BRAZIL OIL STUDY

**REGIONAL PETROLEUM GEOCHEMISTRY
OF CRUDE OILS FROM THE
COASTAL BASINS OF BRAZIL**

**GEOMARK
RESEARCH, INC.**

A PROSPECTUS

EXECUTIVE SUMMARY

GeoMark Research has completed a non-exclusive geochemical evaluation of a large suite of oil samples from the producing basins along the entire coastal margin of Brazil. This study consists of the detailed geochemical analysis of 43 oil samples located throughout each of the petroliferous basins of coastal Brazil. The study is being offered on a non-exclusive basis to participating companies.

Each of the oils in the study was characterized using a detailed analytical program which includes quantitative biomarker and stable carbon isotope analyses. With this information, we have grouped the oils into genetically related families and predicted the character of their respective sources. The results have been used to address several questions of exploration significance, including:

- Determine the number of distinct oil families distributed along coastal Brazil, and characterize their sources.
- Determine if all of the coastal Brazil oils have all been generated by a single Cretaceous source.
- Map the distribution of the oil families along the Brazilian margin.
- Compare and contrast Brazilian oils with presalt and postsalt oils from West Africa. Establish which Brazilian basins are sourced by lacustrine and/or marine sediments.
- Determine if the oil produced in the Reconcavo Basin is related to oils produced in the offshore fields.

All of the analytical data generated from the oils have been compiled together with interpretive reports. These reports include full color, wall-sized maps of oil family and subfamily distributions. In addition, the results include a regional petroleum geology synthesis of each basin.

The cost of the complete study is US $21,500, and is immediately available.

INTRODUCTION

Sedimentary basins along the eastern margin of South America are currently receiving increased exploration attention. This is due to the recent discovery of large reserves along this trend, and to even more impressive discoveries in West Africa (Edwards and Bignell, 1988).

Experience gained in numerous oil studies suggests that future exploration efforts along the eastern margin of South America would be greatly enhanced by a regional evaluation of oil geochemistry. Previous geochemical studies in the region (e.g., Mello *et. al*., 1988; Zumberge, 1984; Talukdar *et. al.*, 1988) have documented the inter-relationships of many of the oils, and similar studies in West Africa have confirmed the value of the regional oil study approach.

To this end, GeoMark Research has completed a non-exclusive study of selected oil samples from each of the producing regions along the Brazilian coast. The study includes 43 oils (Appendix A). A detailed map illustrating the distribution of oil samples is provided in Figure l.

The majority of the samples to be analyzed are production samples, but several DSTs and seeps will also be included. Quantitative biomarker analyses and stable carbon isotopes are the cornerstones of a very detailed analytical program which is discussed later in this proposal.

METHODOLOGY AND EXPLORATION APPLICATIONS

In areas such as the Atlantic margin of Brazil where substantial production has been established, a regional oil study is an excellent way of identifying, evaluating and comparing the various petroleum systems that have contributed to reserves. A regional oil study approach is particularly important in the study area because of possible genetic relationships between the petroleum systems on both sides of the Atlantic Ocean.

Regional petroleum systems can be evaluated by first determining the number of effective source units within a region by establishing the number of compositionally distinct oil families. The source facies of each oil family can then be deduced from the oil geochemistry (e.g., Zumberge, 1987; Moldowan *et al*., 1985). Conclusions can be reached regarding source lithology, anoxicity, salinity, organic input (marine, non-marine or marginal marine) and thermal maturity using a variety of parameters based on molecular and bulk composition. In some cases it may be possible to bracket the age of the source from the oil data.

In an area such as the east coast of Brazil, where sufficient production has been established, a regional oil study is an excellent way of evaluating the entire petroleum system(s).

Figure 1. Location map showing disdribution of oil samples analyzed for the Brazil Oil Study.

ANALYTICAL PROGRAM

The following techniques were employed on each of the oil samples:

- API Gravity
- % Sulfur
- C15+ vs. <C15+
- Deasphalting
- Liquid Chromatography (%Sat %Aro %NSO)
- Capillary GC of Whole Crudes
- Stable Carbon Isotopes for both Sat and Aro Hydrocarbon Fractions
- GC/MS of Saturates for Terpane/Sterane Distributions (quantitative)

PRESENTATION OF RESULTS

Results of the study are presented in both analytical and interpretive formats to insure that all findings are readily accessible to explorationists and research personnel. All of the analytical data is provided in hard copy and on personal computer disks. Whole oil chromatographic and GC/MS raw data are available on mini-tape cassettes.

Analytical data are presented within **Data Volumes,** and include the following:

physical property data
liquid chromatographic data
gas chromatographic results
stable carbon isotope data
GC/MS mass chromatograms.

A synthesis and interpretation of all information is presented in two comprehensive **Final Reports**. Both Volume I (Brazil/Africa) and Volume II (E. Venezuela/Argentina) include sections for:

regional petroleum geology,
production histories,
differentiation of oil families by multivariate statistics,
interpretation of oil characteristics,
inferred oil/source correlations,
oil generation and migration,
overall exploration potential.

In addition, the geographic distribution of oil families and associated petroleum systems will be presented on large format, colored maps.

PARTICIPATION

The cost of the entire study is US $21,500. The study is complete and available for immediate delivery.

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APPENDIX A

Samples Analyzed for the Brazil Study

Sample	Basin	Field	Well	Depth (m)	Reservoir Age	Formation
BR001	Faz do Amazonas	Wildcat DST	1-PAS-9	4376-4391	Oligocene	Amapa Shelf Unit ls
BR002	Barreirinhas	Wildcat DST	1-MAS-5	2823	U. Cretaceous	Talud Unit ss
BR003	Barreirinhas	Wildcat DST	1-MAS-20	3119		
BR004	Ceara	Atum	1-CES-27	2116-2120	Aptian	Açu ss
BR005	Ceara	Wildcat DST	1-CES-33A	2837-2841	L. Cretaceous	Açu ss
BR006	Ceara	Curimã	1-CES-19	2122-2138	Aptian	Açu ss
BR007	Potiguar	Ubarana	7-UB-18D-RJS	2675-2678	Aptian	Açu ss
BR008	Potiguar	Agulha	7-AG-14D-RJS	2000-2007	U.Cret./Tert.	Ubarana
BR009	Potiguar	Agulha	7-AG-16D-RJS	2401-2408	U.Cret./Tert.	Ubarana
BR010	Sergipe	Robalo	7-RB-5D-SES	2070-2073	Camp./Eocene	Piccabubu
BR011	Sergipe	Camorim	7-CM-6-SES	1910-1927	L.Cretaceous	Rio Pitanga ss
BR012	Sergipe	Caioba	7-CB-21D-SES	2306-2360	L.Cretaceous	Serraria ss
BR013	Sergipe	Dourado	7-DO-8-SES	1130-1162	Camp./Eocene	Piccabubu
BR014	Sergipe	Guaricema	7-GA-23D-SES	1415-1435	Camp./Eocene	Arenito Guaricema
BR015	Sergipe	Riachuelo	7-RO-13-SES		L.Cretaceous	
BR016	Sergipe	Sirizinho	7-SZ-41-SES		Cretaceous	
BR017	Sergipe	Carmopolis			Cretaceous	Carmopolis
BR018	Reconcavo	Aracas			Cretaceous	A Sand
BR019	Reconcavo	Buracica			Cretaceous	A Sand
BR020	Reconcavo	Agua Grande			Cretaceous	A Sand
BR021	Reconcavo	Miranga			Cretaceous	Santiago
BR022	Reconcavo	Candeias			Cretaceous	A-1
BR023	Reconcavo	Candeias	7-DJ-187-BA	1617-1670	L.Cretaceous	Candeias
BR024	Reconcavo	Taduipe				Santiago
BR025	Reconcavo	Dom João				Sergi
BR026	Reconcavo	Dom João	7-DJ-674-BA	315-326	U.Jurassic	Sergi
BR027	Bahia Sul	Wildcat DST	1-BAS-64			
BR028	Bahia Sul	Iheus	1-BAS-37	1675-1684	Aptian	Mariricu
BR029	Espirito Santo	Cacao	1-ESS-26	2700-2750	Albian/Cenom.	Barra Nova ss
BR030	Espirito Santo	Cacao	3-ESS-27D	2866-2904	Albian/Cenom.	Barra Nova ss
BR031	Espirito Santo	Cacao	3-ESS-29D	2705-2826	Albian/Cenom.	Barra Nova ss
BR032	Campos	Wildcat DST	1-RJS-104	2094-2100	Tertiary	Campos
BR033	Campos	Wildcat DST	1-RJS-137	1970-1975	U.Cretaceous	Campos
BR034	Campos	Wildcat DST	1-RJS-110	2497-2504	Tertiary	Campos
BR035	Campos	Wildcat DST	1-RJS-116	2344-2350	Tertiary	Campos
BR036	Campos	Wildcat DST	1-RJS-125A	2885-2888	Tertiary	Campos
BR037	Campos	Enchova	3-EN-1-RJS	2126-2168	Tertiary	Campos
BR038	Campos	Enchova	4-RJS-38	2225-2228	Tertiary	Campos
BR039	Campos	Wildcat DST	1-RJS-127	3046-3069	Aptian	Lago Feia
BR040	Campos	Guaroupa	7-GP-8D-RJS	3468-3478	Albian	Macaé ls
BR041	Campos	Cherne	3-CH-1-RJS	3029-3038	U.Cretaceous	Campos
BR042	Santos	Wildcat DST	1-SPS-6	4163-4258	U.Cretaceous	Guaruja
BR043	Santos	Wildcat DST	1-SPS-18		U.Cretaceous	Guaruja