See page 49 on. Autotune.
Partial numeric Display	1. Control board malfunctioning.	1. Return board (P/N 16621).

J. **The RS-232 Interface**

1. WHAT IS RS-232C?

In 1963, the Electronic Industry Association (EIA) established a standard to specify levels and protocol for interfacing data-terminal and data-communications equipment that use serial binary interchange. The latest revision to this standard has been in effect since 1969 and is referred to as RS-232C. While RS-232C specifies a very complex group of date lines and signal levels, most devices equipped with interfaces called "RS-232C" in fact offer a subset of the standard as their interface method. The G-856 is one such device. The RS-232C cable for the G-856 is provided with a 9-pin female D-connector.

2. CONNECTOR PIN ASSIGNMENT

Only 3 of 22 standard RS-232C data transmission lines are used in the G-856. The Geometrics standard RS-232C interface cable, Part Number 16492-01, is wired to connect directly to a PC 9-pin serial port.

The following figure lists the functions assigned to each pin of the RS-232 cable from the G-856.

Figure 7

9-pin connector RS-232	G-856 Front Panel	Function Description
2	T	Transmit Data - from the G-856
5	D	Signal Ground - Zero reference for interface
7	G	Clear To Send - When low, inhibits G-856 output. Leave open if not used.

3. VOLTAGE LEVELS

The RS-232C standard specifies voltage levels for the various data and protocol lines of the interface as ±12V nominal, with voltages from 5V to 25V being acceptable. A logical "1" (mark, off or false state) is indicated when the voltage at the interface point is more negative than -3V; a logical "0" (space, on or true state) is indicated when the voltage is more positive than +3V. Many "RS-232" devices, including the G-856, use 0 and +5 volts for these two logic levels ("TTL levels") instead of ±12V. Most devices designed to work with ±12V will operate correctly with "TTL levels" but there are exceptions. Many large mainframe computers and some minicomputers require data over long cables. If your external equipment requires full ±12V RS-232 levels, you will need to construct or purchase a TTL-to-bipolar interface driver. A schematic of such an interface driver appears in Appendix B.

Figure 8

Wiring Diagram - Front Panel Connector

Pin	Function	Remarks
A	Sensor	
B	Sensor	
C	Sensor Shield	
D	Ground	Power and Control Ground
E	No Connection	
F	Data Accepted	Input from External Device
G	Clear to Send	
H	Battery Positive	Connected to Internal Battery
J	Data 0	
K	Data 1	Note: Serial BCD is no longer used Character Serial BCD Out
L	Data 2	
M	Data 3	
N	Data Valid	
P	End of Data	
R	Instrument Power	External Power In. Otherwise Jumper to H
S	Synchronization	External Read/Store Command
T	Transmit Data	Part of RS-232
U	Receive Data	

> WARNING. Clear all operating functions before removing external power or internal batteries. Failure to clear functions may produce a DATA ERROR. Before clearing the error it is imperative that stored data be dumped into a recording device to prevent complete loss of data stored in memory

4. OUTPUT FORMAT

The G-856 data format on RS-232 and BCD outputs is as follows:

a. Each transmitted character is in ASCII code and consists of:

1 start bit (always logic "1")
7 data bits (ASCII encoded)
1 parity bit (always logic "0")
2 stop bits (always logic "0")

b. Each line of data transmitted by the G-856 is as described on Page 33 and consists of 29 ASCII characters:

	# of Characters
Space or asterisk (*)	1
Line number	3
Space	1
Julian day	3
Space	1
Time	6
Space	1
Station number	4
Space	1
Field	6
Carriage return, line feed	2

c. After all data has been transferred by the G-856, a final character (ASCII EOT) is transmitted.

d. Transmission of data is initiated as described in the G-856 manual, page 33.

a. Press **Output**; Display: Out
b. Optional: Press **Shift**, NNN; to begin output from station number NNN
c. Press **Enter**; display should begin flashing with number in lower window incrementing as each station's data is transmitted.

Be sure that the baud rates of the magnetometer and device being transmitted to match and that G-856 Txd line is connected to computer Rxd line.

5. EXTERNAL POWER

The G856 may be run from external power if desired. Usually you will want to do this because the internal batteries are not sufficient for some specific applications: when surveying in extremely cold weather, or when using the three-reading average (or long polarize) on a base station. The instrument may also be run on 18 volts instead of 13.5 volts to improve the signal to noise ratio.

For this application, connect the external 12v car battery positive to pin R, and the negative terminal to pin D (ground). The G-856 may also be operated from a DC power supply, but this sometimes introduces interference that noticeably reduces signal quality. It is a good idea to install a 1.5-2 ampere fuse in the power input line.

6. EXTERNAL CONTROL OF OPERATION

If pin S, Synchronization, is connected to pin D, ground, the instrument will take a reading and store it automatically. This feature was provided so that a external device could control operation of the magnetometer, and so that readings could be synchronized as desired. You can connect two G-856 magnetometers together so that the readings will be made simultaneously. In a small-area survey (most commonly in archaeological applications) a long cord can be run to the base station for more precise diurnal corrections. You may also wire two G-856 magnetometers together to make a portable gradiometer.

Possibly the most interesting application is in simplifying field operation. If you locate a push-button switch (non-magnetic) and tape it to your staff about shoulder height and wire it to SYNC, you can use the hand holding the staff to operate the magnetometer. You sacrifice the discretion of examining each datum before storing it, but you gain a lot in convenience. Note also that you can use the Auto operation as an alternative and acquire data in "walking" mode. Once you establish a good interval between readings, just walk and stop while the instrument takes its data, then walk to the next point.

Note: SYNC is an output as well as an input. If a G-856 starts a cycle, either because read was pressed or because of Auto operation, SYNC is pulled low and held low until the end of polarize time, then it is released. If SYNC is pulled low externally, the cycle is started. External SYNC may be momentary or held low. If momentary, Pol will shut off at the normal time. If held low Pol time will be extended until SYNC is released. In this manner, two G-856s, wired in parallel, will be synchronized. Either unit may provide the start command.

K. Using the Programming Switch

LOCATION AND PURPOSE

The G-856 has a small programming switch on the microprocessor circuit board. This switch is actually a set of eight individual switches in a small plastic assembly about 1 cm by 2-l/2 cm in size. Its purpose is to allow you to adjust the operation of the instrument to make it more noise insensitive, accurate, power efficient or suited to your specific application.

To locate the switch, remove the instrument from its case just as you do to replace batteries. Look near the right rear corner on the top circuit board. You will find a rectangular switch with eight small levers. Because of its size, you will need a small, pointed object like a pencil to change the switch settings. Notice that the eight levers will have their "on" position identified by the word ON or by a small dot (different types are available and. interchangeable). You will also find the number 1 through 8 next to each small lever, identifying the individual switches. Typically switching 1 through 5 are off, switches 6, 7, and 8 are on.

SWITCHES 1 THROUGH 4 (POLARIZE AND COUNT TIME)

The first four switches adjust the polarize time and affect the sensitivity, speed, and power consumption of the instrument. There are two operations in a proton precession magnetometer. First, a current is fed to a coil of wire immersed in the hydrocarbon fluid, causing the protons in the fluid to align (polarize cycle). Then, the current is removed and proton precessions are counted for a short period (count cycle). These operations take time, and there are tradeoffs to be made in the selection of the length of time involved in each.

In the case of the polarize cycle, the current should be left on long enough to produce a good signal, but not so long that battery power is wasted and not so long that the reading cycle becomes inconveniently long. The precession signal, on the other hand, decays rapidly, and the best readings are obtained by counting for most of the strong (early) part of the cycle. Selection of the best time is again a tradeoff, since the duration depends on the polarization power, and also on the field strength and the magnetic gradient (high gradients cause the signal to collapse more rapidly).

Setting Options Switches 1 through 4

Switch 1, when on, will extend the polarize time from under two seconds to almost three seconds. Using this switch will give you a stronger precession signal, but lengthen the total cycle time and therefore shorten battery life.

Switch 2, when on, will shorten the polarize cycle to less than one second regardless of switch 1's position. This will speed up the cycle time and increase battery life, but the result is a weaker precession signal which in turn can result in lower accuracy.

Switch 3, when on, will shorten the precession signal count time. This of course, will speed up the cycle slightly, but more importantly this setting will help you get good, valid data under conditions where the precession signal might decay very rapidly, in areas of high gradients and low field values. When the switch is on, however, the resolution of the magnetic field becomes .2 rather than .1 gammas. This is the first switch that should be adjusted if the instrument is giving erratic or noisy readings.

Switch 4, when on, will cause the instrument to automatically take three readings, and compute the average. This obviously is designed to give you the highest possible sensitivity, at some significant sacrifice of cycle time and power consumption.
(Note: This option is rarely used as the increase in sensitivity is usually not warranted by increase in survey time and battery consumption.)

Near the magnetic equator, the field is very weak and many proton magnetometers do not operate well, especially those optimized for higher latitudes. Often, the signal may be small and decays before the end of the count period. The solution is to extend the polarization time (switch 1) and shorten the count time (switch 3) so that counting is finished before the signal goes away. You may find that switch 3 is sufficient for good data, or you may need both switches. Remember that you may also need to rotate the sensor into the saddlemount position using the optional mounting bracket.

In high gradients, the problem is similar to the situation at the magnetic equator in that the signal collapses before the end of the count. You will know you are in an area of high gradients when the display truncates, or drops the least significant digit and you hear 5 quick beeps. The solution is the same as that for the equator, switch 1 and switch 3 are used.

Using switch 2 and switch 3 gives a much faster cycle time, longer battery life, and less sensitivity. You would use this combination when accuracy is not important, but speed and battery life are important.

Remember that you can also improve the signal by operating the G-856 at a higher voltage. External power connections as well as other inputs are accessed through the front panel connector. The instrument will operate on 18 volts, with a corresponding increase in polarization power. You can also operate with longer cables in this manner. Please note that the G-856 should give satisfactory performance with its normal 12-volt. supply and the above option is only for special situations.

For highest sensitivity, switch 1 (long polarize) will help. In addition, switch 4 (3 reading average) used with or without switch 1 will again increase signal to noise ratio. Because of the lengthening of the total cycle time needed to perform 3 count averaging, this setting is probably most applicable to base station recording.

Because of the increased power needed to perform 3 reading average (when switch 4 is on), you should consider using alkaline batteries, or external power if switch 1 (long polarize) is also used. The standard batteries supplied with the G-856 will not last through the time it takes to fill the memory when 3 count averaging is being applied.

In summary, proper selection of the polarize and count options will require some judgment on the part of the user, but having this flexibility can produce better data under difficult condition.

Switch 5 (Display off after 5 minutes auto cycle)

Switch 5 is applicable to the AUTO mode. In some uses of automatic recording, it will be desirable to have the readings displayed as they are taken and stored. Typically would be for portable surveys where the operator wishes to automatically record (to save button pushing and to increase the number of readings storable), yet wants to monitor the operation. But, in other cases, base station recording for example, there would be no value in lighting the display, since the display uses about half the power consumption and the system is operated unattended.

Setting Options Switch 5

If switch 5 is turned on, the display will blank if the keyboard is not exercised for five minutes. When you first set up the instrument, the display will light for five minutes to allow initial monitoring of the operation, but after you leave and those minutes have elapsed, the display will shut down to save power.

If switch 5 is off, the display will continue to light each cycle indefinitely.

SWITCHES 6, 7, AND 8 (BAUD RATE)

Switches 6, 7 and 8 are used to set the baud rate. The RS-232 interface will output data at selected speeds, called the baud rate. Different types of devices can send and receive at different rates or combinations of rates. A mechanical teletype with an RS-232 interface will receive at 110 baud. A standard telephone line with a modem will communicate at 300 baud. Printers with RS-232 interfaces may handle 300 or 600 baud (and others). Computers, of course, can handle high speeds of data transmission at 9600 band. The data handling device that you connect to the G-856 will either have a specified baud rate or a selection of baud rates. You will want to use the fastest combination available between the two instruments, but they must be set to the same baud rate to transfer data.

The data transfer rate in characters per second is approximately one/tenth the baud rate. A reading contains about 30 characters (FIELD, TIME, STATION NUMBER, DAY, LINE NUMBER, spaces, punctuation marks, carriage returns, line feed, and some null characters to allow time for the mechanism to return to the start of a new line). That means that a single reading will require as much as three seconds to print on a slow telex machine, or as little as l/5 of a second to feed into a computer.

Figure 9 and Table C-1 (Appendix B) show the switch option settings.

Figure 9
Switch Setting Options

SWITCH		S1	S2	
1		OFF	OFF	NORMAL
	POLARIZE TIME	ON	OFF	LONG
2		ON	ON	SHORT
		ON	ON	SHORT
3	READ TIME	OFF		NORMAL - 920 ms
		ON		SHORT - 460 ms
4	3 READING AVERAGE	OFF		NORMAL
		ON		AVERAGE
5	AUTO CYCLE	OFF		NORMAL
	DISPLAY	ON		DISPLAY SHUTS DOWN
6	BAUD RATE SELECT (See Table C-1)			
7				
8				

L. USING THE RESET SWITCH

There is a small red and white push button reset switch in between the circuit boards on the left hand side of the instrument chassis. Should the instrument experience a processor lock up, it may be necessary to reset the G-856. Care should be taken when using this switch as all memory and internal settings such as the Clock and Cycle times will be reset to default settings. Make sure you attempt to download the data prior to using this switch.

M. SPECIFICATIONS

Displays	Six digit display of magnetic field to resolution of 0.1 gamma or time to nearest second. Additional three digit display of station, day of year, and line number.
Resolution	Typically 0.1 gamma in average conditions. May degrade to lower resolution in weak fields, noisy conditions or high gradients.
Absolute Accuracy	One gamma, limited by remnant magnetism in sensor and crystal oscillator accuracy.
Clock	Julian clock with stability of 5 seconds per month at room temperature and 5 seconds per day over the temperature range of -20 to +50 degrees Celsius.
Tuning	Push button tuning from keyboard with current value displayed on request. Tuning range 20 to 90 kilogammas.
Gradient Tolerance	Tolerates gradients to 1800 gammas/meter. When high gradients truncate count interval, maintains partial reading to an accuracy consistent with data.
Cycle Time	Complete field measurement in three seconds in normal operation. Internal switch selection for faster cycle (1.5 seconds) at reduced resolution or longer cycles for increased resolution.
Manual Read	Takes reading on command. Will store data in memory on command.
Memory	Stores more than 5000 readings in survey mode, keeping track of time, station number, line number day and magnetic field reading. In base station operation, computes for retrieval but does not store time of recording designated by sample interval, allowing storage of up to 12,000 readings.
Output	Plays data out in standard RS-232 format at selectable baud rates. Also outputs data in real time byte parallel, character serial BCD for use with digital recorders.
Inputs	Will accept an external sample command.
Special Functions	An internal switch allows: 1) adjustment of polarization time and count time to improve performance in marginal areas or to improve resolution or speed operation, 2) three count averaging, 3) choice of lighted displays in auto mode.

Physical — Instrument console: 7 x 10 ½ x 3 ½ inches (18 x 27 x 9 cm) 6 LB (2.7 kg)

Sensor: 3 1/2 x 5 inches (9 x 13 cm) 4 LB (1.8 kg)

Staff: 1 inch x 8 feet (3cm x 2.5m) 2 LB (1kg)

Environmental — Meets specifications from 1 to 40°C. Operates satisfactorily from -20 to 50°C.

Power — Operates from 9 D-cell flashlight batteries (or 13.5 volts external power). May be operated at 18 volts external power to improve resolution. Power failure or replacement of batteries will not cause loss of data stored in memory.

ACCESSORIES

Standard:

- Sensor
- Staff
- Backpack
- Two sets of batteries
- Carrying case
- Applications Manual for Portable Magnetometers
- RS-232 Cable

Optional:

- Cold weather battery belt
- Rechargeable Battery option
- 50' External power / Sensor cable
- Spares Kit

APPENDIX A

Operation Short Reference Guide

1) Clearing a key sequence [CLEAR]

2) Taking and Storing a Reading [READ] [STORE]

3) Recalling from Memory --last reading taken
[RECALL] (continue pressing RECALL to decrement memory location, press ENTER to increment memory location)

4) Recalling from Memory --specific station number

RECALL	SHIFT	(station) #	(station) #	(station) #	ENTER

5) Tuning the magnetometer

READ	TUNE	SHIFT	TUNING #	TUNING #	ENTER

6) Erasing data -- last reading

READ	RECALL	ERASE	ERASE

7) Erasing Data -- last group of readings

RECALL	SHIFT	(station) +	(station) +	(station) +	ENTER
ERASE	ERASE				

8) Erasing Data -- entire memory

RECALL	SHIFT	0	ENTER	ERASE	ERASE

9) Time and Line Number Display [TIME] (press while reading is being displayed -- see RECALL)

10) Line Number Set

TIME | SHIFT | (line) + | (line) + | (line) + | ENTER

11) Julian Day set

AUTO | TIME | SHIFT | (day) + | (day) + | (day) + | ENTER

12) Julian Day and Time Set

AUTO | TIME | SHIFT | (day) + | (day) + | (day) + | (hour) + | (hour) + | (minute) + | (minute) + | ENTER

13) Output Initiate

OUTPUT | ENTER

14) Output Stop

OUTPUT | CLEAR

15) Setting Auto Mode

AUTO | SHIFT | (seconds) + | (seconds) + | ENTER

16) Auto Mode Off

AUTO | CLEAR

Operation in the Base Station (Auto Cycle) Mode

Table B-2 is a listing of the functions that can and cannot be executed in the base station (auto cycle) operating mode.

Table B-2

BASE STATION MODE (AUTO CYCLE) FUNCTIONS

Allowed Functions	
RECALL	(recalls stored readings)
TUNE	(tunes the magnetometer)
TIME	(displays time and line number)
AUTO-TIME	(displays time and Julian day)
AUTO-TUNE	(enters or exits auto-tune mode)
AUTO-TUNE-SHIFT	(adjust cable capacitance)
AUTO -ERASE	(enters or exits auto-erase mode)
Disallowed Functions*	
OUTPUT	(outputs data)
READ	(takes a reading)
STORE	(stores reading)
AUTO-ENTER	(enters auto cycle)
AUTO-TIME-SHIFT	(changes time or Ray)

*If an attempt is made to activate a disallowed function, the display will read out

Auto	FIELD/TIME
Err	STATION/DAY

Appendix B

OPERATING THE MODIFIED MODEL G-856 (UNITS HAVING SERIAL NUMBER 27351 AND ABOVE, AND USER-MODIFIED UNITS) AND THE MODEL G-856X

Because of several performance improvements included in the (1) Model G-856X, (2) later models of the Model G-856, and (3) instruments that have been retrofitted to upgrade their performance*, the operating procedures of these instruments differ from those of the earlier, unmodified Model G-856 magnetometers. This appendix describes these performance improvements and the new operating procedures.

Beeper/Annunciator

The beeper/annunciator sounds once each time a key is touched, three times after data from memory have completely transferred through the RS-232 output, and five times whenever high gradients or noise are detected.

Julian Date Display

To distinguish a Julian date from a line number, each Julian date is displayed with a trailing decimal point in all modes (DISPLAY, RECALL, etc.).

Expanded Baud Rate Selection

Table B-1 lists the expanded baud rate selection and the programming switch settings required to configure the magnetometer for a specific rate. Note that Switch 8 is now operable.

Table B-1

BAUD RATE SELECTION

Baud Rate	Programming Switch Setting		
	Switch 6	Switch 7	Switch 8
110	OFF	OFF	OFF
150	ON	OFF	OFF
300	OFF	ON	OFF
600	ON	ON	OFF
1200	OFF	OFF	ON
2400	ON	OFF	ON
4800	OFF	ON	ON
9600	ON	ON	ON

* Two retrofit kits are available: Kit 16640-O1 upgrades an earlier model G-856 to have the newer software features described in this appendix. Kit 16640-02 will essentially convert a Model G-856 to a Model G-856X, complete with expanded memory.

Faster Cycling In Base Station (Auto Cycle) Mode

As shown in Table B-2, single and three-cycle-averaged times for operation in the base station mode have been reduced by approximately one second for all polarization and reading (gate) configurations. The table breaks out the selection of cycle time and the appropriate programming switch configurations.

Table B-3

CYCLE TIME SELECTION

Single Cycle (seconds)	Three-Reading Average (seconds) (switch 4 ON)	Switch 0 (Long Pol, if ON)	Programming Switch Setting Switch 1 (Short Pol)	Switch 2 (Short Gate if ON)
4	10	OFF	OFF	OFF
5	13	ON	OFF	OFF
3	7	OFF	ON	OFF
3	7	ON	ON	OFF
3	7	OFF	OFF	ON
4	10	ON	OFF	ON
2	6	OFF	ON	ON
2	6	ON	ON	ON

Memory Operation

The Model G-856X has a memory capacity of 12,000 readings taken in the base station operating mode or 5,700 readings taken in the field reading operating mode. Models with serial numbers of 27351 or greater have a memory capacity of 2,950 base station readings and 1,450 in-the-field readings. Note that you have the additional option of specifying a G-856X memory for retrofitting your early model G-856 to maximum memory capacity.

A reading is stored in memory when the STORE key is pressed after a reading is made. To indicate that a reading has been stored,

STORED   Field/Time is displayed

To erase a reading recalled from memory and all readings following that reading, the ERASE key is pressed twice while the recalled reading is being displayed. The display will change to *ERASED* Field/Time.

By continuously depressing **ENTER** or **RECALL** key when recalling readings, the readings will be automatically reviewed at an increasing rate; for example, the read out rate will start at one reading every half second, then increase within 10 seconds to 5-6 readings every second.

DATA FIELD / TIME. Should data in memory become corrupted
Err STATION / DAY will be displayed whenever a key is depressed. However, even though this message is displayed, most keystroke sequences are valid. If the stored data are not totally corrupted, the stored information may still be reviewed or output to an RS-232 device to recover the remaining uncorrupted data. Once the data have been recovered the **ERASE** key can be depressed twice to reset the instrument and completely clear the memory. See note on page 17

One way that memory may be corrupted is by removing power (either by disconnecting an external power device or by removing the internal batteries) while the G-856 is in an operating mode; e.g., auto cycle. In most cases only the last reading will be affected, so the remaining stored data should be transferred to a storage device (a computer or recorder). This transfer must be done before the ERASE ERASE sequence is followed or all of the data in memory will be lost. Until the error is cleared, you will not be able to reactivate the auto cycle mode.

Tuning

Tuning is accomplished automatically. When the automatic tuning function is activated, the tuning value is automatically updated after each field reading--unless a high gradient is being read. To activate the automatic tuning function press:

AUTO **TUNE** **ENTER**

This key sequence will activate the following displays:

Auto	FIELD/TIME	*A tunE*	FIELD/TIME
x x	STATION/DAY	*oFF*	STATION/DAY

While the automatic tuning function is enabled, the instrument cannot be manually tuned. The tuning value and signal level may be displayed but they cannot be changed. Attempts to manually tune the instrument will produce this display:

A tunE	FIELD/TIME
Err	STATION/DAY

Note: For best performance, manual tune the G-856 before taking the first reading of a survey area, then activate the automatic tuning function.

To deactivate the automatic tuning function

AUTO TUNE CLEAR

The display will be:

Auto	FIELD/TIME	*A tunE*	FIELD/TIME
x x	STATION/DAY	*on*	STATION/DAY

To determine whether the instrument is in the automatic running mode, press AUTO TUNE The display will indicate whether the automatic tuning is on

	A tunE	FIELD/TIME
	on	STATION/DAY
Or off	*A tunE*	FIELD/TIME
	off	STATION/DAY

To ensure the optimum performance of the automatic tuning function, the magnetometer tuning value should be matched to the capacitance of the sensor cable. Most Geometrics cables for portable sensors have a capacitance of .03 nano-farads per foot; thus, the standard portable sensor cable supplied with the G-856 has a total capacitance of 0.2 nano-farads. To match the instrument's automatic tuning function to this standard cable, press

AUTO TUNE SHIFT

The display will read

Auto	FIELD/TIME	*A tunE*		FIELD/TIME
X X	STATION/DAY	*on*	(or off)	STATION/DAY
CAP	FIELD/TIME	*CAP*		FIELD/TIME
X X X	STATION/DAY	— — - —		STATION/DAY

Key in the capacitance of the sensor cable

SHIFT 0 SHIFT 0 AUTO

and press ENTER

Addendum to Memory Operation'

In the field mode, a reading can be taken and automatically stored each time READ is depressed. To enter the auto store mode, depress the following keys:

AUTO STORE ENTER

To clear the auto store mode press:

AUTO STORE CLEAR

In the base station mode the G-856X can be configured to take readings even if the memory is full. In this auto erase mode, the earliest sixteen stored readings will be deleted and the instrument will continue to take readings. To enter the auto erase mode, depress the following keys:

AUTO ERASE ENTER

To clear the auto erase mode, depress:

AUTO ERASE CLEAR

To determine if either the Auto Store or the Auto Erase feature is ON or OFF, press

AUTO Then press either STORE or ERASE

The display will indicate whether the feature is ON or OFF.

APPENDIX C

G-856 GRADIOMETER OPTION INSTRUCTIONS

1. PURPOSE

The G-856 Gradiometer Option allows a single G-856 chassis to take successive reads from two vertically separated sensors. The result is a measurement of vertical gradient independent of time variations. See Note 1.

2. CONTENTS

This option consists of a Remote Start Switch Box, two special sensor cables, a special second sensor, a staff modification kit, and a Velcro strip.

3. PREPARATION

Configure the G-856 console for normal polarize, normal gate, 9600 Baud data transfer and disable 3 read averaging by setting switches 1 through 4 to "off" and 6 through 8 to "on" on the G-856X CPU board.

Assemble the staff and sensors. Start by removing the standard cable from the original sensor and attaching one of the special sensor cables. Next, connect the staff modification kit parts to the top of one staff section and the bottom of another staff section so that the threaded shafts point towards each other. The second sensor, with two threaded caps, will mount between the two staff sections. Sensor separation may be controlled by choosing an appropriate pair of staff sections.

Typical sensor separation will be two staff sections or 4 ft. Thus the top sensor will be at 8 ft and the lower sensor at 4 ft. Care must be taken not to allow the lower sensor to come close to the console (hold at arms length) due to the magnetic effects of it's circuitry and batteries.

Then assemble staff sections and mount the sensors. The sensor cables may now be connected to the Remote Start Switch box, and the Remote Start Switch may be connected to the G-856 front panel connector. Attach the Velcro strip to the top of the G-856 black front panel bezel. Mount the Remote Start box to this mating Velcro strip.

Appendix B

G-859 Manual

4. OPERATION

To initiate a gradiometer read cycle, depress the Cycle button on the Remote Start Switch. The G-856 will then take two readings, the first from the bottom sensor, and the second from the top sensor. Data will be automatically stored.

5. DATA STORAGE

Gradiometer readings are stored as pairs of field readings. Assuming that the G-856 memory were cleared before operation as a gradiometer, reading 000 would be from the bottom sensor reading and 001 would be the first top sensor reading. From then on, each even numbered reading will be from the bottom sensor and each odd numbered reading will be from the top sensor. The RS-232 output format is described on page 35 of this G-856 manual. MagMap 2000 automatically separates these interleaved readings into two data files

Note 1:

Since readings taken using the gradiometer Box are treated by the magnetometer as external cycles, the internal memory pointer is not updated. Therefore pressing "Recall" may not display the last reading as with internal operation. To view the last reading taken in gradiometer mode press "Recall" "Shift". Then enter a number equal to or greater than the last reading. When erasing a gradiometer station, the last two readings must be erased.

Note 2:

In situations where changes in the earth's field are significant during the interval between sensor reads, some correction of the data will be necessary.

WARRANTY AND SERVICE

Warranty

Geometrics full warrants the Proton Precession Magnetometer to be free of defects in material and workmanship for a period of one year from the date of acceptance. Geometrics maintains good commercial practices in the manufacture of equipment. In the event of malfunction, Geometrics, at its own expense will repair or replace any material, equipment, work, or parts that prove defective or deficient under normal operating conditions.

Except for the express warranty stated above, Geometrics disclaims all warranties of merchantability and fitness, and any stated express warranties herein are in lieu of all obligations or liability on the part of Geometrics for damages, including but not limited to special, indirect or consequential damages arising out of, or in connection with the use or performance of the equipment.

Geometrics reserves the right to perform warranty services FOB San Jose or at the customer's installation site. Geometrics is not responsible for delays or defects in the quality of results from misuse, mishandling, unauthorized modifications, installation, or other operation conditions out side its control.

Should warranty service or technical advice be required, contact Geometrics. No warranty service will be performed unless the customer secures authorization from Geometrics prior to returning equipment. If this instrument or any part of it is returned to the factory for any reason, please complete this form and include it with the instrument or part being returned.

SHIP TO:

Geometrics Inc.
2190 Fortune Drive, San Jose, CA 95131
Phone: (408) 954-0522
Fax: (408) 954-0902

(For international shipments use
San Francisco International Airport,
Attention: KEL International 650-697-6400)

Name

Company

Address

City, State, Zip, Country.

Telephone

IMPORTANT

Please explain why this instrument or part is being returned; include a complete description of any malfunction (use additional paper if necessary). Thank you.

G-859 MINING MAG
Cesium Vapor Magnetometer

Operation Manual

P/N 25309-OMM

GEOMETRICS, INC.
2190 Fortune Drive, San Jose, CA 95131 USA
Phone: (408) 954-0522
Fax: (408) 954-0902

SYSTEM SPECIFICATIONS

MAGNETOMETER / ELECTRONICS

Operating Principle: Self-oscillating split-beam Cesium Vapor (non-radioactive CS-133).

Operating Range: 18,000 to 95,000 nT (γ)

Operating Zones: For highest signal-to-noise ratio, the sensor long axis should be oriented at 45°, ±30° to the earth's field angle, but operation will continue through 45°, ±35°. Sensor is automatic hemisphere switching.

Sensitivity: 90% of all readings will fall within the following P-P envelopes:
- 0.03 nT at 0.2 sec cycle rate (SX=0.113nT)
- 0.02 nT at 0.5 sec cycle rate (SX=0.072nT)
- 0.01 nT at 1.0 sec cycle rate (SX=0.051nT)

Information Bandwidth: < 0.004 nT (γ)/√Hz RMS

Heading Error: < ± 0.5 nT (γ)

Temperature Drift: 0.05 nT per degree C

Gradient Tolerance: > 500 nT (γ)/inch (>20,000 nT (γ)/meter

Cycle Rate: Variable from 0.2 sec to 1 hr in 0.1 sec steps or by external trigger.

Data Storage: Non-volatile RAM with capacity for 8 hrs of Magnetometer time, event marks, location as GPS at maximum sample rates.

Audio Output:
1. Audio tone of earth's field variation, pitch and volume adjustable. (Search)
2. Audio pulse each 1 second (Pace metronome).
3. Alarm for loss of signal, noise in signal (QC) or low battery.

Data I/O: RS-232 standard bidirectional serial port, selectable continuous real time data transmission via RS-232 to PC. Memory dump transfer time less than 5 min at 115Kbaud transmission rate.

Visual Output: Micro-controller driven, 320 x 200 graphic liquid-crystal display, daylight visible with selectable outputs for:
1. Data display: Up to 5 stacked profiles, real time or review mode. Map of survey grid with zoom functions.
2. All system set-up functions, e.g., memory status, data transfer, sample time.
3. All Survey set-up functions, e.g., survey profile number and direction, station or GPS number,
4. Survey monitoring functions, e.g. total field, noise level, profile number x or xy coordinates.

Internal Clock: Resolution of 0.1 sec, drift: < 1 sec/day

Power: 1. 24 VDC rechargeable gel cell, 6 hrs Magnetometer with GPS. Magnetic effect less than 1 nT (γ) at 3 ft.
2.Internal backup battery for clock and non-volatile RAM.

External power input 12 to 34 VDC, 1 amp on turn-on, 600ma operating in magnetometer mode.

Software: Supplied as part of the basic system for installation in the Geometrics or client-supplied PC, and including functions for:

Operating Software:
1. Survey Modes:
   a. Search
   b. Simple survey, station or continuous
   c. Map survey, station or continuous
   d. Base station
2. Data acquisition/display:
   a. Acquire and store data and survey functions.
   b. Display profiles, total field to 0.1 nT resolution,, survey/map parameters and diagnostics.
   C. Map display showing location of all readings.

PC Support Software:
1. Data transfer and corrections:
   a. Transfer of data from the field Magnetometer, GPS, or Base station to the PC.
   b. Diurnal correction using base station data.
   c. Processing the corrected data into ASCII values of X-Y-Z for the magnetometer
2. Optional bundled "Surfer for Windows" by Golden. Provides data presentation/plotting into a contour map or 3D isomagnetic map with Text annotation and color blends.

MECHANICAL

Sensor: 2-3/8" dia., 6-3/4" long, 12 ounces 6 cm x 15 cm, 340 g

Console: 6" W, 3" H, 11" L, 3.5 lbs. (15 cm x 8 cm x 28 cm, 1.6 kg), attaches to harness. Magnetic effect less than 1 nT (γ) at 3 ft

Battery: 3" H, 5" W, 8" L, 3.5 lbs (8 cm x 13 cm x 20 cm, 1.6 kg) attaches to harness.

Backpack specs ?

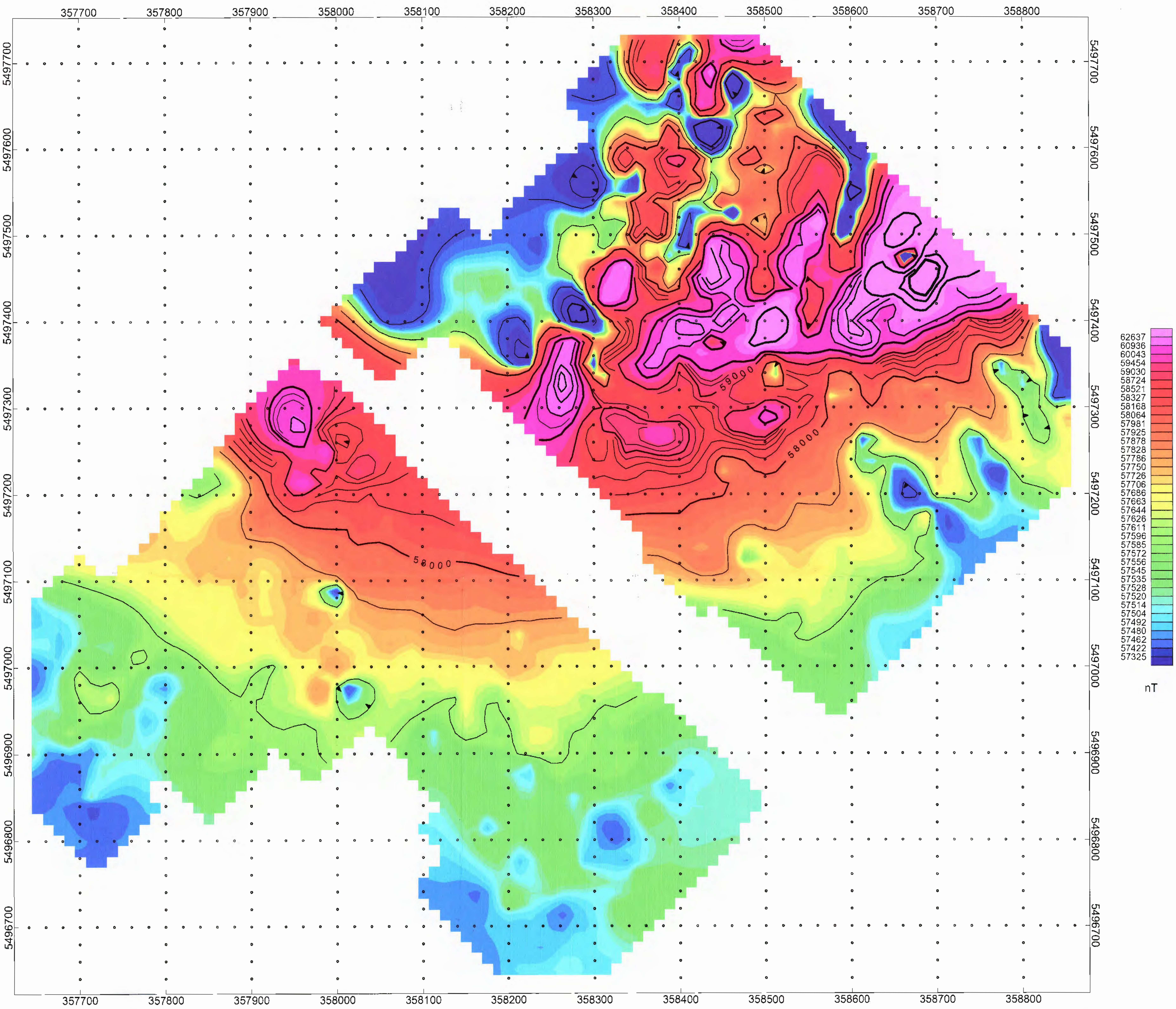
ENVIRONMENTAL

Operating Temperature: -15°C to +50°C (-13°F to + 122°F)

Storage Temperature: -35°C to + 60°C (-30°F to + 140°F)

Water Tight: To 1 ft (0.3 m) depth for 10 seconds.

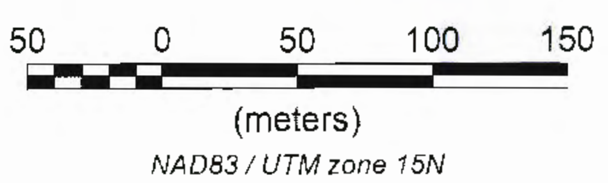
Shock: Drop 3 ft on a hard surface without damage

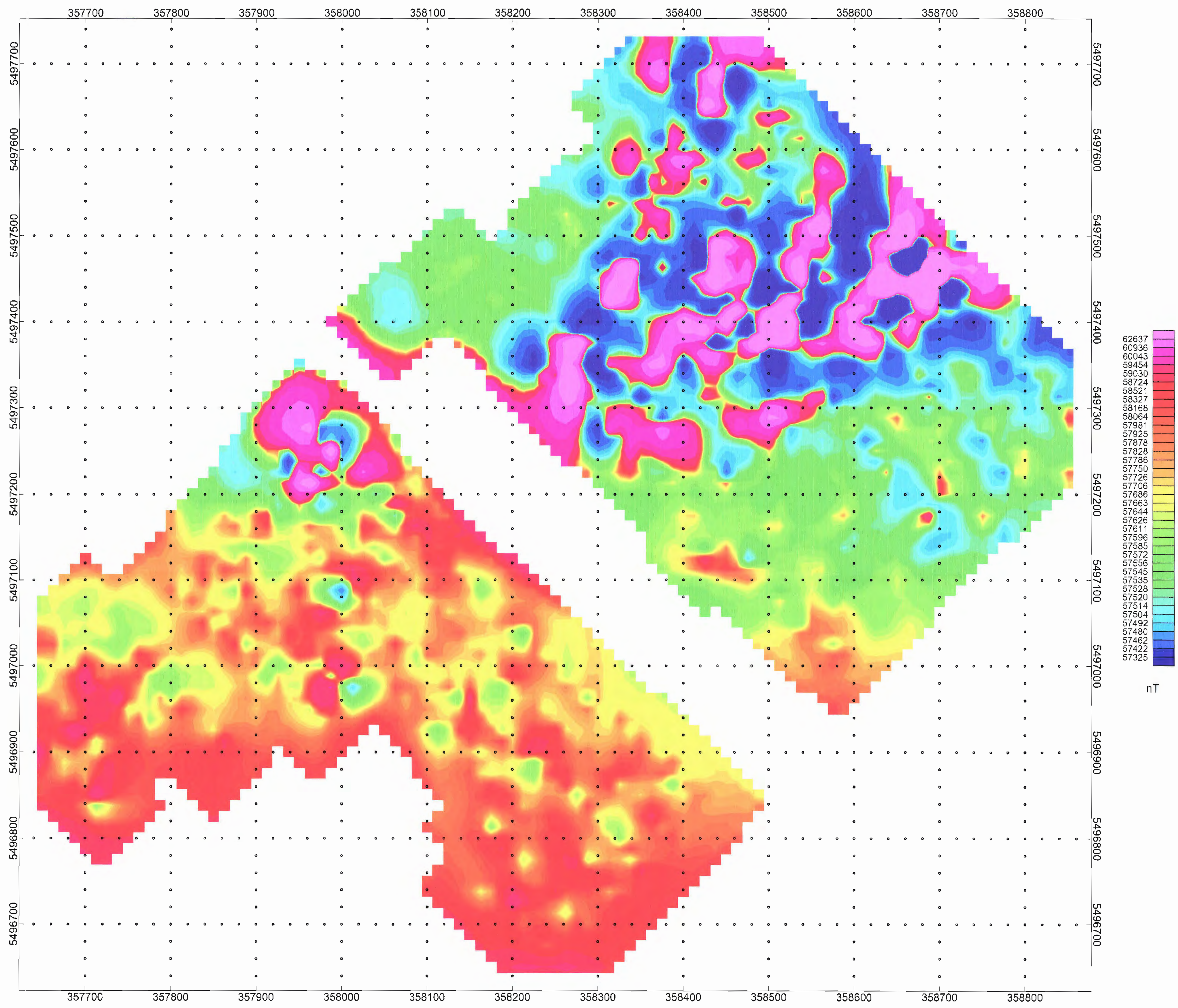


Total Magnetic Intensity Grid - Everton Mag 2

10nT contour interval

April 16, 2010





Vertical Derivative Grid - Everton Mag 2

50 0 50 100 150

(meters)

NAD83 / UTM zone 15N

April 16, 2010