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ESTIMATED PETROLEUM RESOURCES IN THE FORMER SOVIET UNION

by

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INTRODUCTION

This Open-File report provides an assessment (Table I) of undiscovered oil and gas resources in countries of the Former Soviet Union (FSU) made by participants of the World Energy Resource Program of the U.S. Geological Survey utilizing a modified Delphi (subjective) method of assessment (Masters et al, 1991). The assessment is based on a multi-year study of the geology of FSU basins and exploration results. The assessment was made basin-by-basin and, for the first time, includes allocation of Reserves and Undiscovered Resources to the Newly Independent States (NIS) (figure 1). The amounts of Identified Reserves[1], although no more deemed as a high state secret (except for West Siberia), have not been published and the corresponding numbers in the table present a "best guess" based on the count of reserves of the largest fields and/or basin production rates. The reserve estimation is complicated by the "heterogeneity" of the Russian C1 and C2 categories that are a part of the Identified Reserves. These categories include so-called "inactive reserves." These are difficult to produce reserves in low permeability (<50 md) rocks characterized by low well yields, high viscosity oils, and reserves in small fields remote from the infrastructure. A large part of these reserves is non-commercial by Western standards. Inclusion of these reserves (Probable and Possible components) results in a high reserves to production (R/P) ratio for many FSU basins relative to U.S. basins.

The present assessment covers all major productive basins of the FSU, but does not include poorly known frontier basins of the arctic shelf east of the Kara Sea, basins of the Bering Sea, Sea of Okhotsk (except for the North Sakhalin basin), Japan Sea, and Black Sea, the presently non-productive Moscow basin in the central European part of Russia, and a number of relatively small non-productive depressions located primarily in the Russian Far East and in Kazakhstan. Several of these basins have small discoveries (onshore portions of the Anadyr and Khatyrka basins in the Bering Sea, West Kamchatka area of the North Okhotsk basin, basins on the east and northwest of the Black Sea), some others may prove productive in the future.

The largest portion of undiscovered petroleum resources of the FSU is located in basins of Russia. Very significant

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[1]Identified Reserves include approximately economically recoverable Proved, Probable & Possible Reserves in an American sense and, hence, incorporate significantly more resources than commonly reported Proved Reserves. For Proved Reserves estimations, the reader might consider an R/P of 10-15 as applied to 1991 production (Table I).

resources of oil and gas are located in Kazakhstan (primarily in the North Caspian basin), and Turkmenistan possesses large undiscovered resources of gas. Moderate amounts of oil and gas resources belong to Azerbaijan, Ukraine, and Uzbekistan. Other NIS have only limited oil and gas resources (Byelarus, Tajikistan, Kyrgyzstan, Lithuania, Georgia) or are completely devoid of them (Armenia, Moldova, Latvia, Estonia).

PETROLEUM BASINS AND/OR PROVINCES

West Siberia. The West Siberian basin is the principal producer in Russia and possesses the largest undiscovered resources of both oil and gas. The main play that contains the dominant portion of identified oil reserves is in the Neocomian deltaic section in structural traps of central West Siberia (primarily the Middle Ob region). The play is significantly explored, and much of the remaining oil potential is expected to be found in stratigraphic traps in Neocomian rocks and in structural and stratigraphic traps in the pre-Neocomian (mainly Jurassic) section. The presence of significant oil resources in northern West Siberia and offshore in the South Kara Sea remains highly speculative (which is expressed by a large assessment at 5 percent probability). Much of the undiscovered resource is expected to be in reservoir rocks of poor to fair quality characterized by relatively low yields of wells.

Most of the discovered gas reserves is found in upper Albian-Cenomanian continental clastics in huge structural traps of northern West Siberia. Lesser gas reserves with moderate amounts of condensate are contained in deeper Neocomian-Aptian rocks. All the largest structures (except possibly in the northeastern area) have been drilled, and the reserve addition onshore is expected to be located in smaller structures and in deeper parts of the stratigraphic succession (Jurassic-Neocomian and possibly pre-Jurassic rocks). The main gas play clearly extends into the South Kara Sea where the dominant portion of undiscovered resources is located. Two recent huge gas discoveries offshore in the western South Kara Sea support the very high resource assessment numbers.

Volga-Ural. The Volga-Ural province has been maturely explored. The main oil reserves are in Middle Devonian-lower Frasnian clastics in structural traps and in Upper Devonian reefs and drape structures over them. The gas reserves are in Carboniferous-Lower Permian carbonates and are almost entirely concentrated in the giant Orenburg field in the southeast part of the province. The undiscovered potential of the basin is limited. Remaining oil resources are expected to be contained in a large number of small fields (primarily in small Upper Devonian patch reefs) and in the somewhat less explored northern and northwestern parts of the province. The Buzuluk depression on the extreme

south, just north of the North Caspian basin boundary, has a moderate potential for gas condensate and oil in the Devonian clastic section at great depths. A pinch-out zone of Devonian clastics on the northwest has some potential for oil in stratigraphic traps; however, proper sealing conditions have not been demonstrated and no discoveries have been made. The Ural thrust belt on the east is gas-prone. Although two gas fields have been found, we do not value this play highly because of significant faulting and the absence of a good-quality regional seal. Large amounts of oil that can be tapped by horizontal drilling are possibly contained in fractured source rocks of the Domanik Formation, but the available data are insufficient to make a quantitative assessment of these unconventional resources.

Timan-Pechora. Exploration has been successful during the last decade in the immaturely explored northern region of the Timan-Pechora basin. The main potential plays are carbonates below the pre-Middle Devonian unconformity in structural traps, Upper Devonian reefs and drape structures over them, and Lower Permian carbonates (including reefs) below the pre-Late Permian unconformity. Toward the Barents Sea shore, Devonian rocks dip to great depths and the main oil and gas condensate potential offshore is in Lower Permian carbonates and Triassic clastics. A pinch-out zone, hundreds of miles long, of Middle Devonian clastics may contain significant oil reserves in updip stratigraphic traps, but the lower seal may present a problem. The Ural thrust belt play is similar to that in the Volga-Ural province. The same is true for the unconventional play related to horizontal drilling into the Domanik source rocks which has not been assessed here. Our relatively conservative assessment for the basin is based on significant uncertainties of the thrust belt play and on our presumption that the principal Domanik source rocks have only limited distribution offshore. If correct, the petroleum productivity of the large western offshore portion of the basin is dependent on the long-distance lateral migration of hydrocarbons from Triassic(?) source rocks of the South Barents depression which increases the exploration risk.

Barents Sea. The principal potential of the Russian part of the Barents Sea shelf is connected with the large South Barents and North Barents depressions on the eastern side of the sea and with flanks of surrounding uplifts. Our assessment is based on the presumption that the major source rocks occur in the Triassic section of the depressions and that the Upper Jurassic source rocks are immature over the shelf. This suggests a strongly gas-prone character of the depressions because of both the significantly coaly nature of the source rocks and their very deep occurrence. The presence of good clastic reservoir rocks and an excellent Upper Jurassic seal indicates that the potential for gas is high. The oil potential is probably moderate and is chiefly related to shallower parts of the depressions' slopes and to the

Paleozoic-Triassic play north and northeast of the Kola Peninsula. The validity of this play has not yet been demonstrated by exploration results.

Lena-Tunguska. Our assessment of the Lena-Tunguska province is quite conservative considering its giant area. Until recently, the exploration has been concentrated in the southern half of the province and two plays have been proved to be productive. These are Vendian-lowermost Cambrian clastics and carbonates on the Nepa-Botuoba arch on the east, and Riphean carbonates beneath the pre-Vendian unconformity on the Baykit arch on the west. Source rocks, although not geochemically identified, occur in the Riphean section. The relatively moderate assessment of undiscovered resources resulted from poor quality of reservoir rocks, especially in the most promising Riphean section, and uncertainty in areal distribution of Riphean rocks that are supposedly largely limited to rift structures. The hydrocarbon potential of both plays is confined to the area covered by the Lower Cambrian salt seal.

The potential of the superposed middle Paleozoic-Triassic Tunguska basin is uncertain, but probably rather low. The main negative factor is the abundance of dolerite sills and dikes that compose up to 25-30 percent of the section and could adversely affect preservation of petroleum. Thick Triassic volcanics in the upper part of the section strongly hamper the efficiency of seismic surveys.

Anabar-Khatanga. The Anabar-Khatanga basin occupies the eastern part of the fore-Taimyr trough. (The western part of the trough, or the Yenisey-Khatanga basin, is basically characterized by the West Siberian geology and is assessed here together with West Siberia.) The Anabar-Khatanga basin is almost completely unexplored. A few non-commercial oil discoveries were made in the 50's in Permian continental clastics in structures related to Devonian(?) salt domes. The reservoir rocks are poor. The presence of source rocks is suggested by tar sands on the southern basin flank. The resource assessment is highly speculative.

Vilyuy. The late Palezoic-Mesozoic Vilyuy basin is superposed on the margin of the early Paleozoic Siberian platform. The basin is underlain by a Devonian rift filled with volcanics and salt. On the east, the basin is bounded by the Verkhoyansk thrust belt. After several gas discoveries in the 60's, exploration has been rather unsuccessful. The source rocks are believed to be Permian coaly clastics, which results in a strongly gas-prone character for the basin. Middle Cambrian (Kuonam Formation) organic-rich black shales dip under the basin fill, but occur at great depths in the center. They may be within the oil window in a narrow zone on the edge of the Devonian rift; however, the probability of a related oil play is low. Smaller structural traps and stratigraphic pinch-out traps on the basin margins are expected to contain the bulk of undiscovered gas. The narrow

Verkhoyansk foredeep, north and east of the basin, has a very limited gas potential.

North Sakhalin. Almost all discovered oil and gas of the North Sakhalin basin are in structural traps in Miocene-Pliocene deltaic sediments of the paleo-Amur river. The onshore area of the Paleo-delta is maturely explored, the remaining potential is small and is related to stratigraphic traps. The offshore area north of the Sakhalin Island is gas-prone. The main potential is connected with the offshore area east of the island, where several significant discoveries were made in recent years. However, the potential area is rather small because eastward, the deltaic section thins and probably passes into prodeltaic shales. An almost unexplored play is lower Miocene fractured diatomaceous shales (principal source rock of the basin) similar to the Monterey shales of California. The Okruzhnoye field has been discovered in these shales on the south of the basin. The extent and potential of this play remain unknown.

North Caucasus-Mangyshlak (Azov-Kuban and Middle Caspian basins). The North Caucasus-Mangyshlak province includes the Azov-Kuban basin on the west and the Middle Caspian basin on the east. Most of the province occupies the foreland of the Great Caucasus and Crimean Mountains; the South Mangyshlak subbasin (a part of the Middle Caspian basin located east of the Caspian Sea) is bounded by the Karabogaz arch on the south and by the Central Mangyshlak foldbelt (deformed and inverted Triassic rift) on the north. The small and minimally prospective western portion of the province occupying the eastern Crimean Peninsula is in Ukraine, the North Caucasus region is in Russia, and the South Mangyshlak subbasin is in Kazakhstan. The offshore boundaries between the states have not been established. Small areas in the central Caspian Sea appear to be in state waters of Turkmenistan and Azerbaijan.

The onshore areas of the province are maturely explored. Gas dominates in hydrocarbon reserves of the Azov-Kuban basin, whereas most of the Middle Caspian basin and the South Mangyshlak subbasin are more oil-prone. The remaining potential onshore is rather small and is chiefly related to subtle traps, to great depths in the foredeep (especially subsalt Jurassic rocks), and to Triassic carbonates in the pre-Jurassic rift system. The principal part of undiscovered resources is located offshore in the unexplored central Caspian Sea and, to a far lesser extent, in the Azov Bay of the Black Sea. Jurassic and Lower Cretaceous clastic rocks in structural traps are the prime exploration target in the Caspian Sea; in the Azov Bay, the main undiscovered potential is in rocks beneath the Maykop series shales (Oligocene-lower Miocene).

North Caspian. During the last 15 years, three supergiant oil and gas condensate fields and a number of smaller, but significant, fields were discovered in rocks beneath thick Lower Permian (Kungurian) salt of the North Caspian (Peri-Caspian)

basin. The basin is still in the immature stage of exploration because of great depths, high overpressure, and high contents of sulfur in the hydrocarbons. The eastern, southeastern, and central parts of the basin are in Kazakhstan; the southwestern, western, and a narrow zone of the northern margins are in Russia. Although no very large discoveries were made in recent years, the potential of the basin is very high. Subsalt Paleozoic carbonate rocks and associated reefs have the most potential of the exploration plays. An extension of the Karaton-Tengiz carbonate platform (which contains the Tengiz supergiant) offshore into the northern Caspian Sea is especially attractive, but promising exploration targets may be found on all basin margins. Carboniferous and Lower Permian clastic fans are also widespread along the eastern and southern margins; however, the reservoir properties of the clastics are poorer than those of the carbonates. A shallow Mesozoic suprasalt salt-dome play has been explored for many years, but still possesses a significant petroleum potential. Oil and gas with a high content of condensate are expected to dominate in undiscovered resources of the basin. In the central areas of the basin the salt is probably underlain by thick piles of clastic turbidites interbedded with black-shale source rocks that occur at great depths. There is a high probability that turbidites contain very large in-place resources of gas, and possibly oil, in supposedly tight reservoir rocks. This speculative play was not assessed because of the complete lack of data.

Baltic. The FSU portion of the Baltic basin covers parts of the Kaliningrad Administrative Region (Russian enclave), Lithuania, and Latvia. The onshore part of the basin has been thoroughly explored. The dominant portion of discovered reserves is found in the Russian enclave, and several small fields are located in Lithuania. A single play in Middle Cambrian sandstones contains all the reserves. The remaining potential onshore is negligible. The Baltic shelf is essentially undrilled although a few small discoveries have been made in Polish and Russian waters. The offshore extension of the Middle Cambrian play supposedly will contain the bulk of undiscovered resources.

Pripyat. The Pripyat basin is a Devonian rift filled by salt and carbonates and overlain by a Carboniferous and younger sag. The basin is located in Byelarus. The basin is oil-prone; only one small gas condensate field has been found. Production is from subsalt Frasnian and intersalt Lower Famennian carbonates in structural traps at crests of the tilted fault blocks. All discovered fields are concentrated in the northern zone of the basin; the central and southern zones are non-productive, apparently because of immaturity of source rocks. The remaining potential of the heavily explored northern zone is very small and is related to subtle structural and stratigraphic traps. The potential of the rest of the basin is dependent on the presence

and quality of pockets of mature source rock in deep depressions on the southern flank.

Dnieper-Donets. The Dnieper-Donets basin of Ukraine is the southeastward continuation of the Devonian rift of the Pripyat basin; however, the sag sequence in the former is much thicker and contains almost all the discovered reserves. The Dnieper-Donets basin is oil-productive in its northwestern part; southeastward, along the dip, gas becomes dominant because of both overmaturity of source rocks and increase of the amount of coaly material in shales and coal beds. The entire Carboniferous through Lower Permian section is productive, but major gas reserves are concentrated in Devonian salt dome-related traps below the Lower Permian salt seal. The basin is significantly explored to depths of 4 - 4.5 km. The remaining potential is mostly gas in stratigraphic and deeply buried traps (more than 4.5 km) in Lower Carboniferous clastics. Other exploration plays are Devonian clastics and carbonates on the basin margins and possibly Lower-Middle Carboniferous reefs, primarily on the northeastern margin; however, the potential of these plays is lower.

Carpathian. The Ukrainian part of the Carpathian basin occupies a Tertiary thrusted foredeep of the Carpathian foldbelt and the adjacent foreland. From the Ukraine, the foredeep extends, on strike, northward to Polane and southward to Romania. Strongly folded thrust plates of the foredeep are dominantly oil-productive, whereas gas fields are mainly controlled by gentle uplifts on the foreland. Upper thrust plates are significantly explored to depths of 4 - 4.5 km. The remaining potential is largely related to complex structures of the lower thrust plates at great depths and to the underthrust of the Carpathian foldbelt. Some gas potential exists in the foreland where Jurassic reefs may present an unexplored play.

Chu-Sarysu. Several hydrocarbon fields have been discovered in the Chu-Sarysu intermontane basin in central Kazakhstan. Suspected source rocks in the Devonian-Tournaisian section are strongly overmature and all the discoveries are gas. Most of hydrocarbon reserves are in Carboniferous rocks, less productive are Devonian clastics. Gas in the Lower Permian reservoirs, below a salt cap, is dominantly nitrogen with a high content of helium. The basin is lightly to moderately explored. The undiscovered potential of the basin is rather low and is significantly related to the less explored Devonian section below the Upper Devonian salt seal.

South Turgay. The South Turgay basin is located in central Kazakhstan, just northwest of the Chu-Sarysu basin. Exploration began in the early 80's and revealed that flat-lying Tertiary and Cretaceous rocks are underlain by a Lower-Middle Jurassic rift system. Several oil and gas fields have been discovered, but almost all reserves are concentrated in the large Kumkol field. Upper Jurassic and Neocomian clastics of the field are oil-

productive in a structural trap over a horst. Reservoir properties of the clastics are very good and a high recovery efficiency is expected. The basin is lightly explored; however, drilling of many structures similar to the Kumkol field has not resulted in significant discoveries. Much of the remaining potential is probably in stratigraphic and structural traps in the Lower-Middle Jurassic sequence limited to grabens of the rift system.

North Ustyurt. The largest part of the North Ustyurt basin is in Kazakhstan and its eastern part is in Uzbekistan. The basin occupies a median massif (microcontinent) in the Hercynian accreted terrane. The geology of the basin seems to have much similarity with the Tarim basin in China, although foredeeps along the boundary sutures are not as well developed. Jurassic through Tertiary-aged sediments, dominantly clastic basin fill, overlie a carbonate platform of the microcontinent. Most of discovered reserves are heavy oil in Jurassic-Neocomian rocks at shallow depths on the Buzachi Peninsula, on the extreme west of the basin. Source rocks for this oil are unknown and possibly the oil has migrated there from the North Caspian basin. Elsewhere in the basin, several rather small oil fields in Jurassic rocks and a few biogenic(?) gas fields in Eocene rocks have been discovered. The Jurassic-Tertiary sequence is moderately explored and its undiscovered potential is deemed to be low. The deep Paleozoic carbonate sequence has been drilled only in a few locations. The presence of reefs and basinal facies (possible source rocks) has been interpreted from seismic data in the eastern part of the basin. The assessment of undiscovered resources is conservative and highly uncertain.

South Caspian. The rich South Caspian basin is located in western Turkmenistan, the southern Caspian Sea, and Azerbaijan. On the extreme northwest, the basin extends into Georgia where several fields produce oil from Eocene fractured volcanic reservoirs. The dominant amount of discovered reserves is in the thick middle Pliocene clastic section. The largest and most productive fields are found in a narrow structural zone extending across the sea along the northern boundary of the basin from the Apsheron Peninsula in northeastern Azerbaijan into the Peri-Balkhan region of western Turkmenistan. This zone is characterized by the presence of good reservoir sandstones deposited in the paleo-Volga river delta. Southward, the quality of reservoir rocks deteriorates significantly. Oil dominates in the discovered reserves, but gas accumulations become more common seaward. The western onshore area of the basin, parts of the Apsheron-Peri-Balkhan zone offshore, and the Peri-Balkhan region of Turkmenistan have been intensively explored and relatively limited potential remains (primarily at great depths). Offshore exploration has been largely limited to very shallow water depths on the west, and the extensive Turkmenian shelf on the east is

essentially undrilled. A number of recent large discoveries onshore along this shelf suggest high potential of the adjacent area of the sea. Most of the yet undiscovered resources will be found in middle Pliocene clastics in structural traps; however, the potential of updip pinch-out stratigraphic traps is also high. A Mesozoic reef play on the basin margins is possible, but its petroleum potential is perhaps moderate at best.

Amu-Darya. Most of the Amu-Darya basin is located in eastern Turkmenistan and only its northeastern margin is in Uzbekistan; to the southeast, the basin extends into Afghanistan. The central area of the basin (Murgab depression) is filled with a thick sequence of Lower-Middle Jurassic coal-bearing clastics, Upper Jurassic carbonates and salt, and Cretaceous through Tertiary primarily clastic rocks. The basin is significantly gas-prone due to the abundance of coaly organic matter in the Lower-Middle Jurassic and to the deep occurrence and overmaturation of Upper Jurassic marine source rocks. Significant oil reserves are present only on the northeastern basin flank in Uzbekistan, where the fields produce from structural traps and reefs in Upper Jurassic rocks. The rest of the basin contains dominantly gas and gas condensate fields. Production is mostly from Lower Cretaceous clastics above the Upper Jurassic salt. A number of discoveries have been made in the subsalt section, but the fields have not been developed because of a high sulfur content in the gas. However, the suprasalt section has been extensively explored and most of the remaining potential is connected with subsalt rocks. The presence of the essentially undeformed salt seal suggests that the potential is high.

South Takjik. The western part of the South Tadjik (Surkhan-Vakhsh) basin is in Uzbekistan, its larger eastern part is in Tajikistan, and the basin extends across the FSU boundary into Afghanistan. Geologically, the South Takjik basin actually represents an eastward continuation of the Amu-Darya basin which was deformed in the Late Tertiary by the Pamir protrusion. The basin consists of a set of north-to-south thrusted structural ranges, expressed in the surface topography, and separating deep depressions filled with thick Neogene molasse clastics. The basin is moderately explored to depths of approximately 3 km. Deeper drilling has been limited by poor resolution of seismic records. Discovered hydrocarbon reserves are small. Paleogene carbonate reservoirs are oil-productive, whereas Cretaceous clastics and Upper Jurassic carbonates contain mostly gas. The undiscovered resources of the basin seem to be limited, chiefly owing to intensive faulting and poor preservation conditions. However, much uncertainty exists in the assessment because of complex structure and inefficient previous exploration. A large part of the remaining potential is associated with rocks at great depths, especially Upper Jurassic carbonate rocks below the salt seal.

Fergana. The intermontane Fergana basin is a deep Neogene molasse depression overlying Paleogene and Mesozoic platform rocks of a median massif (microcontinent) in the Alpine foldbelt. The basin is divided between Uzbekistan, Kyrgyzstan, and Tajikistan. Previous exploration was dominantly targeted at shallow to moderately deep traps on basin margins, along the boundary thrusts. The principal portion of hydrocarbon reserves has been found in Paleogene clastic and carbonate reservoirs. The amounts of hydrocarbon reserves in Mesozoic and Neogene rock is much smaller. The marginal zones of the basin are thoroughly explored, but drilling in the deep, inner areas of the basin began only recently and a large oil field has been discovered (with a recent catastrophic blowout) in Paleogene rocks and in the lower part of the Neogene molasse section. The exploration potential of the central parts of the basin seems to be high, but drilling depths are great and exceed 6 and even 7 km in large areas. The potential of the unexplored subthrust play along the basin margins is uncertain.

Acknowledgements

The text of this report derives largely from the Russian literature which is not herein referenced. The reader is referred, however, to the several reports on FSU petroleum basins by James Clarke, James Peterson, and Gregory Ulmishek of the USGS World Energy Resources Program (see Selected References). The authors are grateful for the many professional contributions to this understanding made by our program colleagues, including: James Clarke, James Peterson, Keith Robinson, Mahlon Ball, Jack Kingston, Benjamin Law, and Doug Klemme.

Selected References

Clarke, J.W., 1983, Petroleum geology of East Siberia: U.S. Geological Survey Open-File Report 83-367, 167 p.

_____, 1988, Petroleum geology of the sedimentary basins of the Northeastern USSR: U.S. Geological Survey Open-File Report 88-264, 54 p.

Masters, C.D., Root, D.H., and Attanasi, E.D., (1991), World resources of crude oil and natural gas: in Proceedings of 13th World Petroleum Congress, v. 2, p. 51-64.

Peterson, J.A. and Clarke, J.W., 1983, Petroleum geology and resources of the Volga Urals Province: U.S. Geological Survey Circular 885, 27 p.

Ulmishek, Gregory, and Harrison, W., 1981, Petroleum geology and resource assessment of the Middle Caspian basin, USSR, with special emphasis on the Uzen field: Argonne National Laboratory/ES-116, 145 p.

Ulmishek, Gregory, 1982, Petroleum geology and resource assessment of the Timan-Pechora basin, USSR, and the adjacent Barents-Northern Kara shelf: Argonne National Laboratory/EES-TM-199, 197 p.

_____, 1985, Geology and petroleum resources of the Barents-Northern Kara Shelf in light of new geologic data: Argonne National Laboratory/ES-148, 88 p.

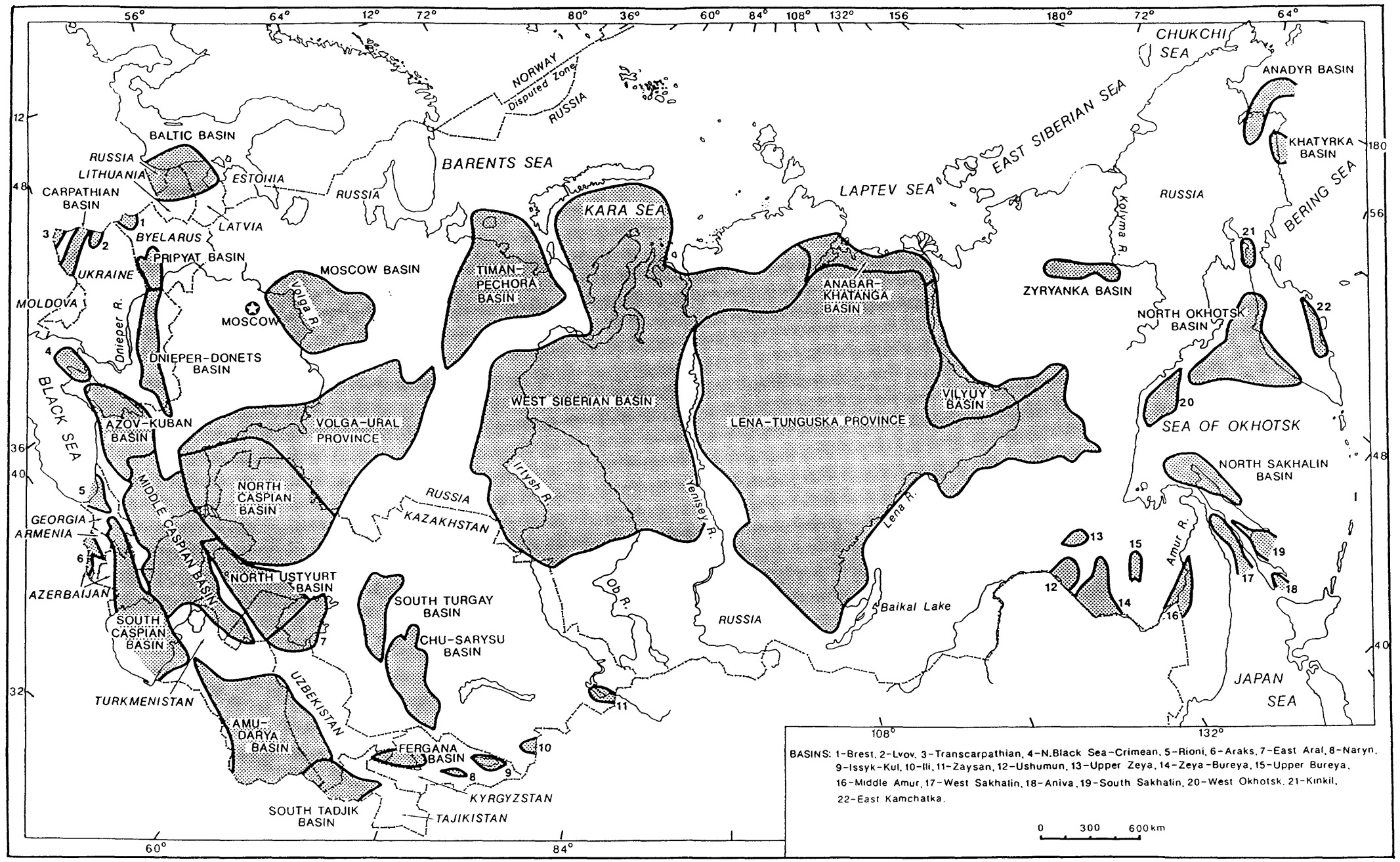

Figure 1. Generalized map of petroleum basins and/or provinces of the Former Soviet Union and boundaries of the Newly Independent States. Small basins are numbered and named in the box.

Table I Petroleum Resources in Former Soviet Union - 3/93

% Resources by country	Basin/Province/ Country Name	CRUDE OIL[1] (Billions of Barrels) Cumulative Production	Identified Reserves	Undiscovered Resources 95%	Mode	5%	Mean	NATURAL GAS (Trillions of Cu. ft.) Cumulative Production	Identified Reserves	Undiscovered Resources 95%	Mode	5%	Mean
	FSU (Aggregate)	109	129	68	115	278	151	411	1820	1140	1924	4703	2541
	Russia (Aggregate)	90	100	40	68	171	91	252	1650	927	1587	4083	2153
100R	W. Siberia	39	60	20	40 (4)	100	52.4	190	1400[2]	400	900	2000	1089.8
100R	Volga Urals	41	21	1	2.5[3]	4	2.5	29	25	2	4	10	5.2
100R	Timan Pechora (incl.offsh.)	2.7	9	2	4[3](.5)	8	4.6	12	24	10	25	60	31.4
100R	Anabar Khatanga	0	0	.2	.5	4	1.4	0	0	2	5	10	5.7
100R	Lena-Tunguska	0	3	3	7	25	11.3	0.1	20	50	100	400	175.2
100R	Vilyuy	0	0	negl.	negl.	negl.	negl.	0	16	10	20	100	40.7
100R	N. Sakhalin	0.7	1.4	1	2.5	5	2.8	1	21	10	15	40	21.1
100R	Barents Sea[4]	0	.1	1	3	8	4.0	0	120	200	500	1500	716.9
	Kazakhstan (Aggregate)	3	17	14	26	89	42	6	83	66	124	495	218
75R,25K	N. Caucusus-Mangyshlak	8.4	6.5	2	3.5	7	4.1	26	5	5	15	40	19.8
20R,80K	N. Caspian	1	16	10	30 (8)	100	45.4		100	70	150[5]	600	261.2
100K	Chu-Sarysu	0	0		0	0	0	0	2	1	2	4	2.3
100K	S. Turgay	0	.7	1.0	1.5	6	2.7	0	negl.	.2	.5	1	0.6
80K 20Uz	N. Ustyurt	.4	2.2	1	1.5	3	1.8	.8	.5	.5	1	2	1.2
75Tk,25Uz[6]	Amudarya[7]	.3	.7	.5	3 (2)	6	3.2	86	200	30	75	200	100.1
60Az 40Tk[8]	S. Caspian[9]	12.1	5	3	6 (.6)	15	7.9	10	30	20	30	70	39.3
70Uz,20Kg 10Tj	Fergana	.4	1	2	3	8	4.2	1	.3	1	3	6	3.3
40Uz,60Tj	S. Tadjik[7]	negl.	<.1	.1	.3	1.5	0.6	.3	.2	.5	1	3	1.5
100B	Pripyat	0.6	.6	<.1	0.2	0.5	0.3	negl.	negl.	negl.	negl.	negl.	negl.
100U	Dneiper Donetz	1.2	.7	.2	0.7 (.3)	1.5	0.8	47	20	10	20	40	23.2
100U	Carpathian[10]	.7	.4	.2	.4	0.9	0.5	8	1.2	1	2	4	2.3
75R,20Lth, 5Lat	Baltic	0.2	0.2	0.1	0.3	0.7	0.4	0	0	negl.	negl.	negl.	negl.

1 Condensate portion of Undiscov. Rscs. in parentheses
2 Includes recent offshore discoveries in Kara Sea
3 Horiz. drilling in Domanik not assessed
4 Offshore Timan-Pechora not included
5 Central Basin turbidite play not considered
6 For gas rscs: 95Tk,5Uz
7 FSU part only--basin extends into Afghanistan
8 Small quantity in Georgia
9 FSU part only--basin extends into Iran
10 Ukrainian part only--basin extends into Poland and Romania

Annual Production - oil (gas) 1991 and Country abbreviations:

Russia (R)	3.365	(22.505)	Lithuania (Lth)		
Kazakhstan (K)	.194	(.277)	Latvia (Lat)		
Azerbaijan (Az)	.085	(.301)	Tadjikistan (Tj)		(.004)
Turkmenistan (Tk)		(2.950)	Kyrgystan (Kg)		(.004)
Ukraine (U)	.036	(.854)	Uzbekistan (Uz)	.020	(.171)
Byelarus (B)	.015	(.010)			