

# **EXPLORATION AND MINING DIVISION IRELAND**

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## **THE BHP AIRBORNE TEM AND MAGNETIC SURVEY (1998) OVER THE BALLINALACK, CARRICKMACROSS EAST, CLARE, LOUGH SHEELIN, MOHILL, FERMOY EAST AND FERMOY WEST AREAS**

August 2003



**Department of Communications, Marine  
and Natural Resources**

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**THE BHP AIRBORNE TEM AND MAGNETIC SURVEY (1998)  
OVER THE BALLINALACK, MOHILL, CLARE, LOUGH  
SHEELIN, CARRICKMACROSS EAST, FERMOY EAST AND  
FERMOY WEST AREAS**

Compiled by  
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## INTRODUCTION

Between September and October 1998, BHP Minerals International Exploration flew a 7,417 line km magnetic and electromagnetic survey over seven areas, around Dublin, Shannon and Cork, encompassing approximately 2005 km<sup>2</sup> (Figure 1).

| Block                      | Line km | Area (sq. km) | Prospecting Licences covered/partially covered by Survey  |
|----------------------------|---------|---------------|---|
| <b>Ballinalack</b>         | 3617    | 969           | 184, 185, 186, 505, 506, 581, 582, 619, 622, 667, 1043, 1044, 1108, 1117, 1226, 1228, 1229, 1244, 1310, 1344, 1345, 1346, 1358, 1803, 1919, 2101, 2102, 2103, 2105, 2774, 3163, 3405, 3406, 3460, 3474, 3527, 3528, 3529, 3530, 3531, 3588, 3722, 3813, 3814, 3877, 1046R |
| <b>Carrickmacross East</b> | 388     | 104           | 2021, 2201, 2928, 3278, 3609, 3691, 3730, 3819  |
| <b>Clare</b>               | 1466    | 420           | 1951, 1952, 2590, 2895, 3005, 3057, 3503, 3508, 3640, 3641, 3642, 3643, 3643, 3643, 3643, 3644, 3679, 3683, 3729, 3787, 3788, 3789, 3863  |
| <b>Lough Sheelin</b>       | 398     | 106           | 1051, 1053, 1991, 3414, 3721  |
| <b>Mohill</b>              | 669     | 180           | 1663, 1667, 1670, 1675, 2664, 2776, 2780, 2881, 3363, 3585, 3628, 3888, 3889, 3890  |
| <b>Fermoy East</b>         | 318     | 81            | 1554, 1555, 1556, 1966, 3718, 3719  |
| <b>Fermoy West</b>         | 561     | 145           | 2597, 2599, 3294, 3612, 3613, 3619, 3626, 3899, 3900, 3901  |

This survey was acquired over four years ago and is available to the general public in fulfilment of the ‘Open Skies’ policy of the Exploration and Mining Division (EMD). The Division acknowledges the cooperation of BHP Minerals International Exploration (now BHP-Billiton).

At this time EMD is primarily concerned with prompt data release and no attempt was made to reprocess or correct survey data. Data is released as submitted and no liability is accepted on the part of the EMD for data quality or accuracy. However, to facilitate ease of use, several grids are provided with an Ordnance Survey base map for ease of geographical reference.

Geotrex-Dighem conducted the survey using a towed bird magnetometer and the GEOTEM<sup>®</sup>III electromagnetic system. This consists of 3 receiver coils, the x-coil and y-coil axes along and perpendicular to the flight direction and a vertical z-coil axis.

Time domain electromagnetic (TDEM), magnetic, radar altimeter and navigation data was acquired during the survey. All processing was carried out by Geotrex-Dighem, which is now part of Fugro Airborne Surveys.

The survey acquisition and processing procedures are outlined in a Geotrex-Dighem report. A brief discussion of the GEOTEM results is included in a separate report. A listing of all digital and hardcopy data (databases, grids, maps and company reports) lodged with the Exploration and Mining Division is included in this publication and outlined below in the data listings section.

## SURVEY EQUIPMENT AND SPECIFICATIONS

|                                   |  |
|-----------------------------------|--|
| <b>Flight Line Spacing</b>        | 300m   |
| <b>Flight Line Direction</b>      | Ballinalack 170°<br>Carrickmacross East 0°<br>Clare 30°<br>Lough Sheelin 35°<br>Mohill 0°<br>FermoyEast 0°<br>Fermoy West 0°               |
| <b>Tie Line Spacing</b>           | Ballinalack 3000m<br>Carrickmacross East 3000m<br>Clare 3000m<br>L Sheelin 3000m<br>Mohill 3000m<br>Fermoy East 2500m<br>Fermoy West 2500m |
| <b>Mean Terrain Clearance</b>     | 120 m  |
| <b>Nominal Survey Speed</b>       | 125 knots ( 65 m/s )   |
| <b>Total Survey Area</b>          | 2005 km <sup>2</sup>   |
| <b>Total Line Km</b>              | 7417 line km   |
| <b>Magnetometer</b>               | CS-2 Cesium Vapour   |
| <b>Sensitivity</b>                | 0.01 nT  |
| <b>Sample Rate</b>                | 10 samples /sec  |
| <b>Mounting</b>                   | Towed Bird   |
| <b>Sensor Height above ground</b> | 73 m   |
| <b>TEM Receiver</b>               | Horizontal & vertical coils  |
| <b>TEM Transmitter</b>            | Vertical axis loop   |
| <b>Cycle rate</b>                 | 75 Hz  |
| <b>Pulse width</b>                | 2.083 msec   |
| <b>Pulse Delay</b>                | 0.104 msec   |
| <b>Off-Time</b>                   | 4.480 msec   |
| <b>Sample Rate</b>                | 4 samples/sec  |
| <b>Mounting</b>                   | Towed Bird   |
| <b>Sensor Height above ground</b> | 70 m   |

Below are the window mean delay times (in milliseconds), from the end of the transmitter pulse, for a 75 Hz base frequency as listed in the Geoterrex-Dighem report and readme file.

|             |        |             |       |
|-------------|--------|-------------|-------|
| <b>em1</b>  | -1.926 | <b>em11</b> | 1.146 |
| <b>em2</b>  | -1.458 | <b>em12</b> | 1.407 |
| <b>em3</b>  | -0.937 | <b>em13</b> | 1.693 |
| <b>em4</b>  | -0.417 | <b>em14</b> | 2.005 |
| <b>em5</b>  | 0.052  | <b>em15</b> | 2.344 |
| <b>em6</b>  | 0.235  | <b>em16</b> | 2.709 |
| <b>em7</b>  | 0.365  | <b>em17</b> | 3.073 |
| <b>em8</b>  | 0.521  | <b>em18</b> | 3.464 |
| <b>em9</b>  | 0.703  | <b>em19</b> | 3.880 |
| <b>em10</b> | 0.912  | <b>em20</b> | 4.297 |

## **PROCESSING OVERVIEW AND MAP GENERATION**

The information provided in this section was taken from the Geoterrex-Dighem report, readme files for the survey (included on CD) and from examination of the data. Part of the Ballinalack block near Athlone town was exposed to excessive interference from nearby RTE radio towers (see Geoterrex report, page 9). Appendix F of the Geoterrex-Dighem report gives a listing of lines affected. Southbound lines seem to have less interference. For smaller areas where noise was less severe (lines 352 to 367), manual interpolations were made. Where noise was most severe, on lines 368 to 387, a graphical linear interpolation was used (see Geoterrex-Dighem report page 9).

### **Magnetics Processing Sequence**

A system lag correction of 3.9 seconds was applied followed by noise editing (de-spiking) and filtering. Pages 8 to 9 and Appendix A of the Geoterrex-Dighem report outline the processing sequence in more detail. The long wavelength component of the diurnal field was removed from the data. The data was leveled, microleveled and gridded using a minimum curvature interpolation (grid cell spacing 75 m). The regional magnetic field (IGRF) was also removed. The difference in the gridded datasets before and after the application of the micro-levelling routine were computed, extracted along the original survey lines and stored in the final line dataset as the final magnetic compensation values.

### **Electromagnetics Processing Sequence**

Appendix A and pages 9 to 10 of the Geoterrex-Dighem report outlines the processing sequence in more detail. A system lag correction of 4.5 secs was applied followed by drift corrections to all 20 channels. Each EM transient decay curve was de-spiked and the data was then noise filtered and smoothed. The data was resampled to 5 samples per second for inclusion in the final database. The GEOTEM grids have grid cell spacings of 75m.

## EM Decay Constant Calculation

The EM early and late decay constants were calculated from the z-coil data by fitting channels 8 to 14 (approx. 0.521 – 2.005 msec) and 12 to 18 (approx. 1.407 – 3.464 msec) respectively to a single exponential function. A slow rate of decay gives a high decay constant which indicates a better conductor.

## Grid and Map Generation

BHP lodged grids in grid exchange format (gxf), which were created with a 75 m grid cell spacing. The original submitted magnetic and decay constant grids (culture edited) were used to generate the EMD maps on an Ordnance Survey base. For Ballinalack data surrounding the RTE radio tower, only the even survey lines (with interpolated data) were used to calculate the grids (see Appendix F of Geoterrex-Dighem report for more detail).

All digital and hardcopy products are in the Irish National Grid (ING) coordinate system:

|                    |                           |
|--------------------|---------------------------|
| Datum:             | TM65 / Airy Modified 1849 |
| Ellipsoid:         | Airy Modified 1849        |
|                    | Major axis: 6377340.189   |
|                    | Eccentricity: 0.081673374 |
|                    | 1/f: 299.3249646          |
| Projection         | Transverse Mercator       |
| Central Meridian   | -8.00.00.000              |
| Latitude of origin | 53.30.00.000              |
| False Northing:    | 250,000 m                 |
| False Easting:     | 200,000 m                 |
| Scale factor:      | 1.000035                  |

## DATA LISTING

### Geosoft polygon files of survey boundaries

Geosoft polygon files (\*.ply) for each survey area are included on the CD. The files are in ASCII format and can be opened in any text editor to view survey boundary coordinates (in ING).

### Parameter table files

Geoterrex supplied waveform parameter table files, one for the beginning and end of each survey flight, in ASCII format. These files provide information on the system geometry, the channel positions in time and the reference waveform. The waveform is used to remove the effects of the primary field on the received secondary signal.

## Anomaly Listings

Anomaly listings for all the survey areas are provided in Appendix G of the Geotrex-Dighem report and also as digital files on the release CD.

## Databases

The raw and final data was supplied in ASCII format and imported into Geosoft Database format (GDB) by EMD. Geotrex-Dighem readme files with channel listings are included on the CD and summarised on page 8. The processed magnetics and EM data is released on CD in Geosoft format.

### Processed GEOTEM and Magnetic Data (Geosoft GDB)

| Database            | Number of Channels | Approx. Size (Mb) | File Name (.gdb) |
|---------------------|--------------------|-------------------|------------------|
| Ballinalack         | 143                | 113               | bhp982_ballin    |
| Carrickmacross East | 142                | 16.6              | bhp982_carricke  |
| Clare               | 142                | 55.6              | bhp982_clare     |
| Lough Sheelin       | 142                | 17.3              | bhp982_lsheelin  |
| Mohill              | 142                | 22.5              | bhp982_mohill    |
| Fermoy East         | 142                | 16.1              | bhp982_ferme     |
| Fermoy West         | 142                | 24.2              | bhp982_fermw     |

## Grids

The following grids in gxf format with 75m grid cell spacing were submitted by BHP.

| Block               | Grid   | Grid Name |
|---------------------|--|-----------|
| Ballinalack         | Total Magnetic Intensity<br>(IGRF removed)   | tmi       |
| Carrickmacross East |  | catf      |
| Clare               |  | cltf      |
| Lough Sheelin       |  | lstf      |
| Mohill              |  | motf      |
| Fermoy East         |  | fetf      |
| Fermoy West         |  | fwtf      |
| Ballinalack         | EM early decay constant<br>(z-coil, ch 8-14) | taue      |
| Carrickmacross East |  | cataue    |
| Clare               |  | cltaue    |
| Lough Sheelin       |  | lstaue    |
| Mohill              |  | motaue    |
| Fermoy East         |  | fetaue    |
| Fermoy West         |  | fwtaue    |

|                     |  |        |
|---------------------|--|--------|
| Ballinalack         | EM late decay constant<br>(z-coil, ch 12-18) | taul   |
| Carrickmacross East |  | cataul |
| Clare               |  | cltaul |
| Lough Sheelin       |  | lstaul |
| Mohill              |  | motaul |
| Fermoy East         |  | fetaul |
| Fermoy West         |  | fwtaul |

## Maps

All colour hardcopy maps submitted by BHP for this release were scanned and stored in a compressed TIFF format, using LZW compression to keep file sizes manageable, and can be opened in most standard packages. Compression was carried out using Imaging for Windows, which is available under the Accessories menu in Windows. *LZW compressed TIFF images can only be viewed in Geosoft when they are imported as a GeoTIFF file.* Maps produced in EMD, on an Ordnance Survey 1:50,000 base, with permission from Ordnance Survey Ireland, are available on the release CD as uncompressed images in JPEG format, or in hardcopy format on request.

### Supplied by BHP

| Block               | Map Title  | Filename  | Scale    |
|---------------------|--|-----------|----------|
| West Fermoy         | Z channel 1 Drape with North Sun   | bhp19.1.1 | 1:50,000 |
| West Fermoy         | Z channel 9 Drape Over TMI with North Sun  | bhp19.1.2 | 1:50,000 |
| West Fermoy         | TMI Drape over TMI with North Sun  | bhp19.1.3 | 1:50,000 |
| East Fermoy         | TMI Drape with North Sun   | bhp19.2.1 | 1:50,000 |
| East Fermoy         | Z channel 9 Drape Over TMI with North Sun  | bhp19.2.3 | 1:50,000 |
| Ballinalack         | DB/DT Processed Z channel 9 Over TMI Residual with North Sun Angle illumination. | bhp19.3.1 | 1:50,000 |
| Ballinalack         | TMI Residual Drape with North Sun  | bhp19.3.2 | 1:50,000 |
| Carrickmacross East | Z channel 9 Drape over TMI with North Sun  | bhp19.4.1 | 1:50,000 |
| Carrickmacross East | TMI Drape over TMI with North Sun  | bhp19.4.2 | 1:50,000 |
| Clare               | TMI Residual Drape with NE Sun   | bhp19.5.1 | 1:50,000 |
| Clare               | Z channel 9 Drape over TMI with NE Sun illumination                              | bhp19.5.2 | 1:50,000 |
| Lough Sheelin       | TMI Drape over TMI with NE Sun   | bhp19.6.1 | 1:50,000 |
| Lough Sheelin       | Z channel 9 Drape over TMI with NE Sun   | bhp19.6.2 | 1:50,000 |
| Mohill              | Z channel 9 Drape over TMI with North Sun  | bhp19.7.1 | 1:50,000 |
| Mohill              | TMI Drape over TMI with North Sun  | bhp19.7.2 | 1:50,000 |

## Supplied by EMD on Ordnance Survey base

| Block               | Map  | Filename           | Scale    |
|---------------------|--|--------------------|----------|
| Ballinalack         | Magnetic Intensity<br>(IGRF removed)         | ballin98_tmi_emd   | 1:50,000 |
| Carrickmacross East |  | carricke98_tmi_emd |          |
| Clare               |  | clare98_tmi_emd    |          |
| Lough Sheelin       |  | lsheelin98_tmi_emd |          |
| Mohill              |  | mohill98_tmi_emd   |          |
| Fermoy East         |  | fermoye98_tmi_emd  |          |
| Fermoy West         |  | fermoyw98_tmi_emd  |          |
| Ballinalack         | EM early decay constant<br>(z-coil, ch 8-14) | ballin98_tmi_emd   | 1:50,000 |
| Carrickmacross East |  | carricke98_tmi_emd |          |
| Clare               |  | clare98_tmi_emd    |          |
| Lough Sheelin       |  | lsheelin98_tmi_emd |          |
| Mohill              |  | mohill98_tmi_emd   |          |
| Fermoy East         |  | fermoye98_tmi_emd  |          |
| Fermoy West         |  | fermoyw98_tmi_emd  |          |

These maps are available, on an Ordnance Survey 1:50,000 base, as scanned images (jpeg format) or in hardcopy format (Ordnance Survey Permit DNE 001001).

## Company reports

The Geotrex-Dighem logistics and processing report for all areas, along with BHP Ireland Zinc Program Geophysics report, which includes a brief interpretation, is included on the release CD.

| Report Title   | Filename (.pdf) | No. of pages |
|--|-----------------|--------------|
| Geotrex-Dighem Logistics, Processing and Interpretation Report.<br>Airborne Magnetic & GEOTEM Electromagnetic Multicoil Survey<br>in the Tullamore and Shannon Areas | bhpr19_1        | 185          |
| Ireland Zinc Program Geophysics Report GEOTEM Surveys Over:<br>Ballinalack, Carrickmacross East, Clare, Fermoy East, Fermoy West,<br>Lough Sheelin                   | bhpr19_2        | 15           |

# GEOSOFT DATABASE CHANNEL LISTING

## Magnetics and EM Database

| CHANNEL NAME      | DESCRIPTION                                       | UNITS             |
|-------------------|---|-------------------|
| FID               | Fiducial  | sec x 10          |
| FLT               | Flight number                                     |                   |
| DATE              | Date  | ddmmyy            |
| X                 | Easting   | metres            |
| Y                 | Northing  | metres            |
| LAT               | Latitude  | Deg x 1000000     |
| LONG              | Longitude   | Deg x 1000000     |
| RAD_ALT           | Radar altimeter                                   | metres            |
| GPS_ALT           | GPS elevation                                     | metres            |
| RAW_MAG           | Raw TMI   | nT x 100          |
| DIURNAL           | Diurnal magnetics                                 | nT x 100          |
| PROC_TMI          | Processed TMI                                     | nT x 100          |
| COMP              | TMI levelling compensation                        | nT x 100          |
| MAG_IGRF          | Final TMI   | nT x 100          |
| IGRF              | IGRF  | nT x 100          |
| MICROLEV_COMP     | Final TMI microlevelling comp.                    | nT x 100          |
| PRIMARY_FIELD     | Em primary field                                  | uV                |
| POWERLINE_MONITOR | Powerline monitor                                 | uV                |
| EARLY_DC_Z        | Early decay constant from z-coil channels 8-14    | usec              |
| LATE_DC_Z         | Late decay constant from z-coil channels 12-18    | usec              |
| X_RMS             | RMS noise (X-coil)                                | pV/m <sup>2</sup> |
| Z_RMS             | RMS noise (Z-coil)                                | pV/m <sup>2</sup> |
| X1 to X20         | Processed EM channel X1 to X20                    | ppm               |
| Z1 to Z20         | Processed EM channel Z1 to Z20                    | ppm               |
| Y1 to Y20         | Processed EM channel Y1 to Y20                    | PV/m <sup>2</sup> |
| RAW_X1 to RAW_X20 | Raw EM channel X1 to X20                          | ppm               |
| RAW_Z1 to RAW_Z20 | Raw EM channel Z1 to Z20                          | ppm               |
| RAW_Y1 to RAW_Y20 | Raw EM channel Y1 to Y20                          | PV/m <sup>2</sup> |
| GRADIENT_MAG      | TMI Vertical Gradient                             | nT/km x 100       |
| FINAL_MAG_EDIT    | Edited Processed TMI (For Ballinalack block only) | nT x 100          |

# SURVEY LOCATION

## THE BHP AIRBORNE TEM AND MAGNETIC SURVEY (1998) OVER THE BALLINALACK, CARRICKMACROSS EAST, CLARE, LOUGH SHEELIN, MOHILL, FERMOY EAST AND FERMOY WEST AREAS

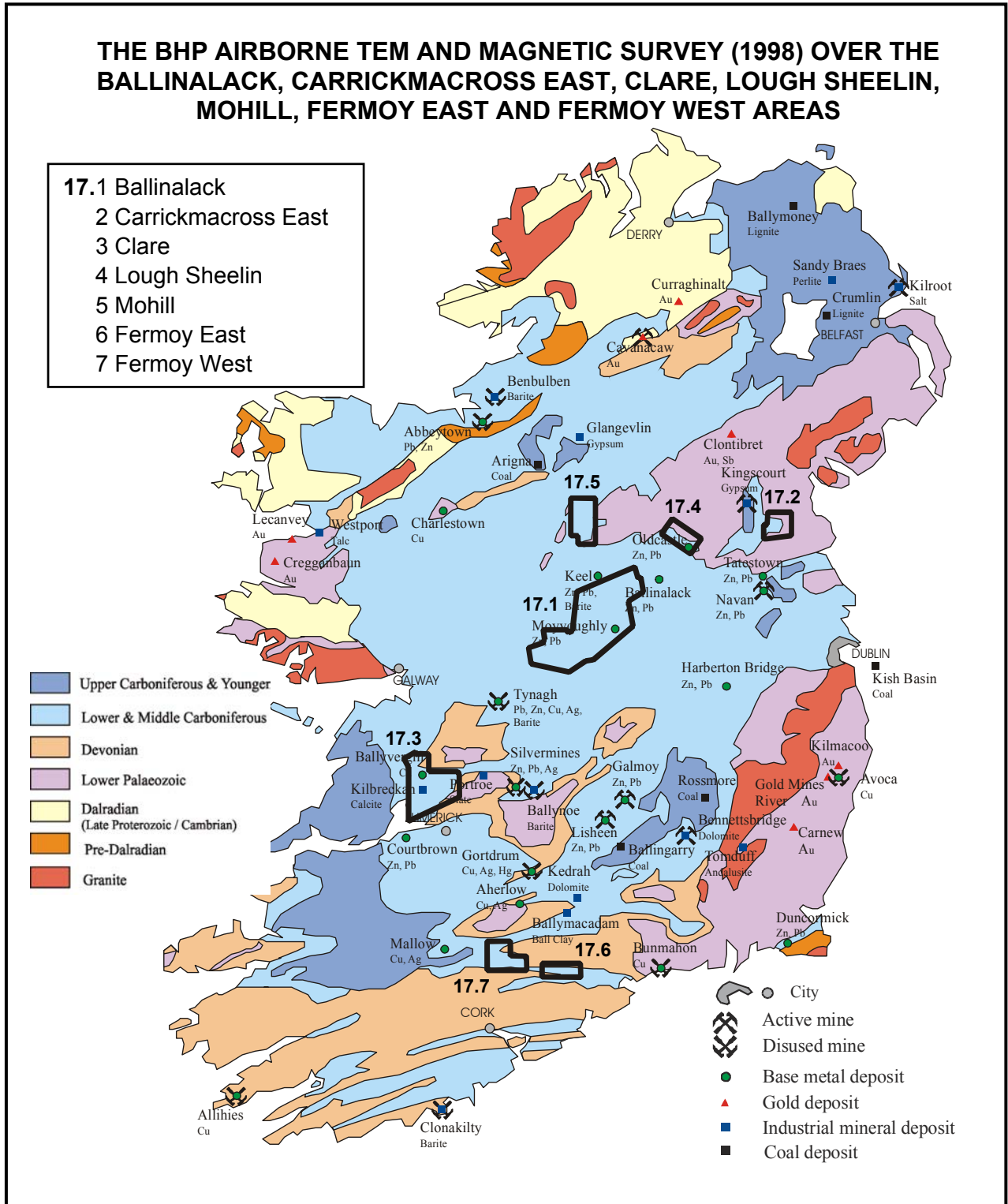
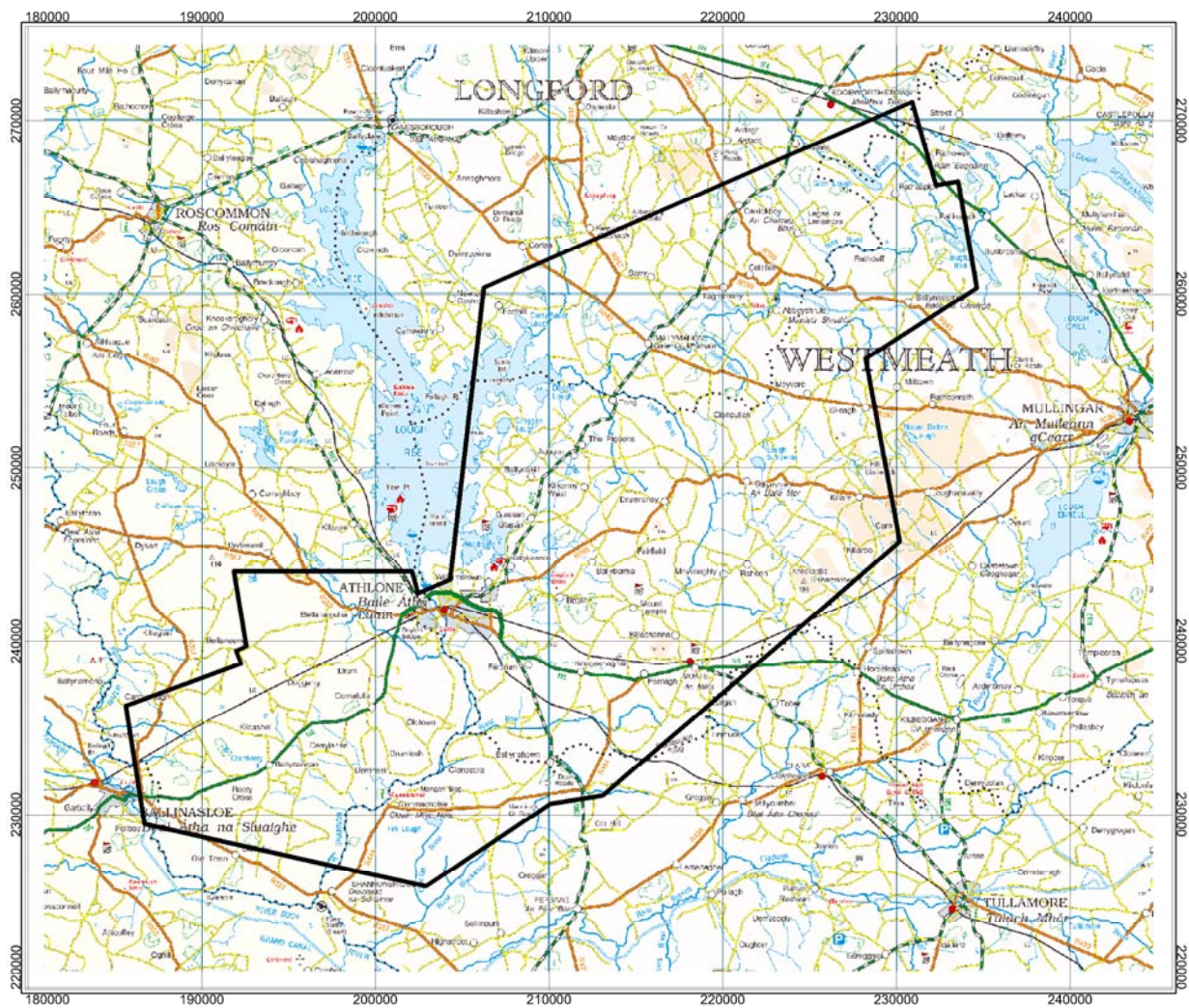


Figure 1. Location of the survey areas on a simplified geology map of Ireland.



**Figure 2. The Ballinalack survey area on a 1:250,000 Ordnance Survey base.**  
 (Ordnance Survey Permit DNE 001001).







Figure 7. The Fermoy East survey area on a 1:250,000 Ordnance Survey base. (Ordnance Survey Permit DNE 001001).

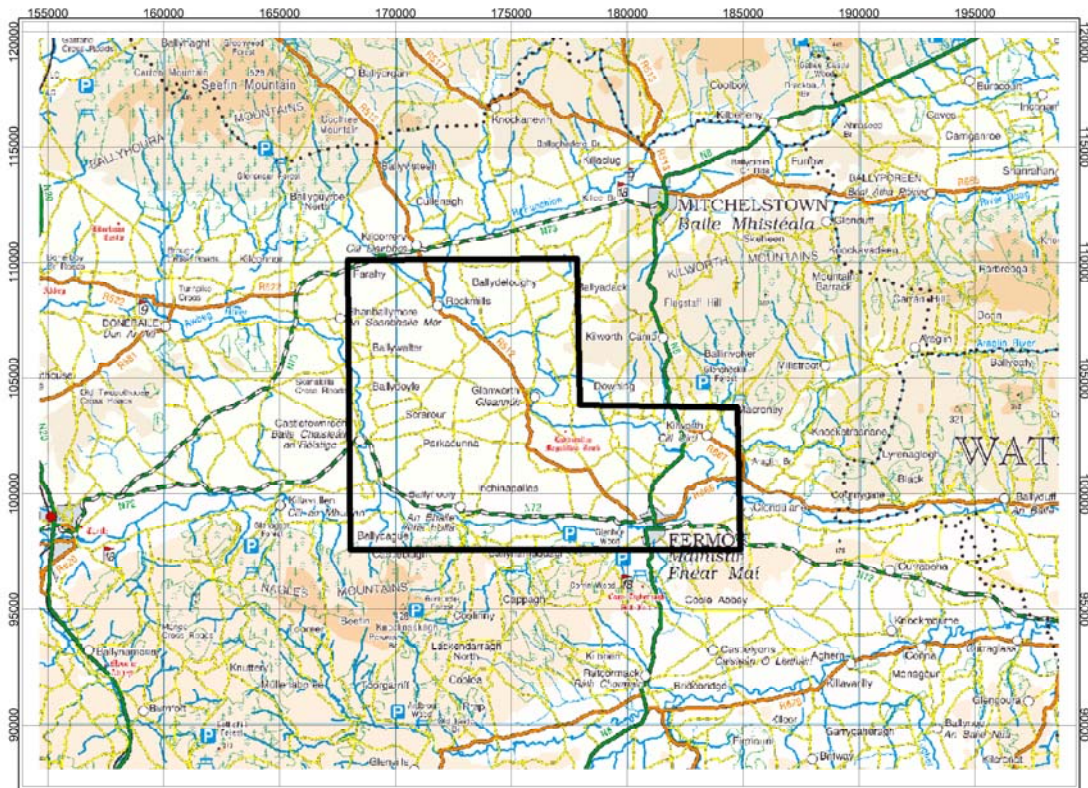


Figure 8. The Fermoy West survey area on a 1:250,000 Ordnance Survey base. (Ordnance Survey Permit DNE 001001).