



McPHAR INTERNATIONAL

AIRBORNE GEOPHYSICAL SERVICES

CANADA • SINGAPORE • INDIA

A Neterwala Group Company

MINING EXPLORATION

**MAGNETICS • GRADIOMETRY • GRAVITY
RADIOMETRICS • ELECTROMAGNETICS**

BASE AND PRECIOUS METALS EXPLORATION

KIMBERLITE EXPLORATION

GROUNDWATER EXPLORATION

REGIONAL MAPPING

GEOHERMAL MAPPING

CONTAMINATION MAPPING



NEW DIMENSIONS IN EXPLORATION



INTRODUCTION

BASE METAL EXPLORATION

Exploration for all kinds of conductive metallic ores has long been the major target of Airborne EM systems. Volcanogenic massive sulphide deposits in Archean environments generally are strongly conductive relative to the surrounding crystalline rocks. Porphyry deposits are generally very large, with conductive zones that are often weak but extensive. Conductivity mapping with HEM is the best application for these types of deposits. Mount Milligan in western Canada is one such porphyry deposit. Strongly conductive deposits like the nickel deposit at Voisey's Bay in Labrador are also excellent targets for HEM.

PRECIOUS METALS EXPLORATION

Exploration for precious metal deposits is another major target of Airborne EM surveys. While gold does not occur in high enough concentrations to be directly detected by an EM survey, its presence is often inferred by accurate geologic mapping, or by detecting related mineralization (pyrite) or alteration. Changes in conductivity, magnetic signature, or gamma-ray emission intensity can be used to map lithological changes and directly detect alteration zones.

Alteration commonly increases clay minerals, reduces magnetite and increases potassium, influencing the conductivity, the magnetic susceptibility, and the potassium radiation emission respectively. The sulphide mineralization often associated with the deposition can create weakly conductive anomalies, or a local conductivity high, which can be mapped by an AEM survey.

MAPPING

Resource and geologic mapping has been successfully undertaken by fixed-wing aircraft equipped with magnetometers and gamma-ray spectrometers for more than 40 years.

Geologic mapping using the AEM technique (resistivity mapping) has been in use since about 1975. Many geologic targets (for example, gold) do not have high enough concentrations to create a strong anomaly by themselves, but exist in or near characteristic lithology or alteration. In many environments the rock may be covered by overburden, weathered beyond recognition or transported from elsewhere. In these conditions airborne geophysical mapping, whether using a fixed-wing or helicopter-borne system, is the lowest cost method to provide the essential geologic base map necessary to identify target areas.

DIAMONDS

The diamond exploration boom in the Lac de Gras area of the Northwest Territories of Canada highlighted the effectiveness of HEM for detecting kimberlite intrusions. Although kimberlite exploration using airborne magnetic surveys has proven to be very successful, EM surveys have proven successful at finding kimberlites that have no detectable magnetic anomaly. A combined EM and magnetic survey is a very effective tool for detecting kimberlite pipes.

The search for and mapping of subsurface natural resources can be a tedious, costly and time-consuming project when conducted on the ground. Traverses must be made across mountains, rivers and swamps and through towns and cultivated areas. In some cases, danger to personnel is involved from disease, animals, insects and extremes in climate and terrain. As equivalent measurements may now be made from the air, however, undertaking exploration using airborne techniques will result in great benefits of time and money and safety of personnel.

Airborne geophysical surveys, whether installed on helicopters or fixed-wing aircraft, are the most effective and rapid means of evaluating the potential for mineral resources in both unexplored areas and mature mining regions. The use of GPS satellite navigation and powerful microcomputers onboard the aircraft, to control the systems and to record data; and on the ground to process, plot, interpret and model the data; has made airborne geophysical surveying a powerful and necessary tool in man's search for materials beneath the ground.

Fixed-wing and helicopter-borne airborne geophysical systems are designed for use in different terrains, although helicopter-borne systems are undertaking high-resolution surveys in areas traditionally the domain of fixed-wing systems.

A fixed-wing aircraft has a number of advantages in addition to its lower operating costs. First, it has a payload and cabin space larger than a helicopter and thus can carry more instrumentation. Second its operating range is generally three or four times greater than that of a helicopter. Surveys can be flown farther from population centres, thereby reducing some of the logistical problems of a helicopter-borne survey.

Undoubtedly, helicopter-borne electromagnetics (EM), combined with total field magnetics and gamma-ray spectrometry, have been the most productive and useful of these airborne system developments to date, and have accounted for the discovery of billions of dollars worth of mineral resources, tapped into numerous ground water reservoirs and provided immense volumes of data for environmental site evaluations. These systems are ideally suited for working in rugged, mountainous terrain, or over small claim block-sized properties, and are the techniques of choice for most mining companies to locate base metal and precious metal deposits and/or kimberlites.



Hummingbird 5-frequency EM/MAG System.



P-THEM time domain EM System.



Magnetometer Stinger on a Bell 206L3 Jet Ranger Helicopter.

HELICOPTER-BORNE GEOPHYSICAL SURVEYS

Our helicopter-borne geophysical systems include:

- Multi-sensor with a 5-frequency **HUMMINGBIRD EM**, magnetometer & gamma-ray spectrometer sensors & GPS navigation
- **THEM** multi-sensor time domain EM magnetic & gamma-ray spectrometer sensors & GPS navigation
- **HELIMAGSPEC** with magnetic & gamma-ray spectrometer sensors & GPS navigation
- **HELIMAG** magnetometer & GPS navigation only – towed-bird or rigid-boom
- **HELIGRAD** magnetic gradiometer with 2 or 3 magnetometer sensors & GPS navigation – horizontal or vertical gradients, towed-bird or rigid-boom



THEM Multi-Sensor time domain EM Magnetic System.



Helicopter Stinger Magnetometer System on a Eurocopter AS350B2 Helicopter.



HUMMINGBIRD 5-frequency EM System with a Eurocopter AS315 Lama Helicopter.

FIXED-WING GEOPHYSICAL SURVEYS

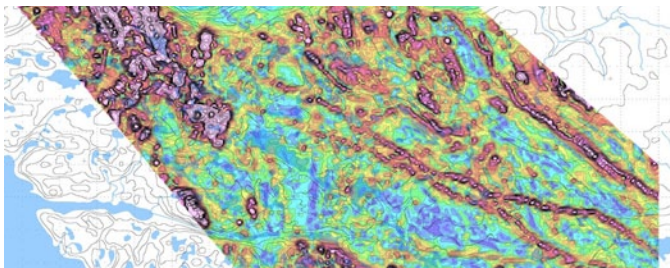
Several fixed-wing geophysical aircraft are available to fly your surveys including the following aircraft.



PIPER PA-31 NAVAJO - a twin-engine aircraft, modified with an extended tail-stinger and wing-tip pods for magnetometer sensors. Has extended fuel tanks providing 7 hours duration. Used to acquire magnetic and gravity and/or gamma-ray spectrometer data.



CESSNA C208 CARAVAN - a single engine turboprop aircraft, features wing-tip pods, an extended tail-stinger and 6 hours duration. Used to acquire gravity and magnetic and/or gamma-ray spectrometer data.



Colour image of the Analytic Signal derivative of the total magnetic intensity.



BEECH C90 KING AIR - a twin-engine turboprop aircraft, modified with an extended tail-stinger and wing-tip pods for magnetometer sensors. Used to acquire magnetic and gravity and/or gamma-ray spectrometer data. Has extended fuel tanks providing 7 hours duration.



QUALITY CONTROL, DATA PROCESSING & INTERPRETATION

QUALITY CONTROL

McPHAR undertakes Quality Control and preliminary data processing in the field at the survey base. For this purpose, all our airborne systems are mobilized with a geophysicist and a PC-based data processing system to support them.

The Field Data Verification Workstation (FWS), as this system is known, can process airborne EM, magnetic and radiometric data, and produce plots and maps in full-colour of the survey data, often within hours of the survey flight ending. The FWS software, which is the core of this system, permits the Q.C. geophysicist to differentially correct the GPS navigation data; carry out flight path recovery; perform magnetic compensation and leveling; undertake radiometric corrections and preliminary processing; EM leveling and processing; and generally to perform filtering, gridding and contouring of data, imaging of selected data and plotting to any map scale and layout.

DATA PROCESSING AND INTERPRETATION

Final data processing is undertaken at our processing centre in India, which is staffed by very experienced geoscientists and equipped with a state-of-the-art network of computers, scanners, plotters and other hardware.

The interpretation of geophysical results into meaningful geological parameters is the prime function of any of our interpreters. The many highly qualified geophysicists and technicians on our staff share a strong geological background. The manipulation of geophysical data is only a means to an end, and the final product of the interpretation is the compilation of a series of maps showing interpreted geological parameters.

The data processing routines and mathematical operators applied to the data are not the end product of the interpretation – they help delineate geologic and economic targets to be discussed in the final report.

We bring many techniques to bear on an interpretation project in order to determine depths to causative sources, to delineate discontinuities and boundaries, and to draw conclusions regarding geological structure beneath the survey.

A wide variety of contour and interpretation maps, profiles, cross-sections and models, and a written report are the result of the interpretation.

H.S.E.

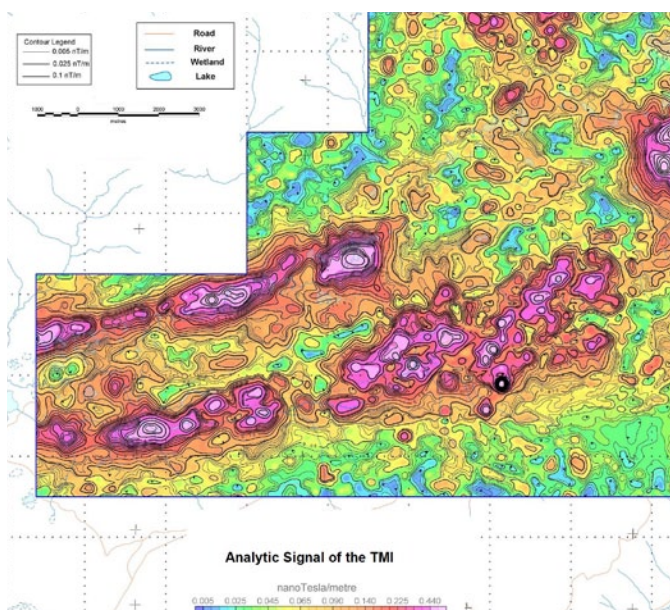
Safety is a very important aspect of McPHAR's operations. A Project Risk Analysis, an Emergency Response Plan (ERP) and a Job Safety Plan (JSP) are prepared prior to the start of any survey by our Project Manager. For the duration of the survey all work will be performed with the utmost regard for safety, and all personnel will be fully conversant with safety standards published in the HSE Manual, by IAGSA. Our Project Manager will review and establish safety procedures with the pilot and will specifically ensure that all crewmembers are aware of emergency and radio communications procedures.

Our Project Manager will conduct weekly safety / operations briefings with the crew. These briefings will consist of the following:

- Review of safety and emergency equipment on board the aircraft
- Review of emergency procedures and available emergency services
- Review of previous weeks work to smooth out any rough points and/or suggest improvements
- Review of project status and operating plans for the coming week



McPHAR's data processing centre in Mumbai.



McPHAR is proud to be an active member of IAGSA.

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