

# **WEST SIBERIAN BASIN GEOCHEMICAL STUDY**

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**REGIONAL PETROLEUM GEOCHEMISTRY  
OF CRUDE OILS AND SELECTED SOURCE ROCKS  
FROM THE WEST SIBERIAN BASIN**

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

**PROSPECTUS**

## **EXECUTIVE SUMMARY**

Recent developments in the former Soviet Union indicate that a substantial portion of the country will be available for foreign investment and/or exploration. To assist in the forthcoming exploration of Russia, and specifically West Siberia, GEOMARK RESEARCH, INC. is just completing a regional oil study of the entire West Siberian Basin. The study involves the detailed analyses and interpretation of a suite of 350 crude oils from over 300 fields representing diverse geographic and stratigraphic distributions, and 44 conventional core samples of selected source rock intervals. The source rock samples have been subjected to conventional source rock analyses. Each of the oils and source rock extracts were 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 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 source rocks and genetically related oils to identify, map, and rank the petroleum systems in each area and in the basin as a whole.

All of the analytical data generated from the oils and rocks is immediately available to participating companies. The interpretive report includes maps showing the a) source rock distribution, b) interpreted source kitchens, c) distribution of oil families at different stratigraphic reservoir levels, and d) inferred migration pathways and associated petroleum systems.

The cost of the entire study is US \$50,000.

## INTRODUCTION

The West Siberian Basin is the largest petroleum province in the former Soviet Union. Production from the basin's 500 fields accounts for nearly seventy percent of Russia's annual oil output, and over fifty percent of the gas. In spite of this fact, the basin is believed by many investigators to be at an early stage of development.

However, future exploration efforts in the Basin are expected to concentrate more on deeper horizons and the location of stratigraphic traps. This naturally increases both exploration risk and the need for a greater understanding of the area.

To assist in a further understanding of the region, GEOMARK RESEARCH, INC. has completed a regional crude oil study of the entire West Siberian Basin. The study involves the analysis of 350 oil samples representing over 300 fields distributed throughout the geographic and stratigraphic confines of the basin, and 44 selected source quality conventional core samples (Figure 1).

Previous investigations (e.g., Kontorovich, 1984; Peters *et al.*, 1991) have suggested that multiple stratigraphic units or distinct facies of the same formation have sourced the oils in various parts of the West Siberian Basin. Figure 2 illustrates key terpane mass chromatograms from three of the West Siberian oils indicating variations in source character. Source units of Silurian, various Jurassic, Cretaceous, and even Tertiary age have been proposed, but as yet no expansive analytical studies, including biomarkers, have been performed for the entire Basin. Consequently, this study is the first comprehensive analysis of the petroleum systems of the Basin.

If multiple source units have been active in the Basin then the chance for exploration success increases. However, it is critical that the location (stratigraphic and geographic), and character (gas vs. oil), of each source unit be known, as well as the relative timing of active hydrocarbon generation. This study is designed to provide this type of information.

Oil samples from fields selected for analysis are listed in Appendix A and shown in green in Figure 1. The rock samples selected for analysis are listed in Appendix B and shown in red on the map. Due to the large aerial extent of the West Siberian Basin and the many oil samples (and associated high cost) necessary to adequately understand the petroleum systems in the basin, we have subdivided the basin into four geographical regions. The Central, Northern, Western, and Southern areas are illustrated on the enclosed map; a listing of the oils within each region is given in Appendix A. Some overlap in samples between the Central area and the Western and Southern areas exists.

Dr. John Zumberge of GEOMARK and Professor Alexi Kontorovich of the Institute of Geology and Geophysics, Siberian Branch of the Academy of Science are the Principal Investigators for this study. The results generated for this study will be integrated with thousands of rock analyses previously generated by Prof. Kontorovich and his associates at the Institute.

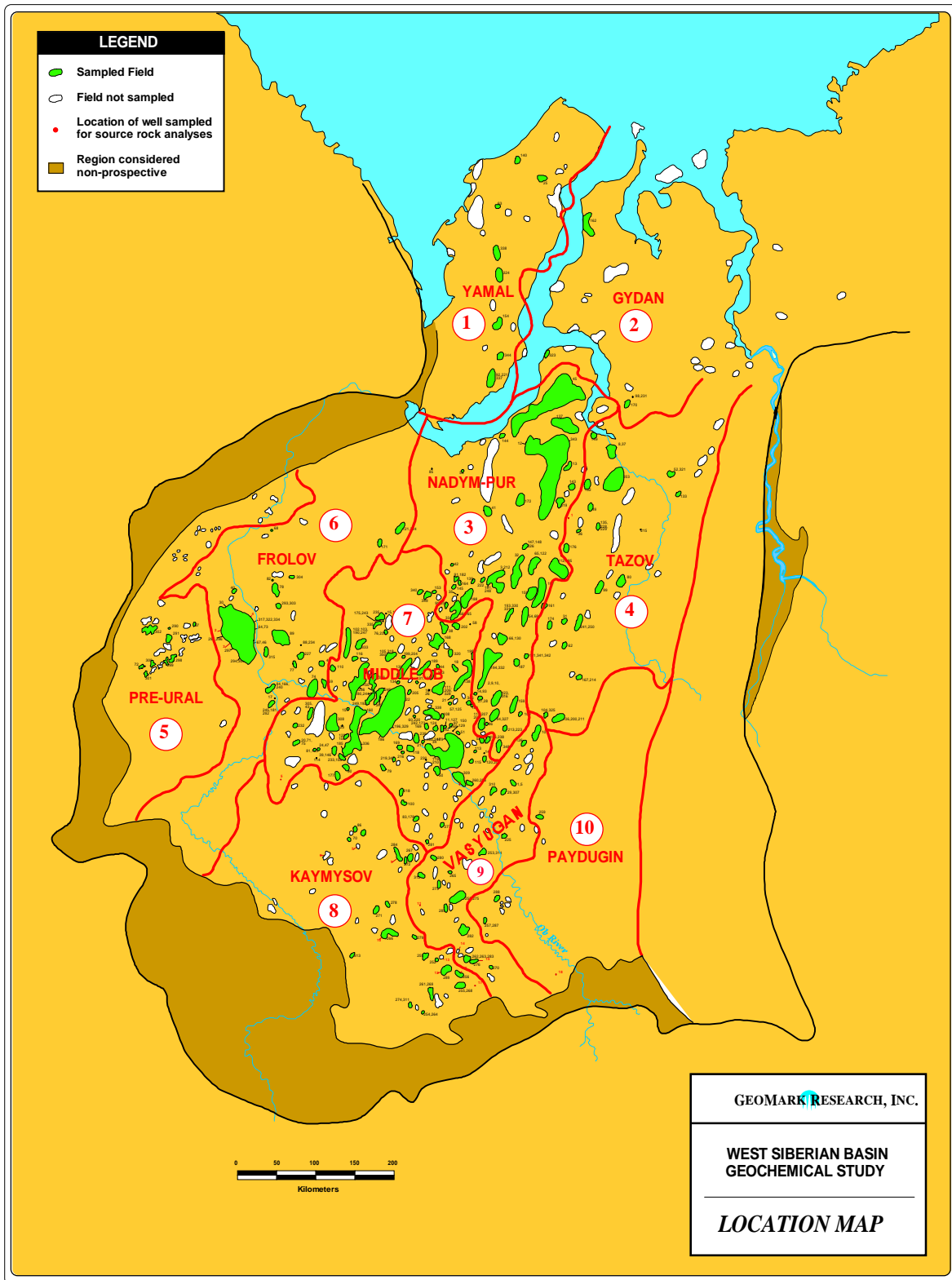


Figure 1. Location map showing distribution of samples analyzed for this study.

## METHODOLOGY AND EXPLORATION APPLICATIONS

In areas such as the West Siberian Basin 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. For this study a regional oil evaluation has been combined with conventional source rock analyses to assess the remaining potential of various regions and for predicting the distribution of new hydrocarbon accumulations, especially non structured traps.

The regional petroleum systems within the study area have 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 have been deduced from the oil geochemistry (e.g., Zumberge, 1987; Moldowan *et al.*, 1985) and correlation with analyzed source rocks. Conclusions are made regarding source lithology, anoxicity, salinity, organic input (marine, non-marine or marginal marine) and thermal maturity using a variety of parameters based on detailed and bulk composition.

The analysis of the 44 selected source rock samples is integrated with, and used to calibrate, results from the previous analysis of thousands of rock samples to effectively evaluate and model the source character of the various potential source units. The previous analyses were performed by Prof. Kontorovich and his staff at the West Siberian Research Institute.

The character, quality, aerial extent and burial histories of the identified source units are compared with the geographic and stratigraphic distribution of the various oil families and subfamilies. This enables an understanding of the conditions controlling the distribution of hydrocarbons within each petroleum system of the Basin, and a possible prediction of the location of undetected or underdeveloped play concepts.

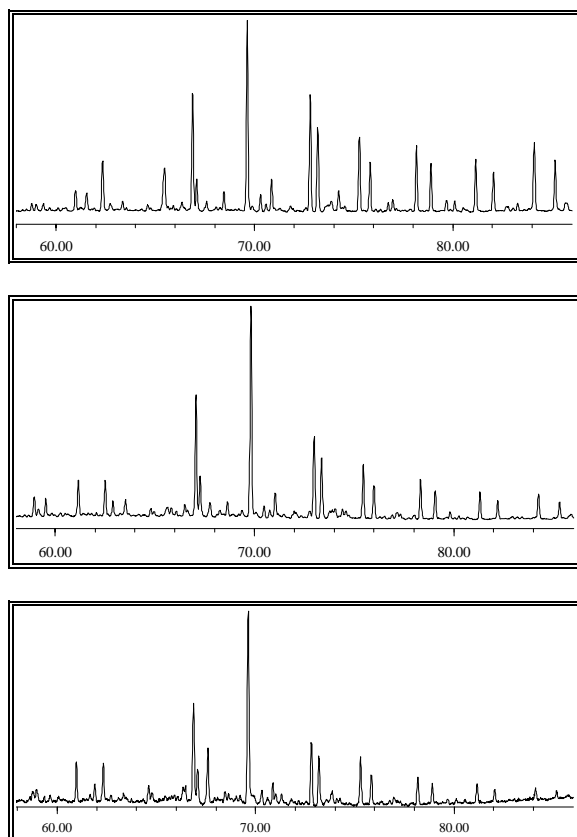


Figure 2. Terpane Mass Chromatograms from three West Siberian Oils

## **ANALYTICAL PROGRAM**

### **SOURCE ROCK SAMPLES**

The source rock samples have each been analyzed by the following techniques:

- Lithological Description
- Total Organic Carbon (TOC)
- Rock-Eval Pyrolysis
- Kerogen Maceral Analysis (TAI)
- Vitrinite Reflectance (% Ro)
- Bitumen Analysis (This includes all the analytical procedures listed below for oils, with the exception of API gravity, Ni/V and %S)

### **OIL SAMPLES**

The following techniques have been employed on each of the oil samples:

- API Gravity
- % Sulfur
- Nickel/Vanadium concentrations
- C15+ vs. <C15+
- Deasphalting (% Asph)
- 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)
- GC/MS of aromatic hydrocarbons (150 samples)

All results are available in digital form. This includes tabulated data as well as raw gas chromatograms and mass fragmentograms if desired.

## **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.

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

- Source rock data
- Basic Oil Data
  - Physical property oil data
  - Stable carbon isotope data
  - Liquid chromatographic data
- Gas chromatographic results
- GC/MS mass chromatograms

A synthesis and interpretation of all information is presented in a comprehensive **Final Report**. The **Final Report** includes sections for:

- Regional Geology
- Interpretation of Oil Characteristics
- Differentiation of Oil Families
  - Using Multivariate Statistics
- Source Rock Quality Maps
- Inferred Oil/Source Correlations
- Oil Generation and Migration
- Overall Exploration Potential

## **PARTICIPATION**

The cost of the entire study is US \$50,000.

## **SCHEDULE**

The study is complete and available for immediate delivery.

## **FOR ADDITIONAL INFORMATION CONTACT:**

**Mr. Stephen W. Brown**  
**GEO-MARK RESEARCH, INC.**  
**9748 Whithorn Drive**  
**Houston, Texas 77095**  
**Telephone: (281) 856-9333**  
**Fax: (281) 856-2987**  
**E-mail: [sbrown@geomarkresearch.com](mailto:sbrown@geomarkresearch.com)**

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## APPENDIX A

## Samples Analyzed for this Study

Field	Field	Field	Field	Field	Field
Koshil'-347	East Noiabr'-669	Soromin-6	Iubilein-10	North Chasel'-56	Strezhev-12
South Vengapur-245	Sakhalin-5	North Kamyn-6	South Pokachev-115	North Orekhov-564	Sobolin-172
Komsomol'-429	Nivagal'-122	Van'egan-143	South Tarkosalin-151	Srednemessoiakh-26	Snezhn-131
Iumantyl'-927	West Krasnosel'kup-47	North Ostrovn-35	Iuk'iaun-581	Sredneshapshin-122	Nizhnetabagan-8
Koshil'-347	East Iuokhtur-528	West Tevlin-83	South Pyrein-229	Srednebalyk-68	Ubin-346
Iakkun'iakh-193	East Bovanenkov-4	Ershov-192	Chupal'-57	Tartasin-1	Filippov-7
Vyinton-180	Pal'ianov-26	Srednekhulym-52	Chistinn-476	Trom'egan-7	Ergin-26
Tazov-58	West Tarkosalin-96	West Tarkosalin-10	Chernogor-130	Taibin-66	Nazym-21
South Vengapur-245	Novogodnee-120	North Var'egan-33	Chumpas-159	Turyn-201	Pottym-100
South Vengapur-245	ElizarovKislor-47	Potochn-30	Ergin-26	Tiumen-1	Talin-127
Malokiuchev-101	Kislor-256	West Mogutlor-285	South Purpei-20	Ur'evsk-11	Talin-1900
Mestsov-20	Etypur-82	Vonter-112	South Iagun-55	Khanty Mansii-2	South Talin-327
Samburg-253	West Iutym-183	Malo Kluchev-90	South Sardakov-21	Kharampur-5	Semividov-1
Valiunin-264	West Salym-289	Malo Teplov-81	South Balyk-235	South Pokachev-81	Tolum-10
West Pereval'n-580	Muly'm'in-74	Malo Chernogor-156	South Surgut-17	Iuk'iaun-581	Teterev-272
West Vat'egan-23	Pal'ianov-26	Novogodnee-156	Yarainer-3	Chumpas-178	Shaim-68
West Frolov-62	Priob-234	East Iagun-253	Muravlenkov-201	Ergin-41	Danilov-90
West Kotukhtin-129	West Salym-281	East Iagun-253	Iagun-100	Iaunlor-58	Nazym-21
West Pereval'n-580	Turyn-202	Mangazei-1	Aipim-7	Aipim-7	Ol'khov-251
West Salym-281	Syn'egan-3	Savui-107	Barsukov-135	Barsukov-135	Prirazlomn-214
West IAnin-73	Tsentral'n-12	North Chasel'-52	Bystrin-124	Bystrin-171	Pottym-107
West Surgut-180	Ugut-57	Tevlin-10	Vengaiakhin-37	Kharampur-305	Vakh-16
West Teplov-91	Ust'chasel'-202	North Urengoi-451	Vengapur-45	Ellei Igai-2	Pravdin-86
Zapadn-21	Udach-1	Povkhov-100	Vengapur-134	South Urmn-1	Sovet-33
West Tambei-117	Verkhne Nazym-286	North Iangtin-301	East Surgut-35	Chkalov-1	Severn-207
West Vat'egan-197	Chistinn-473	Siador-216	East Tarasov-86	Veselov-1	Mezhov-2
West Var'egan-235	Khanty Mansii-5	Tul'egan-21	Vyintoi-154	Kazan-2	South Cheremshan-335
West Var'egan-235	Iarudei-2	North Potochn-62	Vyтин-129	Kalinov-6	Baklian-3
Vakh-10	East Tailakov-157	North Esetin-203	Verkhne Kolik'egan-75	Sobolin-172	Chkalov-2
Lebiazh'e-74	Iakhl'in-11	Tanusalin-17	Ershov-192	Myl'dzhin-44	Galianov-14
West KHarampur-552	Tartasin-1	North Piamaliakh-36	West Noiabr'-732	Linein-5	North Var'egan-61
Gubkin-640	Sredne Nazym-216	Malobalyk-51	Zapoliarn-1	Strezhev-11	Kamenn-132
Kollektiv-44	North Chupal'-25	North Gubkin-68	West Tevlin-204	Verkhnetar-3	Kanitor-180
Lugov-214	South Purpei-18	North Gubkin-58	Ikilor-305	Ostanin-420	East Urengoi-106
East Iakutin-107	Novoportov-131	Salekapt-2	Krainee-81	Ostanin-436	Pogranichn-63
South Geologiche-152	Valiunin-260	North Egur'iakh-8	Van'egan-143	Veselov-8	Rusko Rechen-709
Tazov-58	Var'egan-103	Tundrin-100	Van'egan-143	Srednevasiugan-5	Kamenn-132
Karamov-78	Krainee-80	North Pur-803	Vat'egan-13	Igol'sko Talov-2	Parusov-1001
Malo-Balyk-51	Aiegan-272	Sugmut-400	Vatin-130	Katyl'gin-97	Arktiche-2
Karempost-155	Kurragan-17	Nurmin-1	Verkhne Kolik'egan-75	Kazan-7	Bakhilov-77
Pangodin-65	Srednemessoiakh-2	Srednebalyk-71	Komsomol'-446	Verkhnetar-1	Vachim-6
Kosmiche-44	Verkhnechasel'-165	Tiumen-211	Novoegan-187	Verkhne Koltogor-1	Var'egan-103
Prirazlomn-214	Alimov-447	Teplov-45	Kholmi-650	Krapivin-198	Vat'egan-4
Gribn-5	Stakhanov-901	Tarasov-60	Krasnosel' Kup-17	West Katyl'gin-108	East Surgut-156
Iamburg-162	Aipim-5	Tagrin-56	Ketov-20	Kliuchev-61	Vengaiakhin-38
Elizarov-32	Aipim-5	Ust'Balyk-79	Lokosov-198	Mezhov-4	Vengaiakhin-38
Zapadn-21	Bakhilov-77	Ust'Kharampur-276	Nalo Iugan-405	Myl'dzhin-33	Vengapur-31
Tumann-642	Konitor295	Utrennee-290	Novopokur-245	Mirn-414	Nizhnesortym-208
Iaroiakhin-331	Verkhnekolik'egan-75	Udachn-1	Nivagal'-144	Matiuskin-34	Kamenn-555
Ermakov-331	North Khokhriakov-62	Umsei-4	Novoportov-134	Moiseev-6	Losev-104
Egur'iakh-15	North Pokachev-101	Sutormin-222	Novopurpei-116	Mai-390	Manontov-8
Rusko Rechen-702	Saem Takh-802	Khanty Mansii-2	Novoegan-187	Lomov-200	Novopotov-46
Gun'egan-231	Studen-4	Kholmi-696	Srednekhulym-52	Ledov-1	Neitin-338
Etypur-172	Vat'egan-13	Kholmogor-31	Nikol'-708	Luginet-165	Pokachev-38
Kushelev-45	Senzian-215	South Pokamasov-54	North Gubkin-76	Ostanin-422	Piakutin-531
Sutormin-98	Ruf'egan-3	South Miassoiakh-12	North Seliiar-82	Pervomai-261	Stakhanov-901
West Mogutlor-285	Sorov-1	South Khulym-70	North Chasel'-52	Verkhnesalat -25	Stakhanov-901
Konitor-181	Novomolodezhn-4	Roslavl'-11	E. Siberia Seep	Rostovuev-66	En'iakhin-470
Ur'evsk	Malopiakutin-500	Novopokur-231	Ur'evsk	Agan-13	