Airborne Geophysics in Ireland –Techniques and Benefits to the Extractive Industry.

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Airborne Geophysical Techniques

Since the 1960's, airborne geophysical techniques have been employed to characterise the subsurface. Whether exploring for natural resources, addressing environmental and conservation issues, or searching for submarines these techniques have been routinely applied. The world leaders in technological advances over the years have been Australia, Canada and South Africa. Not surprisingly, these countries have also been the leaders in natural resources exploration and exploitation.

The principal geophysical techniques used for mineral and aggregate exploration are magnetics, electromagnetics, radiometrics and gravity. The most common techniques are magnetics and electromagnetics. The magnetic technique involves passively recording variations in the earth's magnetic field attributable to lateral variations in the magnetic properties of the geology. The electromagnetic technique involves generating an electromagnetic impulse and recording the resulting response generated in the subsurface. The radiometric technique passively records the extent of natural gamma radiation emitted from just below ground level. The gravity technique, similar to magnetics, involves passively recording the variation in the earth's gravity field caused by lateral density variations of the geology.

All of the above techniques reveal information about the physical properties of the subsurface. Surveys are flown in a regular grid as close as possible to the ground. The extent to which subsurface information can be revealed generally depends on both the altitude of the aircraft above the ground and the spacing between each survey line. Some years ago, a typical survey would have been flown at an altitude greater than 200m and with a line spacing greater than 1000m. Today this data is considered to be of low resolution and has limited use, mainly in regional reconnaissance. A typical high-resolution survey today is flown at an altitude of less than 100m with line spacing of 200m or less. This increase in resolution significantly improves resulting data quality and is mainly due to the recent advances in GPS navigation and location technology.

Airborne Surveying in Ireland

The two most commonly acquired airborne geophysical techniques for exploration purposes in Ireland currently are magnetics and electromagnetics. The radiometrics and gravity techniques have not been widely used. The reason for this is not clear, as both techniques have been used in similar ground conditions in other parts of the world with considerable success.

The first airborne surveys in Ireland were carried out in the mid to late 1970's by exploration companies and the Geological Survey of Ireland (GSI). When the GSI commissioned Huntings in 1979 to fly the "central plains" of Ireland it was considered a mammoth task and was one of the largest datasets acquired in Europe at the time (see Figure 2). The line spacing varied between 1 and 2 km's and the average altitude was approximately 500 metres above ground level. Today this is regarded as a low resolution dataset but it is still useful for regional delineation of large scale structural and lithological features. The Huntings data has

been re-processed over the years by a number of companies, most recently by PGW Europe Ltd. in 2000.

Subsequently, in order to stimulate exploration, the Exploration and Mining Division of what is now the Department of Communications, Marine and Natural Resources introduced an 'open skies' policy in 1995 for industry. Since then mineral exploration companies have been actively acquiring airborne geophysical data over prospective areas throughout Ireland. During the period 1995-2002, over 30 airborne surveys consisting of 58 separate survey blocks were flown. This now amounts to in excess of 130,000 line kms covering nearly 30% of the country (see Figure 2). All of the datasets acquired are considered to be of high resolution with an average line spacing of 250m and an average altitude of 100m. Magnetics data was acquired during all surveys and approximately 60% of these surveys also included electromagnetics (EM), mostly time domain EM. The EMD's Airborne Data Release Initiative is systematically releasing these datasets into the public domain after a 4 to 6 year confidentiality period. Almost half of all the surveys acquired have been released to date (approx 60,000 line km's of data).

Benefits of Airborne Geophysics

Magnetics

The interpretation of the magnetic maps generated from the processed data can reveal important information about geological structure and rock type, which is often not discernible by ground geological mapping or drilling. The delineation of magnetic trends and zones reflects the variation in the magnetic properties of the geology, which is associated with depositional environment, structural processes, alteration and emplacement. An experienced eye is required to extract maximum relevant exploration information from these datasets. Figure 3 is a simplified illustration of an interpretation of an enhanced magnetic image to identify geological structure associated with the mineralisation at Tynagh.

Electromagnetics

Interpretation of the electromagnetic data involves identifying the zones of high or low conductivity, depending upon the application. For base metal exploration, the aim is to locate high conductivity anomalies associated with the mineralisation. These can often be masked by other anomalies, therefore careful processing and levelling of the data is vital prior to the interpretation phase. Figure 4 shows the electromagnetic signature of the Lisheen and Galmoy Zn-Pb deposits. For aggregate exploration, the aim is to locate low conductivity anomalies associated with shallow bedrock or gravel deposits. Interpretations can be complicated by cultural and water table effects but these can be taken into consideration and accounted for.

Overview

High-resolution airborne geophysical surveying is a rapid and cost effective technique, and an invaluable tool for natural resource exploration, especially where surface exposure is poor. The extent to which geological and overburden features can be resolved using airborne geophysics depends not only on the physical properties of the subsurface, but also on the survey design (altitude and line spacing) and the survey equipment type and configuration. Enhanced processing and image quality is also vital. The recognition of subtle geological features, associated with economic deposits, are being increasingly identified and understood using airborne geophysics.

Figure 1: View from the rear of a Fugro survey aircraft (Shortt's Skyvan), which can simultaneously acquire magnetic, radiometric and time domain electromagnetic data.

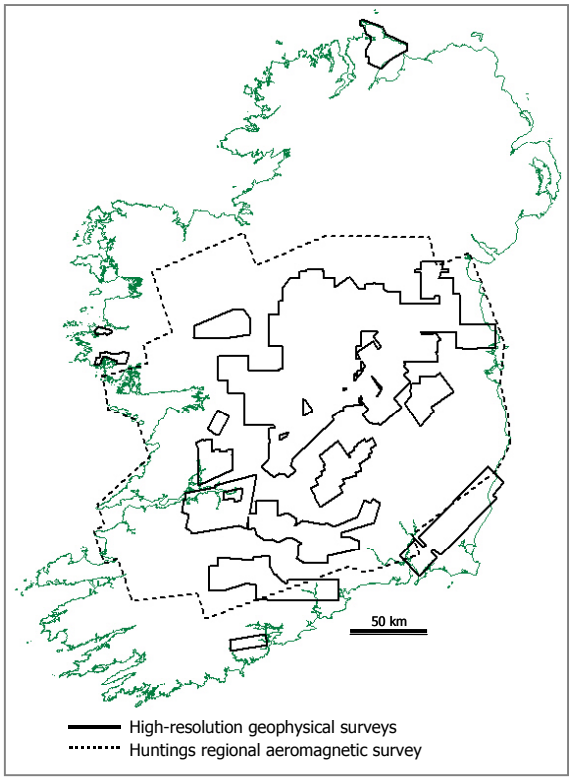

Figure 2: High resolution airborne survey coverage and Huntings 1979 aeromagnetic survey boundary.

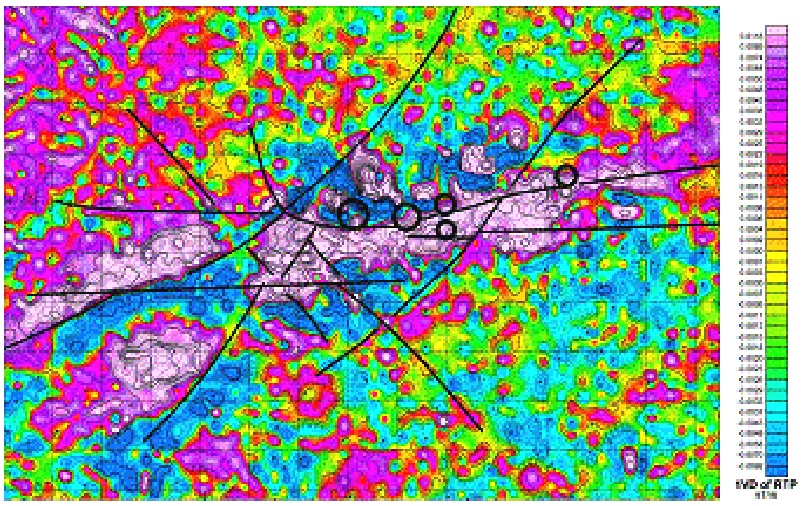

Figure 3: Enhanced magnetics image with structural lineaments (courtesy of PGW Europe Ltd. and Navan Resources Plc.).

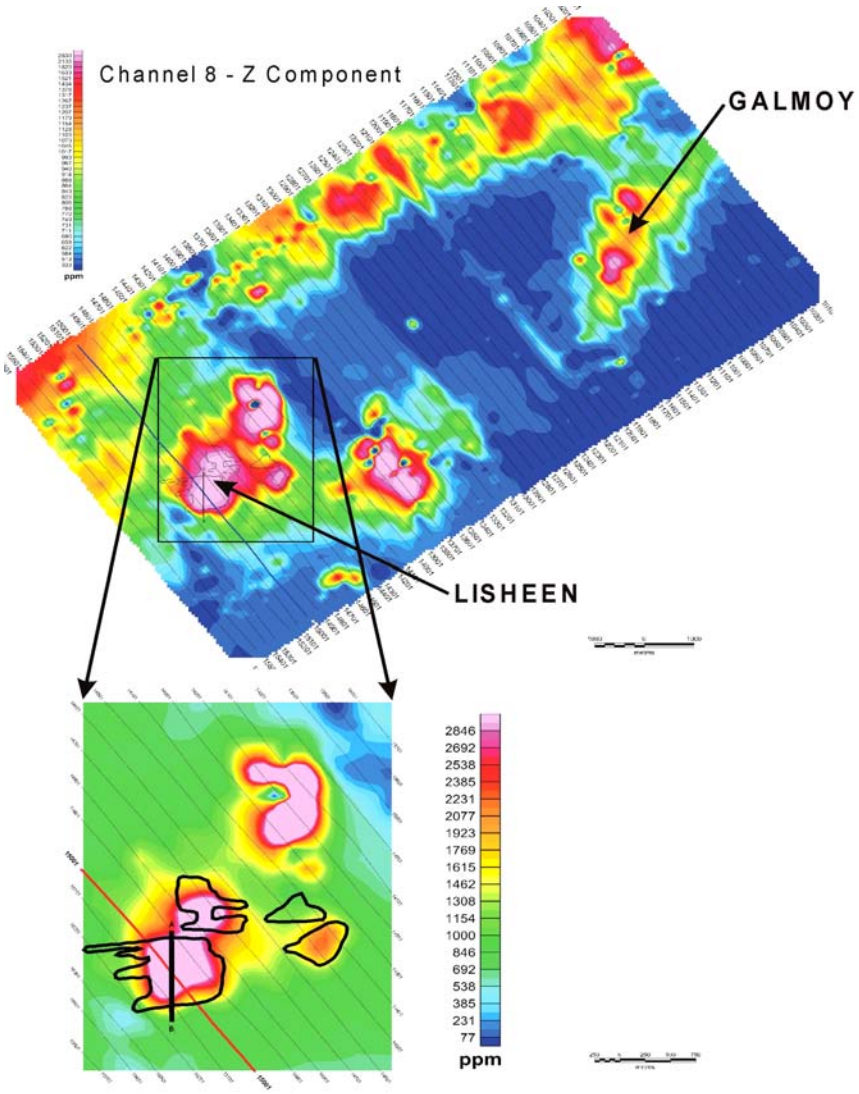

Figure 4: Electromagnetic signature of the Lisheen and Galmoy Zn-Pb deposits (courtesy of Condor Consulting Inc.)