

**GEOCHEMISTRY OF BASINS ON
THE CONTINENTAL MARGINS OF
NORTH WEST EUROPE**

AREA II

SOUTH VIKING GRABEN

**GEOMARK
RESEARCH, INC.**

A PROSPECTUS

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Introduction

GeoMark Research, Inc. has completed a review of aspects of petroleum systems existing in the South Viking Graben. The project area is approximately limited by 1°- 3° East longitude and 58°- 60° North latitude and includes UK Quadrants 9, 15 and 16 and Norwegian Quadrants 15, 16 and 25. The project is the second in a series of oil geochemical, rock property, and modeling studies planned by GeoMark in the North Sea Region. It follows the general format of the successful West of Shetlands study (December 1994).

Significant additions to reserves continue in many areas of the North Sea. UK production in 1995 is expected to equal or slightly exceed the previous production record set in 1985. Norwegian production rose 12% in 1994 and Danish production increased by 11% (Oil and Gas Journal, 1995).

This continuing success is partly related to improved exploration and production technologies such as 3D seismic and directional wells. Advances in geological analyses have also contributed to these successes (Solli, 1995). Sequence stratigraphy (e.g., Cocking et al., 1992 and Underhill and Partington, 1994), basin modeling (e.g., Karlsen et al., 1993 and Farrow et al., 1994), and advances in analysis of petroleum systems (e.g., Buhig, 1989; Cartwright, 1994; Cornford, 1994; and, Holm, 1995) have occurred.

A number of important specific topic papers regarding the organic geochemistry of the area have appeared (Northam, 1985; Bailey et al., 1990; and, Gormly et al., 1994). However, no modern (post mid-1980's), detailed investigation of the oil geochemistry of the South Viking Graben has been undertaken. This is perhaps because the volumetrics of the Humber Group source succession are considered to be more than adequate to meet any reservoir demand placed on them. Work done by GeoMark and others (e.g., Northam, 1985 and Gormly et al., 1994) indicates that a variety of oil types occur in the northern North Sea area. An effort directed at defining the number of oil families is an important contribution to improved knowledge of the petroleum systems in the South Viking Graben.

Oil Geochemistry

Enormous insight into petroleum systems can be gained by the analysis and interpretation of a large collection of oils from a basin. Table 1 provides a list of oils that have been analyzed for the South Viking Graben project. The distribution of these oils is shown on the map of the area (Figure 1). Each oil was characterized by an analytical program that includes bulk compositional data, quantitative biomarker analysis of terpanes and steranes, and determinations of stable isotope composition of the saturate and aromatic hydrocarbon fractions. Rigorous comparison of geochemical data was accomplished using cluster and principal component analyses (Moldowan et al., 1985 and Zumberge, 1987). These statistical techniques were “setup” in a way that permits predictions regarding depositional environments of the source rocks to be made. Data from oil geochemistry were used to evaluate important exploration issues.

- The number of sources (or source facies) responsible for the oils
- The number of depocenters (“kitchens”) for the oils derived from a common source
- Oil maturity contrasted to measured or calculated reservoir rock maturity
- Identification of secondarily altered oils and assignment of these to their proper compositional families
- Identification and evaluation of oil mixing

Rock Properties

Shale velocity (sonic travel time) plots were made for a selection of wells (12) providing data important to basin modeling. These plots provide information about the following phenomena:

- Shale compaction curves
- Undercompacted section
- Erosional breaks
- Erosional breaks where the lost section is greater than the section subsequently deposited
- Late uplift and erosion uncompensated for by later deposition
- Organically rich argillaceous intervals

Wells that are candidates for this analysis will be located on or near the lines of cross section shown in Figure 1.

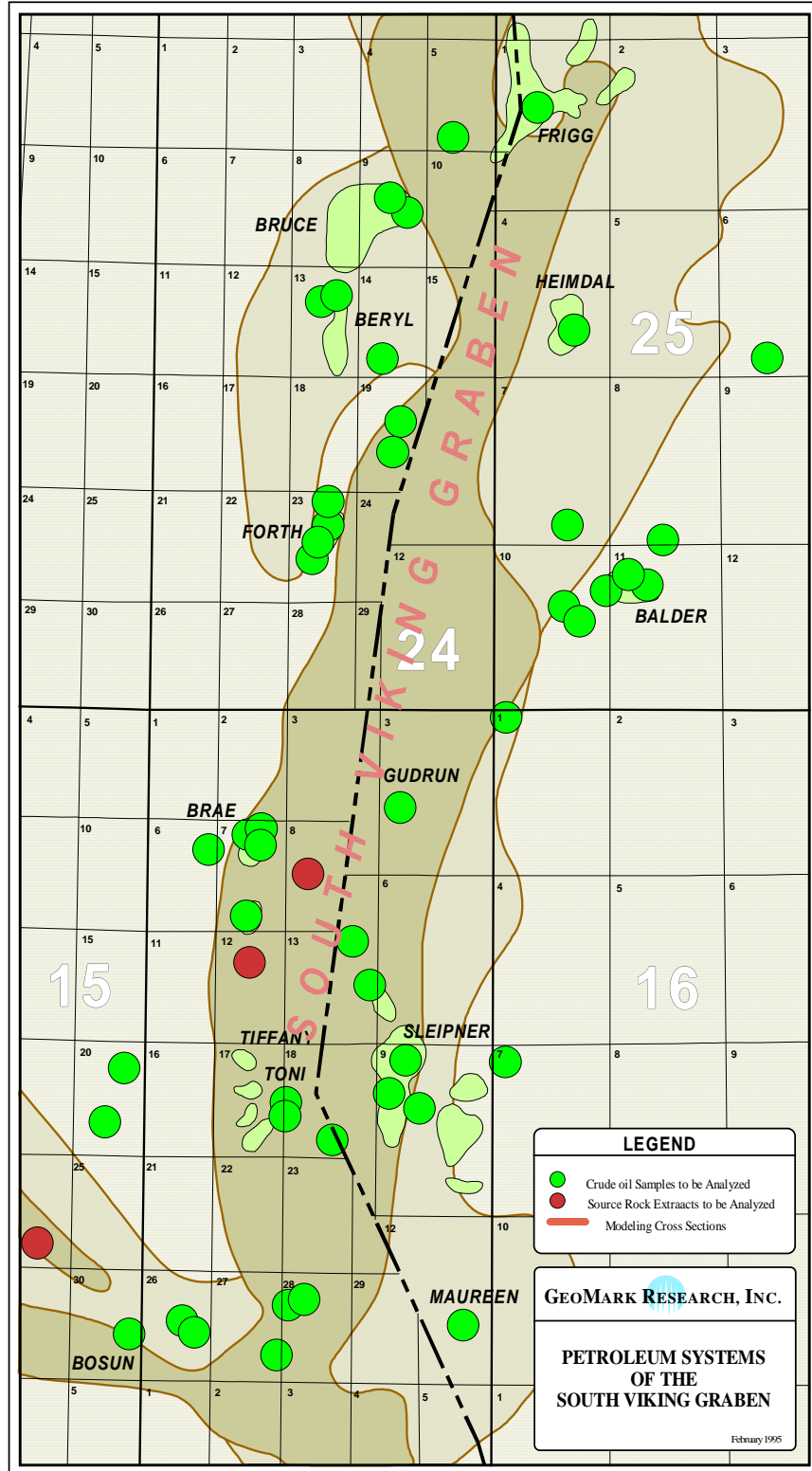


Figure 1. Location map showing distribution of samples analyzed for this study.

Modeling

Selected wells (5-10) have been modeled using a commercially available modeling package. Data from oil geochemistry permits important additional constraints on modeling. Oil data dictates the number of sources or source facies that have to be accounted for in the modeling and provide some maturity estimates for these sources. Maturity data from the oils can be contrasted with measured or calculated maturity for wells. Discrepancies between the oil and rock maturities can be used to acquire an improved view of the evolution of the basin. Modeling can be extended to undrilled locations in the basin to provide additional timing information.

Modeling input is taken from chronostratigraphic reconstruction of wells. All modeled wells are chronostratigraphically justified one to the other. Figure 4 presents an example of a well reconstruction using data from the West of Shetlands project.

Presentation

Data from the project has been organized in an interpretative volume and in an appropriate number of data volumes. The integrated interpretation for the study is preceded by a discussion of the regional setting, summary of oil geochemistry, and results of modeling. A detailed report for the oils is presented separately (as an appendix of the interpretation) for those explorationists who wish to consider the details of the analysis from which the oil summary was derived.

The analytical data from the oil work is provided on personal computer disks and in data volumes. The oil data will include the following.

- Physical property data (API gravity, % Sulfur, Ni/V ratios, etc.)
- C15+ fraction versus <C15+ fraction
- Deasphalting
- Liquid chromatography (% Saturates, % Aromatics, and % NSO's)
- Capillary gas chromatography of whole crude oil
- Detailed C7 gas chromatography
- Stable carbon isotopic composition of C15+ saturate and aromatic hydrocarbons
- Quantitative GC/MS analysis of C15+ saturate hydrocarbons for terpane and sterane distributions
- GC/MS of Aromatic Hydrocarbons

Data for wells is presented in data volumes. Data typically available includes.

- Temperature and maturity data that are used to constrain the models
- Stratigraphic, lithologic, and thermal input to models
- Depth versus present day temperature and maturity plots for models
- Hydrocarbon generation versus depth and time for models
- Burial history plots for individual wells
- Plots of sonic travel time of shales and silty shales for selected wells
- Pressure plots (from RFT or DST summaries)

Participation

The complete study is available at a cost of US \$32,500.00.

Timing

The project is completed and available for immediate delivery.

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TABLE I

Samples Analyzed for this Study

Sample ID	Country	Basin	Field	Well	Depth	Age
UKCS001	UK	S. Viking Graben	Bruce	9/9B-3; DST4	3845-3860m	Jurassic
UKCS002	UK	S. Viking Graben		9/14B-4; DST1A		Tertiary?
UKCS003	UK	S. Viking Graben	Forth	9/23B-5	Stock Tank Oil	Eocene
UKCS004	UK	S. Viking Graben	Forth	9/23B-7; DST1		Eocene
UKCS005	UK	S. Viking Graben		9/23B-8; DST1		Eocene
UKCS006	UK	S. Viking Graben		9/23B-8; DST1		Eocene
UKCS007	UK	S. Viking Graben		9/23B-10; DST1		Eocene
UKCS008	UK	S. Viking Graben		9/23B-11		Eocene
UKCS009	UK	S. Viking Graben		9/23B-11; DST1		Eocene
UKCS010	UK	S. Viking Graben		9/23B-17; RFT	1728m	Eocene
UKCS011	UK	S. Viking Graben		15/20-1; FIT 1+8		Jurassic
UKCS012	UK	S. Viking Graben		16/18B-2; RFT4E	4005.5m BRT	Jurassic
UKCS013	UK	S. Viking Graben		16/18B-2; DST1	5034-5070m	Jurassic
UKCS014	UK	S. Viking Graben		16/28-4; DST2		Paleocene
UKCS015	UK	S. Viking Graben		16/28-4; DST1		Cretaceous
UKCS016	UK	S. Viking Graben		16/28-4; DST2		Paleocene
UKCS017	UK	S. Viking Graben		16/28-4		Paleocene
UKCS018	UK	S. Viking Graben		16/28-9; DST3		Paleocene
NO022	Norway	S. Viking Graben		24/9-5; FMT-1	2012.5-2018.5m	Paleocene
NO023	Norway	S. Viking Graben		24/9-6	2006-2032m	Paleocene
NO024	Norway	S. Viking Graben		24/9-3; DST2	1765-1782m	Paleocene
NO001	Norway	S. Viking Graben	SE of Gudrun	15/3-4; DST1	3789.0-3807.5m	U.Jurassic
NO002	Norway	S. Viking Graben	Dagny	15/5-1; DST2	3561-3584m	M.Jurassic
NO003	Norway	S. Viking Graben	Sleipner Alpha	15/9-1; DST1	3655-3660m	M.Jurassic
NO004	Norway	S. Viking Graben	Sleipner	15/9-19SR; DST1	4316-4338m	M.Jurassic
NO005	Norway	S. Viking Graben	Bream	18/10-1		M.Jurassic
NO006	Norway	S. Viking Graben	Frigg	25/1-9; RFT2	2056.5m	Eocene
NO007	Norway	S. Viking Graben	E. Frigg Alpha	25/2-C-1A #1		Eocene
NO008	Norway	S. Viking Graben	E. Frigg Alpha	25/2-C-1A #3		Eocene
NO009	Norway	S. Viking Graben	E. Frigg Satellite	25/2-10S; RFT5	2252.5m	Eocene
NO010	Norway	S. Viking Graben	Lille Frigg	25/2-12	3692.2m	Eocene
NO011	Norway	S. Viking Graben		25/2-13; DST5	3343-3382m	Jurassic?
NO012	Norway	S. Viking Graben	E. Frigg Satellite	25/2-13; DST2B	3695-3713m	Jurassic?
NO013	Norway	S. Viking Graben	Vale	25/4-6S; DST1	3802-3819m	Eocene?
NO014	Norway	S. Viking Graben	Froy	25/5-1; DST3B	2687-3002m	Jurassic?
NO015	Norway	S. Viking Graben		25/6-1		Paleocene?
NO016	Norway	S. Viking Graben	NE of Balder	25/8-1		Paleocene
NO017	Norway	S. Viking Graben		25/8-4; RFT		Paleocene?
NO018	Norway	S. Viking Graben	Balder	25/11-5		Paleocene
NO019	Norway	S. Viking Graben	Hermod	25/11-15; DST1	1736-1774m	Paleocene?
NO020	Norway	S. Viking Graben	Balder Satellite	25/11-16; RFT		Paleocene
NO021	Norway	S. Viking Graben	Balder	25/11-18T2; SRFT	1755m	Paleocene
NWE003	UK	East Shetland	Cormorant	211/26		
NWE005	UK	East Shetland	Hutton	211/27		
NWE016	UK	Moray Firth	Ettrick	20/2-1 DST3A	3236-3246m	U.Jurassic
NWE017	UK	Moray Firth	Buchan	21/1-B1	2583-2978m	Devonian
NWE018	Norway	East Shetland	Snorre	34/7-6 DST2		M.Jurassic
NWE019	UK	S. Viking Graben	Forth	9/23B-5	Stock Tank Oil	Eocene
NO025	Norway	S. Viking Graben	NE of Sleipner Complex	16/7-2		Paleocene
NO026	Norway	S. Viking Graben	Balder	25/10-3		Paleocene
NO027	Norway	S. Viking Graben	Balder	25/11-14 SA		Paleocene
NWE035	Norway	N. Viking Graben	Oseberg	30/6		M.Jurassic
NWE004	UK	Central Graben	Argyll	30/24		
NWE011	UK	Central Graben		30/14-1 DST2	2947-2958m	Paleocene