

# **EXPLORATION AND MINING DIVISION IRELAND**

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## **THE BILLITON AIRBORNE TEM AND MAGNETIC SURVEY (1998) OVER THE MOATE AREA**

November 2003



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

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(1998) OVER THE MOATE AREA**

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**EXPLORATION AND MINING DIVISION  
MINERALS PUBLICATION MP 15/03**

**NOVEMBER 2003**

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## INTRODUCTION

In October 1998, Billiton Ireland Resources BV flew a 1788 line km magnetic and electromagnetic survey, over the Moate Block near Athlone, encompassing approximately 492 km<sup>2</sup> (Figure 1).

<b>Block</b>	<b>Line km</b>	<b>Area (sq. km)</b>	<b>Prospecting Licences covered/partially covered by Survey</b>
<b>Moate</b>	1788	492	505, 506, 1044, 1108, 1117, 1226, 1228, 1229, 1244, 1310, 1919, 2102, 2105, 3163, 3406, 3460, 3474, 3529, 3530, 3531, 3722, 3813, 3814, 3877, 1046R

This survey was acquired over four years ago and is available to the general public in fulfillment of the 'Open Skies' policy of the Exploration and Mining Division (EMD). The Division acknowledges the cooperation of Billiton Ireland Resources BV (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.

Geoterrex-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 Geoterrex-Dighem, which is now part of Fugro Airborne Surveys.

The survey acquisition and processing procedures are outlined in a Geoterrex-Dighem 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>	170°
<b>Tie Line Spacing</b>	3000m
<b>Mean Terrain Clearance</b>	120 m
<b>Nominal Survey Speed</b>	125 knots ( 65 m/s )
<b>Total Survey Area</b>	492 km <sup>2</sup>
<b>Total Line Km</b>	1788 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 Geotrex-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.

## 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. RTE radio towers, around the town of Athlone, caused interference and survey lines affected by this interference (352-387) were interpolated and subjected to manual editing. Appendix F of the Geoterrex-Dighem report lists the lines and fiducial limits where manual editing was applied.

## 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.

### 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.

### Apparent Conductance Calculation

The apparent conductance was calculated using the entire waveform of the combined x and z-coil data fitted to a thin sheet model.

## **Grid and Map Generation**

Billiton lodged grids in grid exchange format (gxf), which were created with a 75m grid cell spacing. The original submitted magnetic and decay constant grids were used to generate the EMD maps on an Ordnance Survey base.

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**

A Geosoft polygon file (\*.ply) for the survey area is included on the CD. The file is 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**

An anomaly listing for the survey is provided in Appendix G of the Geoterrex-Dighem report and also as a digital text file on the release CD.

## Databases

The raw and final data was supplied in ASCII format and imported into Geosoft Database format (GDB) by EMD. The Geotrex-Dighem readme file with channel listings is included on the CD and summarised on page 7. 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)
Moate	144	165.7	bill98_moate

## Grids

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

Grid Name	Grid
taul	EM late decay constant (z-coil, ch 12-18)
tmi	Total Magnetic Intensity (IGRF removed)
z12	Z-coil channel 12 amplitude
cond	Calculated apparent conductance

## Maps

All colour hardcopy maps submitted by Billiton 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.* Black and white images were compressed using CCIT Group4 compression, which can be opened in all standard packages. 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 Billiton (1:25,000 scale)

Map Title	Filename
Apparent Conductance Map (Resistive Limit Map) sheet 1 of 4	bill18.1.22
Apparent Conductance Map (Resistive Limit Map) sheet 2 of 4	bill18.1.21
Apparent Conductance Map (Resistive Limit Map) sheet 3 of 4	bill18.1.20
Apparent Conductance Map (Resistive Limit Map) sheet 4 of 4	bill18.1.19
EM Channel 12 (Z-coil) Amplitude Contour Map sheet 1 of 4	bill18.1.30
EM Channel 12 (Z-coil) Amplitude Contour Map sheet 2 of 4	bill18.1.29
EM Channel 12 (Z-coil) Amplitude Contour Map sheet 3 of 4	bill18.1.28
EM Channel 12 (Z-coil) Amplitude Contour Map sheet 4 of 4	bill18.1.27



GEOTEM Anomaly Map (X-coil) with Flight Path on Scanned Topobase sheet 1 of 4	bill18.1.34
GEOTEM Anomaly Map (X-coil) with Flight Path on Scanned Topobase sheet 2 of 4	bill18.1.33
GEOTEM Anomaly Map (X-coil) with Flight Path on Scanned Topobase sheet 3 of 4	bill18.1.32
GEOTEM Anomaly Map (X-coil) with Flight Path on Scanned Topobase sheet 4 of 4	bill18.1.31
Late EM Decay Constant (Ch 12-18, Z-coil) Amplitude Contour Map sheet 1 of 4	bill18.1.26
Late EM Decay Constant (Ch 12-18, Z-coil) Amplitude Contour Map sheet 2 of 4	bill18.1.25
Late EM Decay Constant (Ch 12-18, Z-coil) Amplitude Contour Map sheet 3 of 4	bill18.1.24
Late EM Decay Constant (Ch 12-18, Z-coil) Amplitude Contour Map sheet 4 of 4	bill18.1.23
Total Magnetic Intensity Contour Map (I.G.R.F. removed) sheet 1 of 4	bill18.1.38
Total Magnetic Intensity Contour Map (I.G.R.F. removed) sheet 2 of 4	bill18.1.37
Total Magnetic Intensity Contour Map (I.G.R.F. removed) sheet 3 of 4	bill18.1.36
Total Magnetic Intensity Contour Map (I.G.R.F. removed) sheet 4 of 4	bill18.1.35

### Supplied by EMD on Ordnance Survey base

Map	Filename	Scale
Total magnetic intensity (IGRF removed).	moate98_tmi_emd	1:100,000
Late EM decay constant (ch 12-18, z-coil)	moate98_taul_emd	
Calculated apparent conductance	moate98_cond_emd	
Z-coil channel 12 amplitude	moate98_z12_emd	

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

### Company reports

The Geoterrex-Dighem logistics and processing report for the survey is included on the release CD.

Report Title	Filename (.pdf)	No. of pages
Logistics and Processing Report of the Airborne Magnetic & GEOTEM Electromagnetic Multicoil Survey over the Moate Block, Ireland for Billiton Ireland Resources BV.	billr18_1	114

# GEO\_SOFT DATABASE CHANNEL LISTING

## Magnetics and EM Database

CHANNEL NAME	DESCRIPTION	UNITS
X	Easting	metres
Y	Northing	metres
FID	Fiducial	sec
FLT	Flight number	
DATE	Date	ddmmyy
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
COND	Apparent conductance	mS x 1000
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	nT x 100

# SURVEY LOCATION

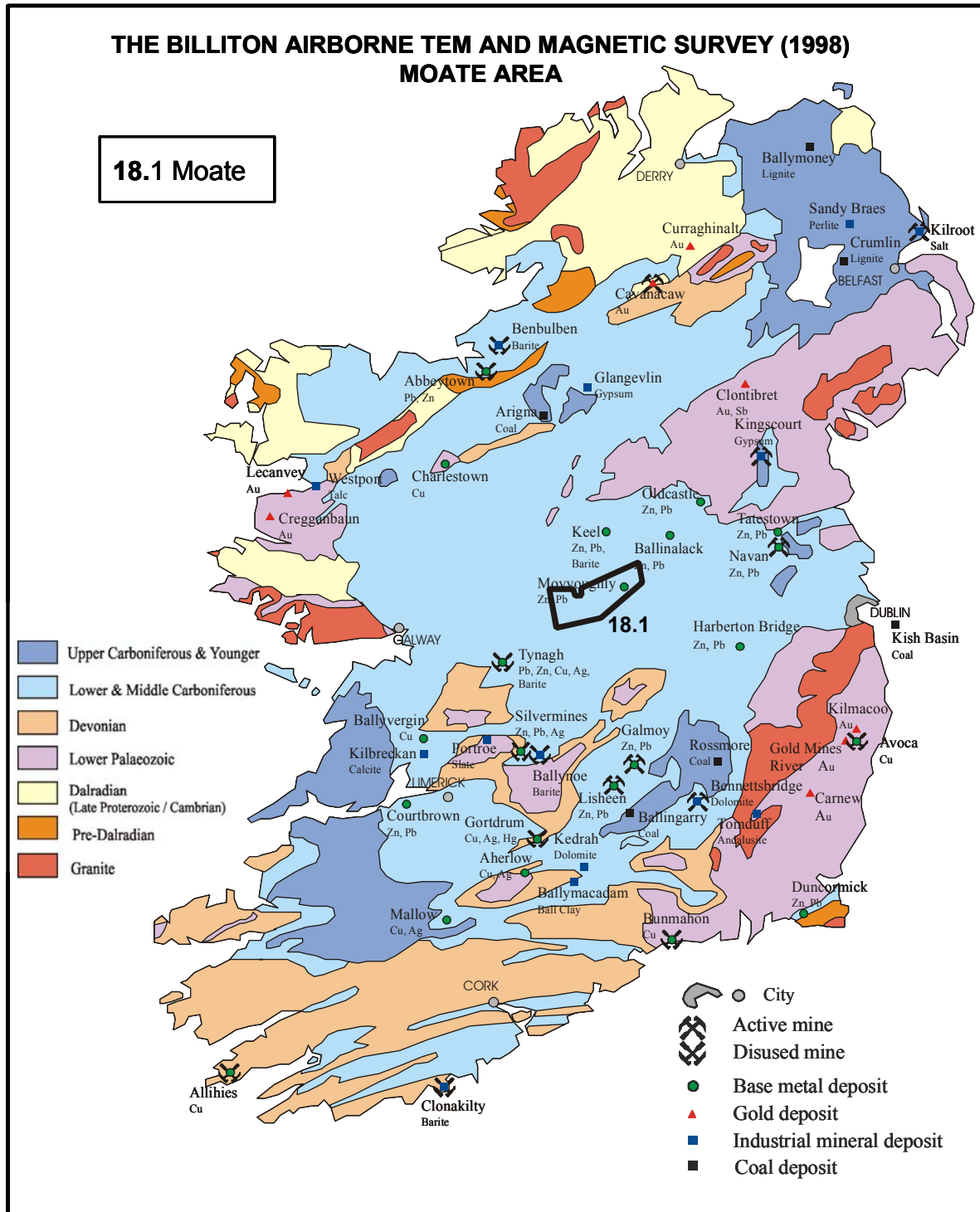
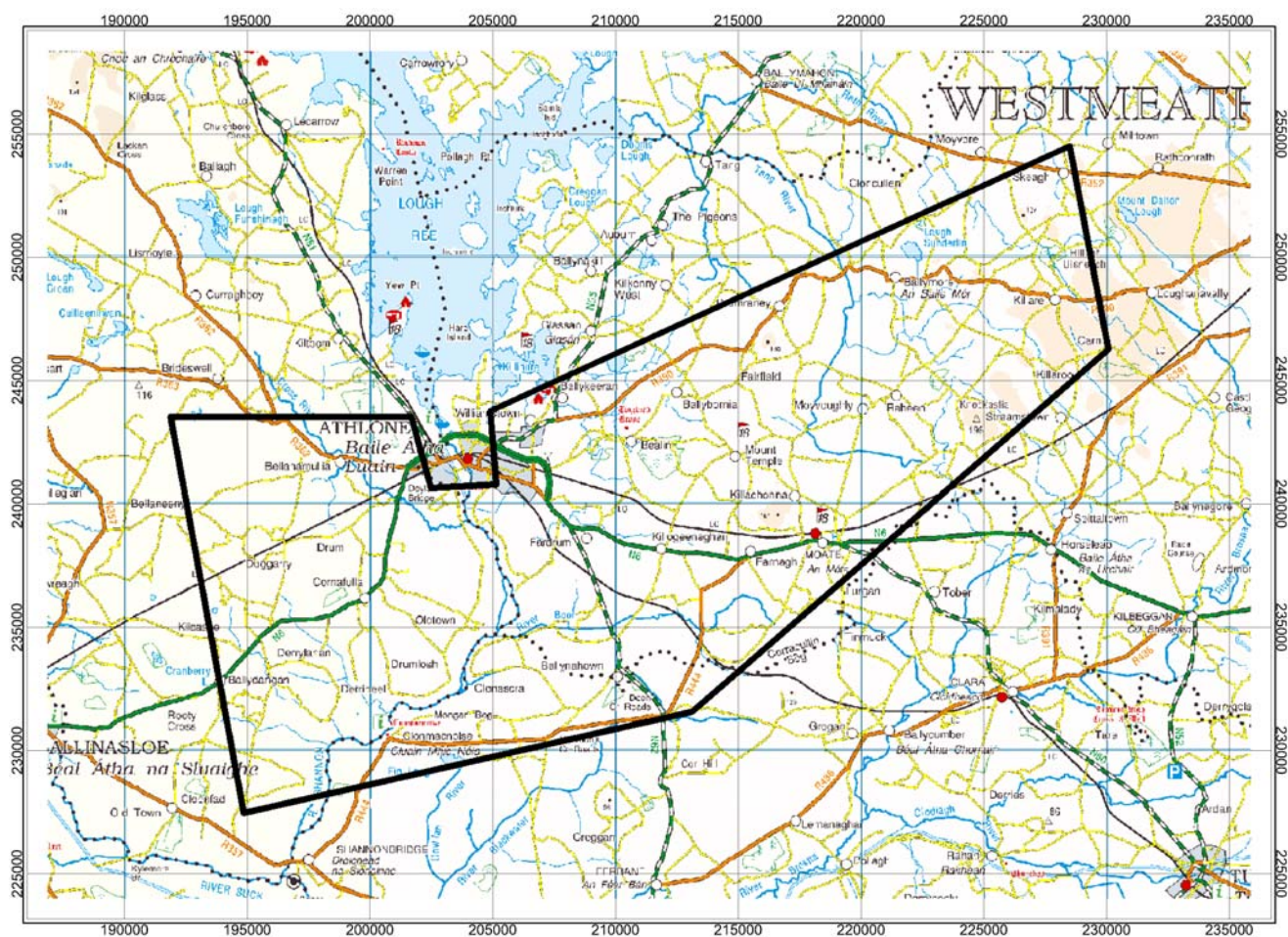


Figure 1. Location of the survey area on a simplified geology map of Ireland.



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