MAGNETOMETRY

BENTOS – Servicios y Equipos Marinos Ltda.

Avda. Suecia 3005, Ñuñoa, Santiago
Telephone: (56 2) 296 373 60
Fax: (56 2) 296 373 77
E-mail: info@bentos.cl

THE MAGNETOMETER, WHAT IT IS

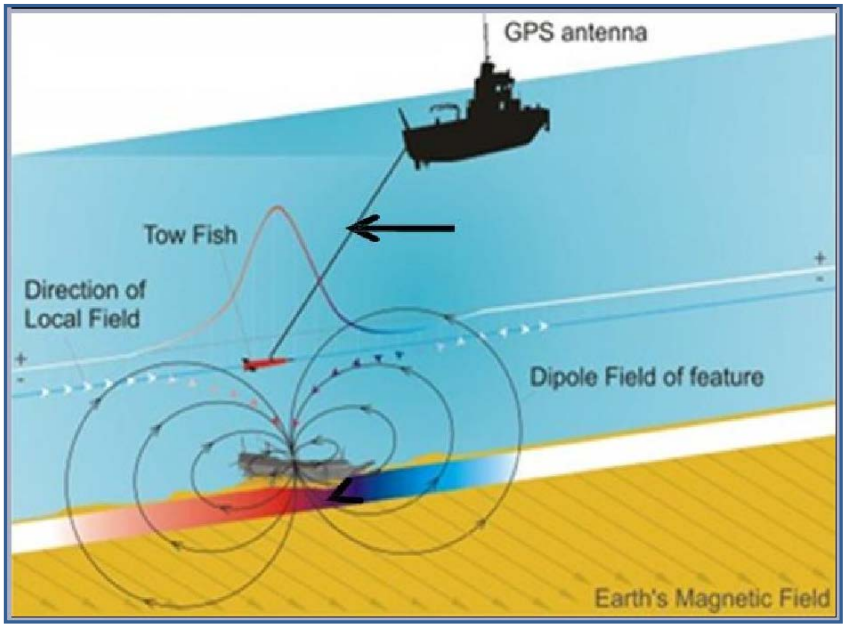
The magnetometer is a sensor designed to quantify the intensity and/or direction of a magnetic field. Among the existing types of magnetic field sensors, the nuclear magnetometers, and specifically those based on the Overhauser effect, enable high resolution to be obtained in the determination of the scalar magnetic field intensity thanks to the effect of the ambient magnetic field on the proton precession.

BENTOS operates by using the Overhauser SeaSpy marine magnetometer by Marinemagnetics.

SeaSpy model magnetometer by Marinemagnetics.
http://www.marinemagnetics.com/

HOW A MAGNETOMETER FUNCTIONS

The marine magnetometer is mounted on a tow-fish structure together with complementary sensors, such as thermometer and barometric depth pressure sensors, included to monitor other environmental parameters of interest, in addition to sensing the magnetic field per se. All of the sensors operate synchronized with GPS receivers located on the surface. The Overhauser effect sensor contains a solution rich in protons and paramagnetic ions on which a radio signal of very high frequency is applied continuously to polarize the nuclear spin. When disturbed by the ambient magnetic field, this makes it possible to observe the intensity of the scalar magnetic field with a high sampling frequency along a line of navigation while additionally obtaining a reading of the instantaneous scalar magnetic field, values of barometric depth of the sensor, water temperature and geographic position. The sensitivity of the Overhauser sensor enables magnetic explorations to be made for various applications, such as studies of discontinuities and the intensity of magnetic fields associated with geologic characteristics and the detection of submerged elements and structures that have a certain amount of magnetic susceptibility.



Scheme of deployment of a marine magnetometer.

HOW A MAGNETOMETER FUNCTIONS

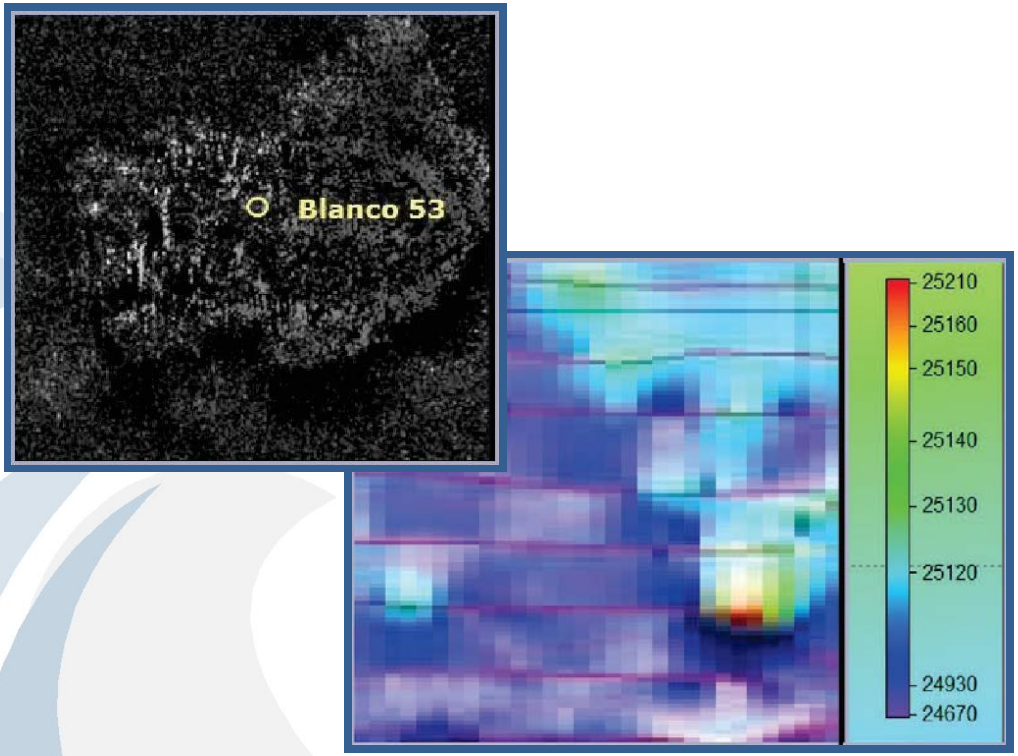
Depending on the objective of a study, the observed data of the spatial distribution of the magnetic field can be reduced by means of different geophysical and mathematical models to obtain: pole reduction, horizontal/vertical magnetic gradient maps, analytical or pseudo-analytical signals and field anomaly maps referred to local magnetic field models. Due to its nature, the daily variation of the earth's magnetic field can mask the capacity to detect disturbances of the field and consequently require the use of an adequate analytical process for the signal and/or monitoring by means of a base station of the diurnal variation of the magnetic field. Giving due consideration to the apparent solar movement and its influence on the intensity of the field and the possible solar storms and even anthropogenic elements are critical for the achievement of an adequate interpretation of the information on the disturbed magnetic field.

BENTOS, in addition to carrying out the numerical treatment of the temporal magnetic records, uses the MAGpic software, commercially offered by GEOMETRICS (http://www.geometrics.com/), to obtain transformations of the spatial distribution of the total observed scalar magnetic field, such as pole reduction, the horizontal gradient, the pseudo-analytical signal and maps of the field anomaly and pseudo-gravity. Through use of digital cartographic and geophysical editing platforms, the magnetic data are then integrated with other geophysical and hydrographical data.

Base station for the earth's magnetic field variation
www.geometrics.com

PRINCIPAL APPLICATIONS

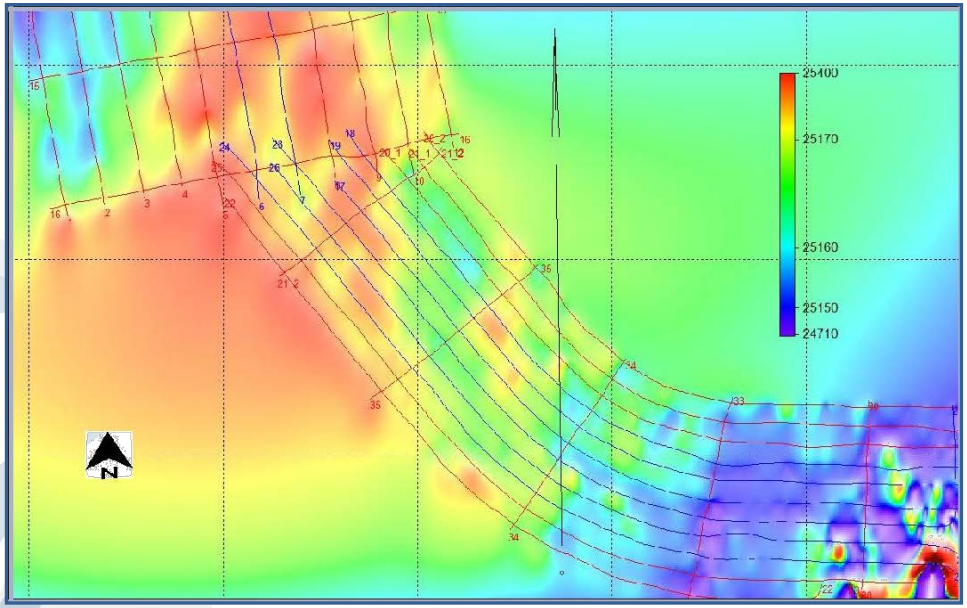
Magnetic exploration makes it possible to compare results with the results of other geophysical exploration work within the support framework provided for **engineering**, **geotechnical studies** and **archeological explorations**. It enables elements having magnetic susceptibility to be detected and objects or obstacles of a ferrous nature to be differentiated.



Identification of a shipwreck by means of acoustic imaging with side scan sonar, correlated in position with a disturbing magnetic dipole of around 300 nT (maximum intensity of 25,210 nT), considering the total magnetic field represented on the map of processed colors. The combination of both sensors, viz., side scan sonar and magnetometer, makes possible the determination of the position and dimensions of the remains of a wreck of metallic nature (Bahía de Concepción, 2013).

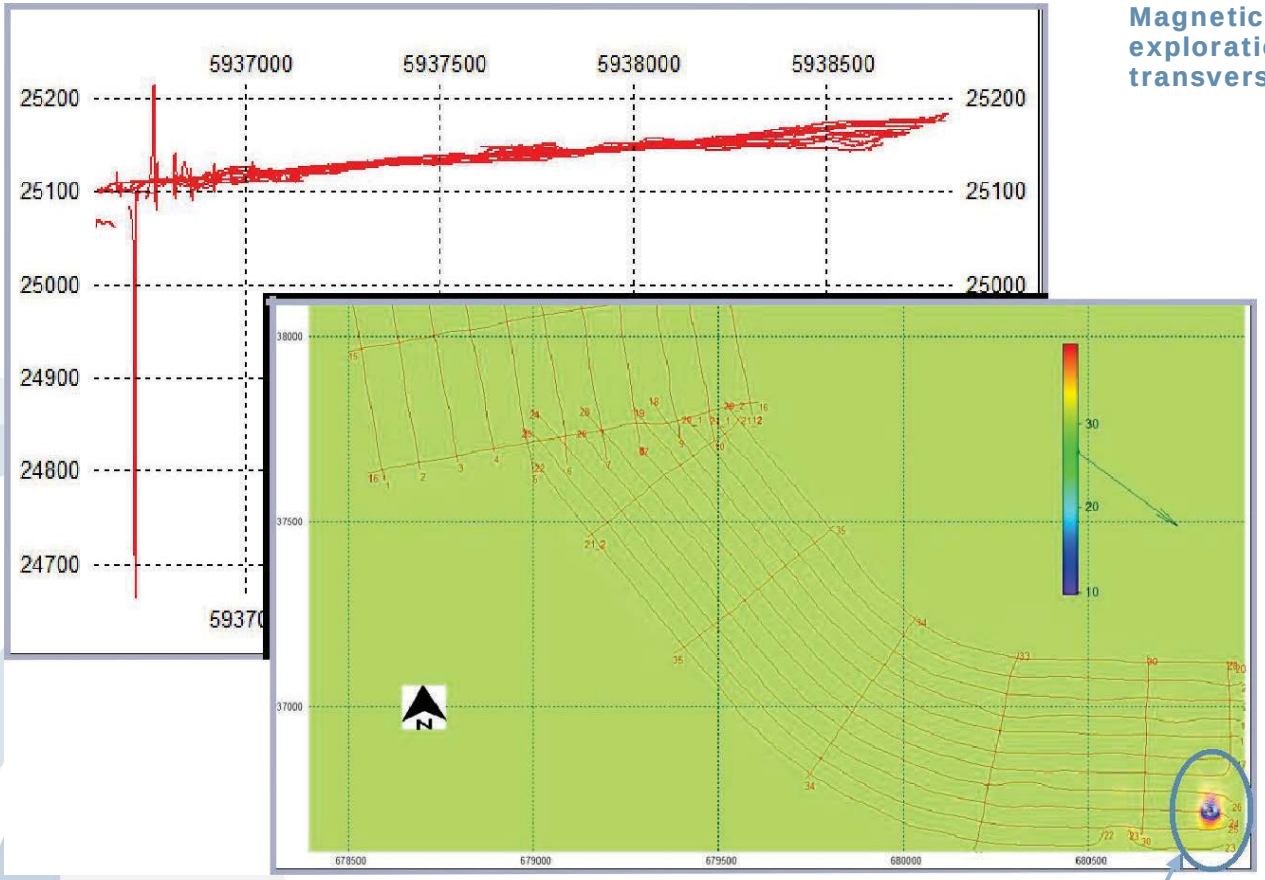
PRINCIPAL APPLICATIONS

Magnetic exploration implements the geologic characterization of scientific studies.



Edited map of total field intensity reduced to the magnetic pole by means of Magpick software (BENTOS, 2013).

PRINCIPAL APPLICATIONS



Magnetic leveling of magnetic exploration lines by means of transversal lines (BENTOS, 2013).

Magnetic dipole in the study zone differentiated by means of an absolute horizontal gradient map (BENTOS, 2013).

BENTOS EXPERIENCE

Official multibeam bathymetry, marine geophysics (sub bottom profiler, side scan sonar, marine magnetometry and piston corer). Puerto Lirquén, Bahía Concepción, Eighth Administrative Region, OCTOPUS LNG Project, **GEOVENOR EXPLORA SpA**., 2013.

Marine geophysical exploration, Mejillones, Second Administrative Region, Gas Atacama Project, **GASATACAMA CHILE S.A.,** 2011.

Marine geophysical exploration, First Administrative Region, Quebrada Blanca Project, Phase 2, **COMPAÑÍA MINERA TECK QUEBRADA BLANCA S.A.,** 2011.

Shallow seismic survey, Bulk Liquid Terminal Project, Electroandina, Second Administrative Region, Chile. **EMPRESA CONSTRUCTORA BELFI**, 2011.

Submarine power cable studies, alignments in the Tenth and Eleventh Administrative Regions, Chile. **TRANSELEC S.A.,** 2009 - 2010.

Marine geophysics studies at Puerto Eten, Chiclayo, Peru, **LUMINA COPPER**, 2009 - 2010.

El Morro Water Desalination Plant Project, Third Administrative Region, **HALCROW GROUP LTD. CHILE, AGENCIA EN CHILE**. 2009.

Marine seismic survey in Bahía Talcahuano, Eighth Administrative Region, **GEOEXPLORACIONES S.A.,** 2009.

Study and design for the improvement and maritime connectivity of the Puerto Montt – Chiloé – Palena, Caleta La Arena and Caleta Puelche network, Tenth Administrative Region, **PRDW AV – PORT WORKS ADMINISTRATION (DOP),** 2008 - 2009.

Marine geophysics studies with approval of the Oceanographic and Hydrographic Service of the Chilean Navy (SHOA) Puerto Yungay and Río Bravo, **CENTRALES HIDROELÉCTRICAS DE AYSÉN S.A.,** 2008 -2009.

BENTOS EXPERIENCE

Geophysical exploration study, El Galeno Project, Pacasmayo, Peru, **MTB PROFESSIONALS.,** 2008.

Geophysics study for the URUCU-MANAUS gas pipeline, Amazonas, Brazil, **PLANAL SERVICOS DE ENGENHARIA**, 2008.

Consulting services for a submarine routing study – conceptual definitions for the Aysén – SIC Grid HVDC transmission system, **CENTRALES HIDROELÉCTRICAS DE AYSÉN S.A.,** 2008.

Geophysical exploration, Melchorita LNG Project, Peru, **JAN DE NUL,** 2008.

Geophysical exploration, Punta Vegueta area, Peru, **TRAMARSA S.A.,** 2008.

Geophysical exploration, Isla Riesco, Twelfth Administrative Region, Chile, **GOLDER ASSOCIATES SERVICES S.A.,** 2007.