Arctic Oil And Gas Resources
Energy Resources Map Circum-Pacific Region, Arctic Sheet

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ABSTRACT

The Arctic Energy-Resources Map published in 2000 covers the North Pacific Ocean, the Arctic Ocean, part of the North Atlantic Ocean and surrounding land. The map shows oil and gas fields, oil sand, oil shale, coal deposits, geothermal energy sites, onshore and offshore thickness of sedimentary rocks, and active tectonic plate boundaries.

Background data on land are from the Arctic geologic map (Moore, 2000). Chief tectonic features of the Arctic are (1) parts of the Canadian and Russian shields, (2) broad belts of undeformed, younger sedimentary platform, and (3) fold belts of sedimentary, extrusive and intrusive igneous rocks that extend along the entire margin of the continents facing the Pacific and Arctic Oceans. Sedimentary basins are shown by sediment isopachs, colored to indicate the age of the oldest major sedimentary unit. Age and lithology of the basement is generally indicated by the surrounding bedrock geology. Basic background for oceanic regions is bathymetry printed in a light blue tint. Overprinted on this are sediment isopachs, colored to indicate the age of the underlying oceanic crust.

Major productive basins of the Arctic include; Cook Inlet, Colville, Canada Territories Mainland, West Siberian, Timan-Pechora, Vilyuy, Anabar-Khatanga, and Mid-Norway. Areas with significant discoveries with no production include, Beaufort-Mackenzie Basin, Sverdrup Basin, Labrador Shelf, and Barents Sea (Norway and Russia). Areas with minor oil and gas discoveries include Eagle Plains and Anadyr basins. A number of the Arctic basins are relatively unexplored, and many of these have significant hydrocarbon potential.

Energy Resources Map of the Arctic Sheet

The Energy Resources Map of the Arctic Sheet of the Circum- Pacific Region is a compilation at a scale of 1:10,000,000 (Drummond, 2000, USGS Map CP-51). Information depicted on the Energy Resources Map of the Arctic Region includes a generalized geologic background, oil and gas fields, oil sands, oil shale, coal deposits, geothermal energy sites, hot springs, onshore basin isopachs, and sediment isopachs in ocean areas.

The geologic background for the Energy Resources Map is designed to show the relevance of the "economic basement" to the sedimentary basin areas. Depicted in a generalized format are Precambrian basement, igneous intrusives, volcanic cover, and deformed sedimentary foldbelts. Bathymetry and sediment isopachs comprise the background for the oceanic areas.

Active plate boundaries shown in red are taken from the Plate-Tectonic Map of the Arctic Region (Moore, 1992, USGS Map CP-44). An Explanatory Notes text supplements the Energy Resources Map of the Arctic Region with additional data, explanations, and references that could not be depicted on the face of the map.

The Energy Resources Map of the Arctic Region was prepared under the direction of Panel Chair George W. Moore, Oregon State University, Corvallis, Oregon U.S.A. Moore and Drummond completed the major compilation, with the assistance and advice of Arctic Region panel members and with contributions for the overlap areas from the Energy Resources Map of the Northeast Quadrant and the Energy Resources Map of the Northwest Quadrant. Other principal investigators and sources of data are indicated in the references section on the map sheet and in the bibliographic references.

Land Areas

The background data on land are generalized from the geologic map of the Arctic sheet (Moore, 2000, USGS Map CP-48). Significant tectonic and lithologic units have been combined into seven divisions. The classification is designed to show the significance of host-rock units or terranes to the occurrence of energy resources. The background units are depicted in pale colors so as not to detract from the resource data. The faults depicted are selected from the Plate-Tectonic Map (Moore, 1992).

The chief tectonic features within the Arctic Region map area are (1) parts of the Canadian and Russian Shields (continental nuclei); (2) broad belts of essentially undeformed, younger sedimentary rocks that constitute platform cover over the shields; and (3) fold belts, a complex zone of sedimentary and extrusive and intrusive igneous rocks that extends along the entire margin of the continents facing the Pacific and Arctic oceans. The fold belts have been involved in interactions between continental and oceanic plates at least since late Paleozoic time and possibly longer. Much of the fold belt terrane is now interpreted as a collage of fragments that originated elsewhere and were accreted to the craton by plate motions.

The background units include basement terrane, Proterozoic sedimentary and volcanic rocks, metamorphic complexes, intrusive rocks of Phanerozoic age, volcanic cover, salt domes, and sedimentary basins. Sedimentary basins are shown by sediment isopachs, colored to indicate the age of the oldest major sedimentary unit above basement. The age and lithology of the basement is generally indicated by the surrounding bedrock geology.

Ocean Areas

The basic background for oceanic regions is bathymetry printed in a light blue tint. Overprinted on this are sediment isopachs, colored to indicate the age of the underlying oceanic crust. The oceanic crustal age mapping from which the isopach coloration was derived was completed by Xenia Golovchenko et al, 1981 (unpublished). Also shown are the major active plate boundaries.

Oil and Natural Gas

The main oil and gas fields of the Arctic Sheet are plotted as close to real scale and location as possible. Some of the smaller fields, of necessity, have been enlarged slightly, and in some areas several small fields in close proximity have been grouped as one. Estimated reserves of oil and gas for countries of the Arctic Sheet are shown in Table 1. The discovered recoverable oil and gas resources as of December 31, 1998 are 274 billion barrels of oil and 2,630 trillion cubic feet of natural gas. Of this total 200 million barrels of oil and 2481 Tcf of gas is in the Former Soviet Union.

Table 1. Estimated initial and remaining resources by country/ region

Country	Initial Resources		Cum. Production (as of 12/31/98)		Remaining Resources (as of 12/31/98)	
	Oil (MMB)	Gas (BCF)	Oil (MMB)	Gas (BCF)	Oil (MMB)	Gas (BCF)
Canada (N of 60°)	1,626	29,070	177	550	1,449	28,520
Alaska	19,637	46,636	13,458	12,684	6,179	33,952
Norway (N of 64°)	2,390	11,150	499	0	1,891	11,150
Former Soviet Union	199,692	2,481,000	133,051	576,650	66,641	1,904,350
Mongolia	-	-	-	-	-	-
China	50,240	57,650	16,720	15,290	33,520	42,360
Japan	202	3,997	142	2,617	60	1,380
North Korea	-	-	-	-	-	-
South Korea	-	-	-	-	-	-
Total	273,788	2,629,503	164,048	607,791	109,740	2,021,712

Coal

Major coal deposits occur throughout much of the Arctic Region. Most of the significant deposits and production are associated with interior basins and bordering foreland-thrust belts. Coal resources of the Canadian Arctic Islands are in Triassic and Late Cretaceous to Tertiary rocks of the Sverdrup Basin, and in Devonian strata of the Franklinian fold belt. Major coal resources of the Russian Arctic occur in the Eastern Siberia region, in the Tunguska, Vilyuy and Zyryanka Basins. The main producing areas, as Kuznetsk and Kansk-Achinsk are located in more southern areas of Russia.

SEDIMENTARY BASINS OF THE ARCTIC SHEET

The main sedimentary basins of the Arctic areas of the Arctic Sheet are shown in figure 1. These basins in general occur north of 60^0 N. The general characteristics for the basins of the Arctic Sheet are summarized in table 3. The major productive basins of the Arctic area include; Cook Inlet, Colville, Canada Territories Mainland, West Siberian, Timan-Pechora, Vilyuy, Anabar-Khatanga, and Mid-Norway. Areas with significant discoveries with no production include, Beaufort-Mackenzie Basin, Sverdrup Basin, Labrador Shelf, and Barents Sea (Norway and Russia). Areas with minor discoveries of oil and gas include Eagle Plains Basin, and Anadyr Basin. A number of the Arctic basins are relatively unexplored, and many of these have significant hydrocarbon potential.

The 37 sedimentary basins of the Arctic region have a total area of about 12.8 million square kilometres. Many of these basins are relatively unexplored. The Explanatory Notes accompanying the map contains a list of selected oil and gas fields with estimated ultimate oil and gas from the more important basins. A summary of the selected oil and gas fields, as of early 1999 is shown as table 2. A total of 246 fields are listed with ultimate recoverable resources of 150 billion barrels of oil and 1,159 trillion cubic feet of gas. To the end of 1998, 10% of the oil and only 1% of the gas had been produced from these fields. The remaining resources in the Arctic Regions are large and an additional large volume remains to be discovered.

Table 2. Totals of Tabulated Selected Oil and Gas Fields
ENERGY RESOURCES MAP - ARCTIC SHEET, CIRCUM-PACIFIC MAP

	No of	First	Million Barrels		Billion Cubic Feet			
Basin	Fields	Discov	Cum Oil	EUR_OIL	Cum Gas	EUR_GAS	% GAS	% OIL
Barents Sea	3	1984		150		10,295	0.9%	0.1%
Colville	21	1949	12,773	18,021	3,900	33,789	2.9%	12.0%
Cook Inlet	25	1957	1,273	1,300	5,941	8,514	0.7%	0.9%
Eagle	2	1960		12		74	0.0%	0.0%
Mackenzie	37	1970	0	949	0	8,845	0.8%	0.6%
Mainland Terr.	7	1921	184	260	578	1,124	0.1%	0.2%
Norwegian Sea	12	1983	809	3,024	339	15,352	1.3%	2.0%
Sverdrup	18	1969	2	334	0	17,983	1.6%	0.2%
Timan-Pechora	7	1930		4,140		17,500	1.5%	2.8%
Vilyuy	18	1956	24	409		27,790	2.4%	0.3%
West Siberian	96	1961		121,127		1,017,431	87.8%	80.9%
Grand Total	246	1921	15,066	149,727	10,758	1,158,696	100.0%	100.0%

Sedimentary basins of the Arctic are characterized by several platform areas bordering the Canadian, Baltic and Siberian Shields, foreland basins, rift, continental margin, and deep ocean basins. Oil and gas fields discovered in some of these basins, as the West Siberian Basin are among the largest in the world. Field size distributions for the larger fields in the major basins are shown in figure 2.

Table 3. General Characteristics of Sedimentary Basins of the Arctic Sheet, Circum-Pacific Region, North of 600 N.

MAP NO.	BASIN NAME	COUNTRY / STATE	SQ_KM AREA	THICKNESS (M) AVERAGE	THICKNESS (M) MAXIMUM	AGE OF FILL	AGE OF BASEMENT	DOMINANT LITHOLOGY
1.	COOK INLET	ALASKA	44,800	4,600	7,600	JUR,U CRET,TERT	PRE-JURASSIC	CLASTICS
2.	BRISTOL/ST. GEORGE	ALASKA	166,800	2,900	5,000	TERT-QUAT	PRE-CRET	CLASTICS
3.	NAVARIN	ALASKA	109,800	3,400	5,300	TERT-QUAT	PRE-CRET	CLASTICS
4.	ANADYR	RUSSIA	75,100	3,000	6,700	U CRET, TERT	PRE-CRET	CLASTICS
5.	NORTON BASIN	ALASKA	98,400	1,500	6,500	TERTIARY	PRE-CRET	CLASTICS
6.	HOPE	ALASKA	218,900	2,000	3,000	U CRET, TERT	PRE-CRET	CLASTICS
7.	VILKITSKII-NORTH CHUKCHI	AK, RUSSIA	385,500	2,300	6,000	JUR-CRET,TERT	PRE-MESOZOIC	CLASTICS
8.	COLVILLE	ALASKA	291,200	4,900	9,100	U PALEOZ-TERT	PRECAMB	CLASTICS & CARBONATES
9.	ALASKA BEAUFORT SHELF	ALASKA	134,600	3,000	9,100	U CRET, TERT	L PALEOZOIC	CLASTICS
10.	MACKENZIE DELTA/BEAUFORT SEA	CANADA	388,500	3,000	9,100	U PZ,JUR-CRET,TERT	PRE-MESOZOIC	CLASTICS & CARBONATES
11.	CANADA TERRITORIES MAINLAND	CANADA	489,500	1,500	4,900	CAMB-U PZ, U CRET	PRECAMB	CARB, CLASTICS & EVAP
12.	EAGLE PLAINS	CANADA	26,200	5,800	7,000	PZ,JUR-CRET	PRECAMB	CARB, CLASTICS
13.	KANDIK BASIN	CAN, ALASKA	20,800	3,000	5,500	PZ,JUR-CRET	PRECAMB	CLASTICS & CARBONATES
14.	ARCTIC ISLANDS SHELF	CANADA	388,500	3,000	6,100	CRET,TERT,QUAT	PRE-CRET	CLASTICS
15.	SVERDRUP BASIN	CANADA	313,100	4,700	10,700	U PZ,MZ,TERT	L PALEOZOIC	CARB, CLASTICS, SOME EVAP
16.	FRANKLINIAN-GREENLAND FOLD BELT	CAN, GRNLAND	349,600	4,600	9,100	L PALEOZ	PRECAMB	CARB, CLASTICS, SOME EVAP
17.	ARCTIC ISLANDS PLATFORM	CANADA	782,400	1,600	4,600	L PALEOZ	PRECAMB	CARB, CLASTICS, SOME EVAP
18.	HUDSON BAY	CANADA	971,200	700	2,400	L PZ, CRET	PRECAMB	CARB, MINOR CLASTICS
19.	FOXE	CANADA	168,300	300	600	L PALEOZ	PRECAMB	CARB, MINOR CLASTICS
20.	LABRADOR SHELF	CANADA	396,300	4,900	9,100	U PZ,MZ,TERT	PRECAMB-L PZ	CLASTICS, MINOR CARB
21.	SOUTHWEST GREENLAND	GREENLAND	230,500	2,600	7,000	U PZ,MZ,TERT	PRECAMB-L PZ	CLASTICS
22.	BAFFIN BAY	CAN, GRNLAND	569,800	2,700	6,100	U PZ,MZ,TERT	PRECAMB-L PZ	CLASTICS
23.	EAST GREENLAND	GREENLAND	297,900	2,700	9,000	U PZ,MZ,TERT	PRECAMB-L PZ	CLASTICS, CARBONATES
24.	LINCOLN SEA	GREENLAND	85,500	3,000	7,000	U PZ,MZ,TERT	L PALEOZOIC	CLASTICS, CARBONATES
25.	WANDEL SEA	GREENLAND	41,400	2,000	4,600	U PZ,MZ,TERT	L PALEOZOIC	CLASTICS, CARBONATES
26.	MID-NORWAY BASIN	GREENLAND	157,800	3,300	8,200	TRIAS,JUR,CRET	PRE-TRIASSIC	CLASTICS, CARBONATES
27.	NORWAY BARENTS SEA	NORWAY	466,800	2,700	4,600	U PALEOZ, MZ, TERT	L PALEOZ	CLASTICS, CARBONATES
28.	RUSSIA BARENTS SEA	RUSSIA	384,500	10,000	11,000	U PALEOZ, MZ, TERT	L PALEOZ	CLASTICS, CARBONATES
29.	TIMAN-PECHORA	RUSSIA	443,700	7,000	10,000	PALEOZ, MZ	PRECAMB	CLASTICS, MINOR CARB
30.	WEST SIBERIAN	RUSSIA	1,932,100	9,000	16,000	MESOZ, TERT	PRECAMB	CLASTICS, MINOR CARB
31.	NORTH KARA SEA	RUSSIA	349,900	6,700	7,000	U PZ - TERT	PRECAMB-L PZ	CLASTICS, MINOR CARB
32.	TUNGUSKA	RUSSIA	699,500	3,700	7,500	U PROT,PZ,JUR-TRIAS	PRECAMB	CLASTICS, CARBONATES
33.	ANABAR-KHATANGA	RUSSIA	390,600	4,600	9,000	PZ,MZ	PRECAMB-L PZ	CLASTICS, CARBONATES
34.	VILYUY	RUSSIA	313,000	3,000	11,000	U PZ,TRIAS,JUR	PRECAMB	CLASTICS, CARBONATES
35.	LAPTEV SEA	RUSSIA	326,500	3,700	7,000	PZ, JUR-CRET	L PALEOZ	CLASTICS
36.	ZYRYANKA	RUSSIA	115,000	2,100	4,000	PZ,MZ,TERT	PRECAMB	CLASTICS
37.	EAST SIBERIAN SEA	RUSSIA	136,800	3,000	5,800	PZ,PM-TR,JK,TERT	PRECAMB-L PZ	CLASTICS

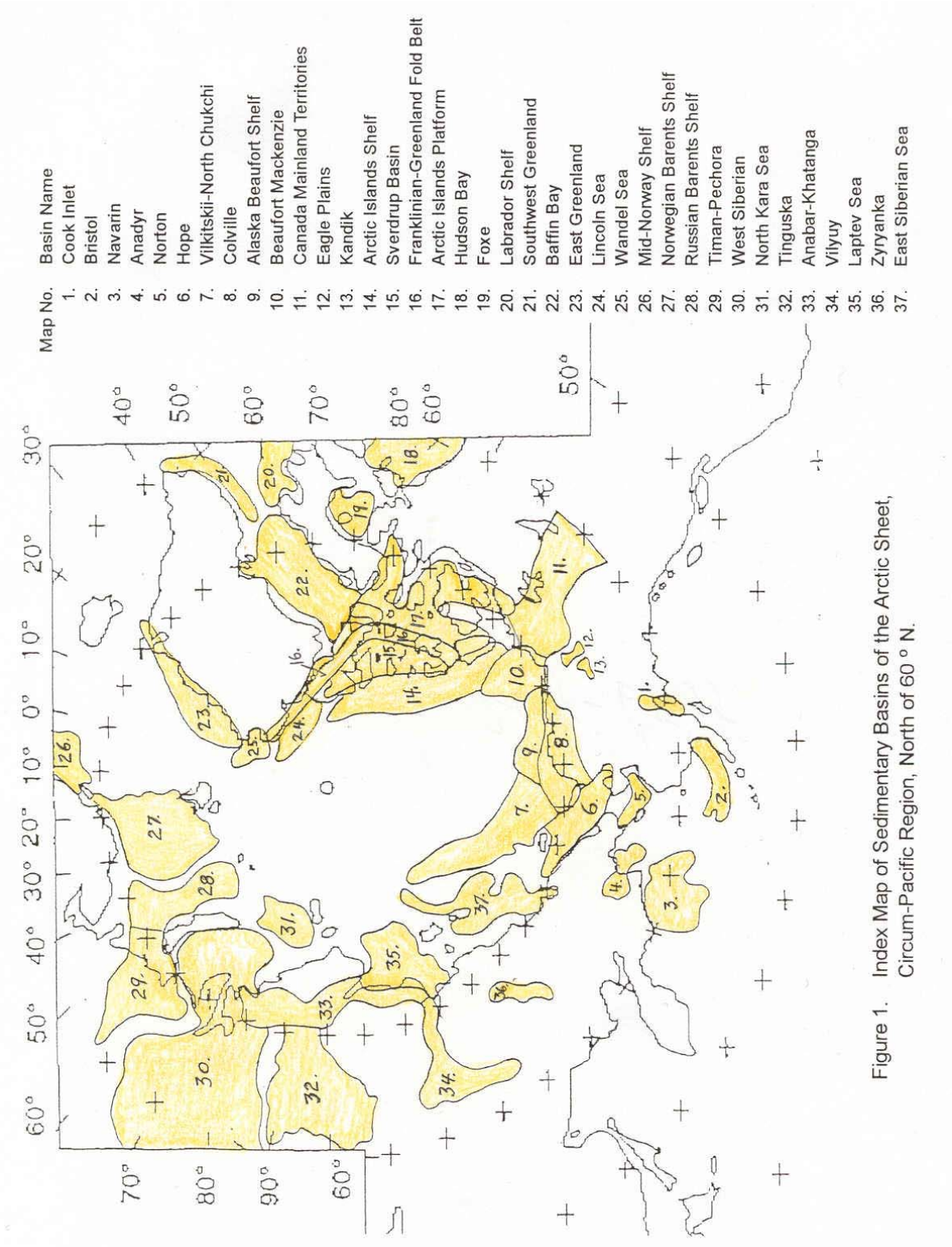

Figure 1. Index Map of Sedimentary Basins of the Arctic Sheet, Circum-Pacific Region, North of 60 ° N.

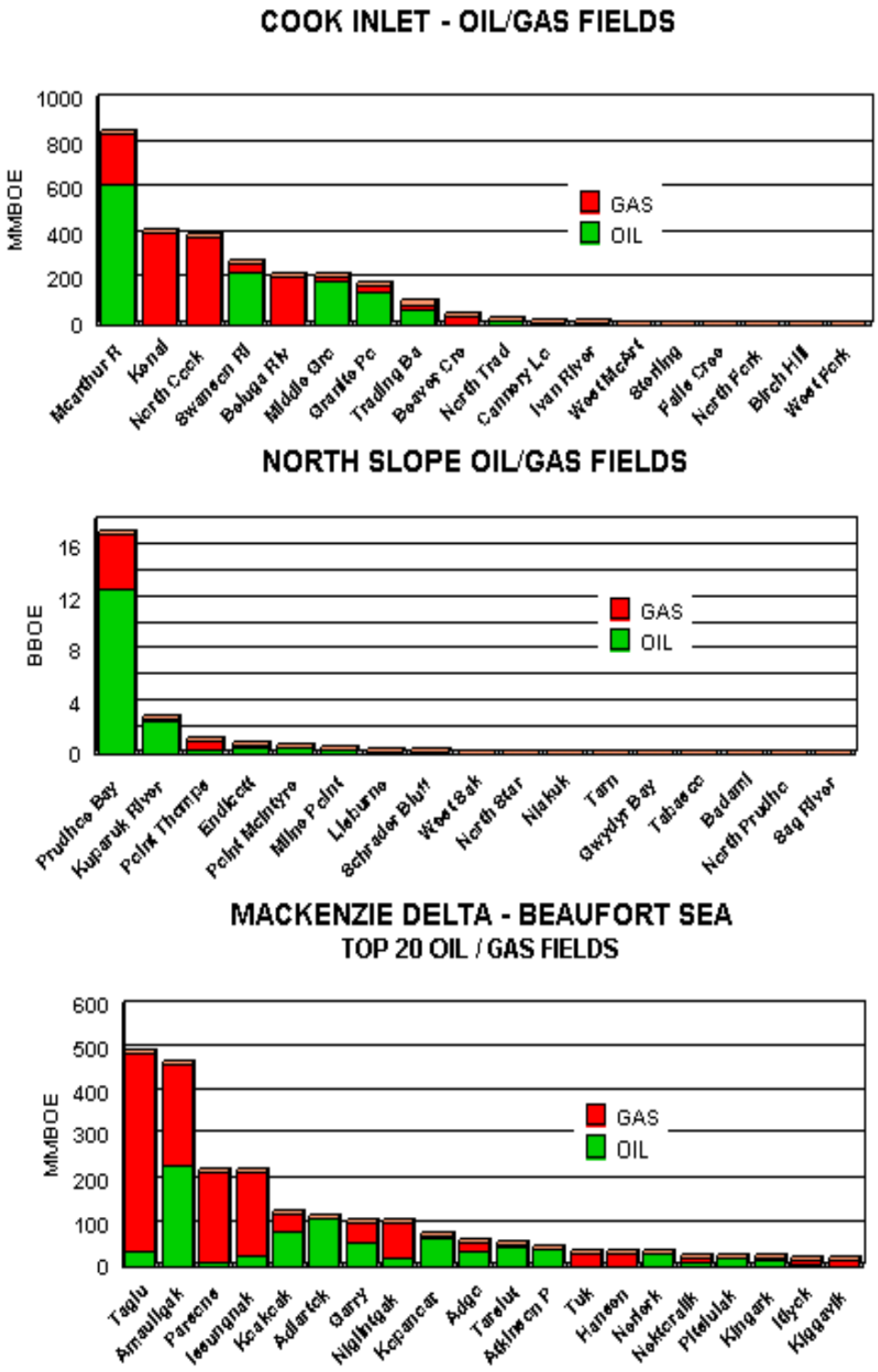

Figure 3a. Field Size Distribution Selected Oil and Gas Fields

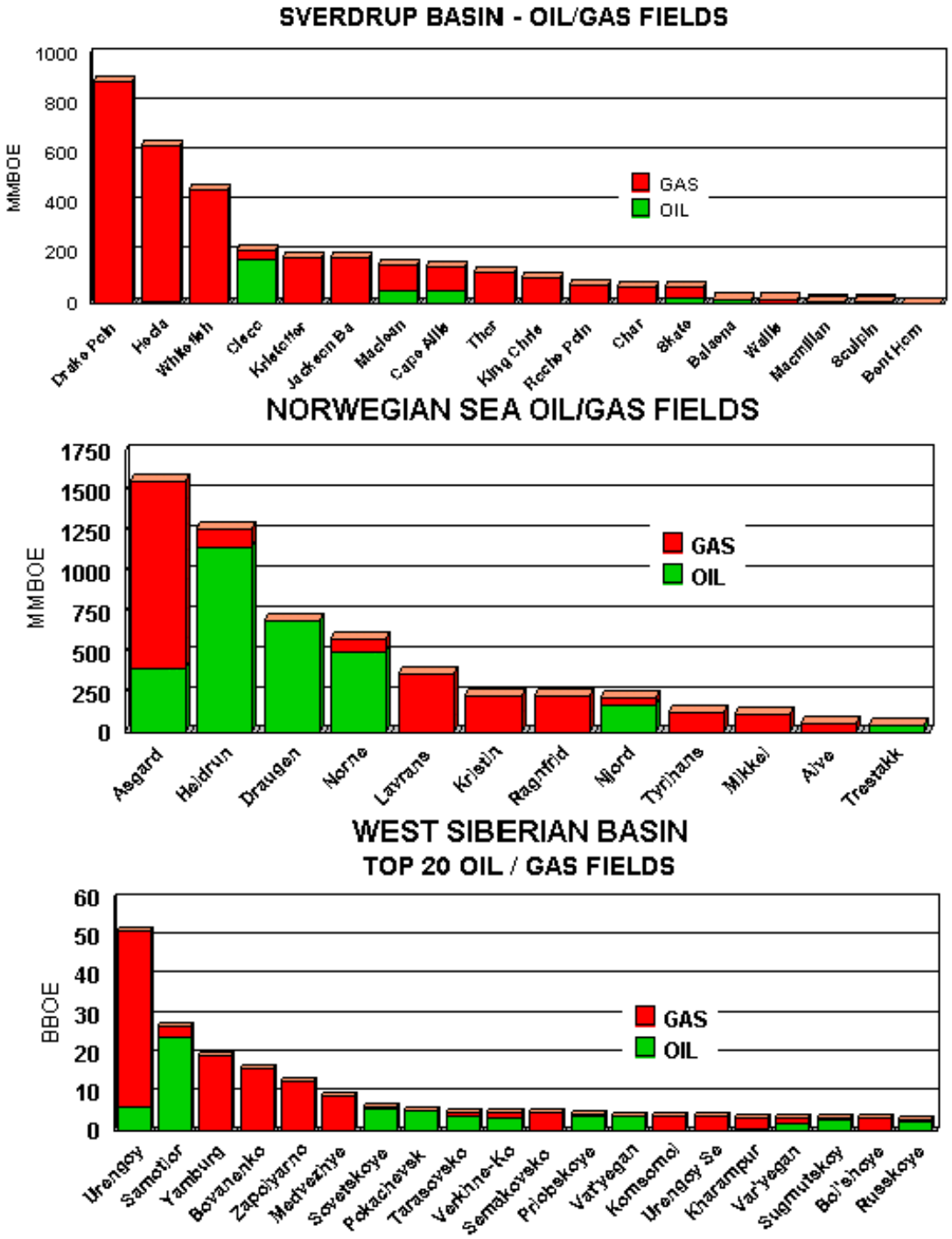

Figure 3b. Field Size Distribution Selected Oil and Gas Fields

References

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