G-880 Cesium Marine Deep Tow Magnetometer

High Resolution Marine Magnetics

- Sensitivity 0.02 nT at 10 Samples per Second – Remotely programmable
- Multi-sensor Gradiometer Arrays for Precise Search or Diurnal Corrected Total Field
- Quick Connect Integration to Sidescan Sonar Systems with Simultaneous Data Display
- Tow Cable Lengths to 500M or 6Km with telemetry. -- Digital Data Immune to Shipboard Noise
- Petroleum -- Oceanographic -- or Search Surveys
- Includes Sensor Depth Data -- Calibration of Absolute Accuracy – World Wide Operation

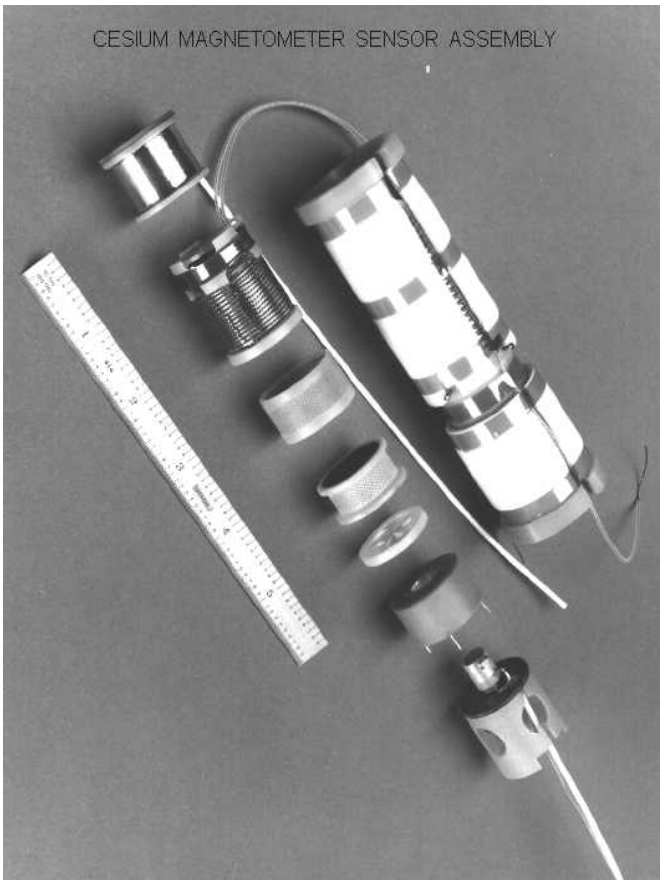
Geometrics presents a new high resolution marine Cesium magnetometer system for all types of production surveys. Simultaneous readings may be obtained from up to 6 individual sensors through cable lengths to 500m (1600ft.) or through 6Km of armored steel coax with telemetry. System features include very high sensitivity measurements of total field and gradient combined with rapid sampling to provide reliable detection of geologic features and man made objects. A new Larmor counter provides direct connection to host CPU for integrated SideScan or ROV installations. The G-880 is completely digital, unaffected by shipboard noise, easily deployed and simple to operate. Installed as a single sensor through a long cable or deployed in tandem with a Side Scan, performance is over 100 times better than earlier systems.

Installed with dual fore-afl sensors (in-line gradiometer) the high sensitivity allows a very short separation between sensors for improved noise rejection and diurnal correction of the total field. Installed as a fixed horizontal (transverse) gradiometer array with controlled distance off the

bottom, a wide swath of coverage is obtained providing high confidence in detection of small targets such as ordnance.

GENERAL

The cesium magnetometer, like it's Proton predecessor, provides a scalar measurement of the earth's magnetic field. The measurement is expressed as the "total field" intensity in nano-Teslas or gammas (nT or Ñ) and may range from 20,000 to 100,000 nT (0.2 to 1 gauss) at the earth's surface. Local perturbations from geology or man made objects add to or subtract from the primary field. Such disturbances or anomalies in the field can be sensed at large distances and the data presented in contoured or false color maps which display a very wide dynamic range. When two or more sensors are separated by a fixed distance for the purpose of measuring the magnetic gradient, the instrument is more properly termed a "Geomagnetic Gradiometer." Gradient data offers enhanced detection of small anomalies and diurnal free total field profiles.



Cesium sensor assembly above with sensor components (lamp, optics, gas cell and photo cell below.)

CESIUM THEORY

The Cesium magnetometer is sometimes referred to as "optically pumped" because of the manner in which energy is fed into the system. In brief, energy from a special light source is used to excite Cesium atoms to a higher level, which are then forced to a lower excitation level by an RF de-pumping coil. Whensubjected to an external magnetic field, the rate of energy transition or "pumping de-pumping" (Larmor frequency) is determined solely by the strength of that ambient field. Special packaging design has been employed to provide a remarkably rugged sensor assembly housing the internal components of glass, optics and electronics. Field life is generally indefinite and will exceed many thousands of hours under even severe operating environments.

CESIUM ADVANTAGE

Very high sensitivity and rapid sample rates are inherent in the basic system and are usually determined only by the peripheral components such as the accuracy of the Larmor frequency counter.

Sensitivities of 0.001 nT at 10 samples per second are possible but often unusable because of the noise of the environment itself. In marine applications such noise factors as sea swells, magnetic effects of the vessel, lack of control or knowledge of the position of the sensor and other systematic survey errors are the limiting factors that constrain system performance. An important operational advantage of the Cesium design is it's tolerance of movement. Compared to the Proton system, the "Doppler effect" from the rate

of sensor rotation in rough seas is an order of magnitude less for Cesium. In addition, due to the very stable Cesium "fish" under tow and smaller internal heading errors, motion effects are no longer a source of troublesome noise.

SENSOR ORIENTATION

The Cesium principles of operation dictate that the sensor be mounted so that the earth's field angle is never less than 15 degrees from the center line of the sensor both along it's length and it's width. This operating "active zone" can always be attained by tilting or rolling the sensor to obtain the optimum angle for both signal amplitude and maximum tolerance to tilt and roll. (A program is provided to assist the user for the best setting in all directions at any geographic location.) Provision is made in the mounting of the sensor in the fish to allow tilt adjustment of the sensor. Rotational adjustment is obtained by shifting the keel weight located on the stabilizer ring fin. Typically, these adjustments are made only once at the beginning of a survey. Orientation adjustments: Sensor swivel mount with fore & aft adjust and ring fin with keel weight for roll adjust.

LARMOR SIGNAL COUNTER

A key element in the high performance of the system is the conditioning and counting of the Larmor signal. Using a proprietary design mounted into the electronics pressure vessel, sensitivity, measurement rates, number of sensors and data format are selected by commands from the vessel. Counters from multiple sensors (up to 6 sensors depending upon the measurement rates and the total amount of data to be collected) may be concatenated together to provide a sequential stream of RS-232 data for transmittal through the tow cable. Alternately, the data may be transmitted locally to a host CPU such as that employed in a SideScan Sonar or ROV system. Since all counters are linked by software commands, the collection of data from multiple sensors is simultaneous and controllable from the surface.

Each Larmor counter also includes up to six A/D converters that may be selected for inclusion in the data stream. Thus analog inputs from transducers measuring, depth, echo sounder altitude, water temperature or other data may be recorded concurrently with the magnetics.

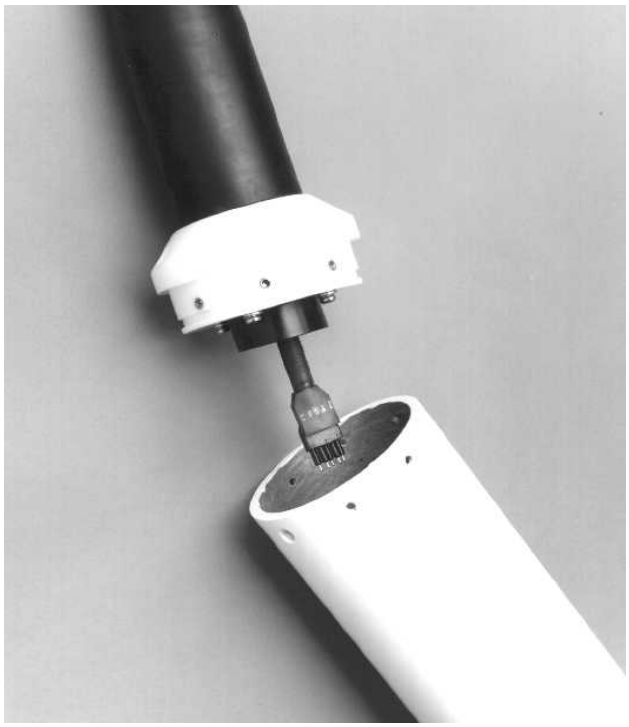
MULTIPLE SENSOR ARRAYS

As noted above, the system easily accommodates a number of sensors limited only by the sample rates and the total amount of data to be passed up the cable.

Pressure vessels with connecting cable. Note depth sensor mounted on the electronics vessel end cap.

Moreover, the cable remains the same type whether for one or six sensors. This unique combination of high sensitivity, rapid sample rate, synchronized data transfer and multiple sensors allows measurements and data quality never before possible, .e.g.

A. Two in-line sensors separated from 10 to 50 ft. for Diurnal correction. (Refer to Geometrics brochure G-880G magnetometer/gradiometer)
B. Two to six sensors mounted on an underwater towed platform for defining the vectors of the horizontal or vertical gradients. (Very useful In the detection and plotting of magnetic objects wherein the gradient vectors "point" to the object.)



Tow cable termination is field replaceable.

DIGITAL QUALITY

The raw magnetics data are converted to digital format within a few feet of the sensor and transmitted via the tow cable for recording or integration into Side Scan type systems. Long cable lengths are easily accommodated with little degradation of data quality. Because of this and the oftentimes strong shipboard noise from AC power, transients and ground loops and also because of the inherent low noise characteristics of the Cesium signal, the magnetic measurement is essentially immune from shipboard induced noise.

BASIC SOFTWARE

A basic software package for data logging and system control is provided with each model G-880. This can be installed by the user in his existing computer or by Geometrics in a computer to be provided as part of the complete system. (A standard IBM Pentium based computer is suggested.) The software includes: Geometrics "MagLogLite" logging program which allows the recording and display of GPS in addition to magnetics, with new replay function that allows any portion of the data recorded on disk to be called up for display on the screen or printer, and CsAz for determining optimum sensor orientation.

BASIC HARDWARE

A complete system ready for operation consists of:

A. Marine "fish" with sensor and electronics installed in pressure vessels, depth transducer and all interconnecting underwater cables and connectors.
B. Tow cable with terminations to shipboard cable and the "fish". (Length may range from 200 ft to 2500 ft., 60 to 800 meters and is to be specified by the client.)
C. On-board power/signal cable connecting computer to the tow cable.
D. Power supply. Operates off 115/220 V AC. Alternatively, the system may be operated off 24-30 VDC batteries.
E. Computer, Pentium based with two com ports, large capacity hard disk, CD and 64MB of RAM . (Computer is optional with user to specify if he or Geometrics will supply.)

SPECIFICATIONS

MAGNETOMETER ELECTRONICS
Operating Principle: Self-oscillating split-beam Cesium Vapor (non-radioactive Cs 133) with automatic hemisphere switching.

Operating Range: 17,000 to 100,000 nT

Operating Zone: For highest signal-to-noise ratio, the sensor long axis should be oriented at 45 ° ,+35 ° . Sensor is automatic hemisphere switching.

Sensitivity (Magnetometer): 90% of all readings will fall within the following Peak-to-Peak envelopes.

0.05 nT at 0.1 sec cycle rate
0.03 nT at 0.2 sec cycle rate
0.01 nT at 1 sec cycle rate

Larmor Counter:

a) Integrated into sensor electronics in "fish"
b) Ref Osc: Nominal 22 mhz
c) Magnetics data converted directly into nT.
d) Output data concatenated with other counters or data sources if present.
e) A/D converters: 3 single and 3 differential, 12 bit resolution.
f) Control functions: Keyboard commands from surface.

Information Bandwidth:<0.004 nT/ Hz RMS

Absolute Accuracy (single sensor):+2nT throughout range.

Relative Accuracy: Provision to adjust for zero difference between two or more sensors.

Heading Error:<+0.5 nT

Gradient Tolerance:>500 nT /inch>20,000 nt/meter

Temperature Drift:0.05 nT per ° C

Cycle Rate: Selectable from 0.1 sec to 10 sec or by external trigger

Data Output: Three wire RS-232, magnetics, up to 6 A/D channels for other sensors if present.

Deph Transducer: Accuracy=0.25% of preassure in lbs per sq inch. Typical resolution:+0.5 ft

BASIC SOFTWARE SUPPLIED
Data Logging: MagLogLite records on disk all magnetics, GPS, depth and other data.

Plot: Visual review of all recorded data, annotation and or printing at any scale or speed.

Command: Keyboard control of sensitivity, sample rates and selection of data source.

CsAz: Determines optimum sensor orientation in any geographic location.

Optional Data Logging: MagSea, records on disk all magnetics, GPS, depth and other data.

SYSTEM COMPONENTS

POWER SUPPLY
a) Converts 115/220 50/60 Hz AC to 28 to 32 V DC, 150W
b) Provides cable junction for power & data
c) 8 x 9 x 4.5 inches, 6 lb

ON-BOARD POWER/SIGNAL:
Selectable length with connector attached.

TOW CABLE

a) Shielded twisted pair of #12 conductors with 8 separate #20 conductors.
b) Strain member: Kevlar, 10,000 lbs breaking strength
c) Maximum working load: 1250 lbs
d) Outside diameter: 0.48 inch
e) Bending diameter: 24 inch
f) Weight: Air: 215 lbs per 1000 ft of cable. Water: 70 lbs per 1000 ft of cable
g) Outer jacket: Polyethylene
h) Cable termination: field replaceable
i) Lengths selectabte to 2,500 ft (762 meters)

SENSOR "FISH"

a) Heavy duty filament wound fiberglass, free flooded with stabilizer ring-fin assembly.
b) Length: 83 inch (cable stiffener and bulkhead termination adds 16 inch to length)
c) Body outside diameter: 4.5 inch
d) Ring fin outside diameter: 14.25 inch
e) Weight in air: 38 lbs
f) Weight in water: 12 lbs
g) Depth transducer installed

ENVIRONMENTAL

a) Operating/Storage Temperature: -45°C to +60°C (-40°F to +140°F)
b) Depth: Pressure vessels in "fish" rated to 4,000 ft (Increased depth possible upon request.)

OPTIONS:

a) Gradiometer: horizontal or vertical configuration, up to 6 sensors.
b) Computer: IBM type, 486 based complete with software installed.
c) Special software:
    1. Process measured horizontal gradient to provide diurnal corrected total field.
    2. MagPick Dipole Modeling Software (Free from Website)
    3. GPS log and pilot indicator
d) System rental available

CONTACT INFORMATION:

AlphaGeofisica - Brazil
Tel.: 21 2556-1295
Fax: 21 2205-5100
Internet: info@alphageofisica.com.br