

# **PETROLEUM SYSTEMS OF SOUTHERN EUROPE**

**REGIONAL PETROLEUM GEOCHEMISTRY  
OF CRUDE OILS FROM SOUTHERN EUROPE**

**GEOMARK**  
**RESEARCH, INC.**

**A PROSPECTUS**

## **EXECUTIVE SUMMARY**

GeoMark Research, Inc. has completed a regional crude oil study of the Mediterranean. This study consists of the detailed geochemical analysis of 300 oil samples located throughout southern Europe and North Africa. The study is being offered on a non-exclusive basis to participating companies. Due to the large size of the Mediterranean Study we have elected to offer the Southern Europe portion of the study as a separate report. We ask that you review the following proposal and consider participation in all or part of the study.

Each of the oils have been characterized by a detailed analytical program which includes quantitative biomarker analysis of terpanes and steranes and determination of stable carbon isotope composition of both saturate and aromatic hydrocarbon fractions. This information, integrated with the source rock data, allowed us to accomplish the following:

- Determine the number of genetically distinct oil families in each producing region.
- Map the stratigraphic and geographic distribution of the oil families and distinguish areas with single oil families (single sources) from those with multiple oil families (multiple sources).
- Utilize geochemical characteristics of the oil families to deduce their source facies, thermal maturity level, and degree of preservation.
- Determine the most likely source unit(s) in each area by comparing the distribution of oil families and their inferred source facies with regional stratigraphy, burial history, and source rock data.
- Estimate migrational directions by comparing oil family distributions with the location of known oil kitchens.
- Utilize the geographic, stratigraphic, and structural distribution of oils to identify, map, and rank the petroleum systems in each basin and in the region as a whole.

The cost of the Southern Europe portion of the study is US \$20,000. The cost of the entire Mediterranean Study is \$ 42,000. The reports are complete and available for immediate delivery.

## **INTRODUCTION**

The purpose of the study was to geochemically evaluate crude oil samples from Southern Europe in order to predict source rock depositional environments, related oil families, thermal histories, and probable subsurface migrational directions. The field locations of the ninety-three (93) crude oil samples included in this study are shown in Figure 1. A detailed sample list is presented in Appendix A.

The samples analyzed for this study represent the end products of hydrocarbon generation, migration, and entrapment which has occurred within this which is one of the most prolific hydrocarbon-bearing regions in Southern Europe. A further understanding of the region, specifically the multiple petroleum systems operating in the area, is essential to future successful exploration efforts.

## **METHODOLOGY AND EXPLORATION APPLICATIONS**

Crude oils from the entire region were geochemically evaluated in order to 1) determine the number and members of genetically related families; 2) predict the depositional environment and/or other characteristics of the corresponding source rock units, and 3) determine the thermal history of oils within each family. All the oils were analyzed with respect to bulk (e.g., API Gravity, % Sulfur, metal content), molecular (e.g., n-paraffin, sterane, and terpane biomarkers) and stable carbon isotopic parameters. The results were assessed using multivariate techniques including cluster and principal component analyses.

The results of this study have enabled us to develop an understanding of the source history of Southern Europe. This new understanding will enhance future exploration efforts in the region, and we feel confident, become the basis for the future development of the region.



Figure 1. Location of samples in the Gulf of Suez, Western Desert and Nile Delta Regions.

## 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 are provided in hard copy and on personal computer disks. Raw data results of the whole oil chromatographic and gas chromatographic/mass spectrographic results are available on mini-tape cassettes.

Analytical data are presented within **Section 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 a comprehensive **Final Report**. For each of the areas studied, the **Final Report** includes sections for:

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

## **PARTICIPATION**

The cost of the study is US 20,000. The reports are completed and available for immediate delivery.

### **FOR ADDITIONAL INFORMATION CONTACT:**

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## REFERENCES

- MOLDOWAN J.M., SEIFERT W.K., AND GALLEGOS E.J.** (1985) Relationship between petroleum composition and depositional environment of source rocks. *AAPG Bul.*, **69**, 1255-1268.
- ZUMBERGE J.E.** (1987) Prediction of source rock characteristics based on terpane biomarkers in crude oils: A multivariate statistical approach. *Geochim. Cosmochim. Acta*, **51**, 1625-1637.

**APPENDIX A**

## Samples Analyzed for this Study

Country	Basin	Well	Country	Basin	Well
Turkey	E. Turkey	Kahta	Italy	Sicily	Vega-10
Turkey	E. Turkey	Kurkan	Italy	Sicily	Gela-32
Turkey	E. Turkey	Sahaban	Italy	Sicily	Cozzo Disi Mine E2
Turkey	E. Turkey	S. Sahaban	Italy	Sicily	Cozzo Disi Mine E5
Turkey	E. Turkey	Kayakoy	Italy	Sicily	Ragusa-51
Turkey	E. Turkey	W. Kayakoy	Italy	Sicily	Ragusa
Turkey	E. Turkey	Cemberlitas	Italy	Sicily	Mila
Turkey	E. Turkey	Akpinar	Italy	Sicily	Mila
Turkey	E. Turkey	Mollcabir	Italy		Tabiano-4
Turkey	E. Turkey	Adiyaman	Greece		Thasos E1
Turkey	E. Turkey	Yenikoy	Greece		Prinos
Turkey	E. Turkey	West Firat	Greece		Crete Seep
Turkey	E. Turkey	Sincain	Greece		
Turkey	E. Turkey	Cukurtas	Greece		
Turkey	E. Turkey	Karakus	Greece		Zakinthos Seep
Turkey	E. Turkey	Beykan	Spain	Tarragona	Angula
Turkey	E. Turkey	Barbes	Spain	Tarragona	Amposta Marino E3
Turkey	E. Turkey	Selmo	Spain	Tarragona	Amposta Marino B2
Turkey	E. Turkey	Raman	Spain	Tarragona	Amposta Marino C3
Turkey	E. Turkey	Malatepe	Spain	Tarragona	Ayoluengo
Turkey	E. Turkey	Garzan	Spain	Tarragona	Tarragona B12
Turkey	E. Turkey	Magrip	Spain	Tarragona	Tarragona F1
Turkey	E. Turkey	Camurlu	Spain	Tarragona	Castellon B5
Turkey	E. Turkey	G. Dincer	Spain	Tarragona	Casablanca
Turkey	E. Turkey	B. Kozluca	Spain	Tarragona	Casablanca-6
Turkey	E. Turkey	B. Raman	Spain	Tarragona	Casablanca
Turkey	E. Turkey	Bulgurdag	Spain	Tarragona	Ayoluengo
Syria	E. Syria	Babasi-3	Spain	Tarragona	Casablanca
Syria	E. Syria	Derik-1	Spain	Tarragona	Casablanca
Syria	E. Syria	Al Holl-1	Spain	Tarragona	Casablanca
Syria	E. Syria	Jebissa-207	Spain	Tarragona	Mantanazo A2
Syria	E. Syria	Leilak	Portugal	Lusitanian	Abadia 1A
Syria	E. Syria	Naour-1	Portugal	Lusitanian	Abadia 14A1
Syria	E. Syria	Oudeh-108	Portugal	Lusitanian	Torres Veedras-4
Syria	E. Syria	Oudeh-111	Portugal	Lusitanian	Abadia-17
Syria	E. Syria	Rumelan-35	Portugal	Lusitanian	Sismaria
Syria	E. Syria	Rumelan-106	Croatia		JJ-3
Syria	E. Syria	Souedie-403	Croatia		Skip RD95
Syria	E. Syria	Saida-6	Croatia		Vrgorac RD31
Syria	E. Syria	Tishrin-24	Croatia		Radosic RD312
Syria	E. Syria	Tishrin-24	Croatia		Misijen RD48
Syria	E. Syria	Ullyan-20	Croatia		Vinisce RD318
Syria	E. Syria	Zarabeh-6	Croatia		Vrgorac RD27
Syria	E. Syria	Souedie	Turkey		Pasinler
Iraq	Kurdish Mountains	Ain Zalah-2	Turkey		Cakirbey
Iraq	Kurdish Mountains	Alan-1	Turkey		Cankiri
Italy	Sicily	Ragusa-20	Turkey	Kurdish Mnts.	District 5
Italy	Sicily	Gela-9	Turkey	E. Turkey	Bulgurdag