

DATA REVIEW OF CURRENTLY AVAILABLE WIDE ANGLE REFLECTION AND REFRACTION DATA PORCUPINE BASIN AND GOBAN SPUR

**Petroleum Infrastructure Program
Porcupine Studies Group**

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**Preliminary Report
14th August, 2000**



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Introduction

Fastnet Geophysical Laboratories (FGL) were contracted by the Porcupine Studies Group to provide a short review of currently available wide-angle reflection and refraction data over the Porcupine basin and Goban Spur. The purpose of the review is to provide information on deep seismic data, which is potentially useful to the group for modeling studies. The information includes acquisition, processing and modelling details, and the quality, status and availability of the data.

A list of the seismic lines covered by this report is provided in the table below.

Survey	Organisation	Type	Year
COOLE 3A and 3B	Dias/Hamburg	refraction	1987
IOS	SOC	refraction	1973
WIRE 1, 2 and 5	BIRPS	reflection	1987
WAM	BIRPS	reflection	1985
Norestlante 55 and 59	IFREMER	refraction	1983
Reframarge	IFREMER	refraction	1987
AMP-N	BIRPS	reflection	1998
CM	IOS	reflection	1975
SPB-97	Commercial	reflection	1997

The acquisition and processing details for the WAM, WIRE, AMP, CM and some of the commercial data are included as an appendix. Most of these were photocopied from sections stored in the Petroleum Affairs Division of the Dept. of Marine and Natural Resources, Dublin. A sketch map is also provided to indicate the locations of the seismic lines.

COOLE85 PROFILES 3A and 3B

Two refraction / wide-angle reflection profiles were shot in 1985 by the Celtic Onshore Offshore Lithospheric Experiment which was part of an Irish-German cooperative programme involving DIAS, UCG and the University of Hamburg.

Target:

The profiles were designed to study the transition from continental structure under southwest Ireland across the Porcupine Basin to oceanic structure under the abyssal plain.

Acquisition:

5 OBS were deployed along Coole 3B and 15 along Coole 3A (see Makris et al., 1988 for OBS positions). Analogue magnetic tape continuously recorded for 100 hours at each OBS. The shot spacing was 2.0 to 2.5 km and a 40kg charge generated signals with main spectral peaks between 5 and 6 Hz. Larger 120 kg shots were fired at the midpoint and ends of the profiles.

The profiles were also covered by airgun shots (150m spacing) generated from four 8 litre airguns operating at 150 bar to provide shallow structural detail.

Processing:

The analog data was digitised (sampling rate 125/sec) and band-pass filtered (3-12Hz).

Modelling:

The ray-tracing package Seis83 (two-point method) was used to model the data based on first arrivals and wide-angle reflections (Makris et al., 1988). Potential field modelling was also carried out on a profile coincident with 3A and 3B (Conroy and Brock, 1989).

Comments:

The data quality was acceptable at the time.

Data Availability:

All the COOLE data is stored in the University of Hamburg. At the moment Jannis Makris is away in Canada (due back Aug. 22nd). Manadou Gaye has located the data on tape but as he is having trouble reading the tapes he cannot give any information on the data format at present.

Contacts:

- Brian O'Reilly, DIAS, email: bor@cp.dias.ie, Tel: 01 6621333
- Jannis Makris, University of Hamburg, email: makris@dkrz.de, Tel: 49 40 428 38 39 69
- Manadou Gaye, University of Hamburg and Geopro, email: gaye@dkrz.de, Tel: 49 40 30 39 95 76

References:

Conroy, J.J. and Brock, A. 1989. Gravity and magnetic studies of crustal structure across the Porcupine basin west of Ireland. *Earth and Planetary Science Letters*, 93, 371-376.
Makris, J., R. Egloff, A.W.B. Jacob, P. Mohr, T. Murphy, and P. Ryan, 1988, Continental crust under the southern Porcupine Seabight west of Ireland, *Earth and Planetary Science Letters*, 89, 387-397.

IOS PROFILE

The Institute of Oceanographic Sciences (IOS) in 1973 shot a 200 km refraction line over the Porcupine ridge (Whitmarsh et al. 1974).

Target:

The aim was to demonstrate continental crust under the Porcupine ridge.

Acquisition:

A reversed profile was shot along the ridge. Ocean bottom seismometers (2/3) were used. The shot spacing was approximately 10 km. On line 1, from North to South, 26 136 kg depth charges at a depth of 150m were used. On line 2, from South to North, 26 Geophex shots ranging in size from 2.3-136 kg at depths of between 40 and 65m were used.

Modelling:

None except for a model of crustal structure (to 40 km depth) produced from first arrivals in Whitmarsh et al. (1974).

Comments:

The shot spacing was only sufficient to give an approximation of true crustal structure beneath the ridge. The quality of the data was acceptable for its age (1973). As far as Dr. Whitmarsh and FGL are aware no other publications exist or work has been done on this data. The IOS refraction line is very close to and parallel to BIRPS WIRE 5 profile and is intersected by BIRPS WIRE 2.

Data Availability:

The original tapes have been destroyed. B. Whitmarsh has located a paper copy of the record section for Line 2 (Line 1 is in the process of being located) and has given permission for its use.

Contacts:

- Bob Whitmarsh, SOC, B.Whitmarsh@soc.soton.ac.uk, Tel: 44 2380 596564

References:

Whitmarsh, R.B., J.J. Langford, J.S. Buckley, R.J. Bailey, and D.J. Blundell, 1974, The crustal structure beneath Porcupine Ridge as determined by explosion seismology. *Earth and Planetary Science Letters*, 22, 197-204.

WIRE PROFILES 1, 2 and 5

In 1987 the British Reflection Profiling Syndicate (BIRPS) shot the WIRE (West of Ireland) lines 1,2 and 5. The WIRE lines were the first successful deep reflection profiles to be recorded on the continental shelf and margin west of Ireland (Klemperer et al., 1991)

Target:

The WIRE 1 profile was designed to provide a transect across the Caledonides which could be compared with the images obtained east of Ireland and east of Britain. WIRE 1B extends the main Caledonian transect southwards across the Variscan thrust belt. WIRE 2 images the Porcupine basin while WIRE 5 images the Porcupine Bank.

Acquisition:

Western Geophysical acquired the data in 1987 using an airgun array with a capacity of 3590 cubic inches at 4500 psi and a streamer 4 km in length with 150 geophone groups. Although WIRE 1B is a direct continuation of WIRE 1, it was recorded three days later in poorer weather conditions, and the signal-to-noise ratio on WIRE 1B is lower than on WIRE 1. Data quality on WIRE 5 is not as good as WIRE 1, due to increased swell noise in the open ocean and to deep-water (350m) multiple energy that is hard to attenuate in processing.

Processing:

The data was processed in 1989 by London Digital Centre. The record length is 18 secs. Processing details are provided in the appendix.

Comments:

Richard Hobbs feels that WIRE would benefit from reprocessing using more recent multiple suppression algorithms. Three months was quoted as a rough time estimate for the reprocessing of both the WAM and WIRE data, if carried out by a commercial processing house such as BiPS who processed the AMP data. Recently other organisations have requested the raw BIRPS data from Cambridge including SOC so the possibility of sharing or coordinating reprocessing tasks may exist.

Data Availability:

The stack data is available from the Geological Society of London in SEG-Y format on CD's as part of the recently published BIRPS ATLAS II. The raw data is available on Exabyte through Richard Hobbs at Cambridge.

Contacts:

Richard Hobbs, Cambridge, email: hobbs@esc.cam.ac.uk, Tel: 44 1223 337060

References:

Klemperer, S.L., Ryan, P.D. and Snyder, D.B. 1991. A deep seismic reflection transect across the Irish Caledonides. *Journal of the Geological Society, London*. 148, 149-164.

Croker, P.F. and Klemperer, S.L. 1989. Structure and stratigraphy of the Porcupine Basin: relationships to deep crustal structure and the opening of the North Atlantic. In: Tankard, A.J. and Balkwill, H.R. (eds.) *Extensional Tectonics and Stratigraphy of the North Atlantic Margins. AAPG Memoir* 46, 445 - 459.

WAM PROFILE

The seismic reflection profile WAM (Western Approaches Margin) was recorded in 1985 by BIRPS and ECORS. 645 km of deep seismic reflection data was collected across the continental shelf and slope in the Goban Spur area (Peddy et al., 1989).

Target:

The line was designed to determine the behaviour of lower crustal reflections in crust which has undergone significant reflections. The line was shot perpendicular to Goban Spur continental margin and orthogonal to the Goban Spur passive margin so it is representative of the whole margin.

Acquisition:

The Geophysical Company of Norway (GECO) acquired the data (5 profiles) in 1985. using a tuned array of 40 airguns having a capacity of 7235 cubic inches at 2000 psi and a streamer 3 km in length with 60 geophone groups

Processing:

Processing details are provided in the appendix. The data was processed by Seismograph Service (England) Ltd. in 1987. The record length is 15 s two-way travel time. Processing comprised trace mixing to simulate longer source and receiver arrays, spherical divergence correction, velocity analysis, normal moveout correction, post-moveout mute, nominal 30-fold stacking, pre- and post-stack deconvolution and bandpass filtering. In addition, a pre-stack f-k filter was applied to the portion of the profile crossing the continental slope (western end) in order to suppress multiple events.

Modelling:

The velocity-depth model for Line 3 of the Reframarge data (see figure 1) was converted to two-way time for comparison with the WAM line (Horsefield et al., 1993).

Comments:

As for the WIRE data, Richard Hobbs feels that WAM would benefit from reprocessing using more recent multiple suppression algorithms. Three months was quoted as a rough time estimate for the reprocessing of both the WAM and WIRE data, if carried out by a commercial processing house such as BiPS who processed the AMP data. Recently other organisations have requested the raw BIRPS data from Cambridge including SOC so the possibility of sharing or coordinating reprocessing tasks may exist.

Data Availability:

The stack data is available from the Geological Society of London in SEG-Y format on CD's as part of the recently published BIRPS ATLAS II. The raw data is available on Exabyte through Richard Hobbs at Cambridge.

Contacts:

- Richard Hobbs, Cambridge, email: hobbs@esc.cam.ac.uk, Tel: 44 1223 337060

References:

Peddy, C., Pinet, B., Masson, D., Scrutton R., Sibuet J-C., Warner, M.R., Lefort, J.P. & Shroeder, I.J., 1989. Crustal structure of the Goban Spur continental margin, Northeast Atlantic, from deep seismic reflection profiling. *J. geol. Soc.*, 146, 427-437.

Horsefield S.J., Whitmarsh R.B., White R.S. & Sibuet J-C, 1994. Crustal structure of the Goban spur rifted continental margin, NE Atlantic. *Geophysical Journal International* 119, 1-19.

NORESTLANTE 55 and 59

Louvel et al. (1997) who carried out forward modelling and inversion of marine magnetic anomalies along the WAM profile also used single channel OBS data from profiles Norestlante 55 and 59 which are parallel to WAM (see figure 1). The Norestlante data was collected by IFREMER in 1983. Contact has been made with J-C Sibuet via email for more information and we are awaiting a reply. However, the data, if deemed useful, should be available from the SISMER data bank (see appendix).

Contact:

- Jean-Claude Sibuet, IFREMER, email: jcsibuet@ifremer.fr, Tel: 33 98224224.

References:

Louvel V., Dymant J., Sibuet J-C, 1997. Thinning of the Goban Spur continental margin and formation of early oceanic crust: constraints from forward modelling and inversion of marine magnetic anomalies. *Geophysical Journal International* 128, 188-196.

REFRAMARGE PROFILES

Three airgun wide-angle seismic refraction lines were shot over the Goban Spur in 1987 as part of the Reframarge Project (see figure 1). Line 3 was positioned to coincide with the WAM reflection profile across the margin. The data was collected by IFREMER in 1987 (see appendix). The SOC and GSI also participated in the project. Contact has been made with J-C Sibuet via email for more information and we are awaiting a reply. However, the data, if deemed useful, should be available from the SISMER data bank (see appendix).

Acquisition:

Several digital OBS were deployed on each line. The source was an array of eight 161 (1000 cu inches) airguns fired every 120s, giving a shot spacing of approx. 300m. The data were recorded at 75 samples per second for a time of up to 60s.

Modelling:

The data were traveltimes and amplitude modelled at Cambridge (Horsefield et al., 1993).

Contacts:

- Jean-Claude Sibuet, IFREMER, email: jcsibuet@ifremer.fr, Tel: 33 98224224.

References:

Horsefield S.J., Whitmarsh R.B., White R.S. & Sibuet J-C, 1994. Crustal structure of the Goban spur rifted continental margin, NE Atlantic. *Geophysical Journal International* 119, 1-19.

AMP-N PROFILE

Acquired in 1998 as part of the Atlantic Margin Project.

Target:

To investigate the deep structure of the Porcupine trough.

Acquisition:

I have requested the acquisition parameters from Richard Hobbs.

Processing:

The data was processed by Bedford Interactive Processing Services Ltd (BiPS) in 1999. The processing sequence is given in the appendix.

Data Availability:

The data is confidential but a trade would be considered.

Contacts:

- Richard Hobbs, Cambridge, email: hobbs@esc.cam.ac.uk, Tel: 44 1223 337060

CM SURVEY

The continental margin reflection survey was collected by the Institute of Oceanographic Sciences (IOS, now SOC) in 1975.

Acquisition:

Acquired by S & A Geophysical in 1975. The record length is 13 secs.

Processing:

Following from the original processing, 4 lines of the survey CM-6, 8, 17 and 19 were reprocessed in 1997 by Geodata (details given in appendix).

Modelling: None as far as Peter Croker and FGL are aware.

Data Availability:

The data is released and available from the PAD.

Contacts

- Peter Croker, PAD, email: Peter_croker@marine.irlgov.ie Tel: 353 1 6199200
- Bob Whitmarsh, SOC, email: B.Whitmarsh@soc.soton.ac.uk, Tel: 44 2380 596564

SPB-97 SURVEY

Acquisition:

The South Porcupine Basin reflection survey was acquired by Fugro Geoteam AS. in 1997. Details are given in the appendix.

Processing:

Robertson Research International Ltd. processed the data in 1997. The record length 9 secs TWT. Details are given in the appendix.

Modelling: No modelling information is available.

Comments:

The Petroleum and Marine Geology group of the BGS wrote a report which included this data. A copy of the report is in the PAD Dublin). Some deep reflectors are visible on some of the lines eg. SPB 97-101 at 7.5 - 8 sec TWT.

Data Availability:

This data is confidential but as the survey was widely sold, some PSG members may have acquired some lines.

Contacts:

- Peter Croker, PAD, email: Peter_croker@marine.irlgov.ie Tel: 353 1 6199200

References:

BGS Report. Structural Geology and Petroleum Prospectivity of the Main Porcupine and Seabight Basin.

Needham, C.E.J., Chilovi, C., Bocca, P. & Tiltman C. 1999. A proposed model for the structural development of the South Porcupine Basin. In *Petroleum Exploration of Irelands Offshore Basins Extended Abstracts*. Eds: Croker P.M. & O'Loughlin, O.

