U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Potential Additions to Technically Recoverable Resources for Each Continuous-Type (Unconventional) Play of the U.S. Geological Survey 1995 National Assessment of United States Oil and Gas Resources -- Graphical and Tabular Presentations

by

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Open-File Report 95-75E

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

1995

[1] All in Denver, CO

INTRODUCTION

The U.S. Geological Survey periodically makes appraisals of the undiscovered oil and gas resources of the Nation. For the 1995 National Assessment (Gautier and others, 1995; U.S. Geological Survey National Oil and Gas Resource Assessment Team, 1995), the onshore areas and adjoining State waters of the Nation have been divided into eight regions and 71 provinces. The basic assessment unit of each province is the play. A play is a set of known or postulated gas and (or) oil assemblages sharing similar geologic, geographic, and temporal properties.

This report presents figures showing assessment results in both graphical and tabular form for plays of the 1995 National Assessment, other than coalbed methane plays, that represent continuous-type (unconventional) accumulations. A continuous-type gas or oil accumulation is one that is not significantly affected by hydrodynamic or hydrostatic influences, for which the standard conventional-play methodology of the 1995 National Assessment is not appropriate.

Continuous-type accumulations are essentially large single fields having spatial dimensions equal to or exceeding those of plays. Continuous-type accumulations cannot be represented in terms of discrete entities delineated by down-dip hydrocarbon-water contacts, as are conventional fields, and they cannot be assessed using methods based on the sizes and numbers of discrete fields.

For the 1995 National Assessment, those gas and oil plays identified as continuous-type were assessed using newly developed approaches (Crovelli and Balay, 1995; Schmoker, 1995). The figures depicting assessment results at the play level presented here were not included in the original documentation of the National Assessment (Gautier and others, 1995).

NATURE OF CONTINUOUS-TYPE ACCUMULATIONS

Geologic Setting and Production Characteristics

The identification of a continuous-type hydrocarbon accumulation is based on an enduring concept, the geologic setting of the accumulation. This geologically grounded definition does not incorporate ephemeral criteria such as special regulatory status or the concept of unusual engineering techniques, or arbitrary criteria such as a particular low value of API gravity or matrix permeability ("tight"), that are sometimes used to define other types of unconventional accumulations. A legally designated tight-gas accumulation, for example, might or might not be a continuous-type accumulation.

The geologic setting typical of continuous-type accumulations is illustrated by figure 1. Common geologic characteristics of a continuous-type accumulation include occurrence downdip from water-saturated rocks, lack of obvious trap and seal, crosscutting of lithologic boundaries, large areal extent, relatively low matrix permeability, abnormal pressure (either high or low), and close association with source rocks. Common production characteristics of a continuous-type accumulation include large in-place hydrocarbon volume, low recovery factor, absence of truly "dry" holes, dependence on fracture permeability, and a serendipitous "hit or miss" character for production rates and ultimate recoveries of wells.

Continuous-Type Plays of the 1995 National Assessment

A continuous-type accumulation can be represented by a single play or subdivided into several plays to isolate areas of roughly uniform attributes. Continuous-type plays of the 1995 National Assessment are listed in table 1. Table 2 identifies the assessment regions and provinces referred to by number in table 1, and figures 2, 3, and 4 are maps showing locations and boundaries of the continuous-type plays. Narrative descriptions of each continuous-type play have been compiled by Schmoker and Oscarson (1995).

Some continuous-type plays identified in the 1995 National Assessment were not quantitatively assessed (table 1). In conformity with the protocol adopted for conventional plays, a continuous-type play was not assessed if the play probability was 0.10 or less. In other cases, so little data were available for a play that an effort at quantitative assessment could not be defended.

Sixty-one continuous-type plays were defined for the 1995 National Assessment, of which 47 were quantitatively assessed (table 1). Of the assessed plays, 34 are gas plays and 13 are oil plays. The predominant reservoir rock is sandstone for 32 plays (fig. 2), shale for 20 plays (fig. 3), and carbonate for nine plays (fig. 4). Continuous-type gas and oil accumulations are not geologic oddities limited to one or two United States basins. Twenty-three geologic provinces are represented by the continuous-type plays developed for the 1995 National Assessment (table 2).

Continuous-type accumulations include basin-center gas, gas in many of the so-called "tight" sandstone reservoirs, and gas and oil in self-sourced shale reservoirs. Immense in-place volumes of gas and oil are present in such accumulations, but only those quantities judged to be technically recoverable were reported in the 1995 National Assessment. Existing technology and development practices were assumed. Reference was not made to economic viability.

ASSESSMENT RESULTS FOR CONTINUOUS-TYPE PLAYS

Potential additions to technically recoverable resources for continuous-type plays, aggregated by province, region, and the Nation, are shown in table 3.

Potential additions to technically recoverable resources for each of the 47 assessed continuous-type plays (table 1) are presented as graphs of probability distributions and as tabular data in figures 5-51. Figures are arranged in order of increasing play number.

The upper chart of each figure represents the primary commodity (nonassociated gas or crude oil) of the play; the lower chart represents the secondary commodity (natural gas liquids or associated-dissolved gas) of the play. The absence of a lower chart for some gas plays means that no natural gas liquids were assessed. The inset on each chart lists selected parameters of the unconditional probability distribution: mean, median, mode, 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of the graph's horizontal axis.

This collection of figures (figs. 5-51) documents 1995 National Assessment results for continuous-type accumulations (excluding coalbed gas) at the basic assessment level of the play.

REFERENCES CITED

Crovelli, R.A., and Balay, R.H., 1995, Probabilistic methodology and computer programs for assessment of unconventional oil and gas resources, in Gautier, D.L., Dolton, G.L., Takahashi, K.I., and Varnes, K.L., eds., 1995 National Assessment of United States oil and gas resources - Results, methodology, and supporting data: U.S. Geological Survey Digital Data Series DDS-30 [CD-ROM].

Gautier, D.L., Dolton, G.L., Takahashi, K.I., and Varnes, K.L., eds., 1995, 1995 National Assessment of United States oil and gas resources - Results, methodology, and supporting data: U.S. Geological Survey Digital Data Series DDS-30 [CD-ROM].

Schmoker, J.W., 1995, Method for assessing continuous-type (unconventional) hydrocarbon accumulations, in Gautier, D.L., Dolton, G.L., Takahashi, K.I., and Varnes, K.L., eds., 1995 National Assessment of United States oil and gas resources - Results, methodology, and supporting data: U.S. Geological Survey Digital Data Series DDS-30 [CD-ROM].

Schmoker, J.W., and Oscarson, S.A., 1995, Descriptions of continuous-type (unconventional) plays of the U.S. Geological Survey 1995 National Assessment of United States oil and gas resources: U.S. Geological Survey Open-File Report 95-75B, 44 p.

U.S. Geological Survey National Oil and Gas Resource Assessment Team, 1995, 1995 National Assessment of United States oil and gas resources: U.S. Geological Survey Circular 1118, 20 p.

Table 1. Continuous-type plays (excluding coalbed methane) of the 1995 National Assessment, onshore United States. Regions and provinces are identified in table 2.

Region	Province	Play	Assessed?	Gas/oil	Rock Type	Play name
2	4	412	no	gas	sandstone	Willamette - Puget Sound Basin-Centered Gas
2	5	503	yes	gas	sandstone	Columbia Basin - Basin-Centered Gas
2	14	1408	no	gas?	sandstone	Deep, Overpressured Fractured Rocks of the Central Syncline
3	20	2007	yes	gas	sandstone	Tight Gas Piceance Mesaverde Williams Fork
3	20	2009	yes	oil	shale	Cretaceous Self-Sourced Fractured Shales
3	20	2010	yes	gas	sandstone	Tight Gas Piceance Mesaverde Iles
3	20	2015	yes	gas	sandstone	Tight Gas Uinta Tertiary East
3	20	2016	yes	gas	sandstone	Tight Gas Uinta Tertiary West
3	20	2018	yes	gas	sandstone	Basin Flank Uinta Mesaverde
3	20	2020	yes	gas	sandstone	Deep Synclinal Uinta Mesaverde
3	21	2103	yes	oil	shale	Fractured Interbed
3	22	2205	yes	gas	sandstone	Dakota Central Basin Gas
3	22	2208	yes	oil	shale	Mancos Fractured Shale
3	22	2209	yes	gas	sandstone	Central Basin Mesaverde Gas
3	22	2211	yes	gas	sandstone	Pictured Cliffs Gas
4	27	2703	no	oil	carbonate	Cone Calcareous Member, Marias River Shale
4	28	2804	yes	oil	shale	Bakken Shale Fracture Systems
4	28	2810	yes	gas	sandstone	Northern Great Plains Biogenic Gas, High Potential
4	28	2811	yes	gas	sandstone	Northern Great Plains Biogenic Gas, Moderate Potential (Suffield Block Analog)
4	28	2812	yes	gas	sandstone	Northern Great Plains Biogenic Gas, Low Potential
4	31	3110	yes	oil	shale	Bakken Fairway
4	31	3111	yes	oil	shale	Bakken Intermediate
4	31	3112	yes	oil	shale	Bakken Outlying
4	31	3113	yes	gas	carbonate	Southern Williston Basin Margin - Niobrara Shallow Biogenic
4	33	3308	no	oil	shale	Mowry Fractured Shale
4	33	3311	no	oil	shale	Niobrara Fractured Shale
4	34	3404	no	gas	sandstone	Basin-Center Gas
4	35	3505	no	gas	sandstone	Basin-Center Gas
4	37	3740	yes	gas	sandstone	Greater Green River Basin - Cloverly-Frontier
4	37	3741	yes	gas	sandstone	Greater Green River Basin - Mesaverde
4	37	3742	yes	gas	sandstone	Greater Green River Basin - Lewis
4	37	3743	yes	gas	sandstone	Greater Green River Basin - Fox Hills-Lance
4	37	3744	yes	gas	sandstone	Greater Green River Basin - Fort Union
4	38	3803	no	oil	carbonate	Upper Cretaceous Niobrara Fractured Shale Oil
4	39	3904	yes	oil	carbonate	Greater Wattenberg Codell/Niobrara Oil and Gas
4	39	3906	yes	gas	sandstone	J Sandstone Deep Gas (Wattenberg)
4	39	3911	no	oil	shale	Fractured Shale - Pierre
4	39	3920	yes	oil	carbonate	Fractured Niobrara - Greater Silo/Dale Salt-Edge Oil
4	39	3921	yes	oil	carbonate	Fractured Niobrara - Greater Northern Denver Basin Oil
5	45	4503	no	oil	shale	Mississippian Barnett Shale
6	47	4747	yes	oil	carbonate	Austin Chalk-Pearsall

Table 1. Continued

Region	Province	Play	Assessed?	Gas/oil	Rock Type	Play name
6	47	4748	yes	oil	carbonate	Austin Chalk-Giddings
6	47	4749	yes	oil	carbonate	Austin Chalk-Outlying
6	49	4923	yes	gas	sandstone	Cotton Valley Blanket Sandstones Gas
7	58	5811	no	gas	shale	Woodford/Chattanooga/Arkansas Novaculite of Midcontinent
8	63	6319	yes	gas	shale	Antrim Shale Gas, Developed Area
8	63	6320	yes	gas	shale	Antrim Shale Gas, Undeveloped Area
8	64	6407	yes	gas	shale	Illinois Basin - New Albany Shale Gas
8	66	6604	yes	gas	shale	Devonian Black Shale Gas
8	67	6728	yes	gas	sandstone	Clinton/Medina Sandstone Gas High Potential
8	67	6729	yes	gas	sandstone	Clinton/Medina Sandstone Gas Medium Potential
8	67	6730	yes	gas	sandstone	Clinton/Medina Sandstone Gas Medium-Low Potential
8	67	6731	no	gas	sandstone	Clinton/Medina Sandstone Gas Low Potential
8	67	6733	yes	gas	sandstone	Upper Devonian Sandstone Gas High Potential
8	67	6734	yes	gas	sandstone	Upper Devonian Sandstone Gas Medium Potential
8	67	6735	yes	gas	sandstone	Upper Devonian Sandstone Gas Medium-Low Potential
8	67	6736	no	gas	sandstone	Upper Devonian Sandstone Gas Low Potential
8	67	6740	yes	gas	shale	Devonian Black Shale - Greater Big Sandy
8	67	6741	yes	gas	shale	Devonian Black Shale - Greater Siltstone Content
8	67	6742	yes	gas	shale	Devonian Black Shale - Lower Thermal Maturity
8	67	6743	no	gas	shale	Devonian Black Shale - Undeveloped NE Ohio and Western Pennsylvania

Table 2. Assessment regions and provinces referenced by number in table 1.

Region	Province	Region or province name
2		Pacific Coast
	4	Western Oregon-Washington
	5	Eastern Oregon-Washington
	14	Los Angeles Basin
3		Colorado Plateau and Basin and Range
	20	Uinta-Piceance Basin
	21	Paradox Basin
	22	San Juan Basin
4		Rocky Mountains and Northern Great Plains
	27	Montana Thrust Belt
	28	North-Central Montana
	31	Williston Basin
	33	Powder River Basin
	34	Big Horn Basin
	35	Wind River Basin
	37	Southwestern Wyoming
	38	Park Basins
	39	Denver Basin
5		West Texas and Eastern New Mexico
	45	Bend Arch-Fort Worth Basin
6		Gulf Coast
	47	Western Gulf
	49	Louisiana-Mississippi Salt Basins (includes Province 48 - East Texas Basin)
7		Midcontinent
	58	Anadarko Basin
8		Eastern
	63	Michigan Basin
	64	Illinois Basin
	66	Cincinnati Arch
	67	Appalachian Basin

Table 3. Potential additions to technically recoverable resources estimated for continuous-type plays in sandstones, shales, and carbonates, onshore United States. [Gas includes both nonassociated and associated-dissolved gas. F95 represents a 19 in 20 chance and F5 represents a 1 in 20 chance of the occurrence of at least the amount tabulated. Fractile values (F95, F5) are not additive. NGL, natural gas liquids. Dash (-) indicates less than 0.5 million barrels.]

Area	Crude oil (million barrels)			Gas (trillion cubic feet)			NGL (million barrels)		
	F95	F5	Mean	F95	F5	Mean	F95	F5	Mean
ONSHORE U.S.	1539	2695	2066	219.36	416.55	308.08	1122	3542	2119
BY REGION									
2 - Pacific Coast	00	00	00	2.80	30.87	12.20	28	309	122
3 - Colorado Plateau and Basin and Range	249	940	525	24.88	55.02	38.09	63	140	96
4 - Rocky Mountains and Northern Great Plains	271	695	452	91.86	268.89	165.76	810	3104	1733
6 - Gulf Coast	752	1516	1089	5.91	12.13	8.67	89	235	151
8 - Eastern	00	00	00	56.08	118.70	83.36	11	25	17
BY PROVINCE									
5 - Eastern Oregon-Washington	00	00	00	2.80	30.87	12.20	28	309	122
20 - Uinta-Piceance Basin	59	139	94	11.55	23.38	16.74	63	139	96
21 - Paradox Basin	61	597	242	0.05	0.48	0.19	00	00	00
22 - San Juan Basin	68	394	189	10.66	36.84	21.15	-	2	1
28 - North-Central Montana	00	00	00	19.92	79.03	43.16	00	00	00
31 - Williston Basin	97	283	167	0.08	0.24	0.14	00	00	00
37 - Southwestern Wyoming	00	00	00	55.95	213.51	119.30	810	3104	1733
39 - Denver Basin	139	502	285	1.49	5.69	3.16	-	-	-
47 - Western Gulf	752	1516	1089	1.82	3.67	2.63	00	00	00
49 - Louisiana-Mississippi Salt Basins (includes Province 48 - East Texas Basin)	00	00	00	3.55	9.40	6.03	89	235	151
63 - Michigan Basin	00	00	00	5.82	42.60	18.87	00	00	00
64 - Illinois Basin	00	00	00	0.91	7.59	3.28	1	4	2
67 - Appalachian Basin	00	00	00	43.12	83.66	61.21	9	23	15

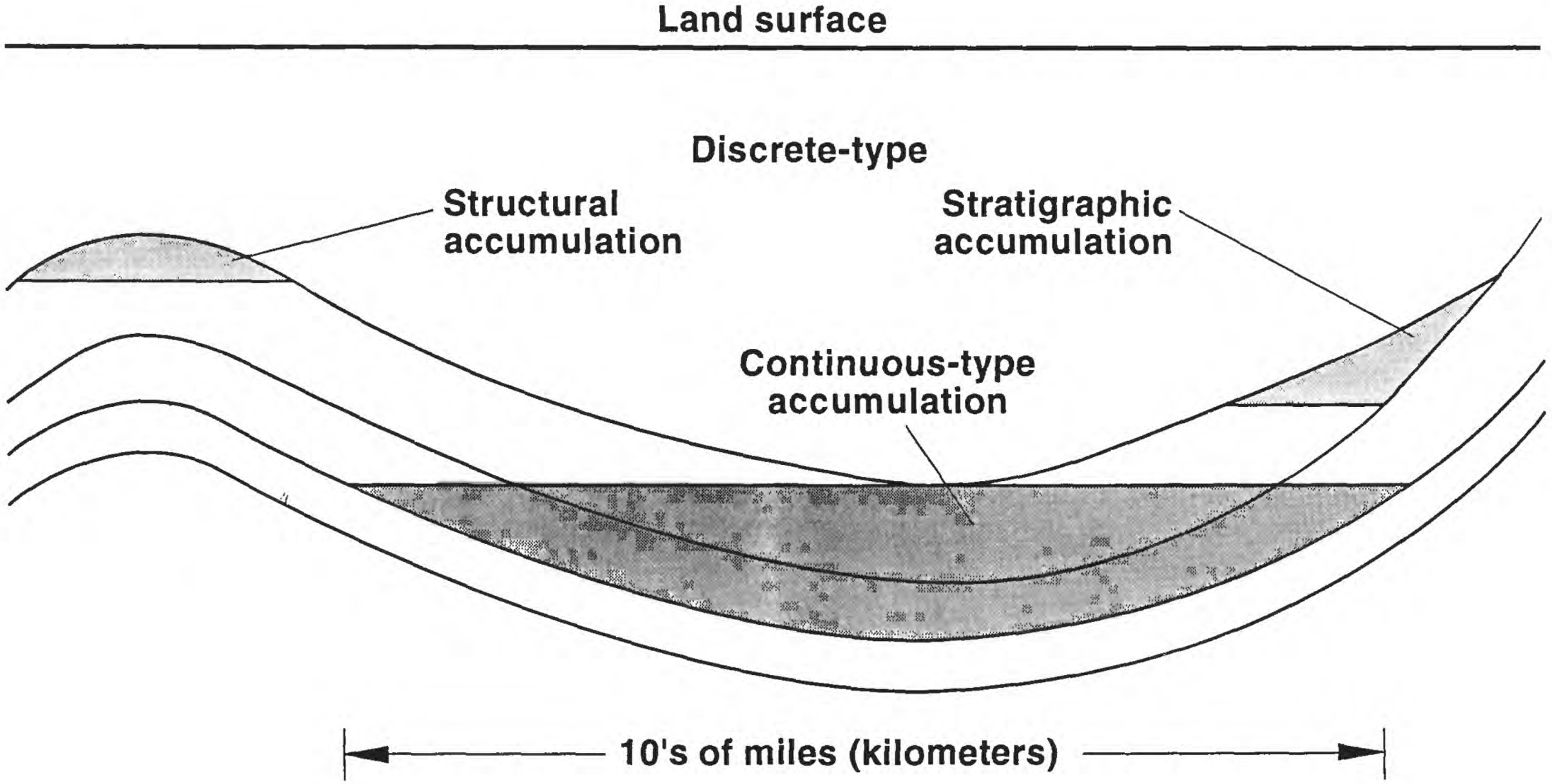


Figure 1. Geologic setting of continuous-type gas and oil accumulations relative to discrete accumulations in structural or stratigraphic traps.

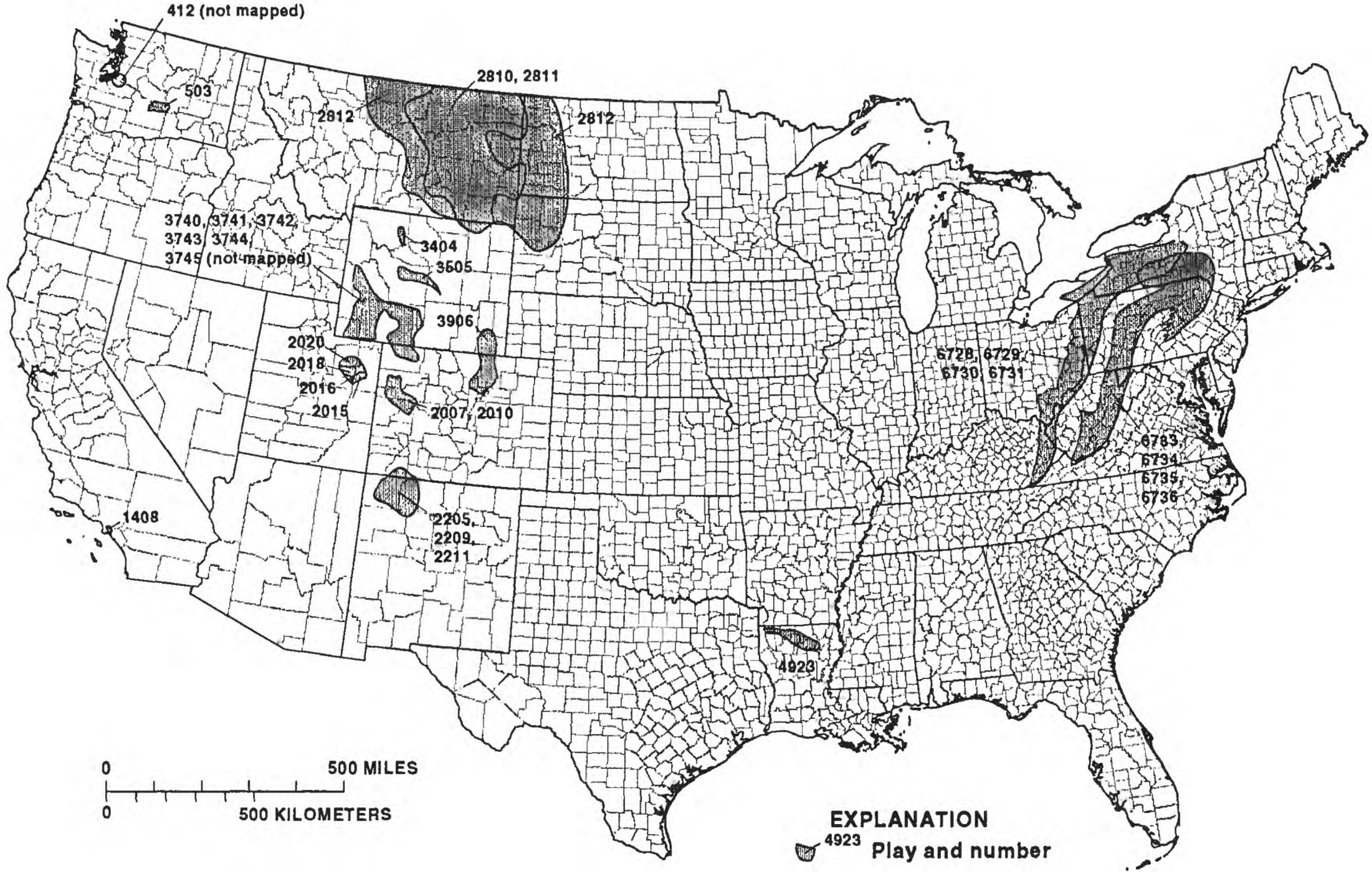


Figure 2. Continuous-type plays of the 1995 National Assessment for which the predominant reservoir rock is sandstone. Numbers shown are play numbers (table 1).

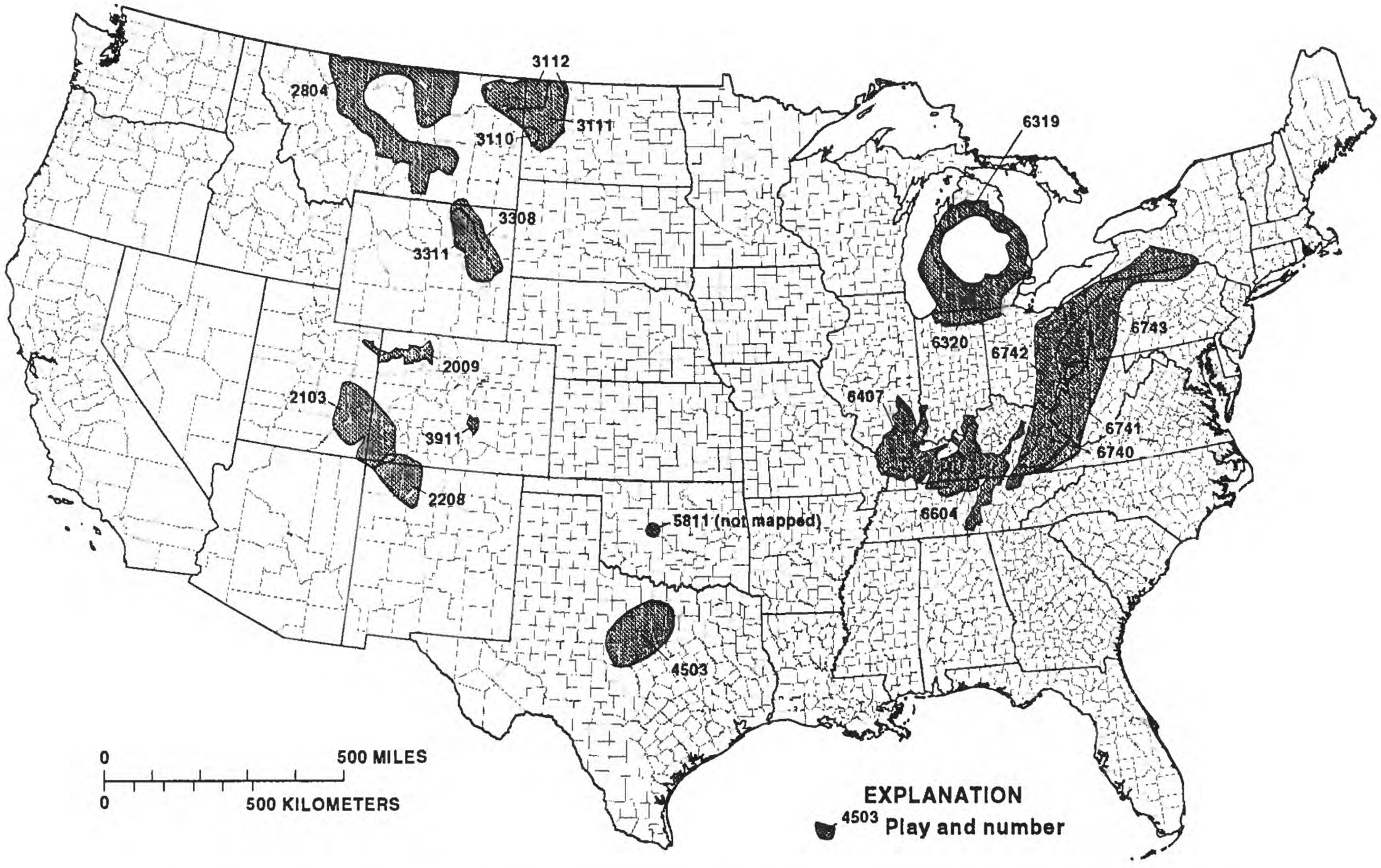


Figure 3. Continuous-type plays of the 1995 National Assessment for which the predominant reservoir rock is shale. Numbers shown are play numbers (table 1).

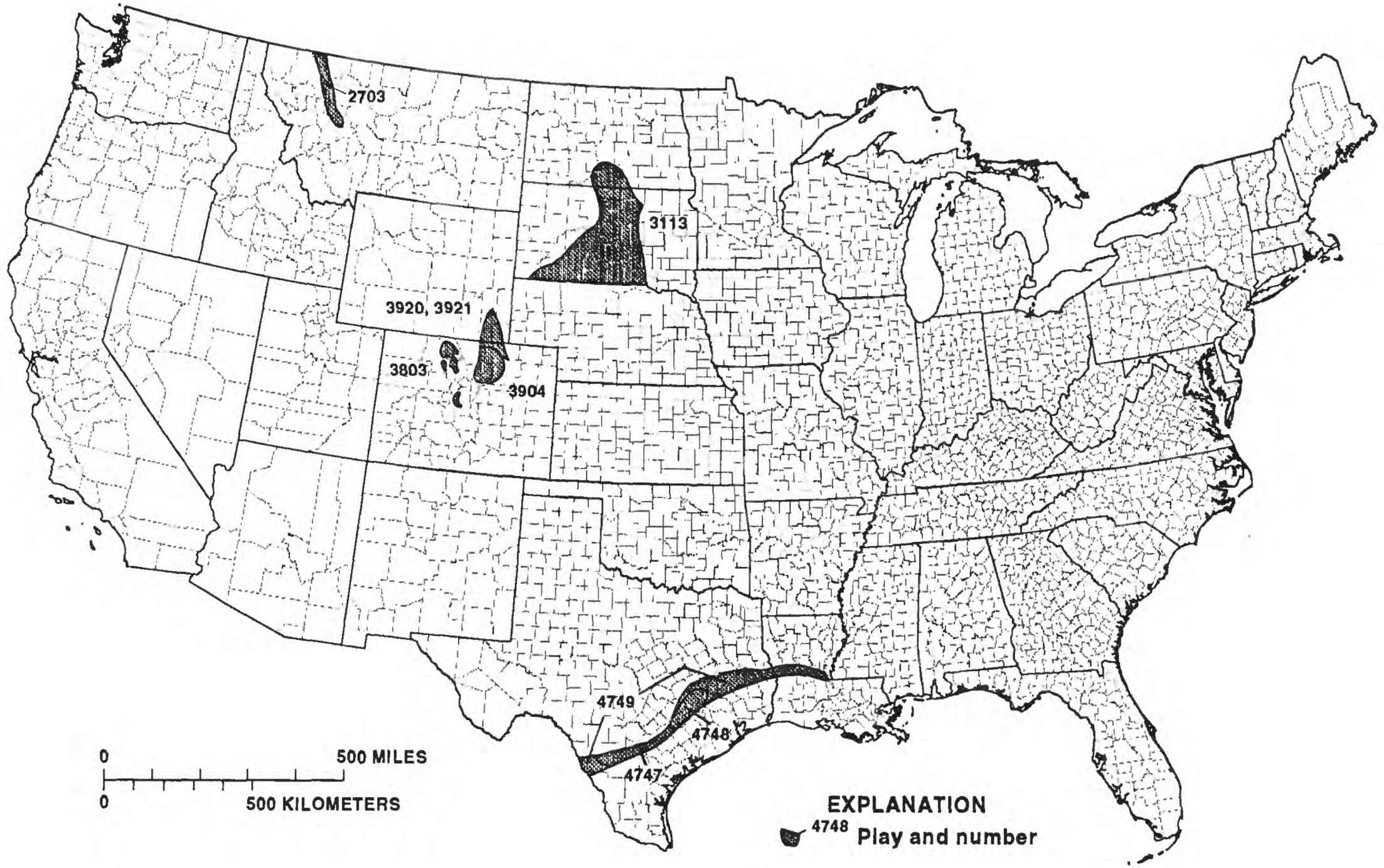
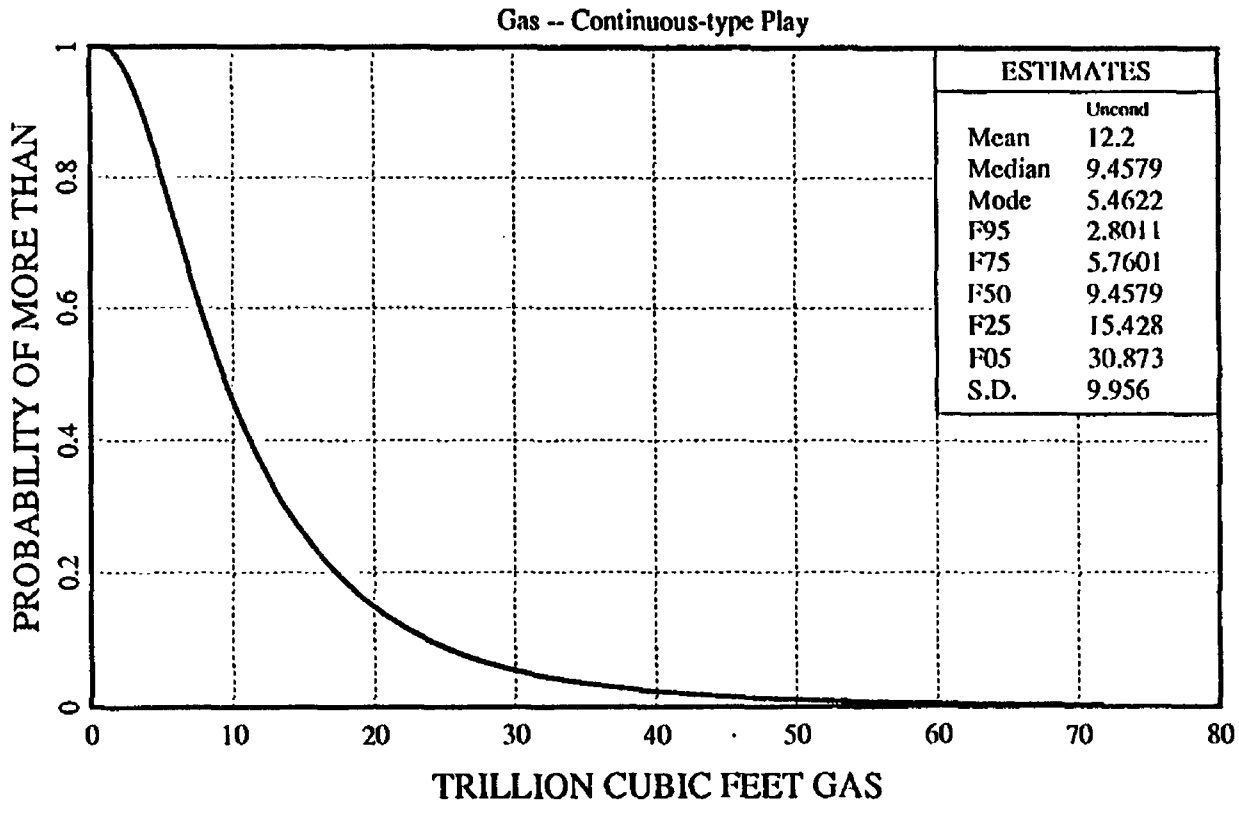


Figure 4. Continuous-type plays of the 1995 National Assessment for which the predominant reservoir rock is carbonate. Numbers shown are play numbers (table 1).



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

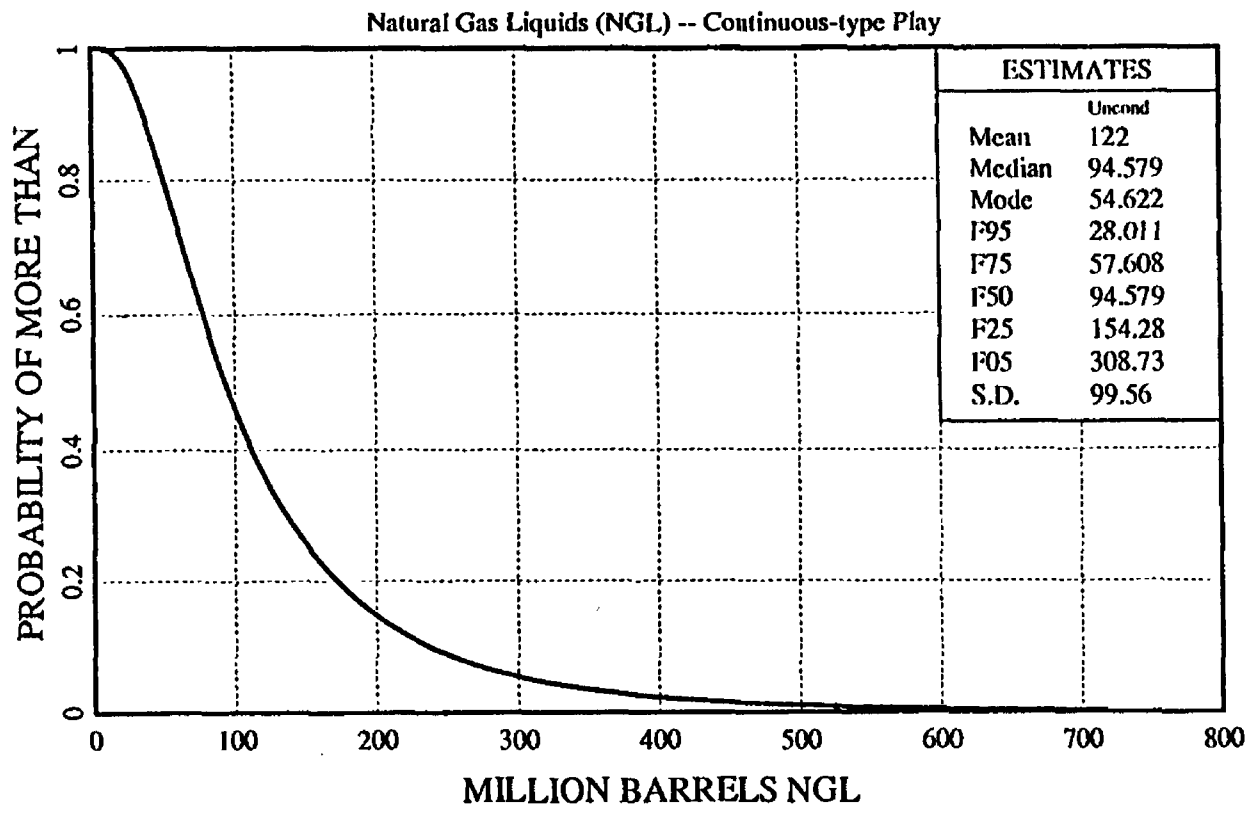
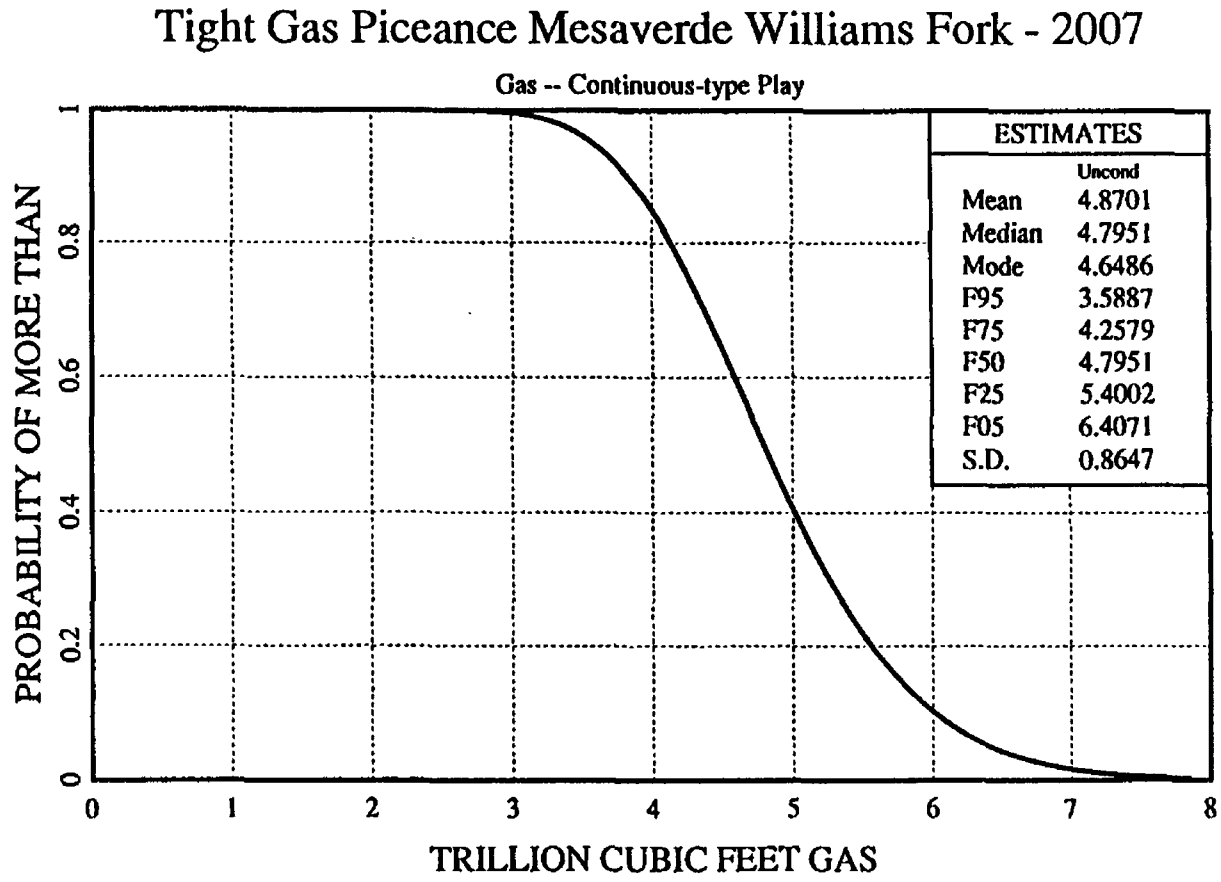


Figure 5. Potential additions to technically recoverable resources for Play 503, Columbia Basin - Basin-Centered Gas.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

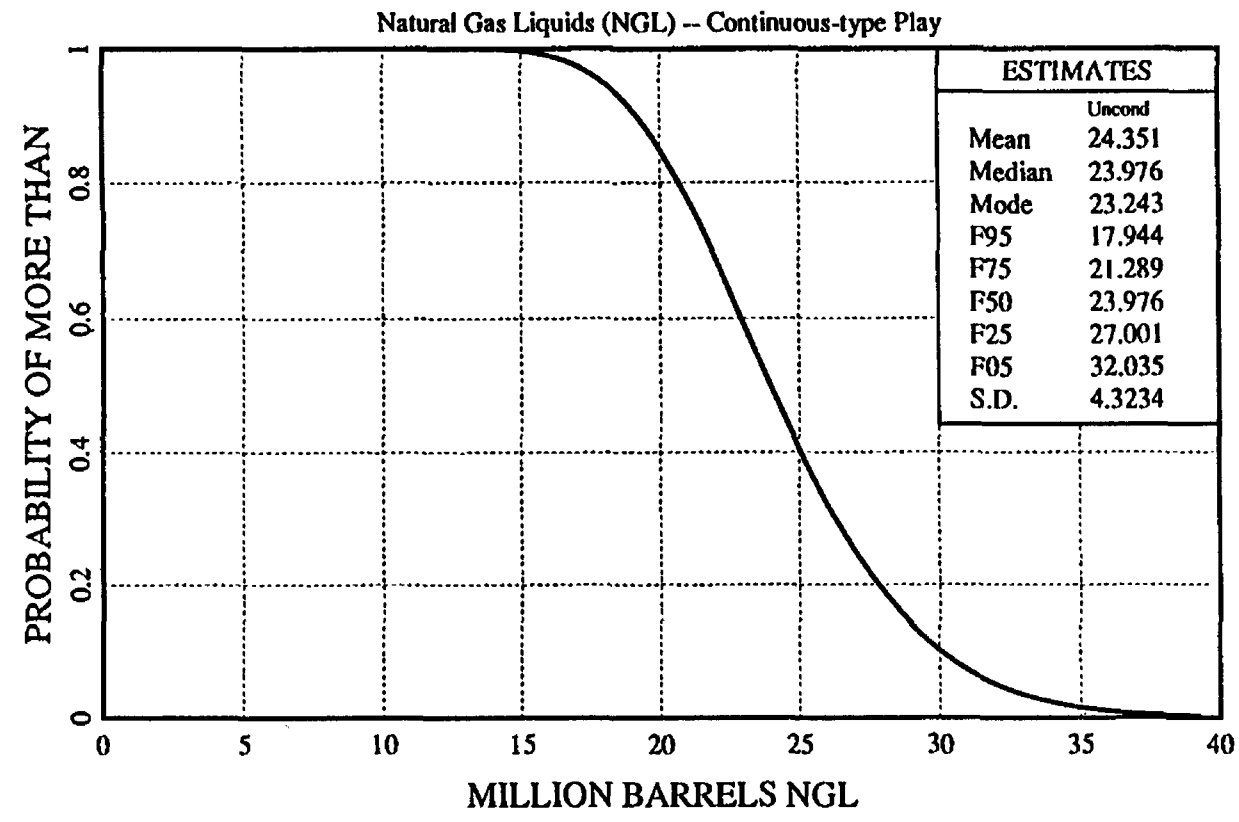
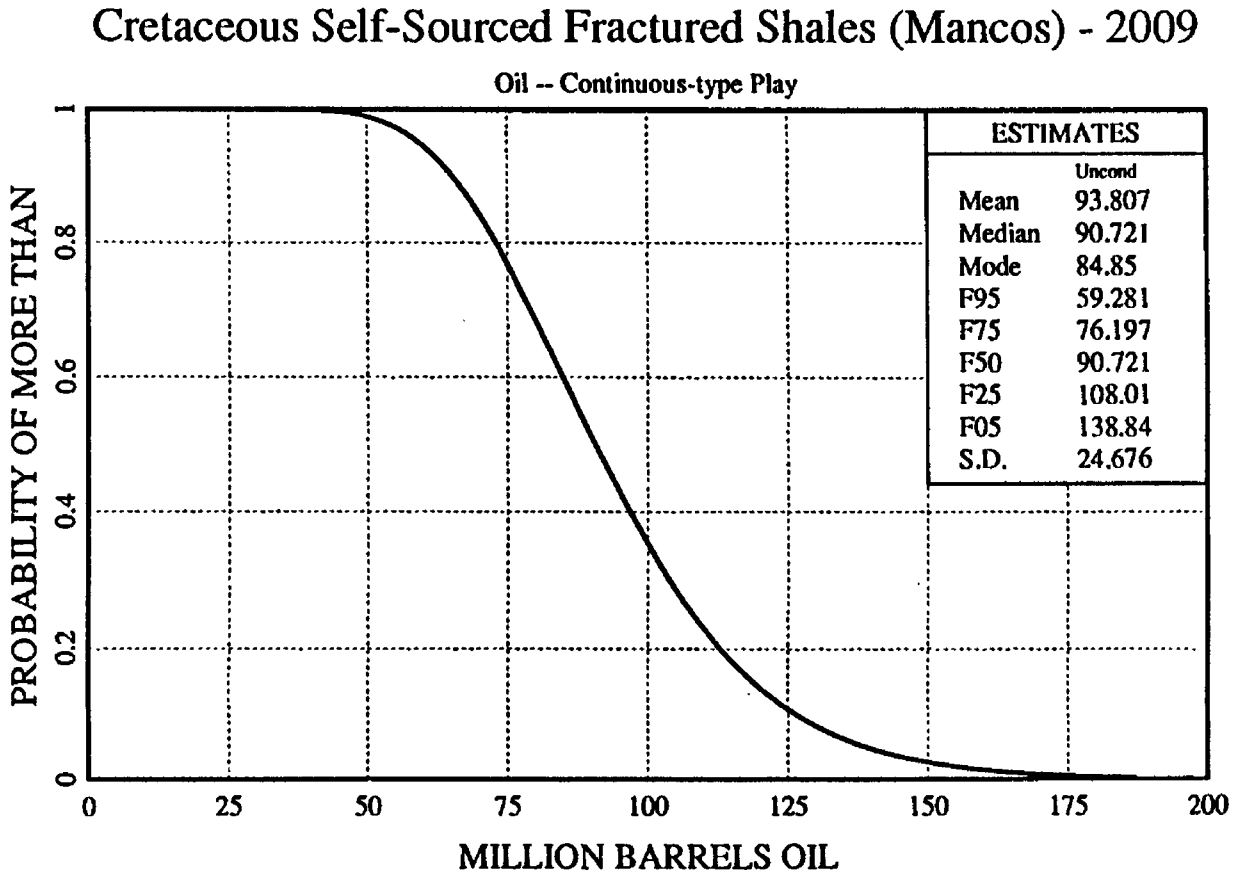
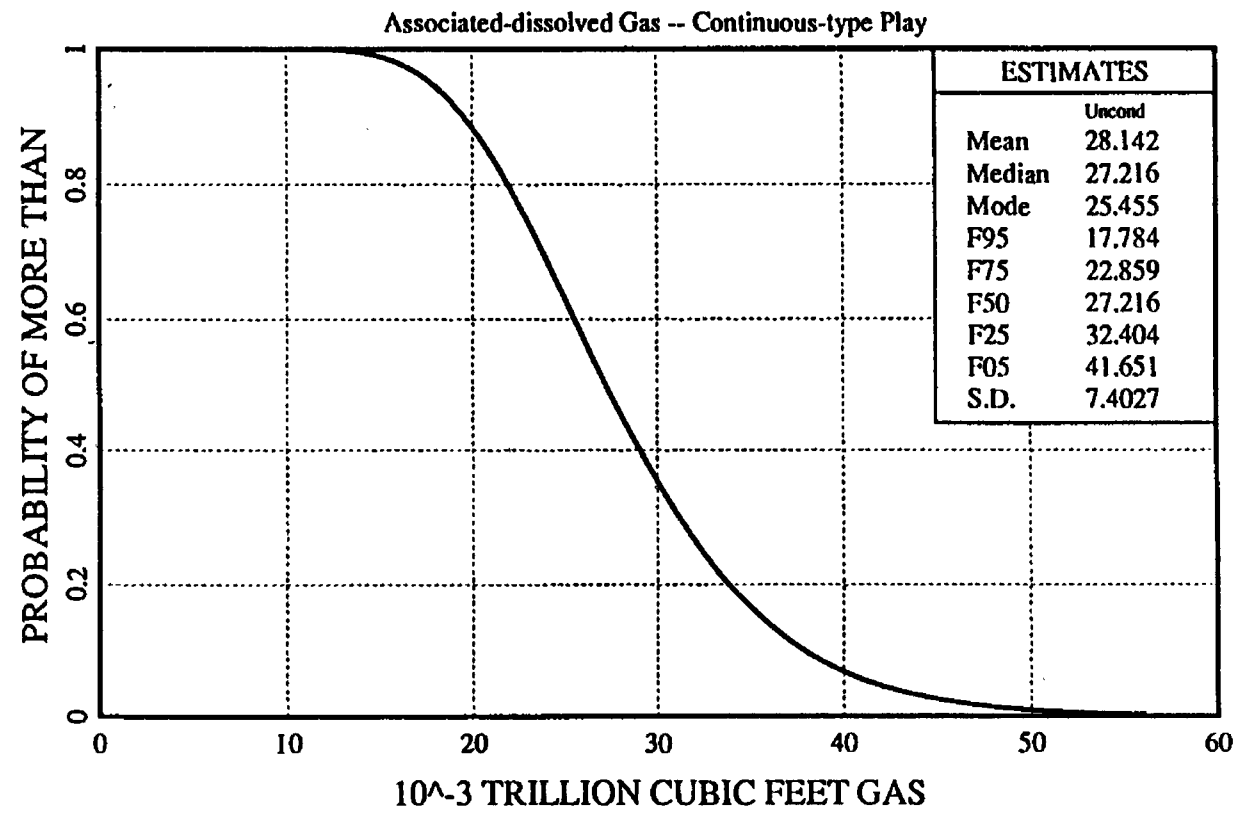


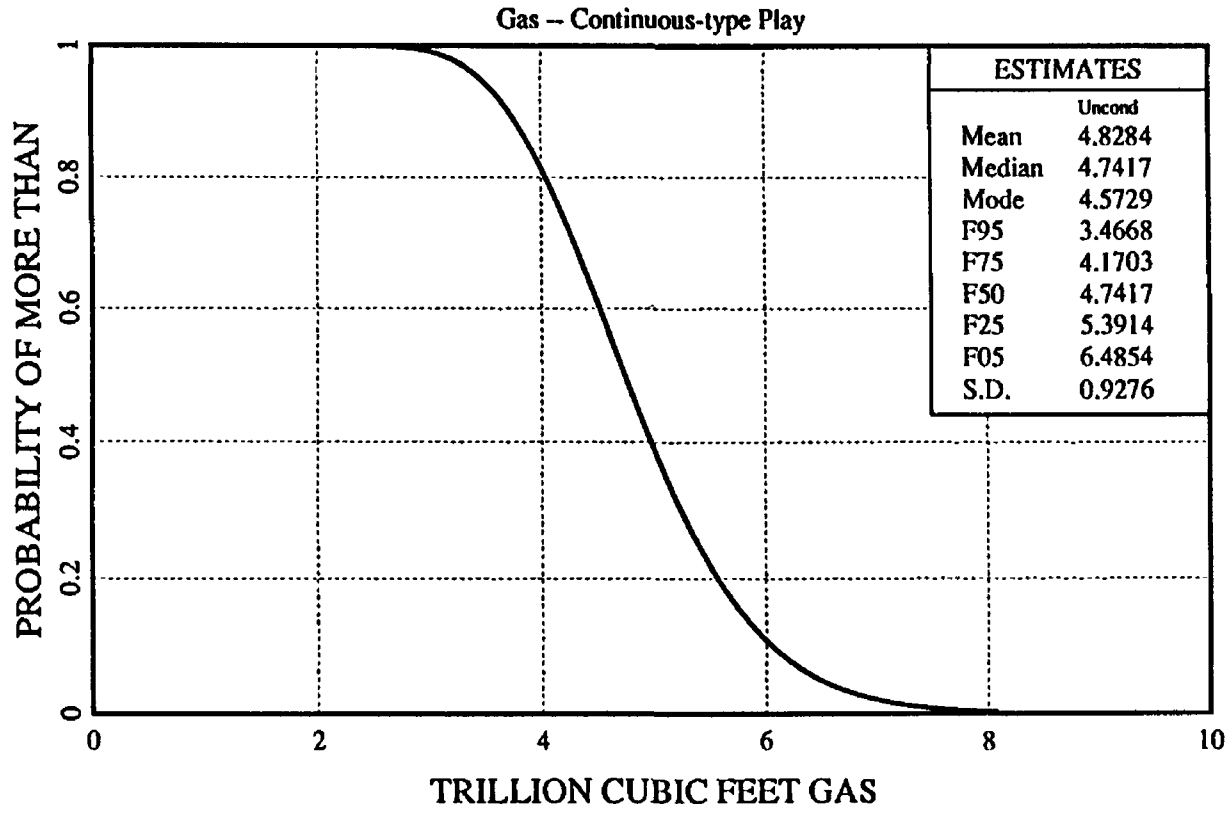
Figure 6. Potential additions to technically recoverable resources for Play 2007, Tight Gas Piceance Mesaverde Williams Fork.

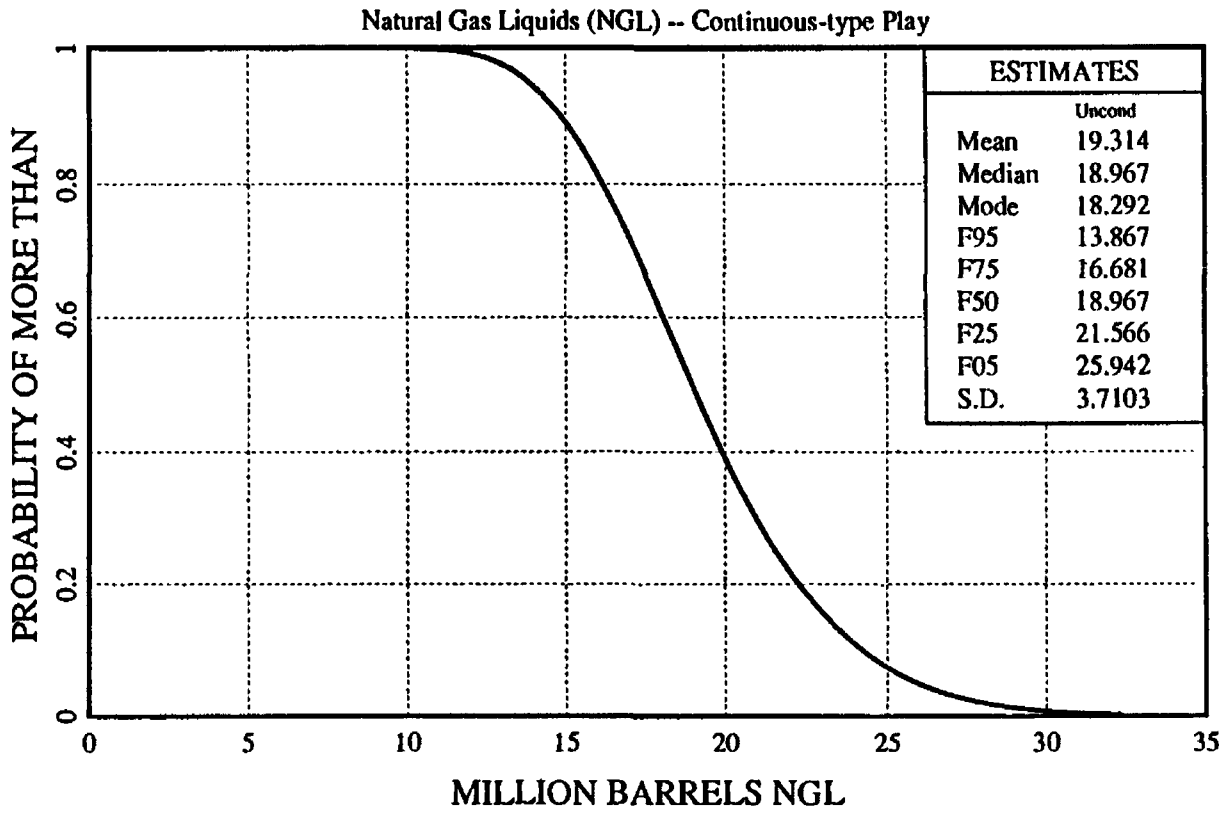




[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

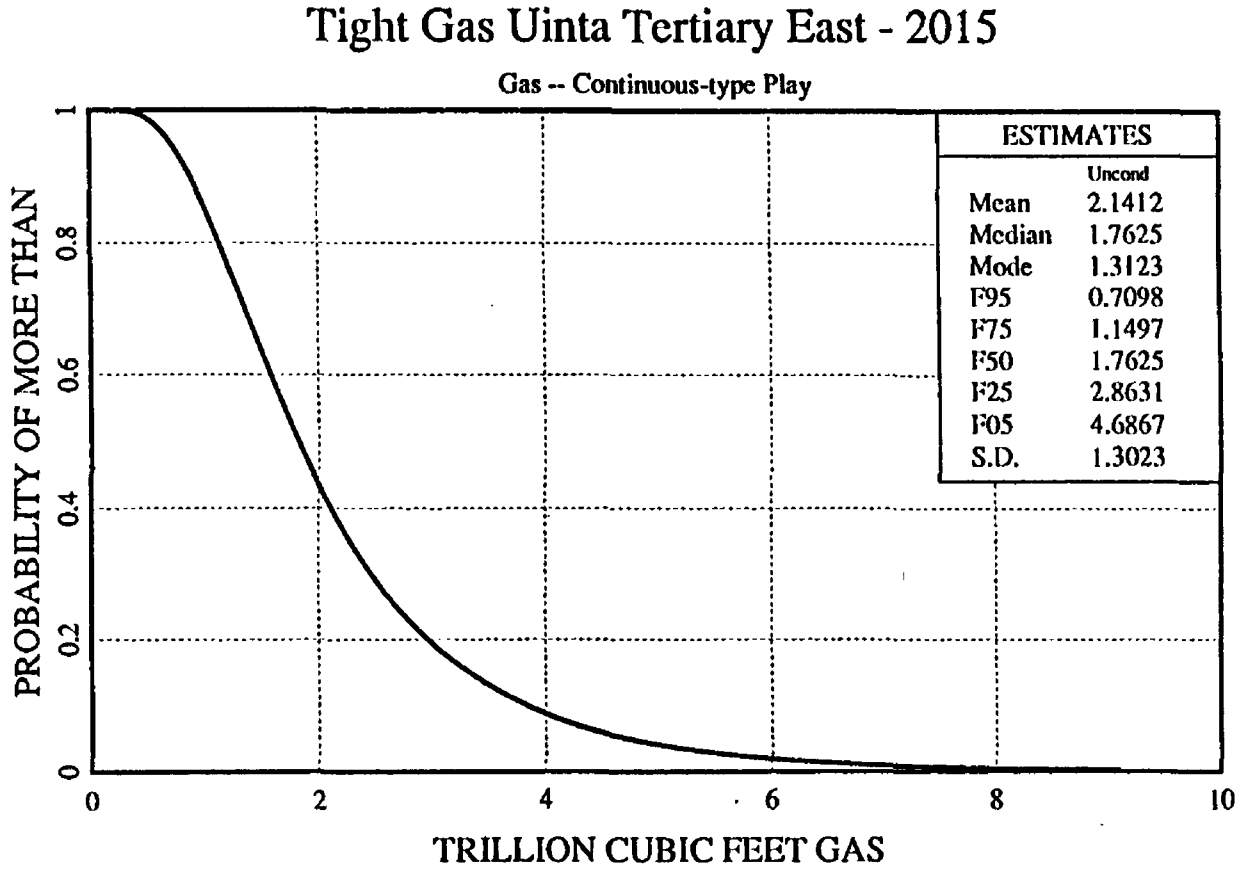
Figure 7. Potential additions to technically recoverable resources for Play 2009, Cretaceous Self-Sourced Fractured Shales.





[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 8. Potential additions to technically recoverable resources for Play 2010, Tight Gas Piceance Mesaverde Iles.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

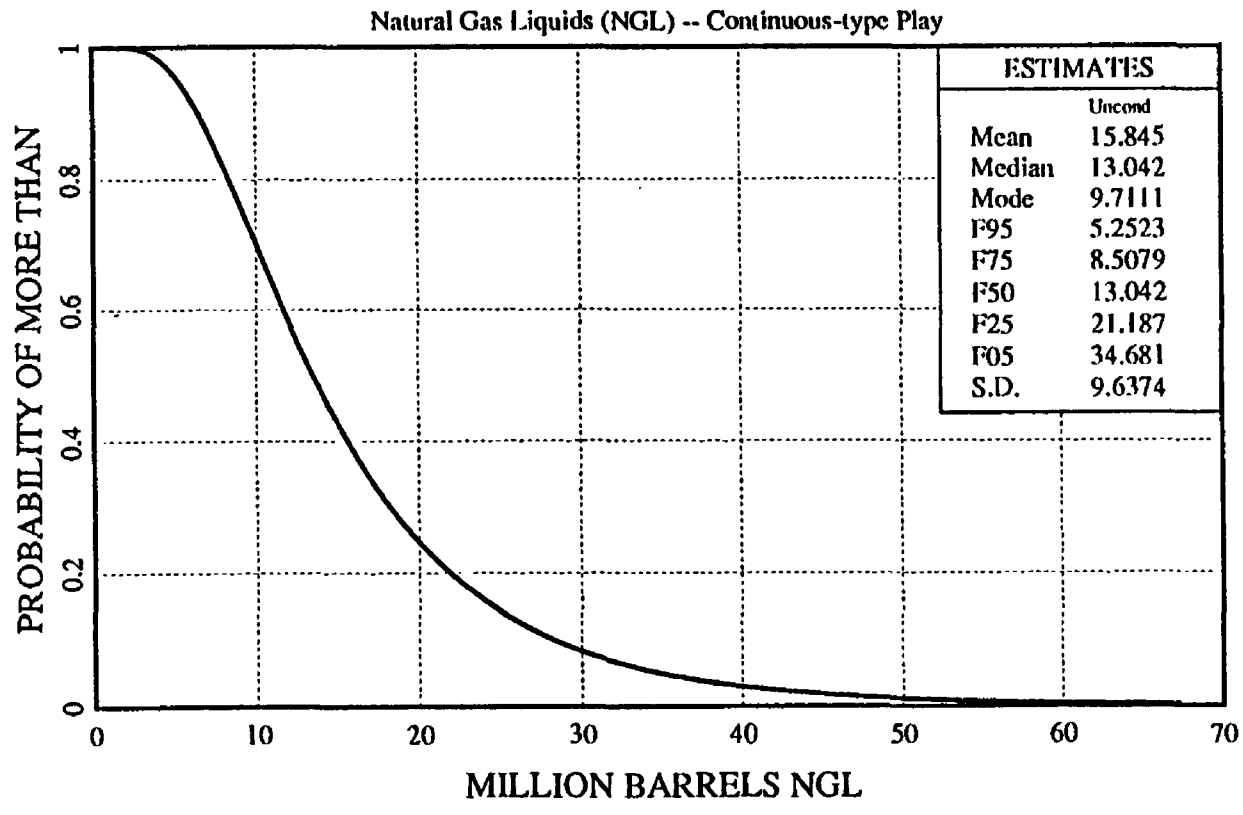
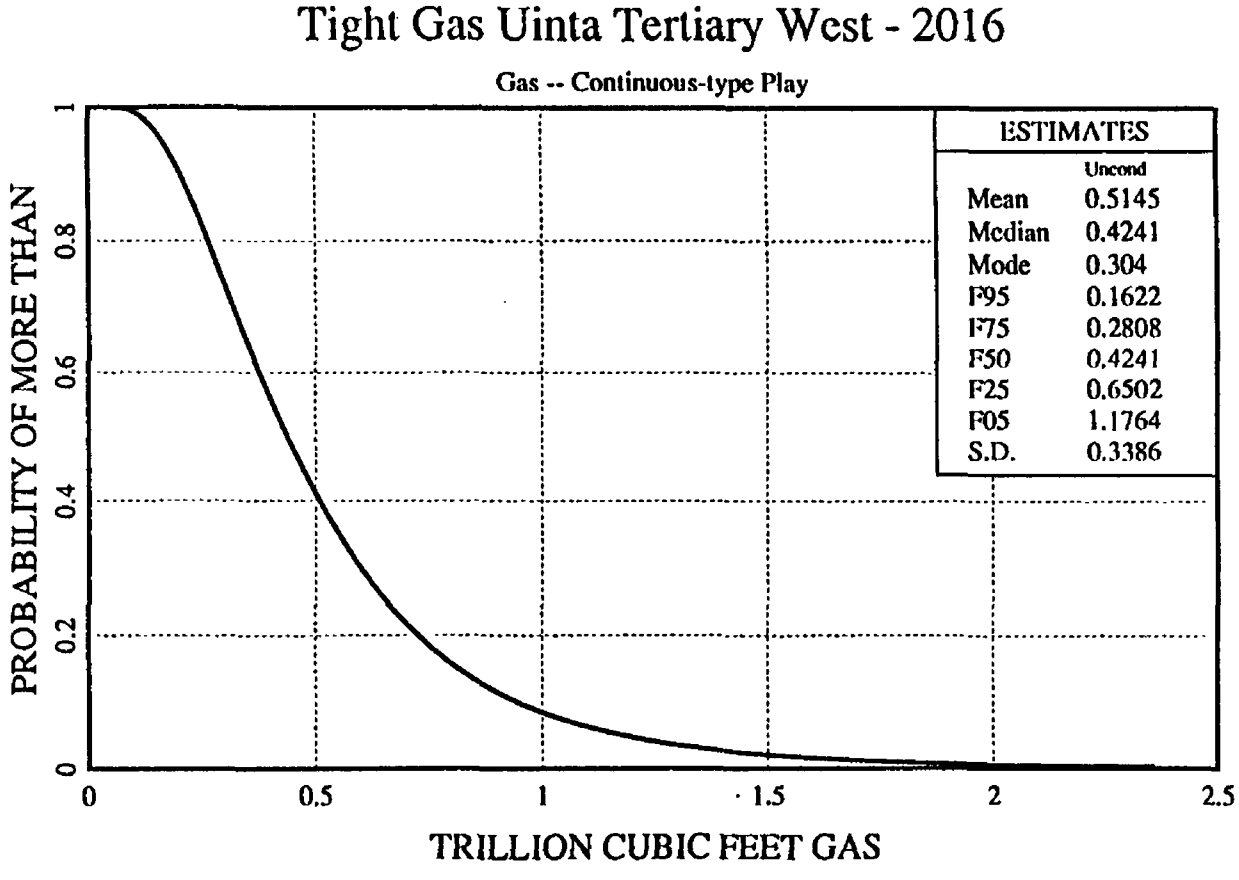


Figure 9. Potential additions to technically recoverable resources for Play 2015, Tight Gas Uinta Tertiary East.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

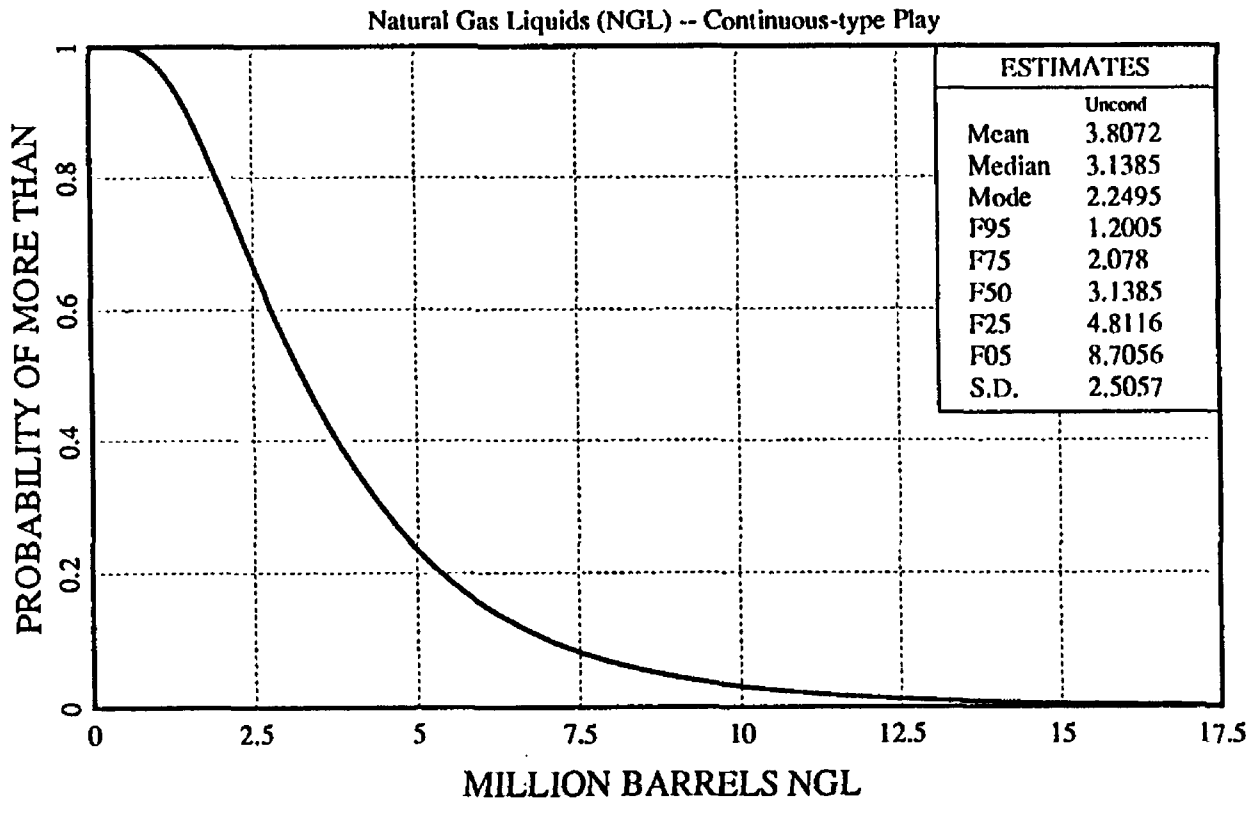
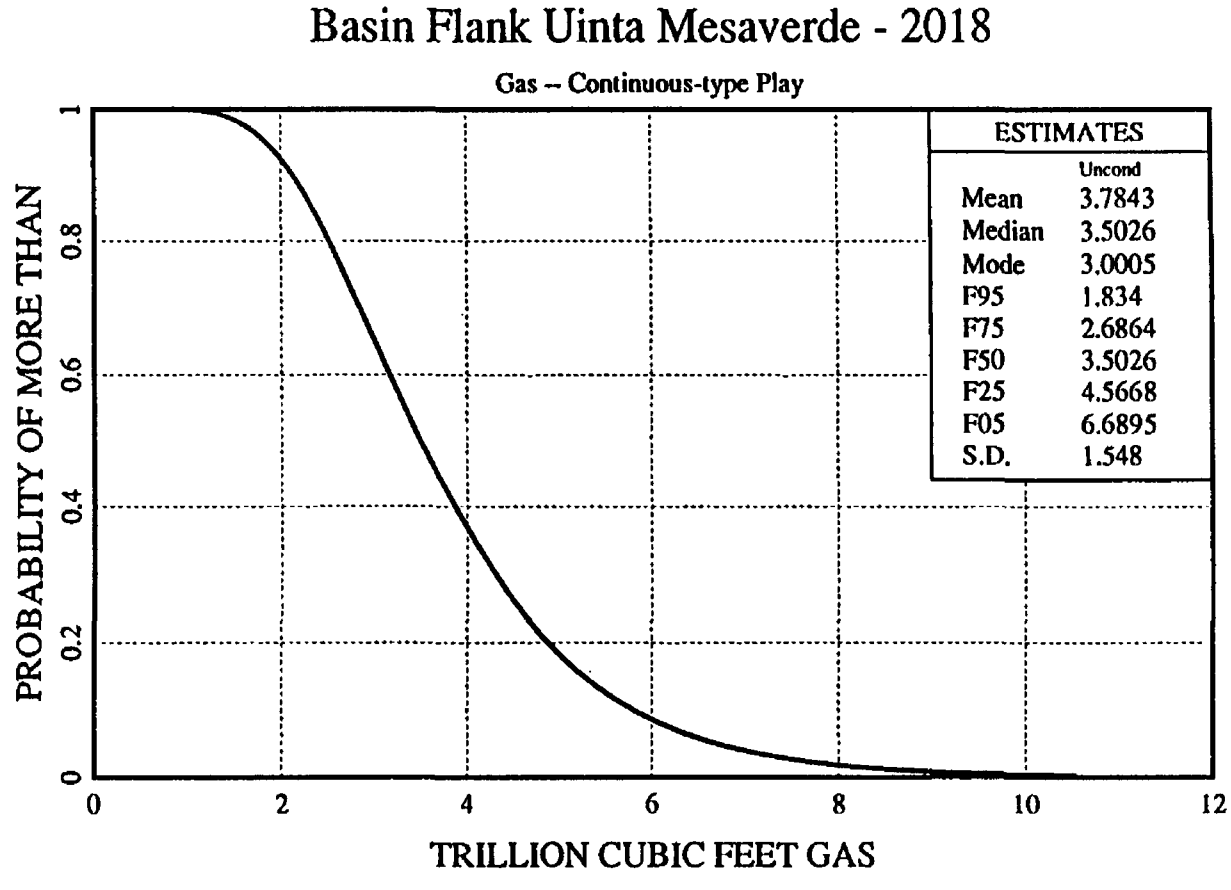


Figure 10. Potential additions to technically recoverable resources for Play 2016, Tight Gas Uinta Tertiary West.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

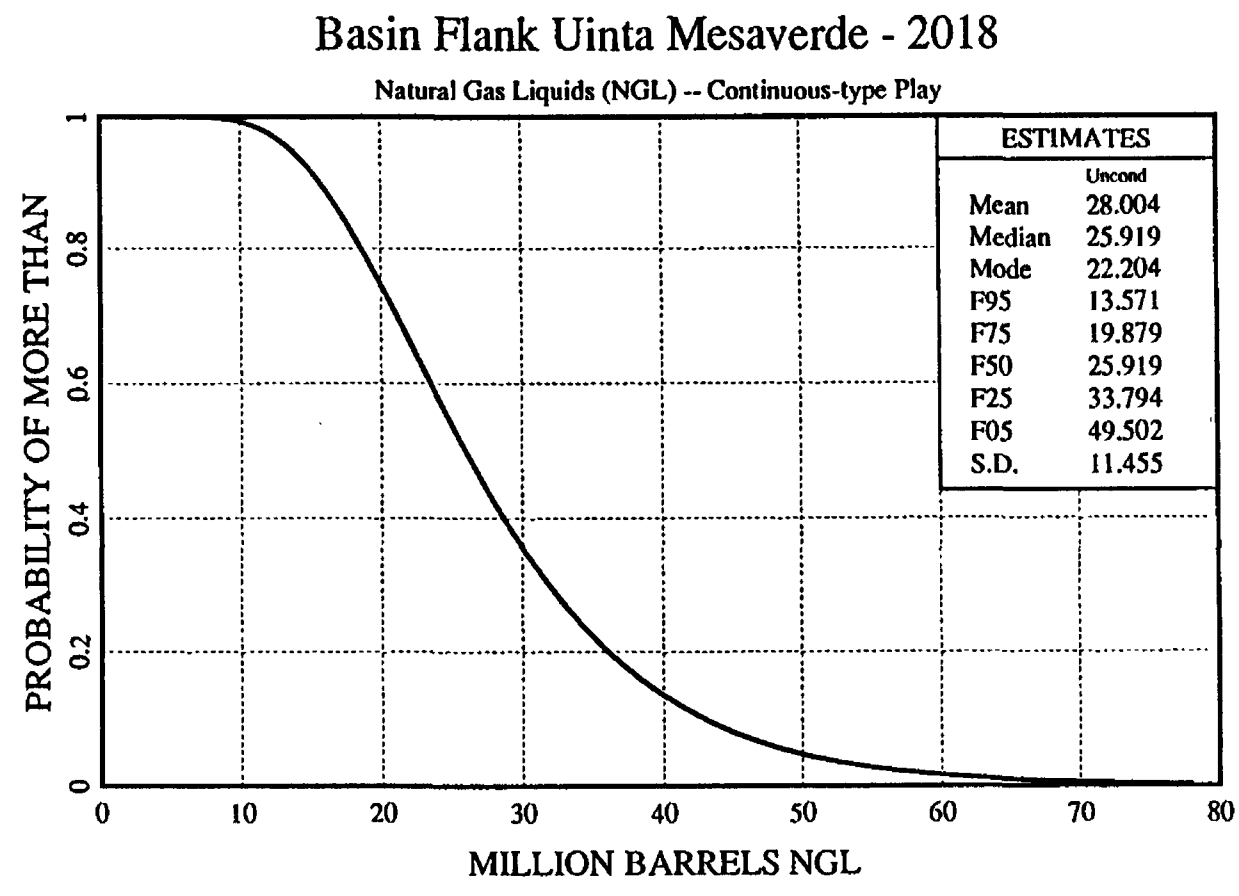
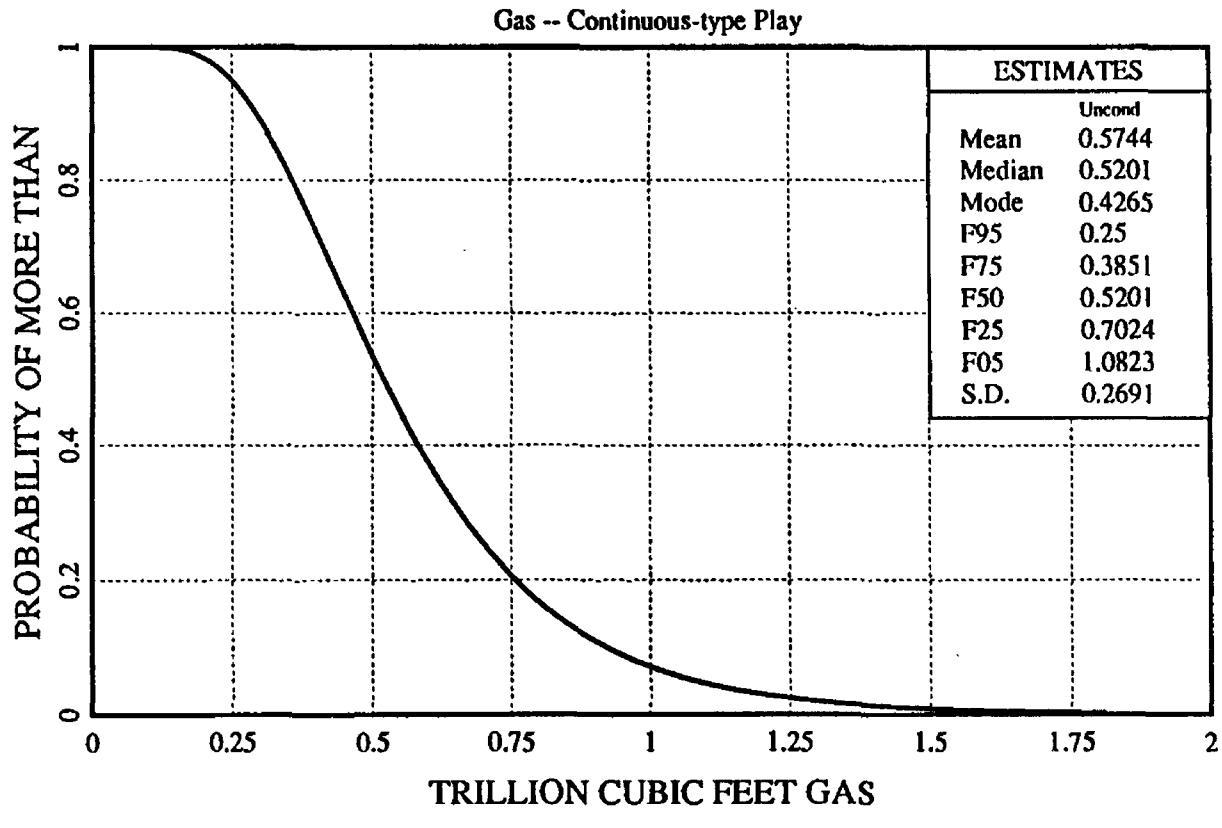


Figure 11. Potential additions to technically recoverable resources for Play 2018, Basin Flank Uinta Mesaverde.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

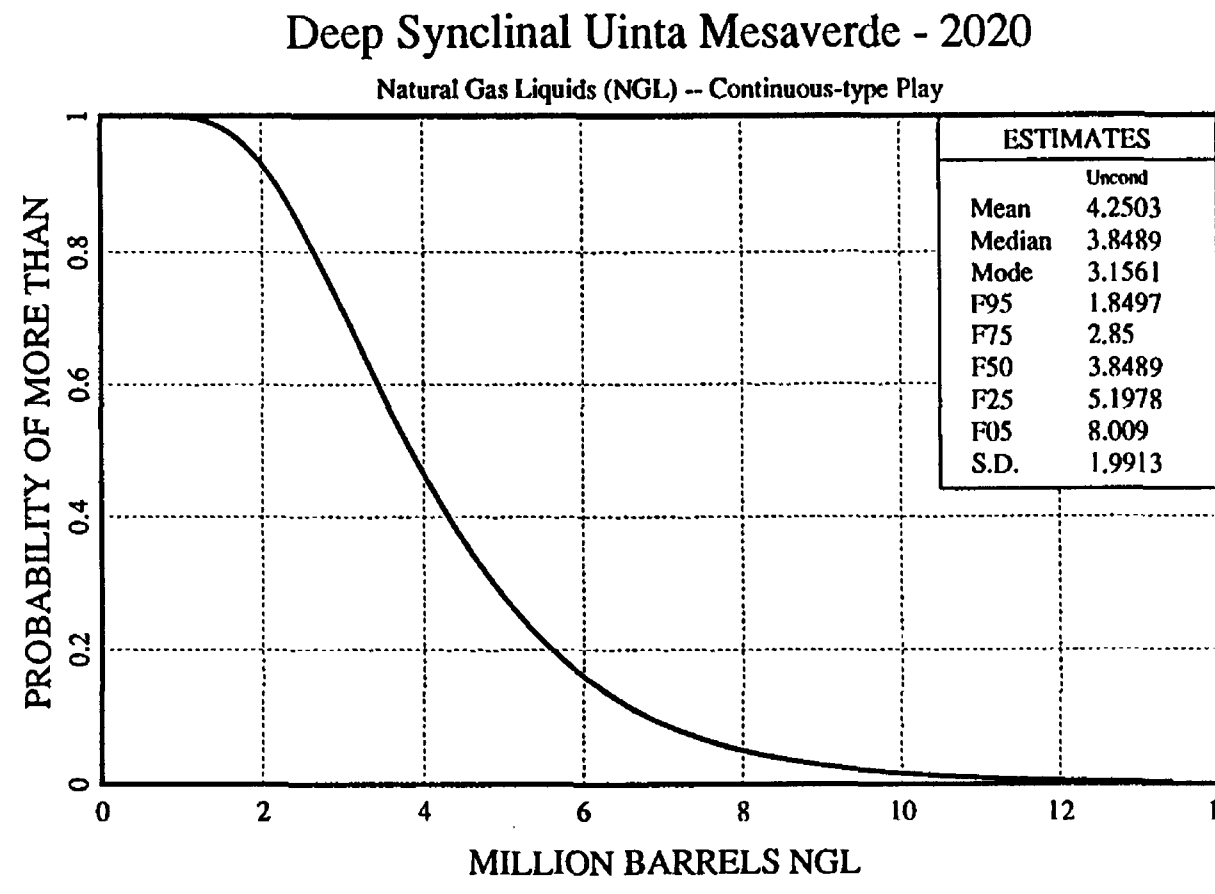
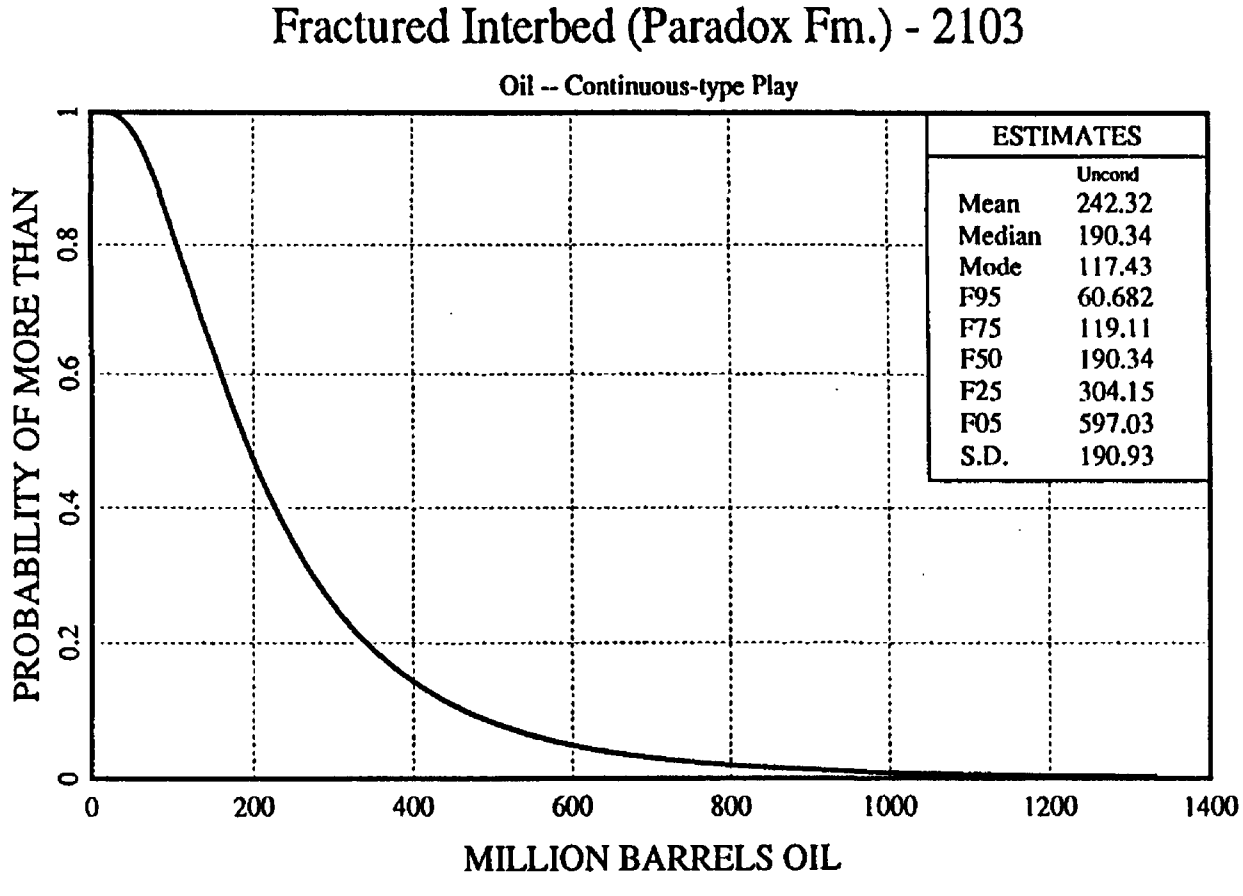


Figure 12. Potential additions to technically recoverable resources for Play 2020, Deep Synclinal Uinta Mesaverde.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

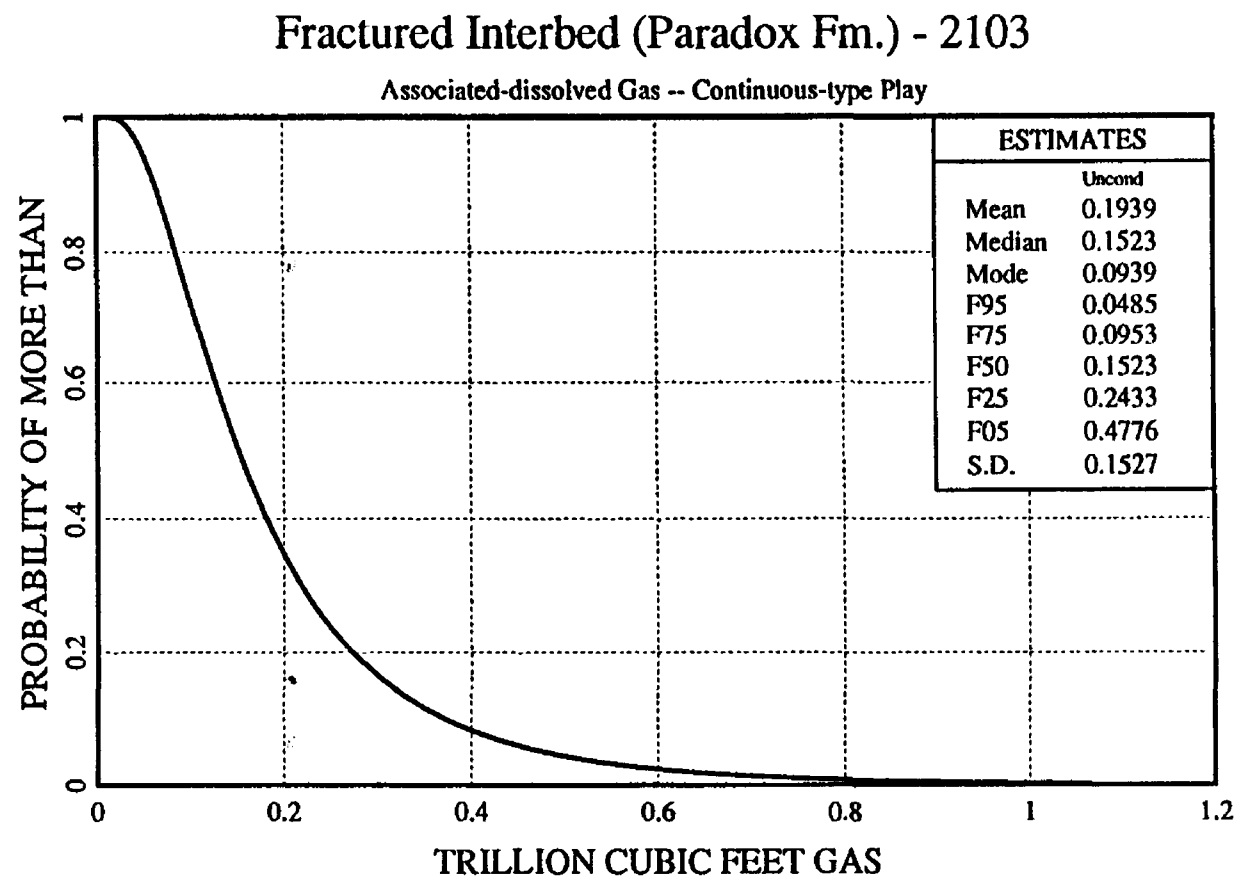
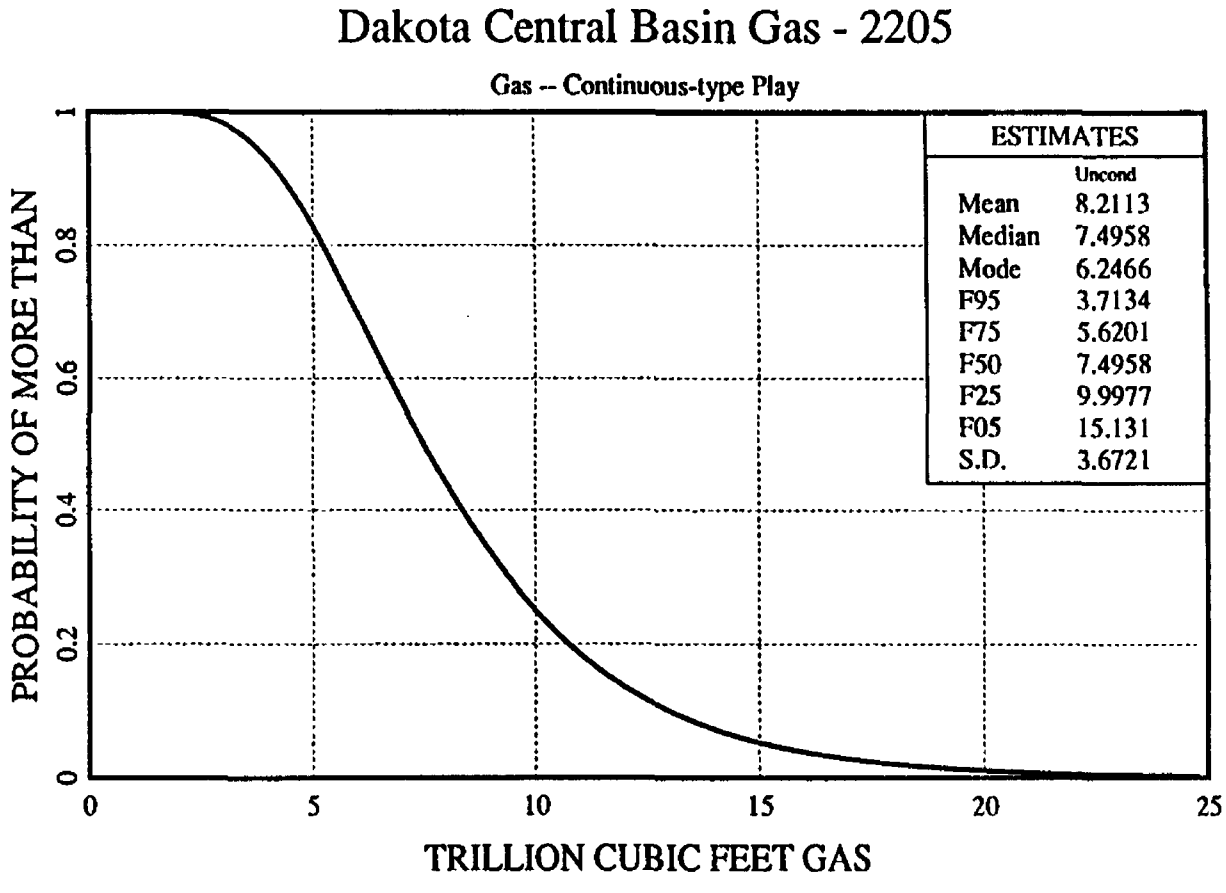


Figure 13. Potential additions to technically recoverable resources for Play 2103, Fractured Interbed.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

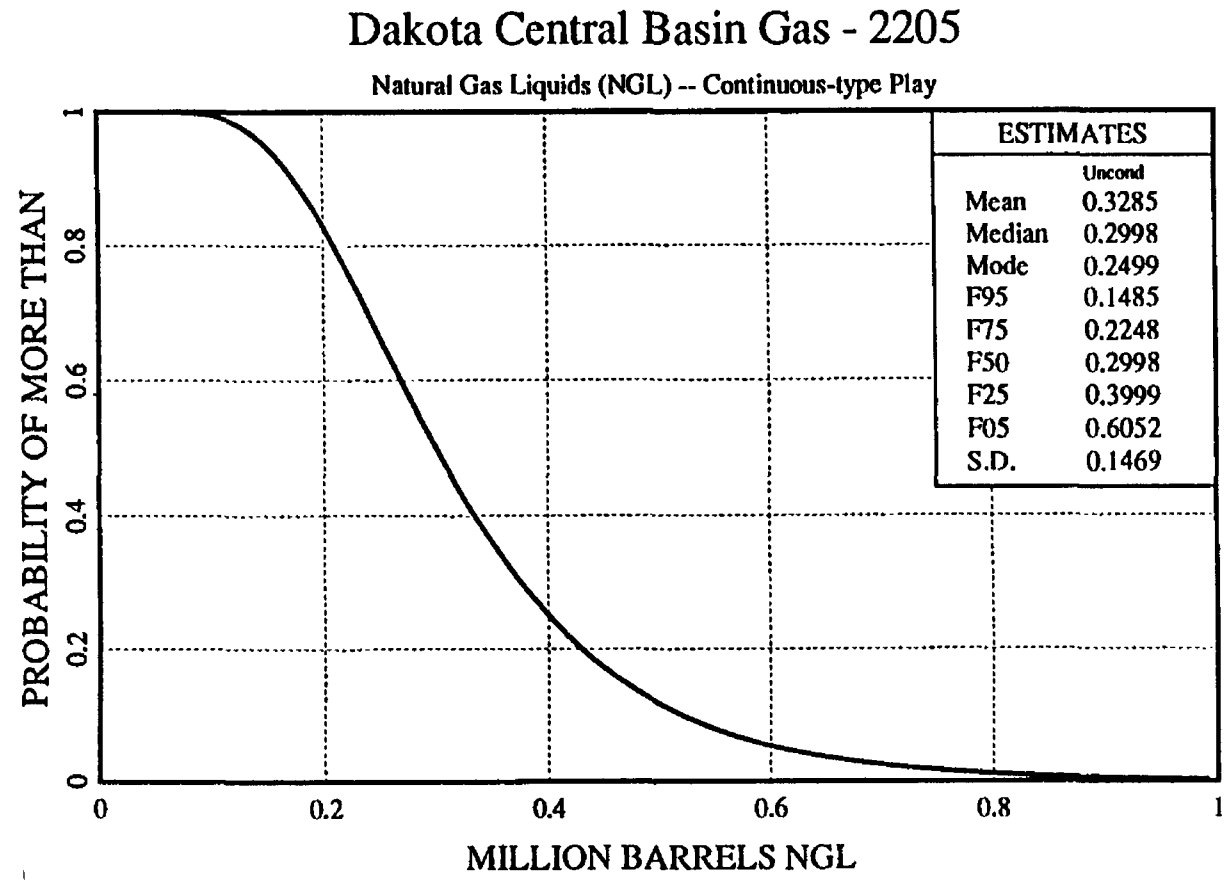
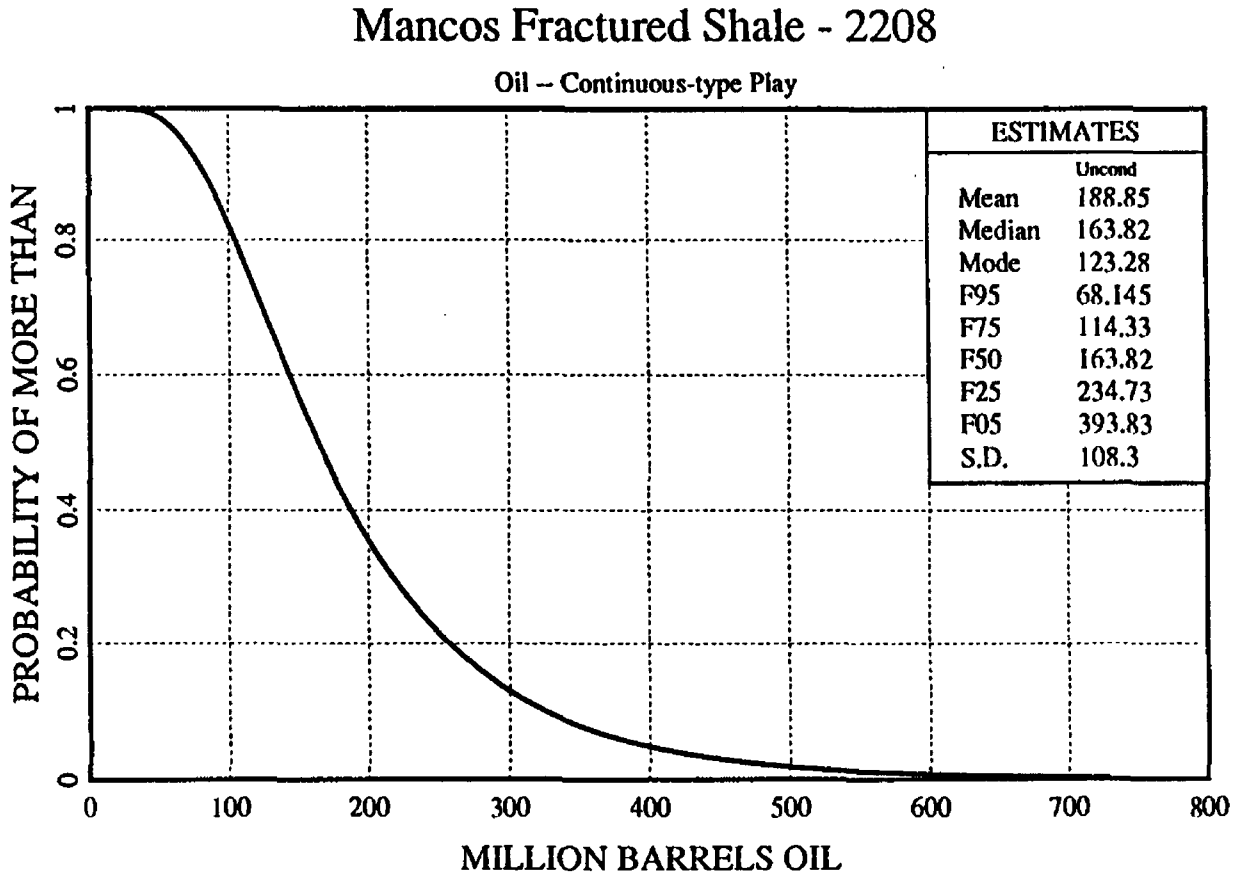


Figure 14. Potential additions to technically recoverable resources for Play 2205, Dakota Central Basin Gas.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

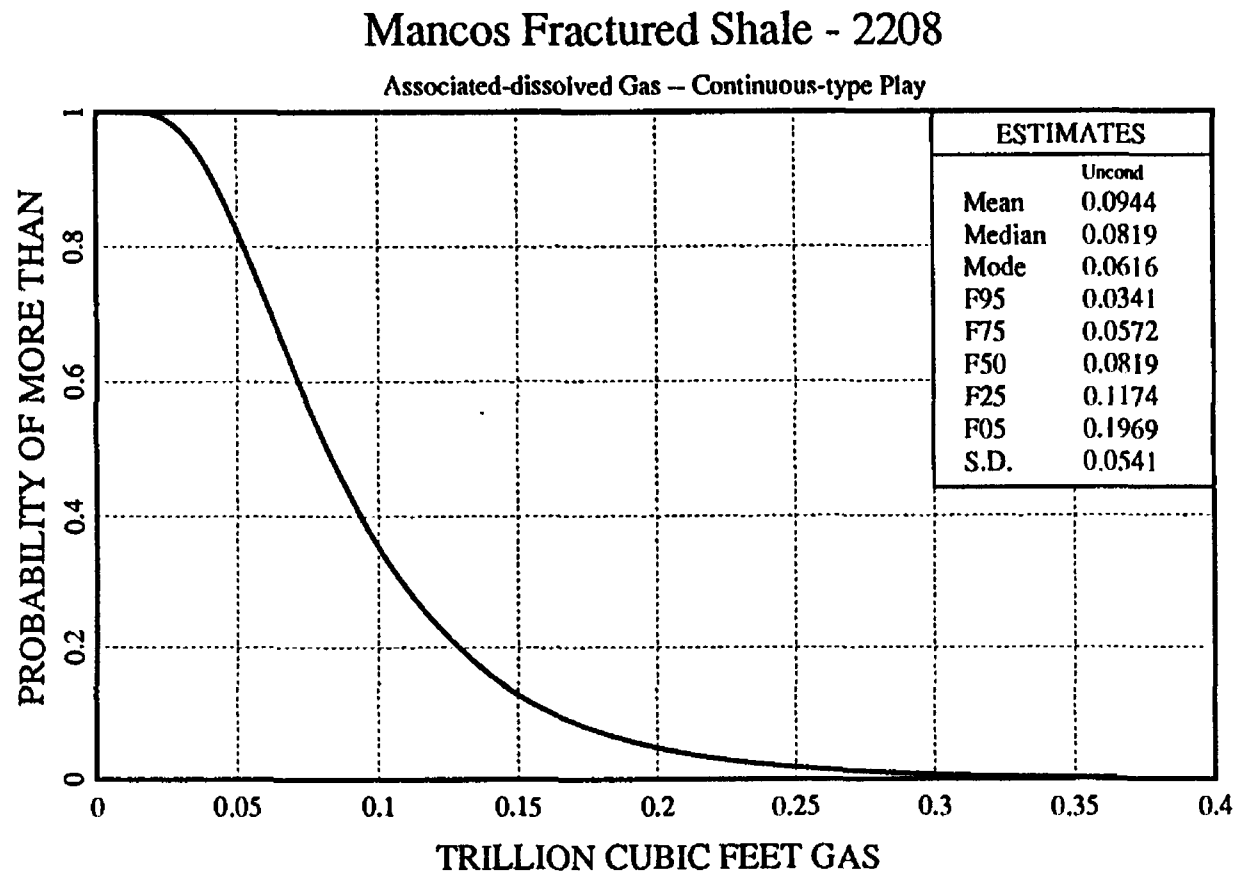
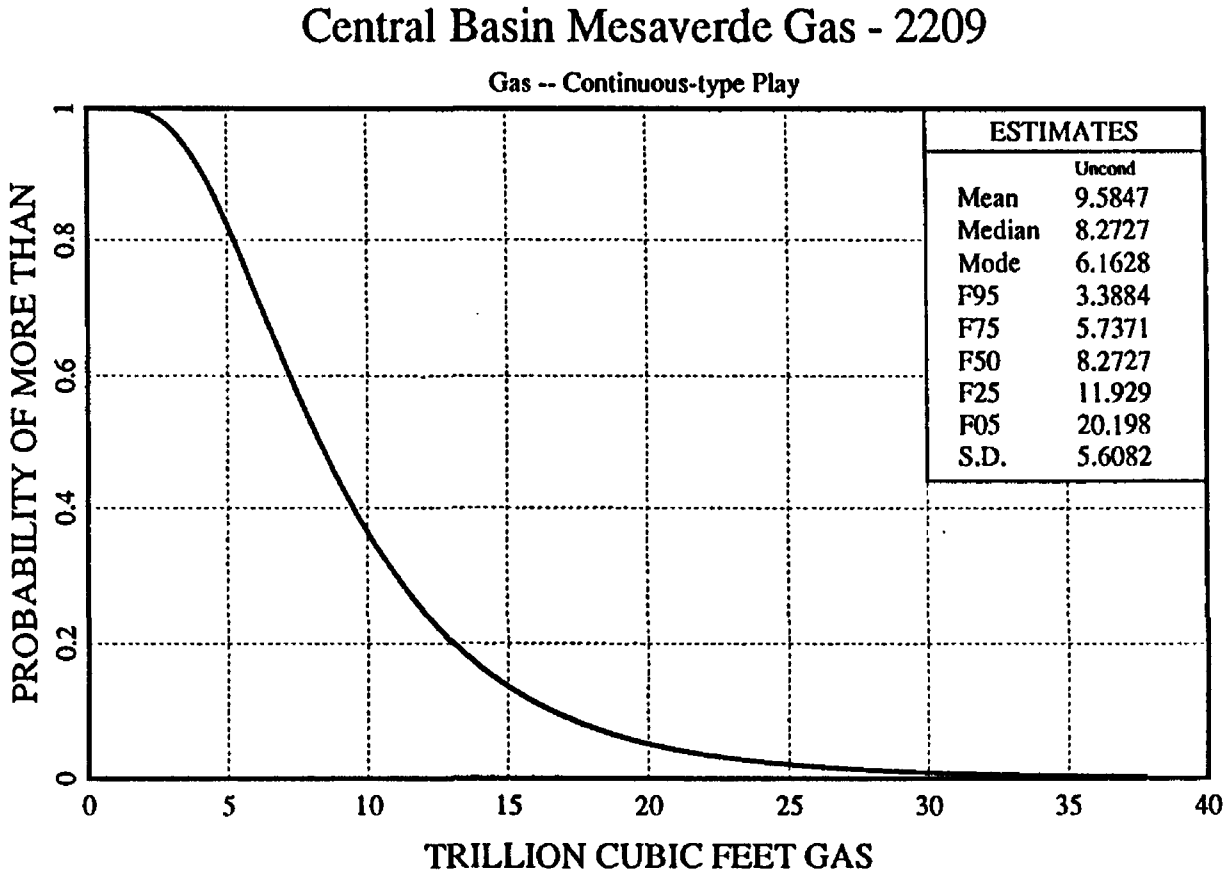


Figure 15. Potential additions to technically recoverable resources for Play 2208, Mancos Fractured Shale.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

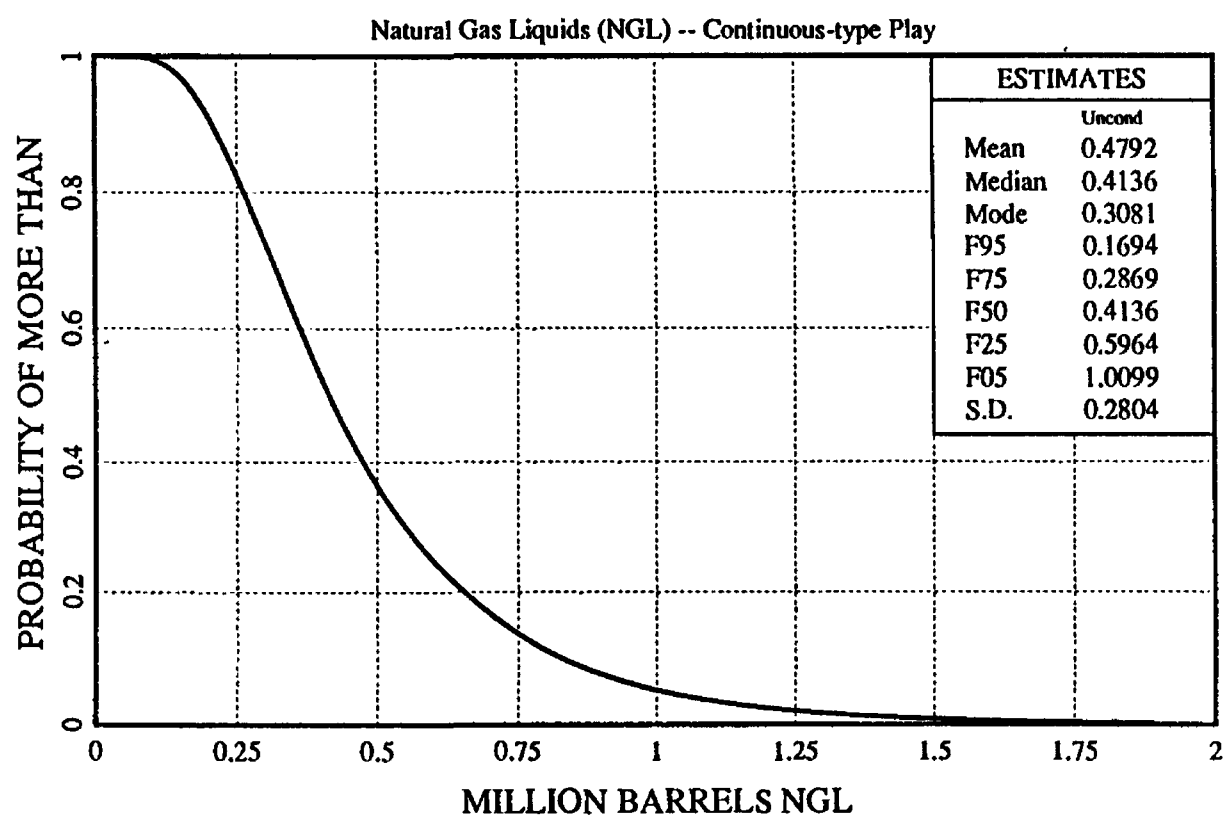
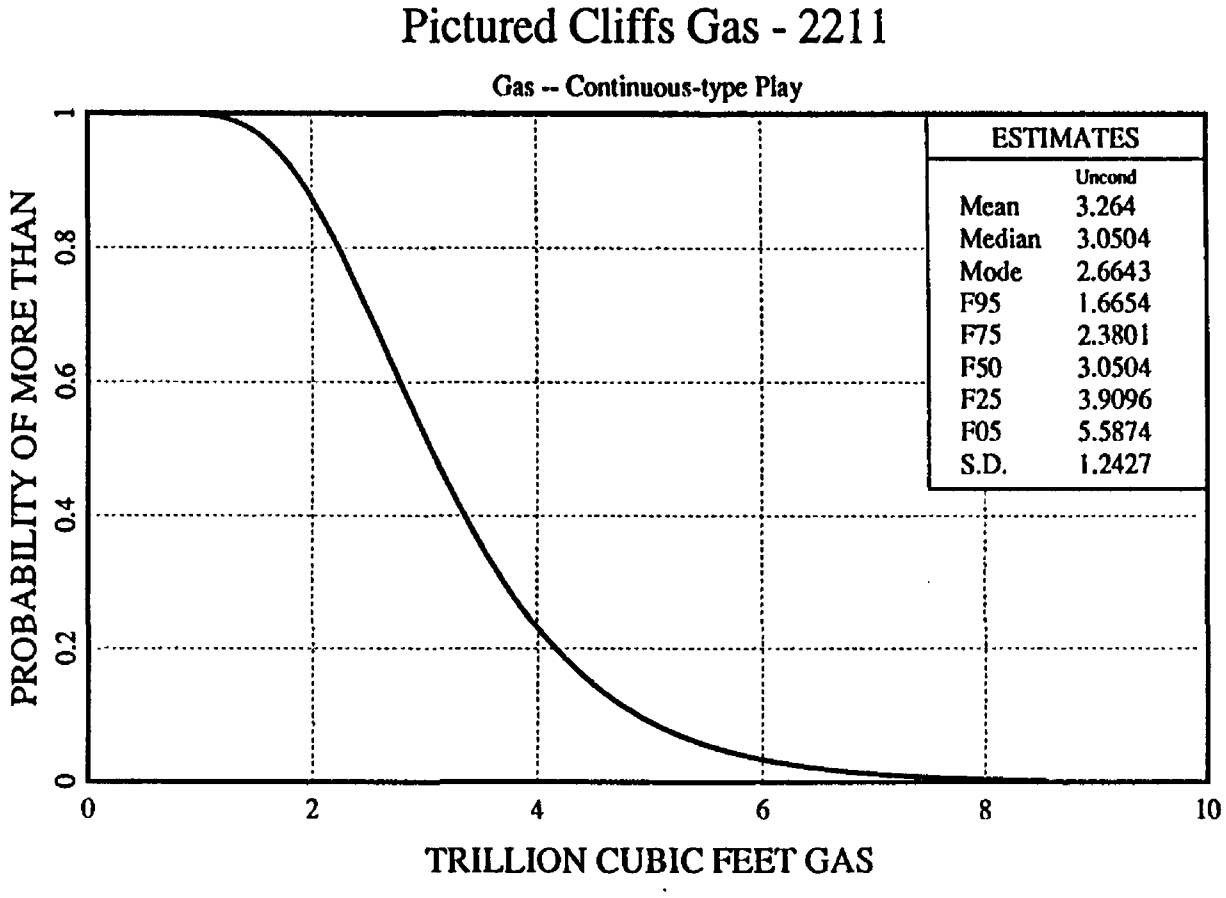


Figure 16. Potential additions to technically recoverable resources for Play 2209, Central Basin Mesaverde Gas.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

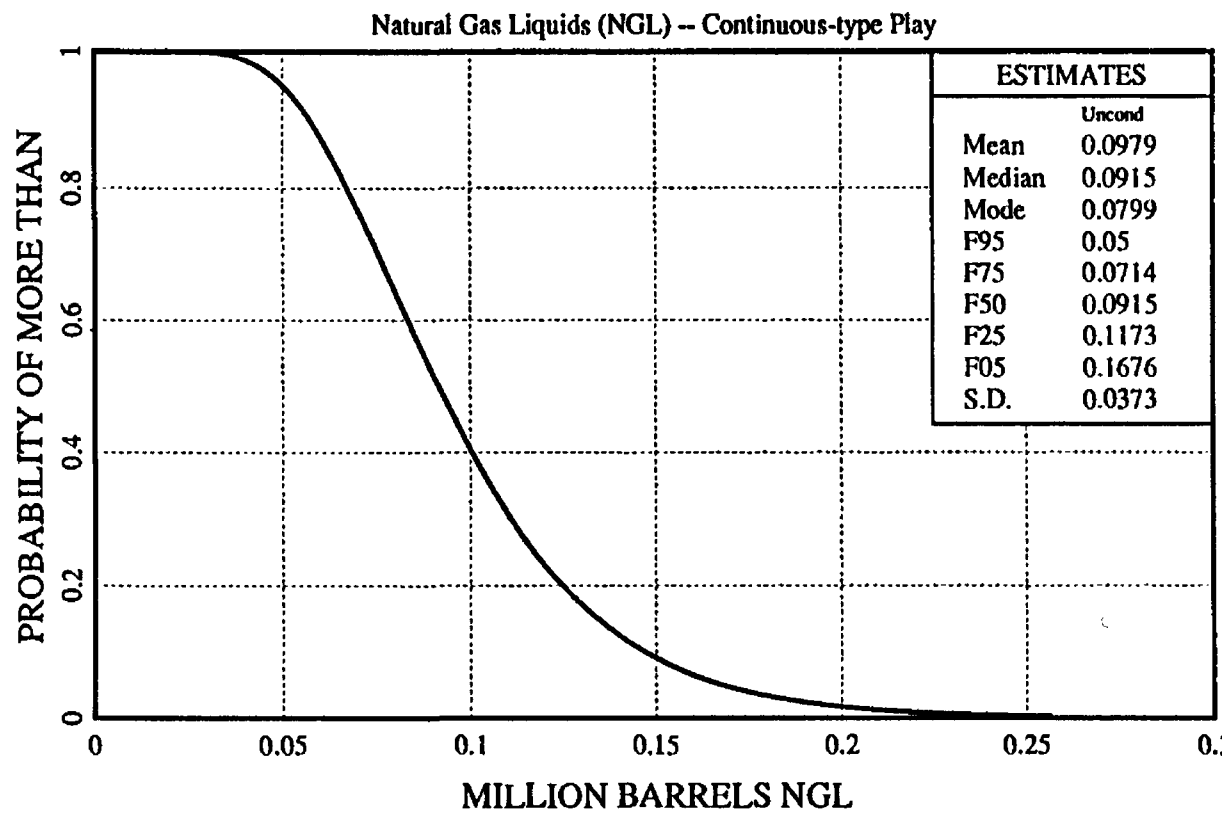
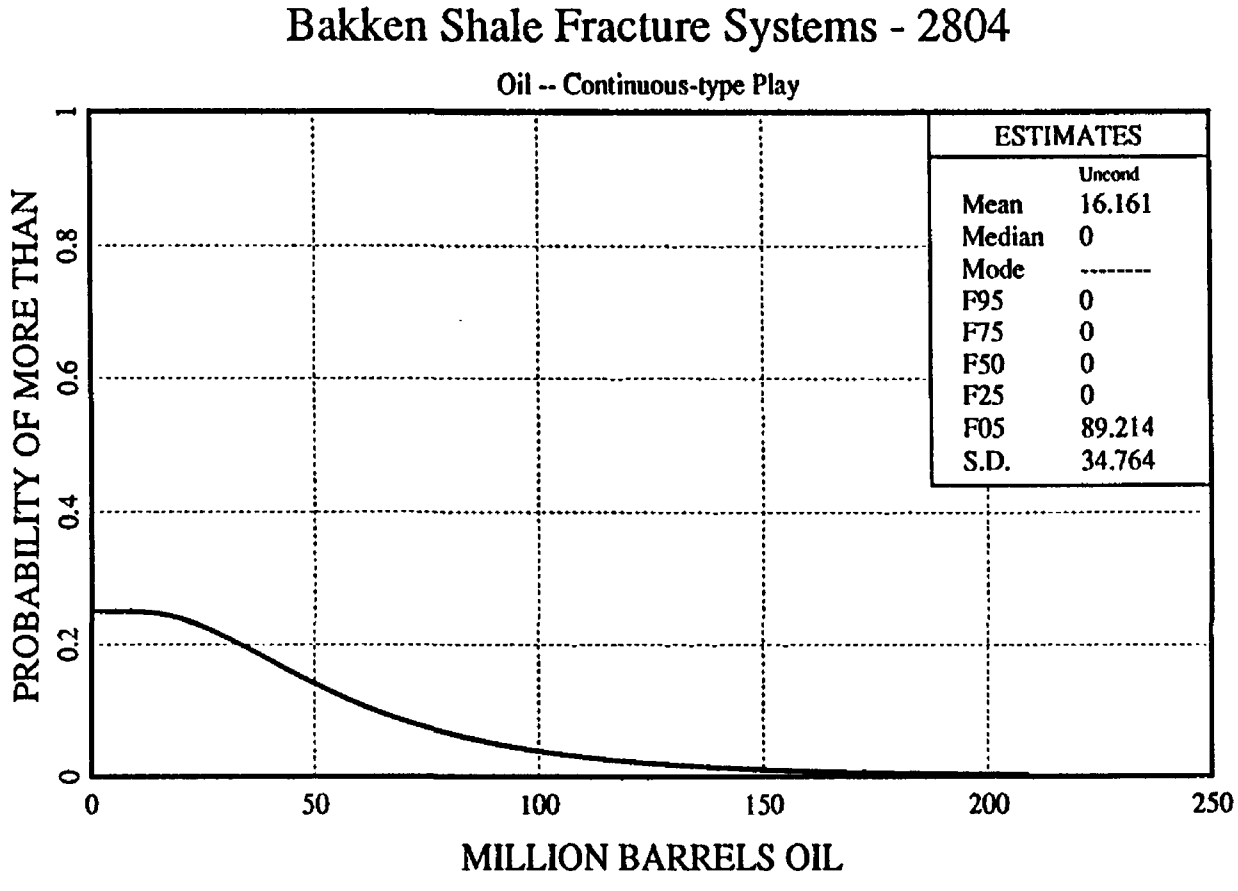


Figure 17. Potential additions to technically recoverable resources for Play 2211, Pictured Cliffs Gas.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

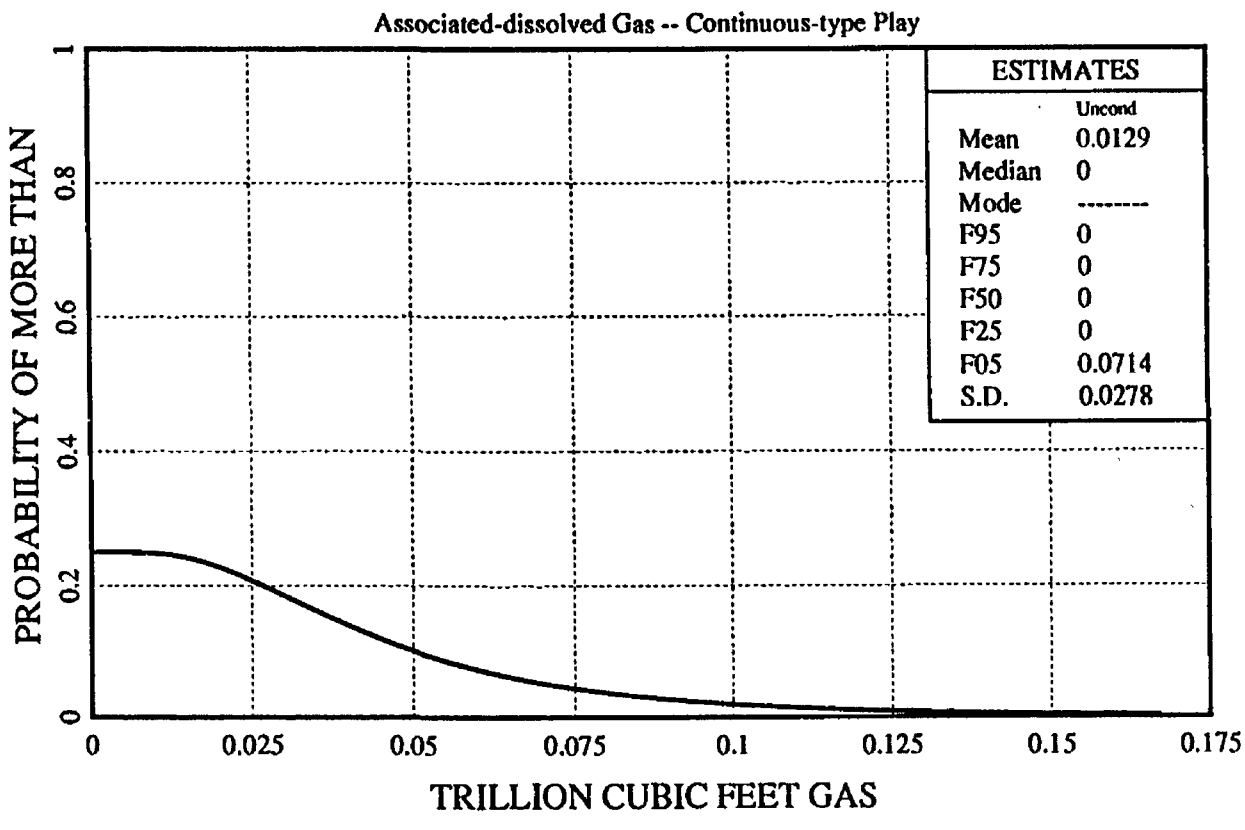
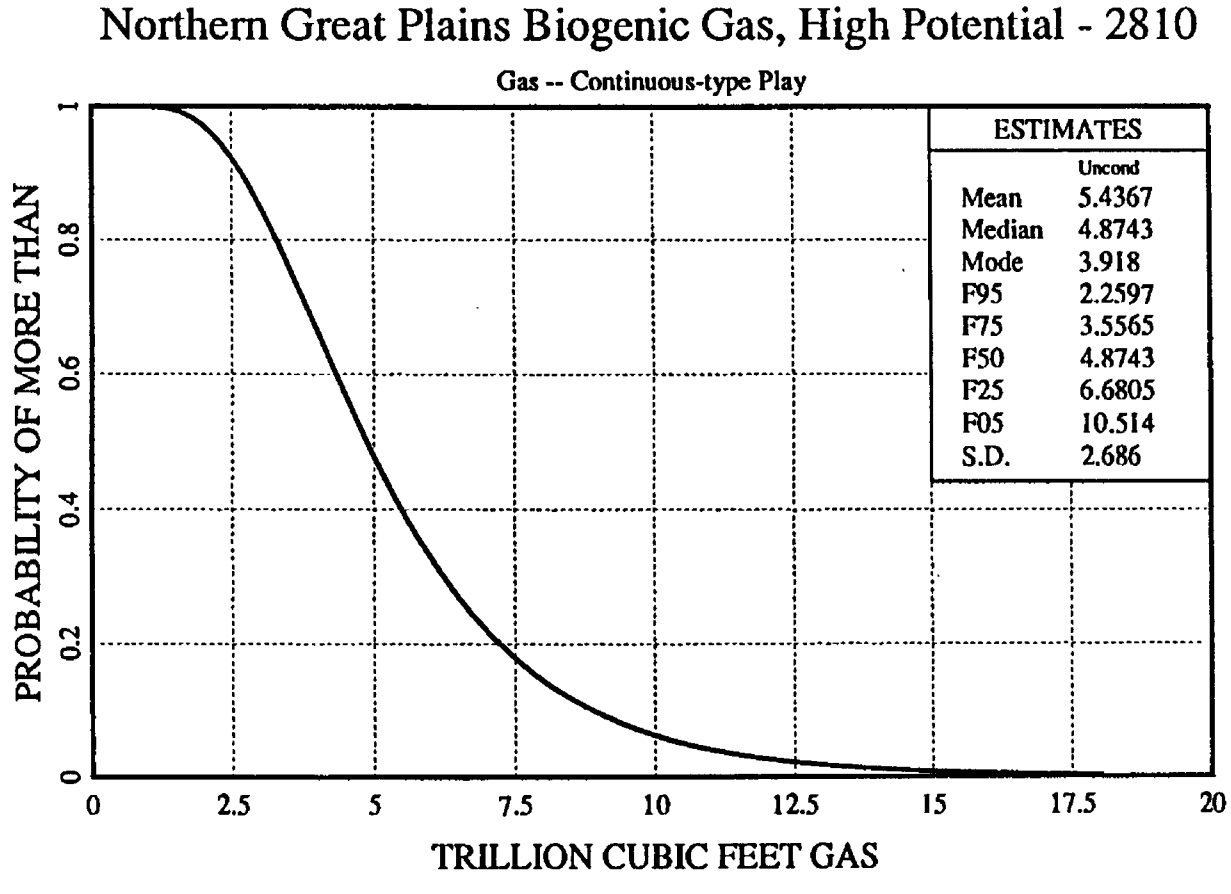
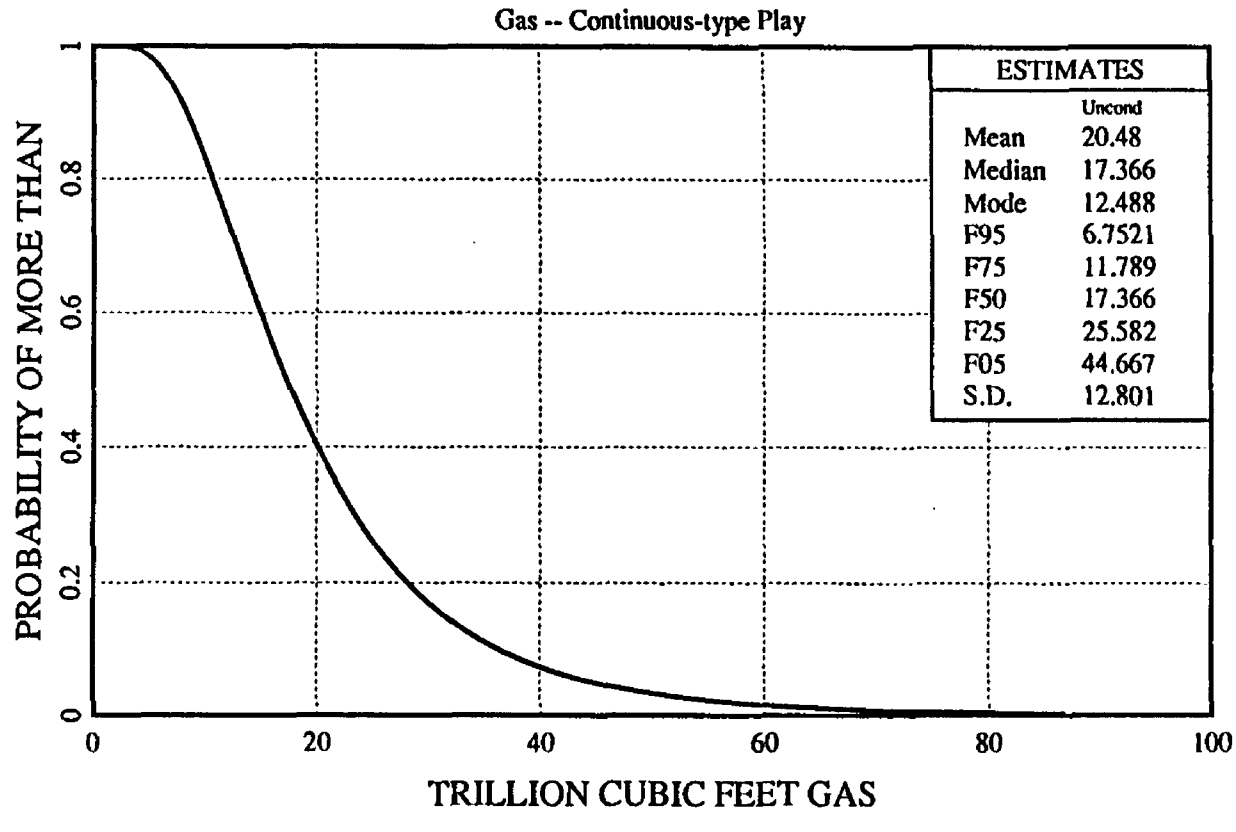


Figure 18. Potential additions to technically recoverable resources for Play 2804, Bakken Shale Fracture Systems.



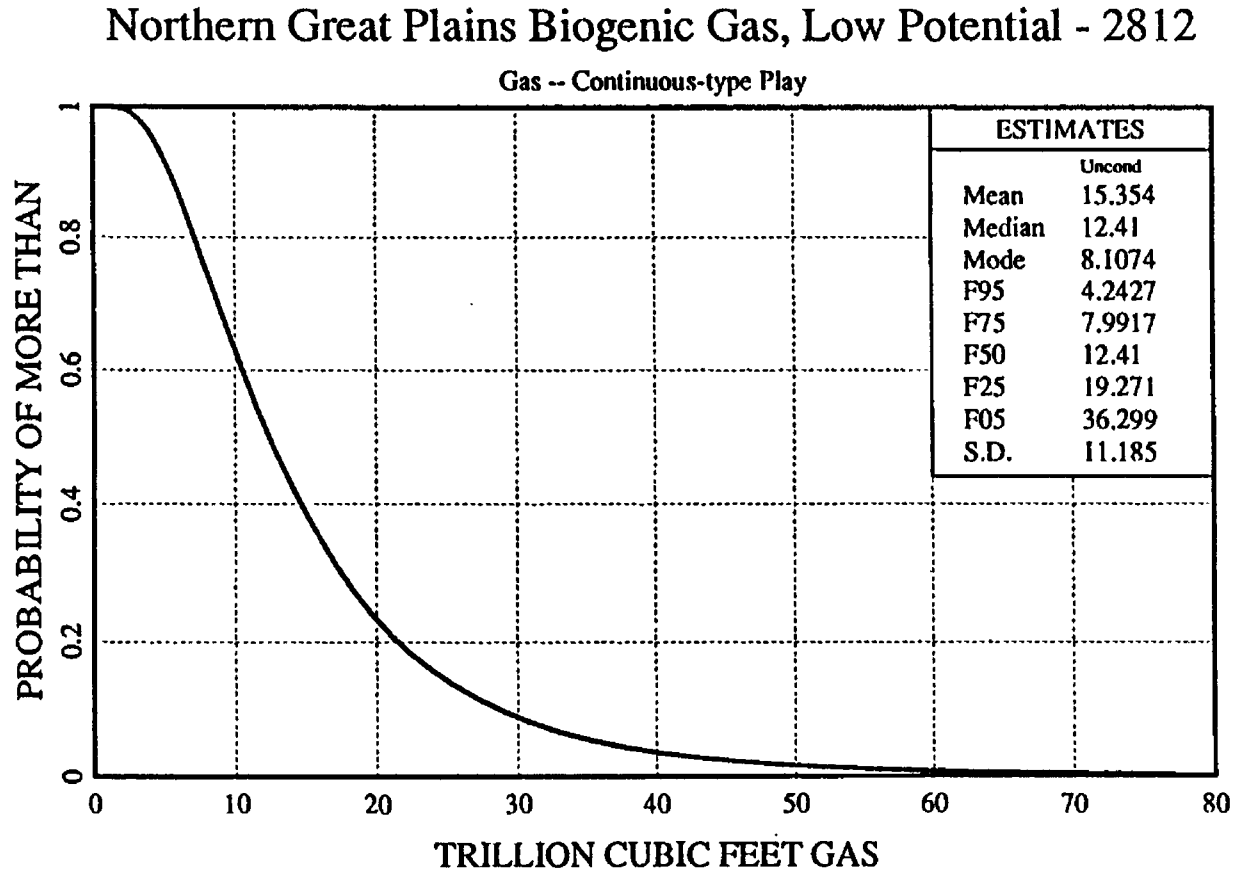
[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 19. Potential additions to technically recoverable resources for Play 2810, Northern Great Plains Biogenic Gas, High Potential.



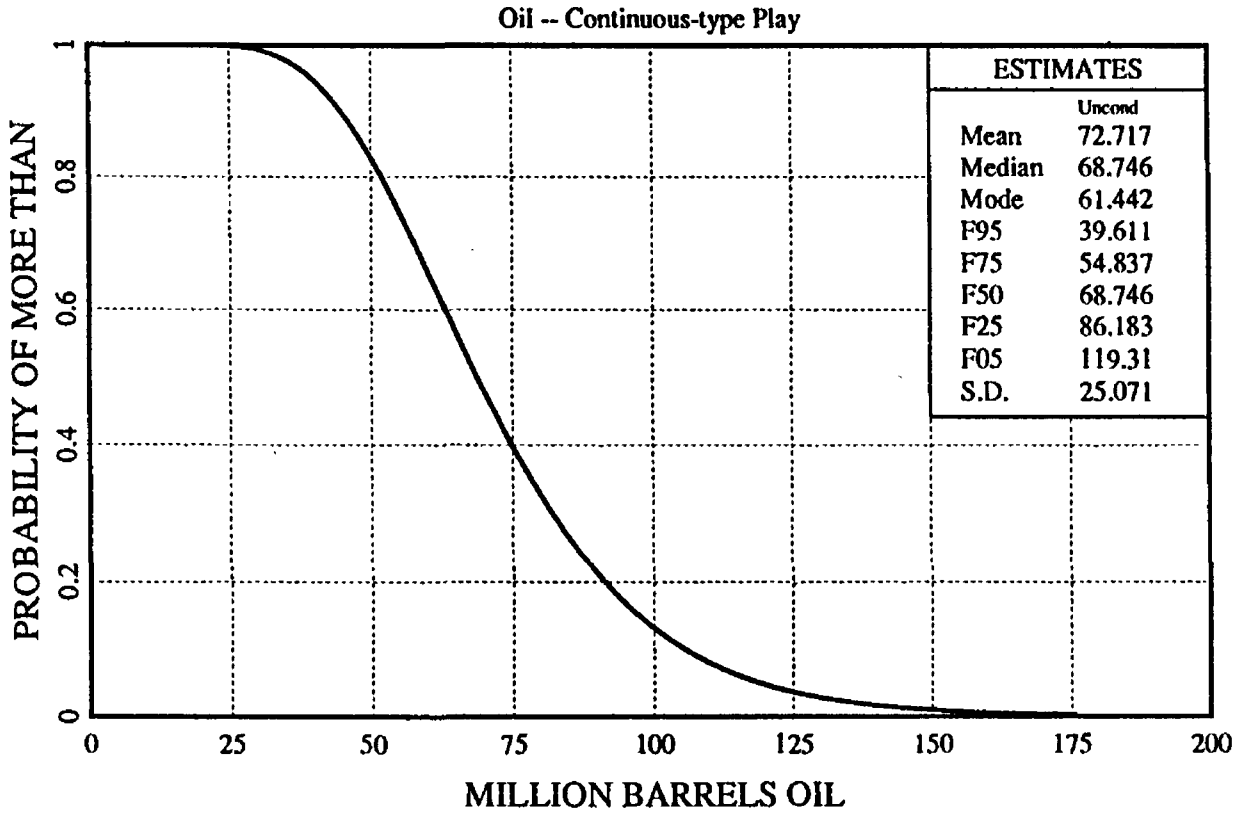
[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 20. Potential additions to technically recoverable resources for Play 2811, Northern Great Plains Biogenic Gas, Moderate Potential (Suffield Block Analog).



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 21. Potential additions to technically recoverable resources for Play 2812, Northern Great Plains Biogenic Gas, Low Potential.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

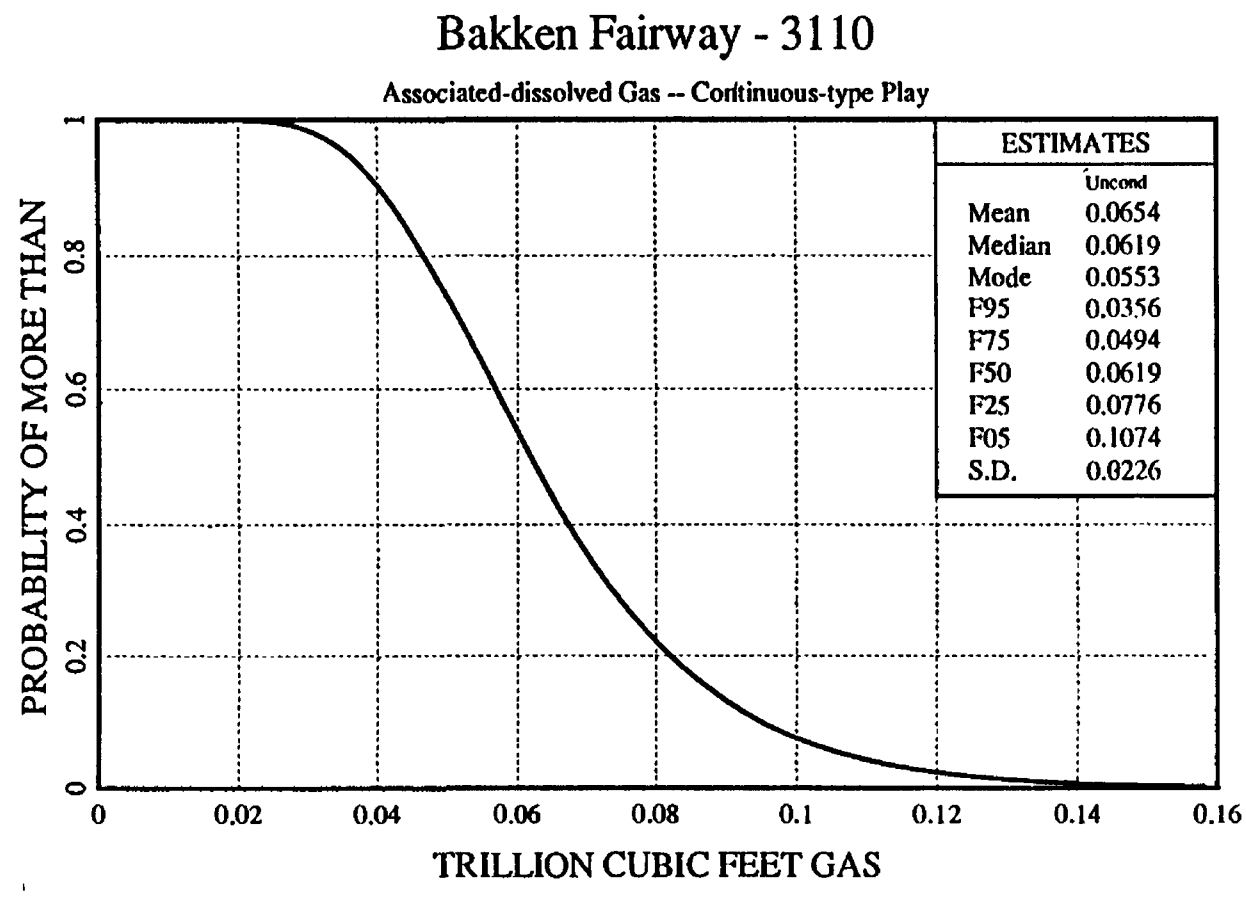
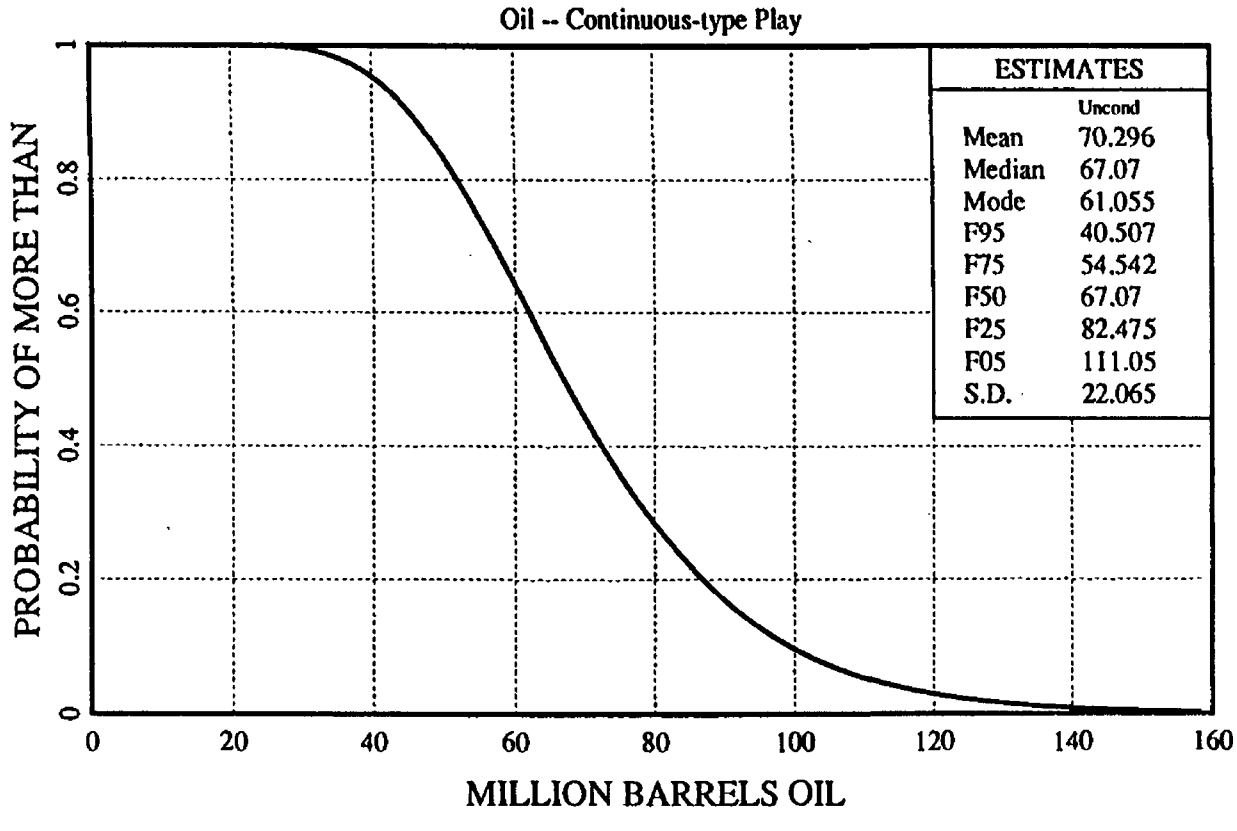
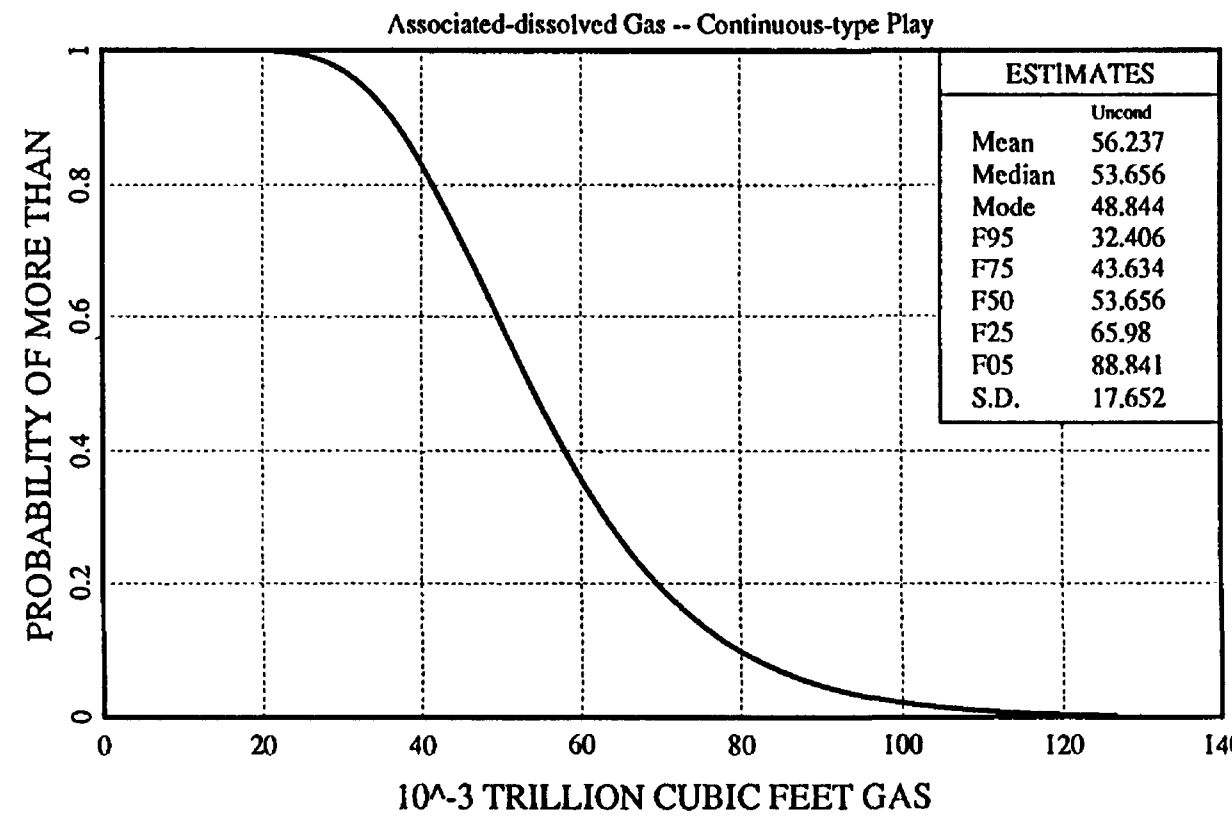


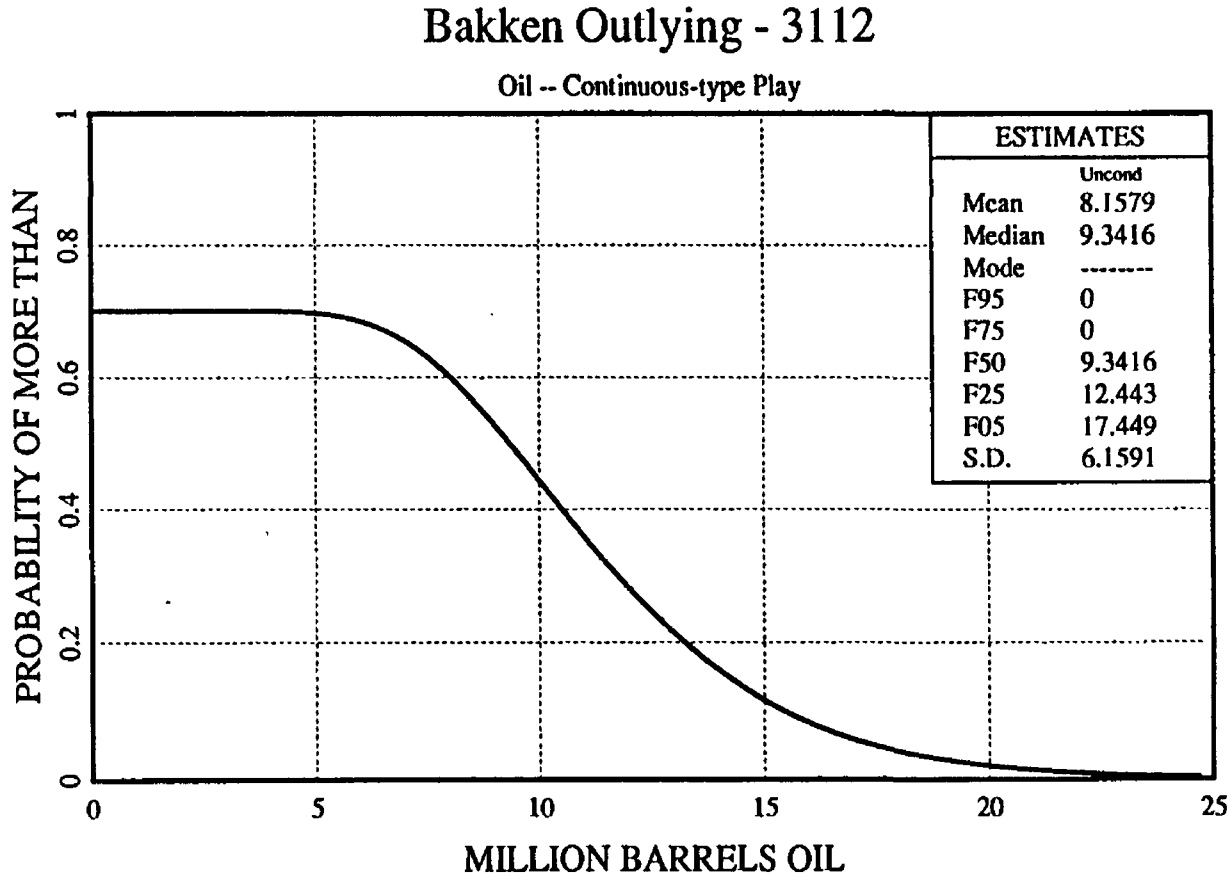
Figure 22. Potential additions to technically recoverable resources for Play 3110, Bakken Fairway.

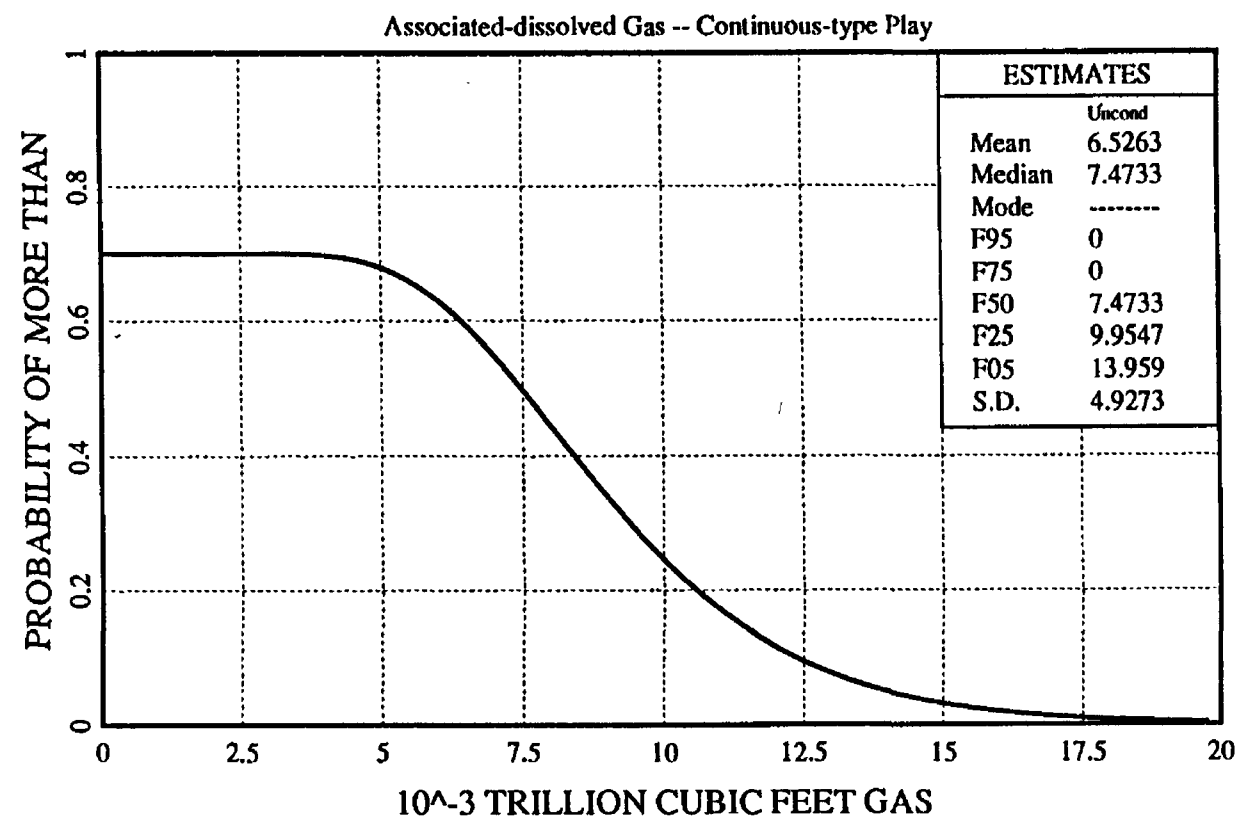




[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

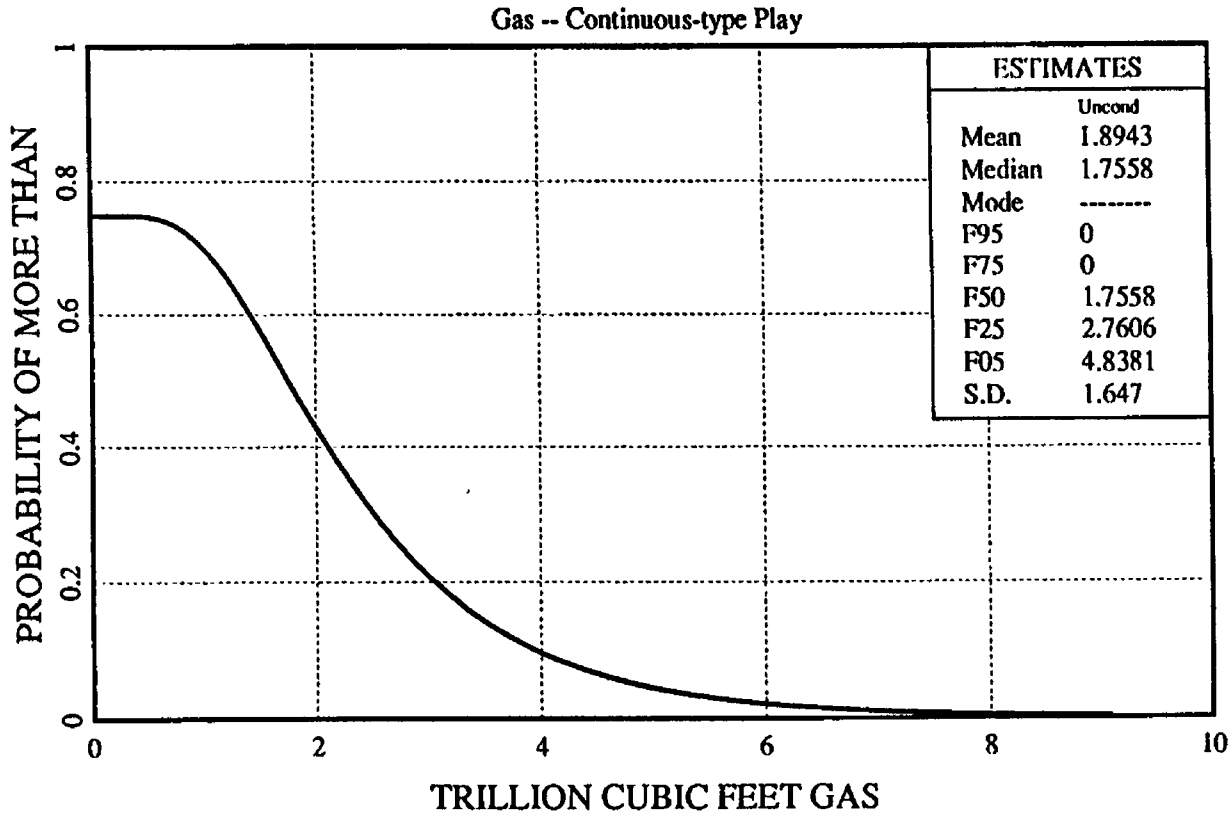
Figure 23. Potential additions to technically recoverable resources for Play 3111, Bakken Intermediate.





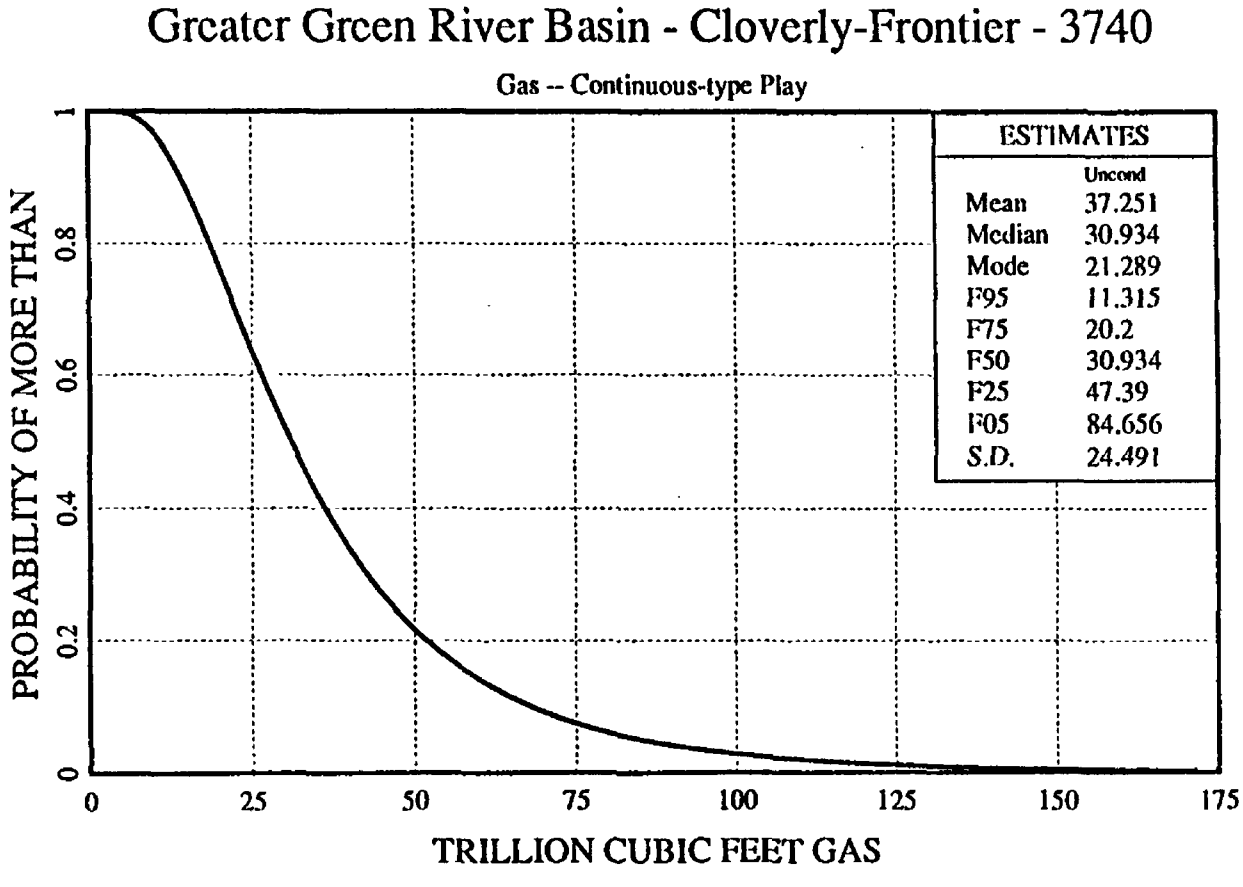
[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 24. Potential additions to technically recoverable resources for Play 3112, Bakken Outlying.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 25. Potential additions to technically recoverable resources for Play 3113, Southern Williston Basin Margin - Niobrara Shallow Biogenic.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

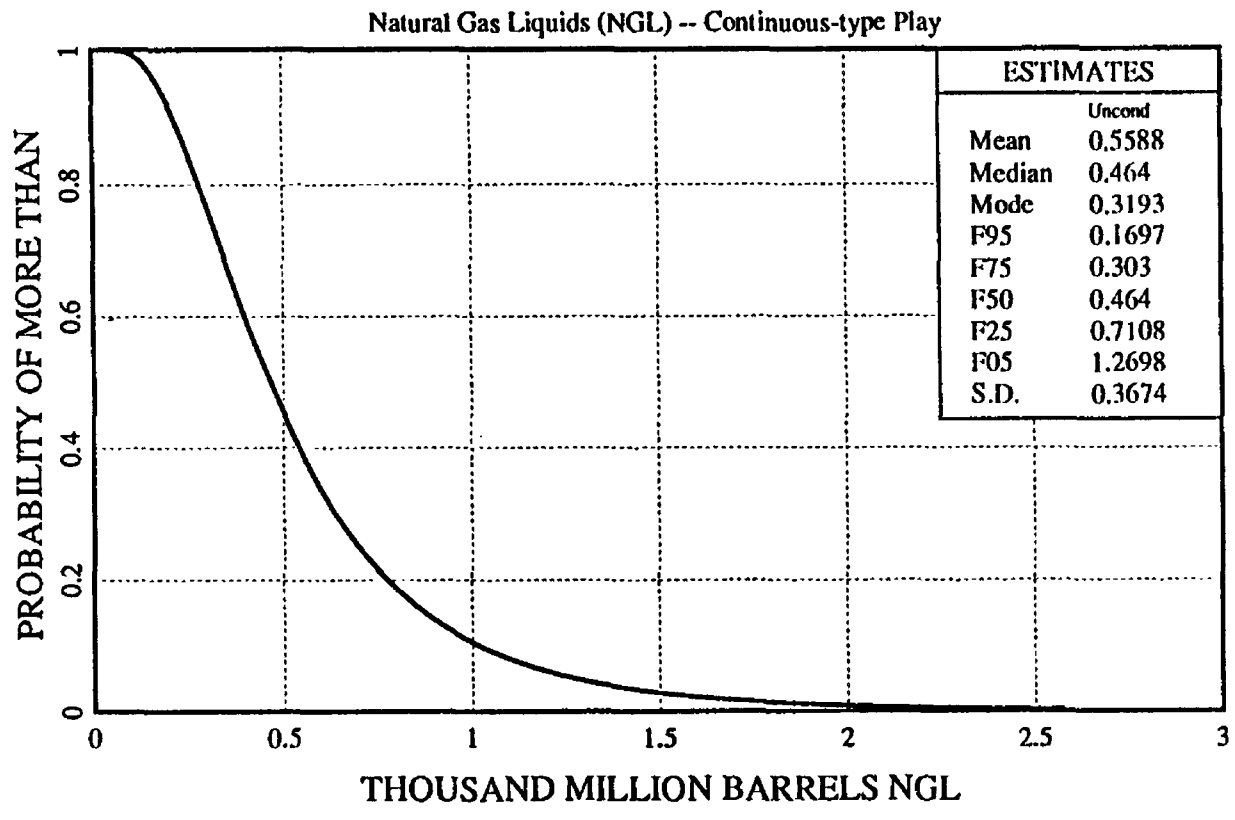
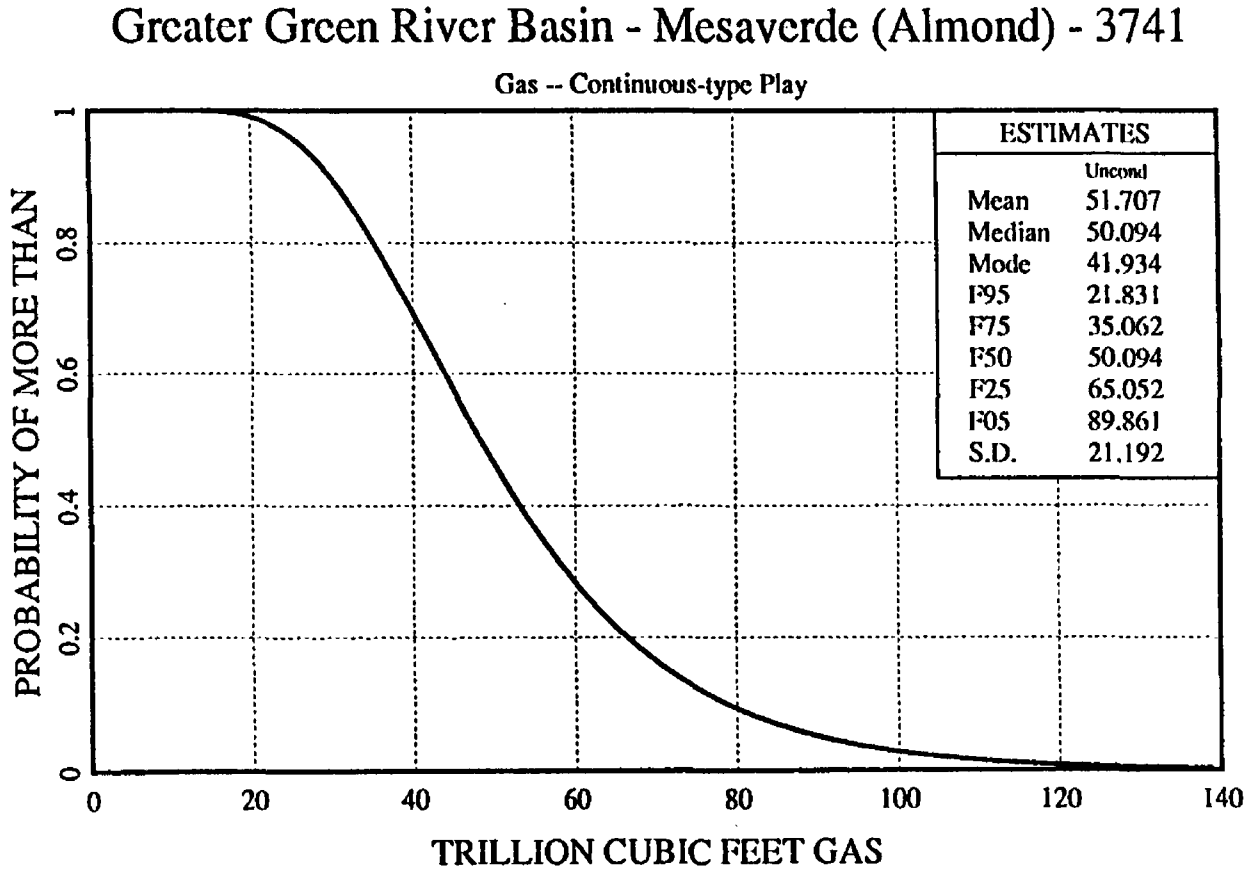


Figure 26. Potential additions to technically recoverable resources for Play 3740, Greater Green River Basin - Cloverly-Frontier.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

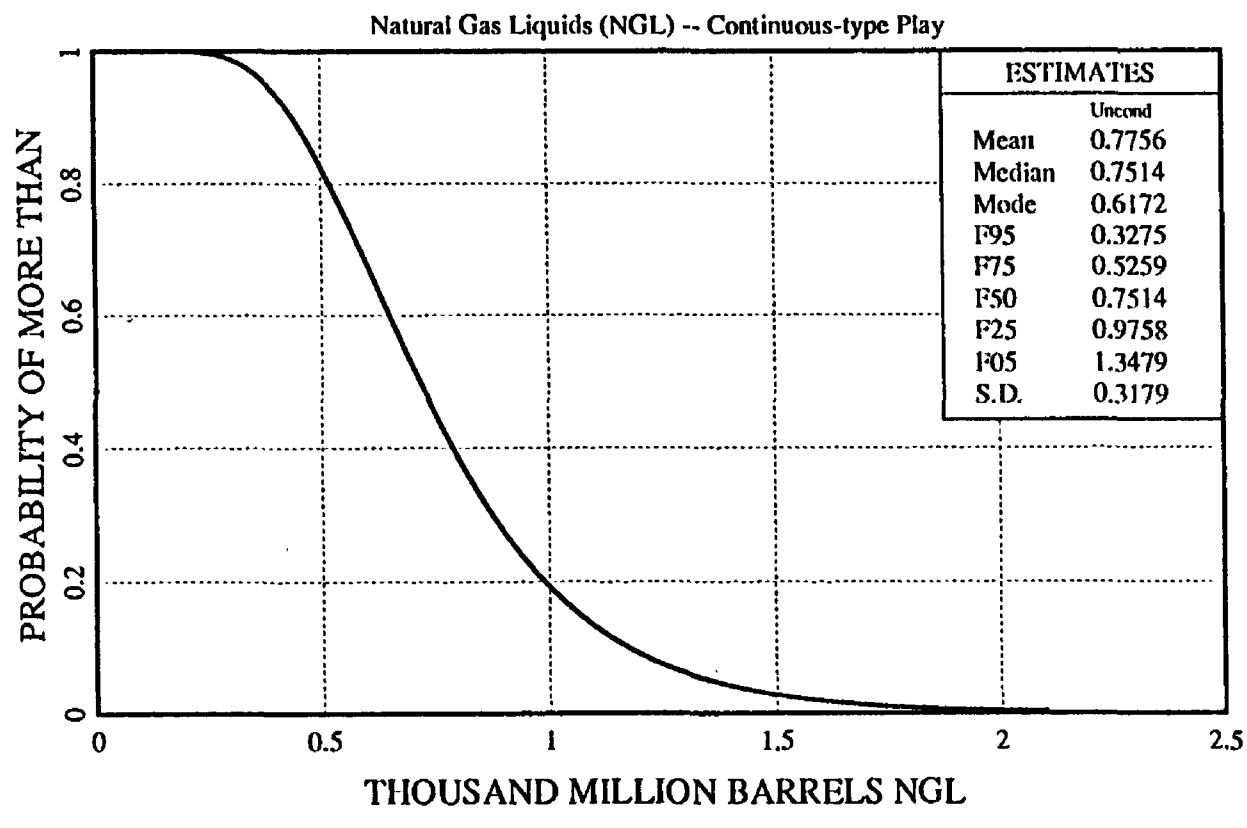
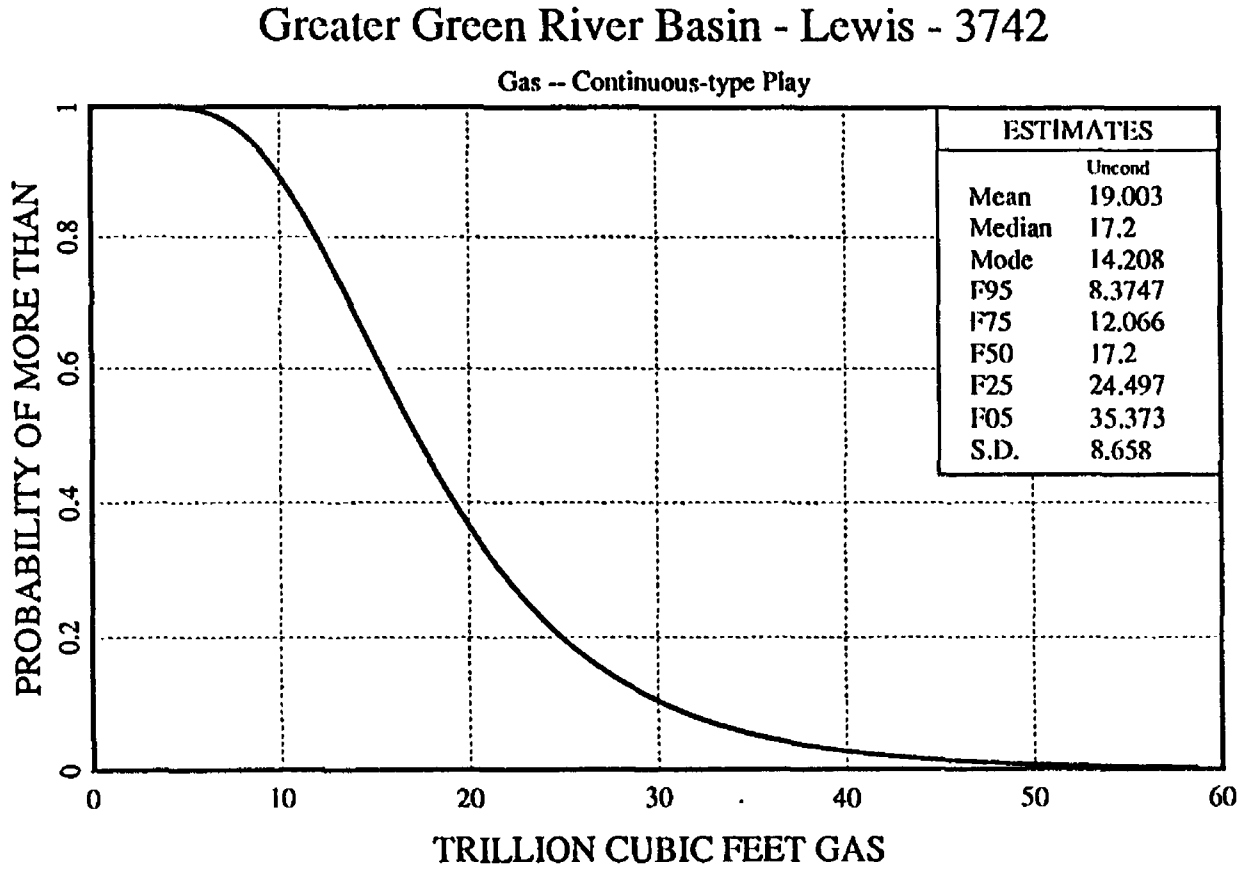


Figure 27. Potential additions to technically recoverable resources for Play 3741, Greater Green River Basin - Mesaverde.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

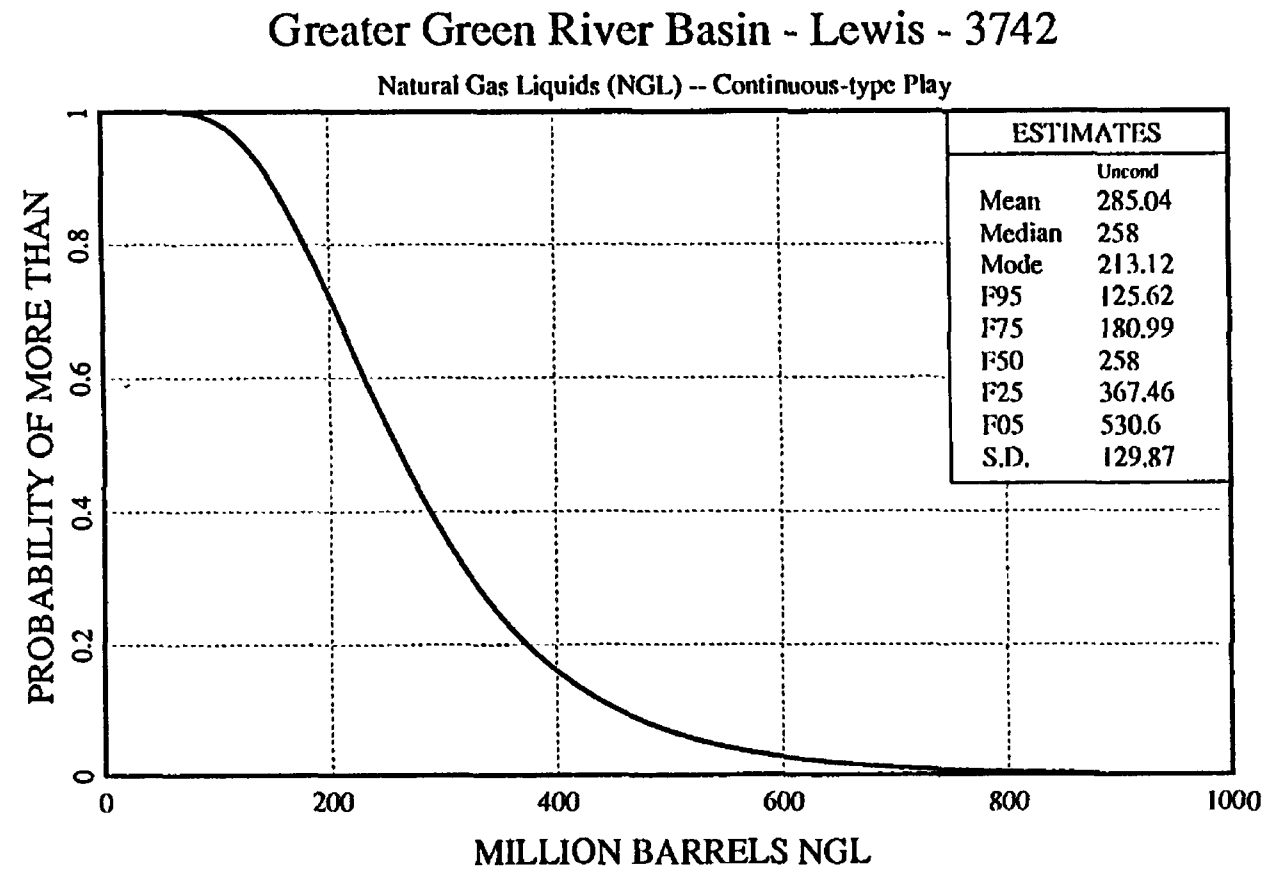
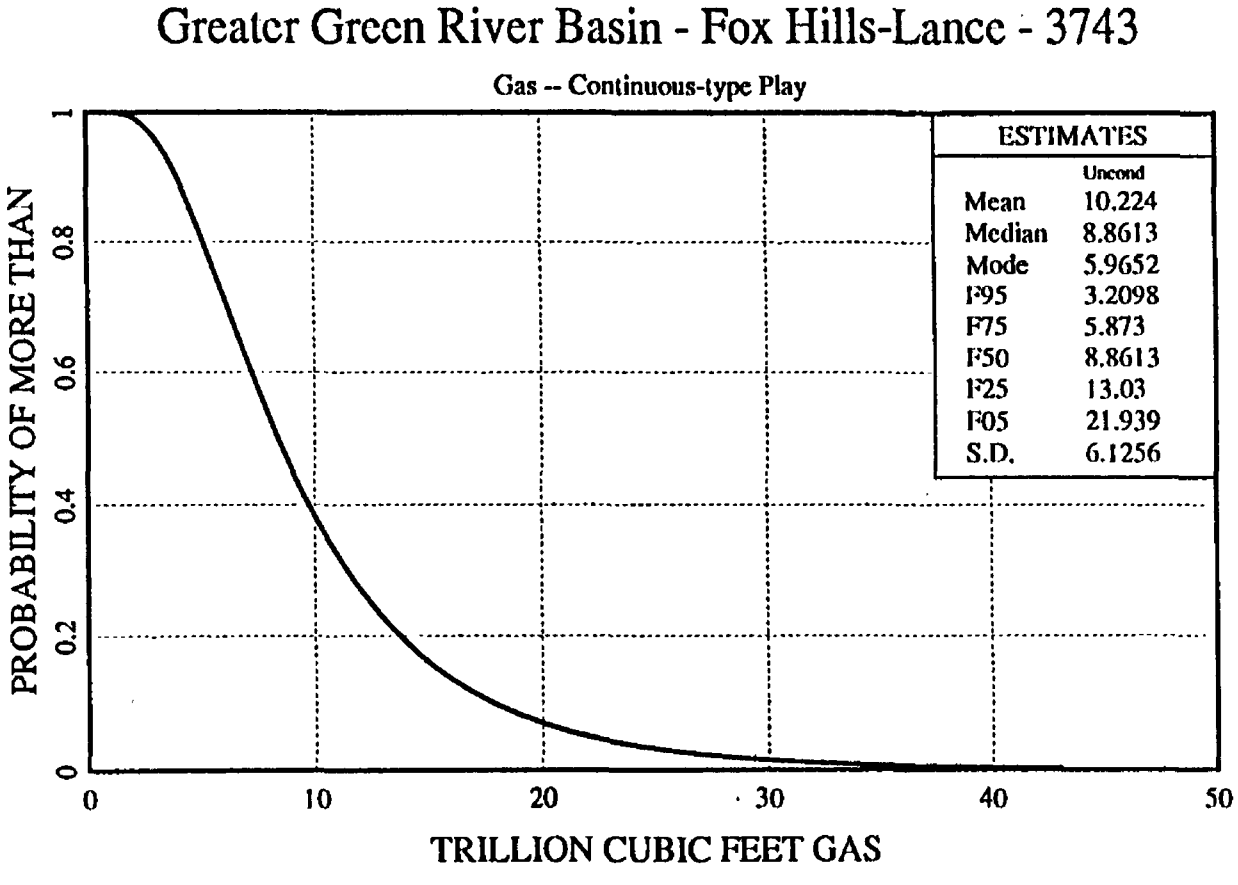


Figure 28. Potential additions to technically recoverable resources for Play 3742, Greater Green River Basin - Lewis.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

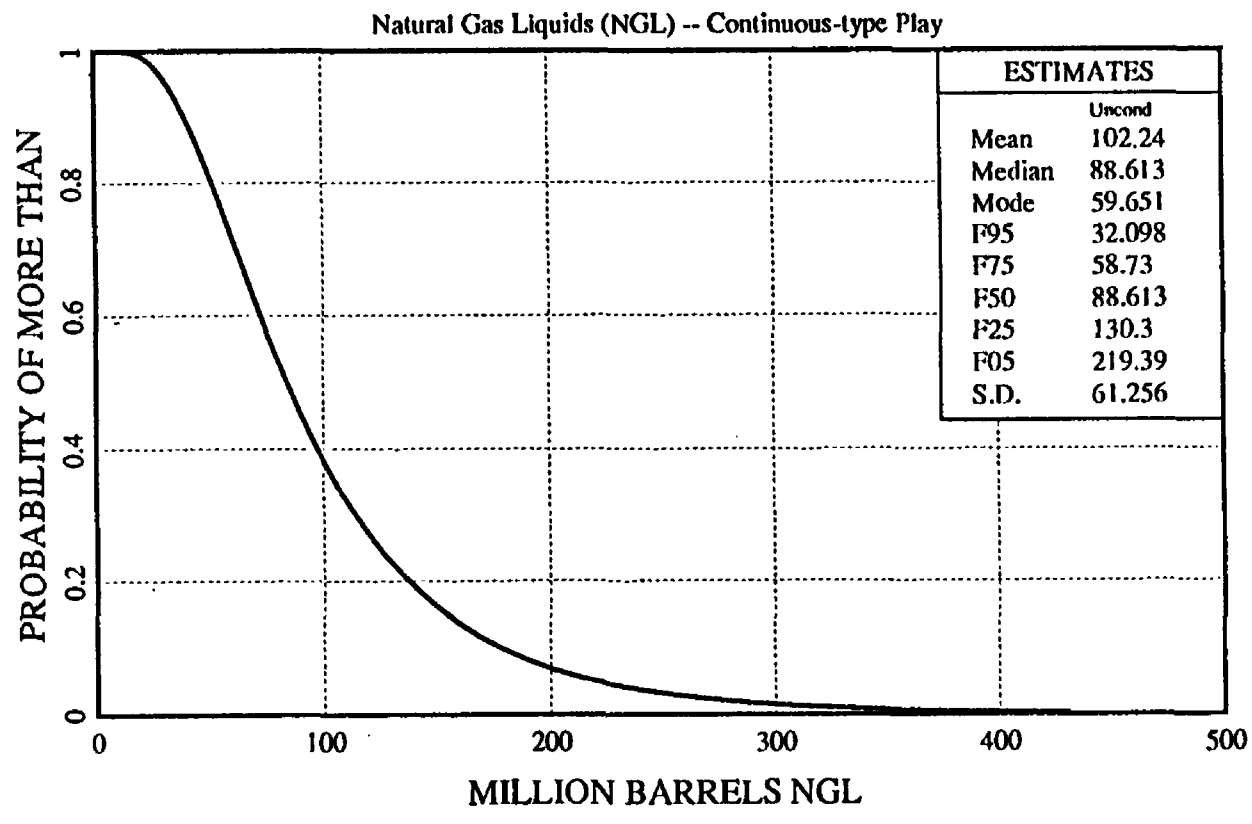
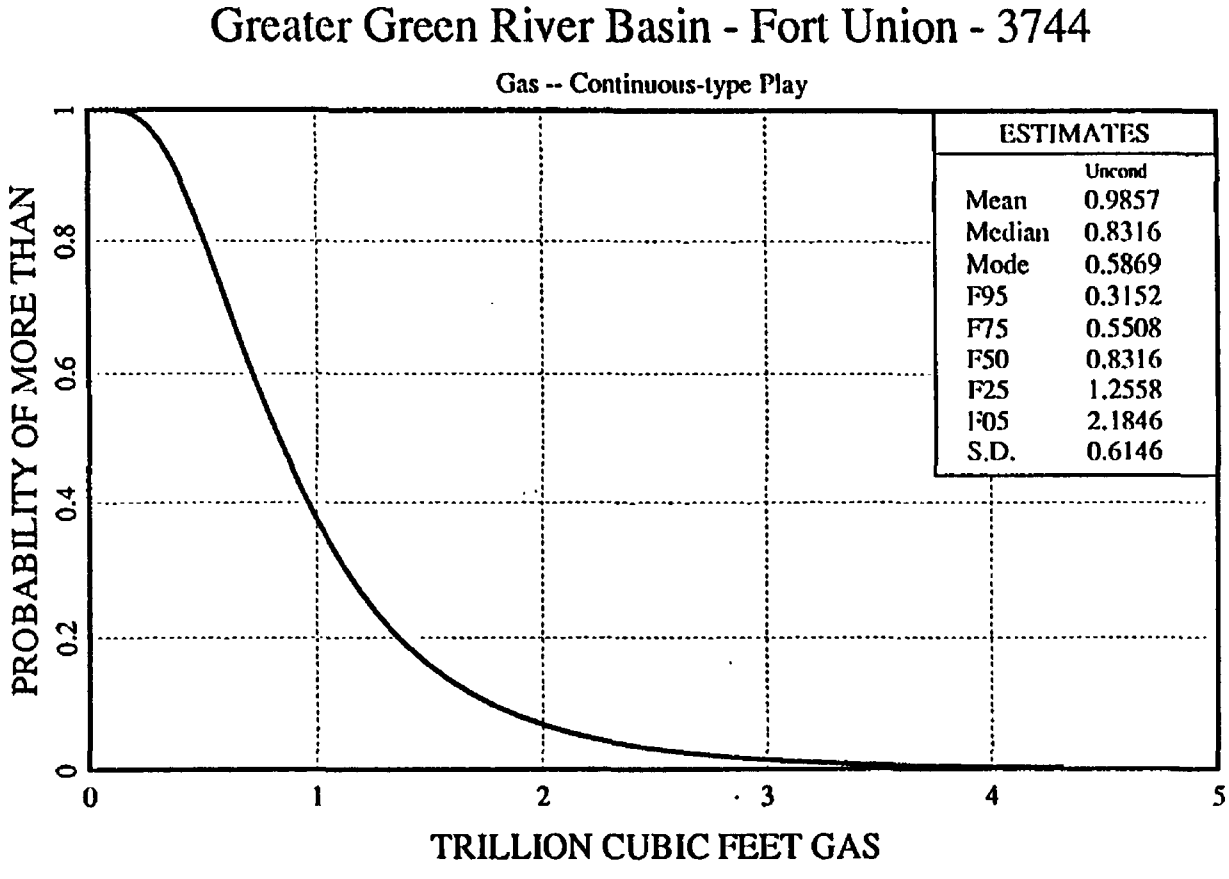


Figure 29. Potential additions to technically recoverable resources for Play 3743, Greater Green River Basin - Fox Hills-Lance.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

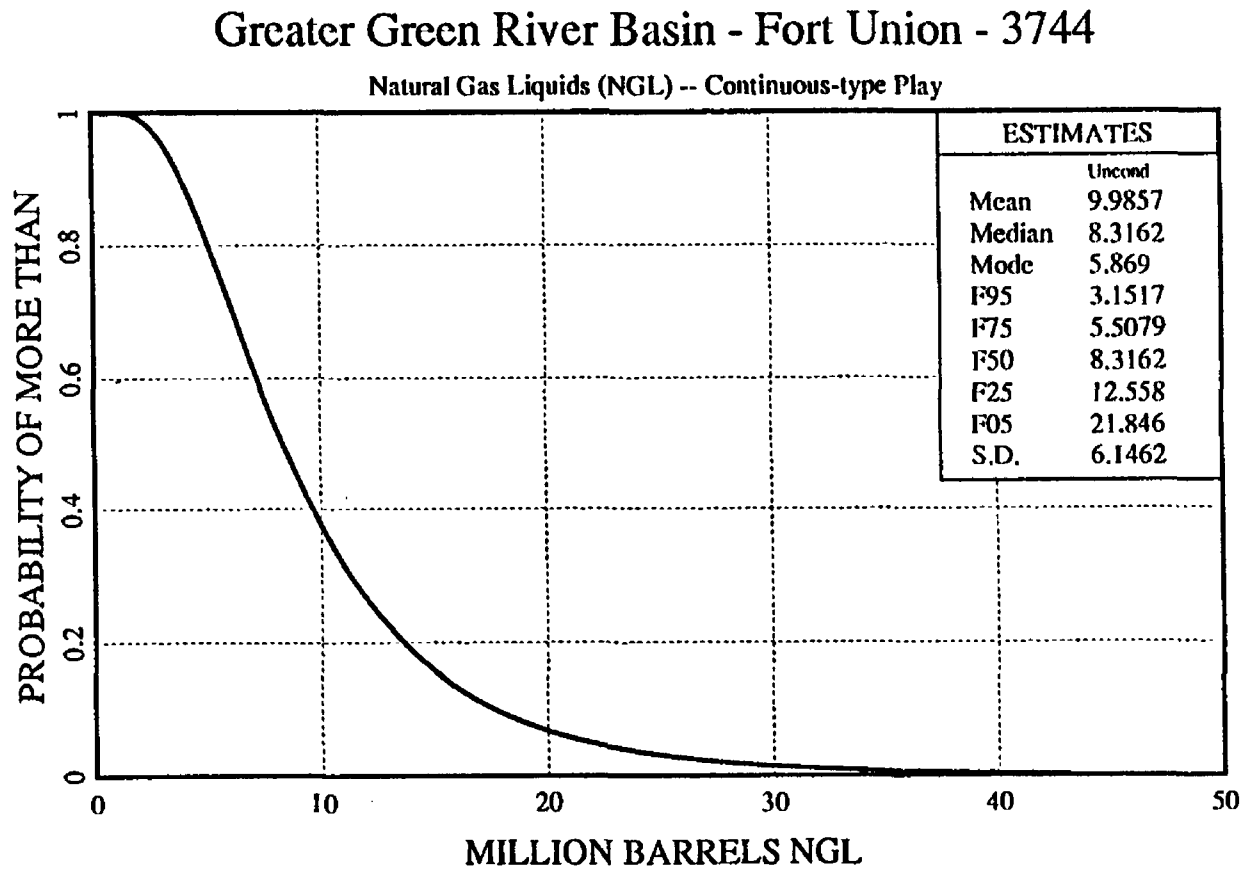
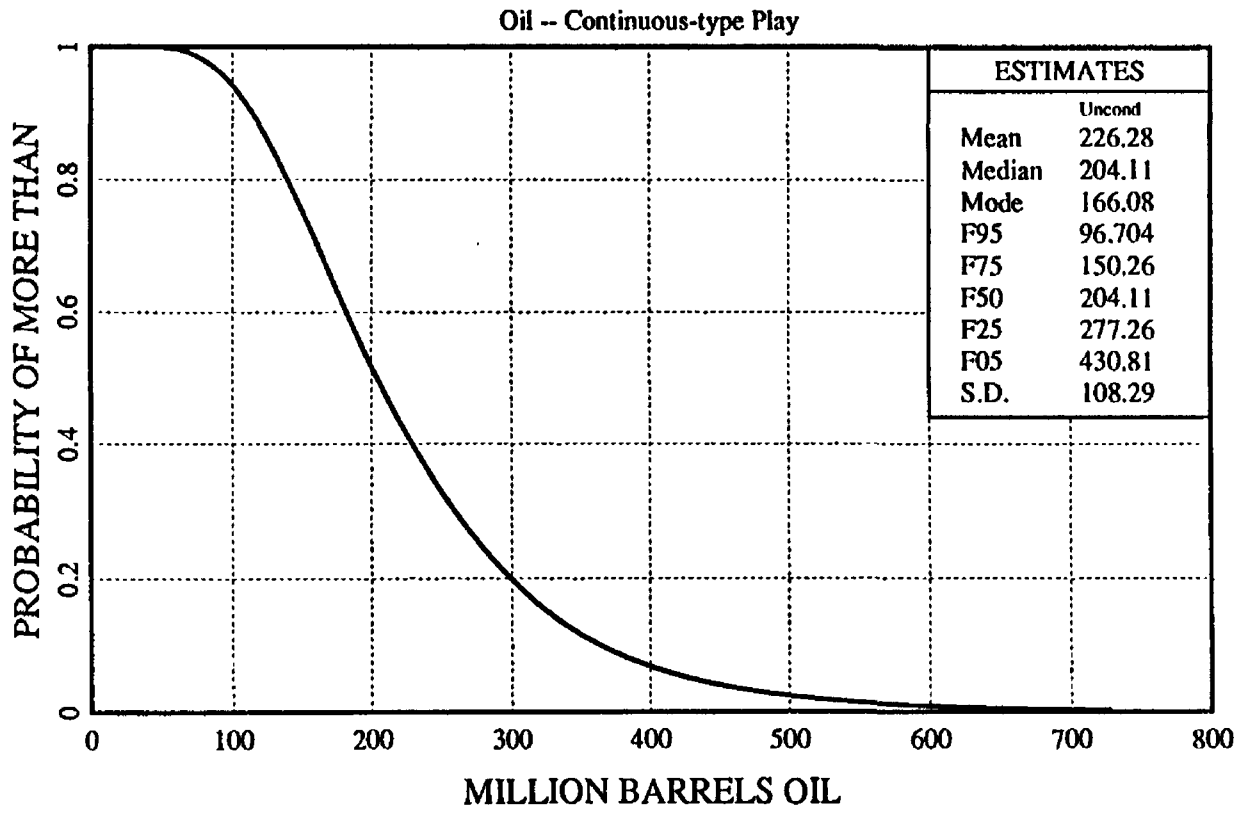


Figure 30. Potential additions to technically recoverable resources for Play 3744, Greater Green River Basin - Fort Union.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

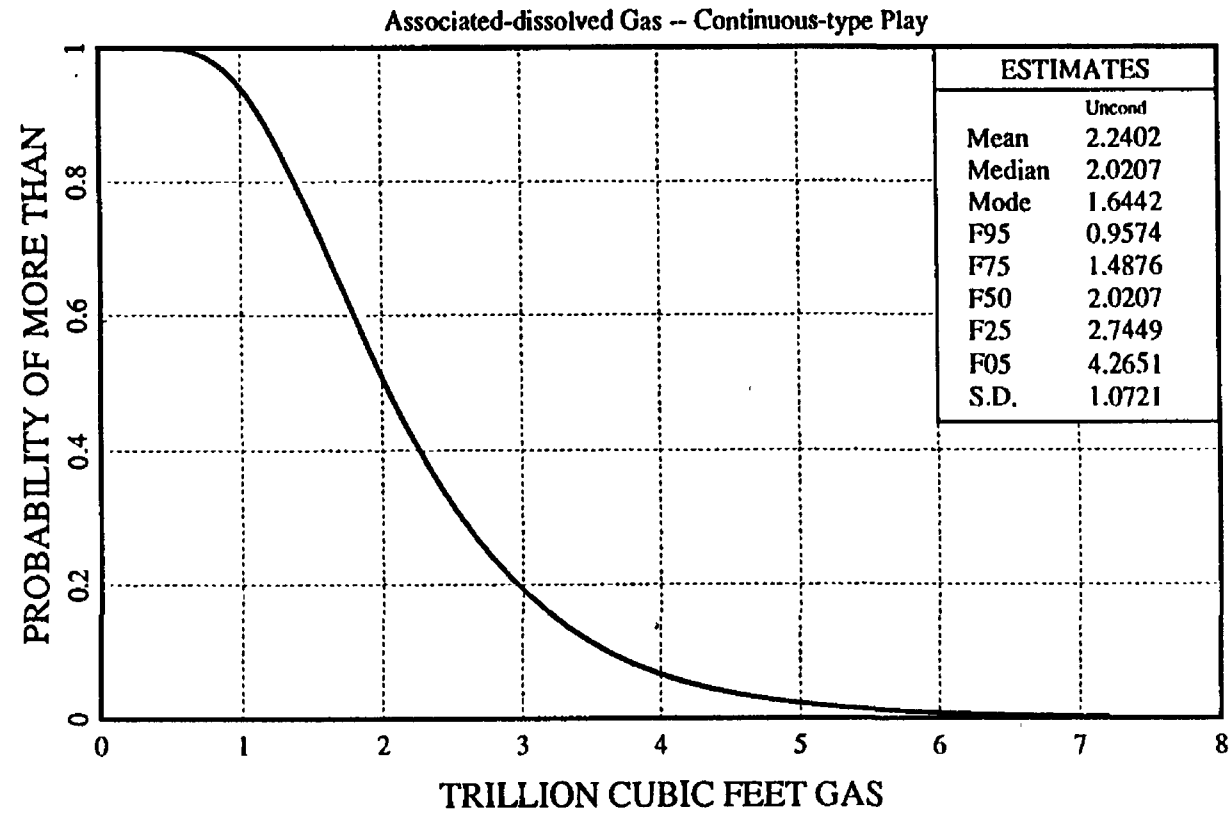
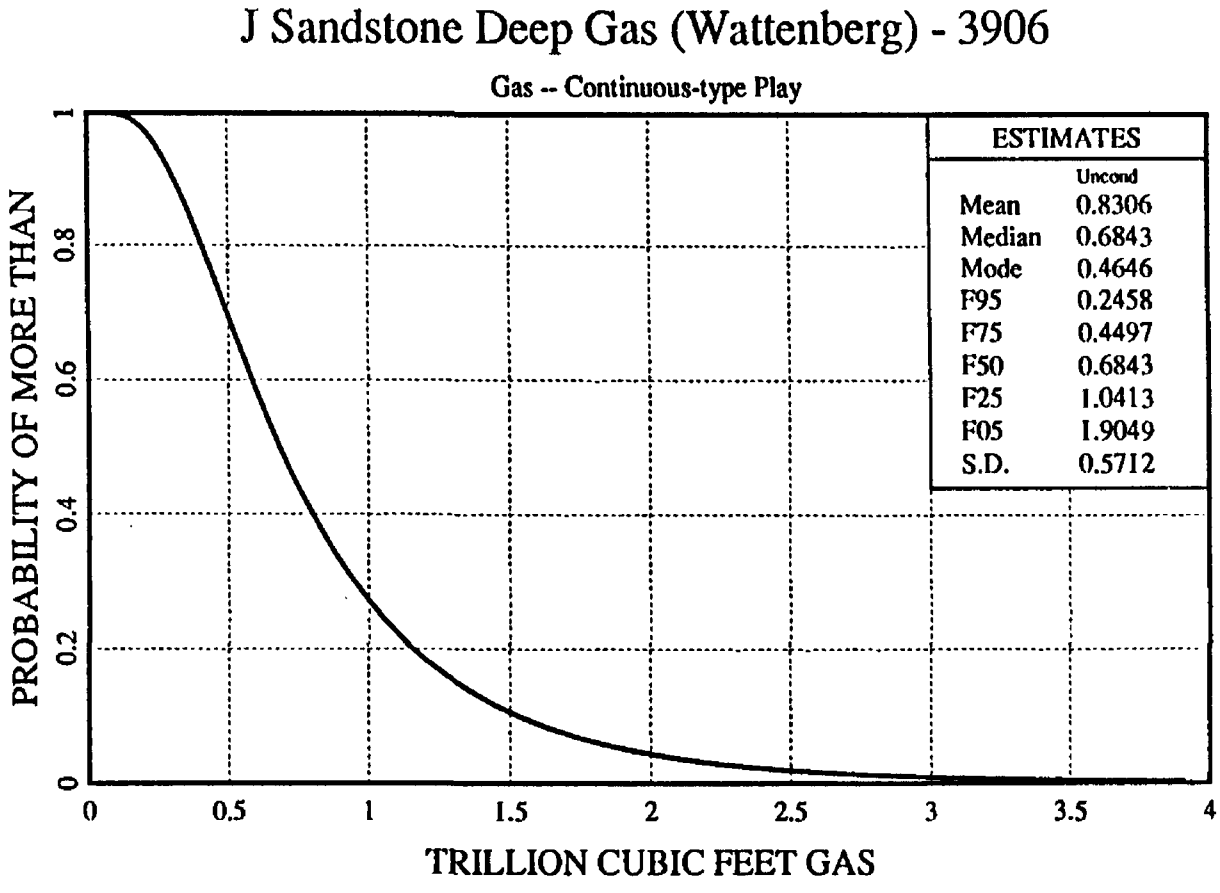


Figure 31. Potential additions to technically recoverable resources for Play 3904, Greater Wattenberg Codell/Niobrara Oil and Gas.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

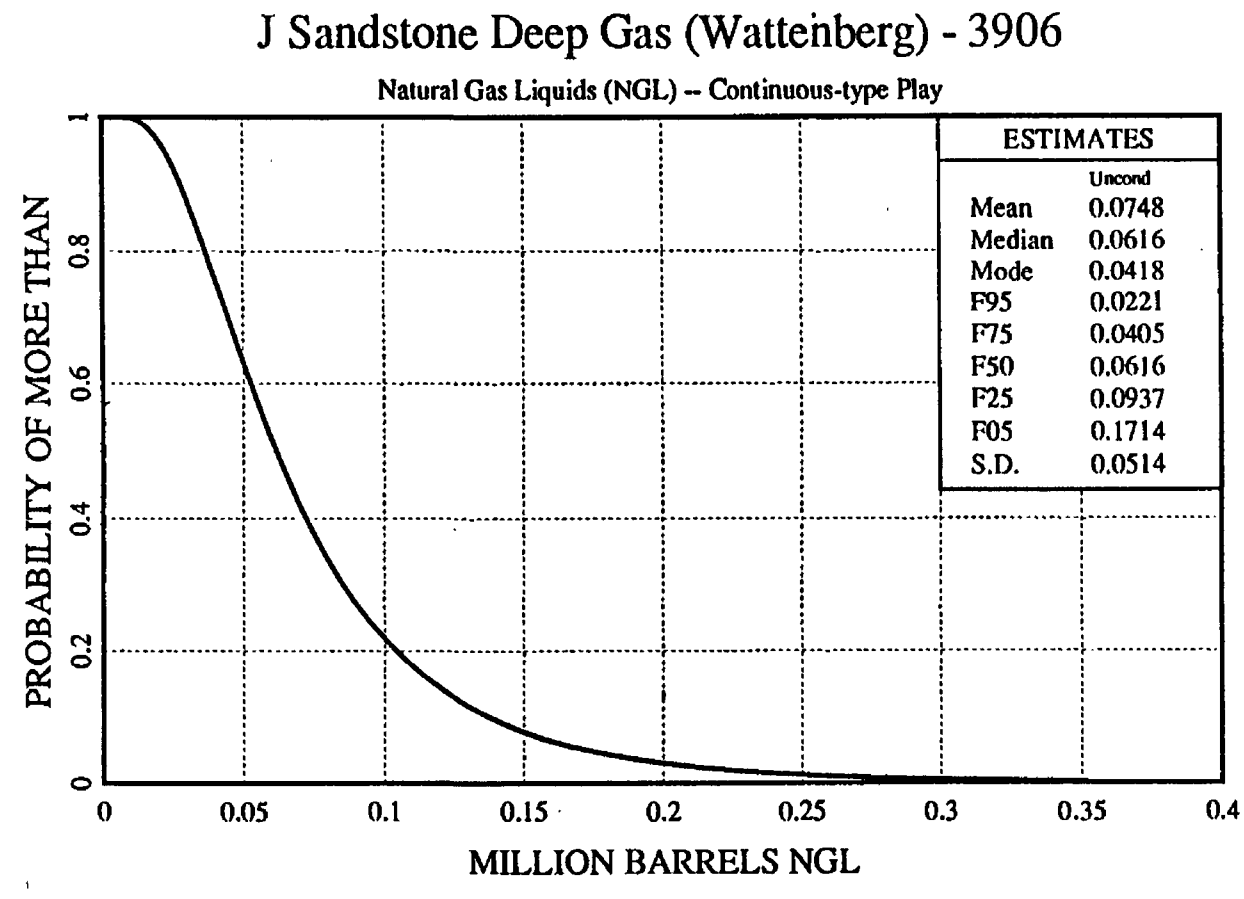
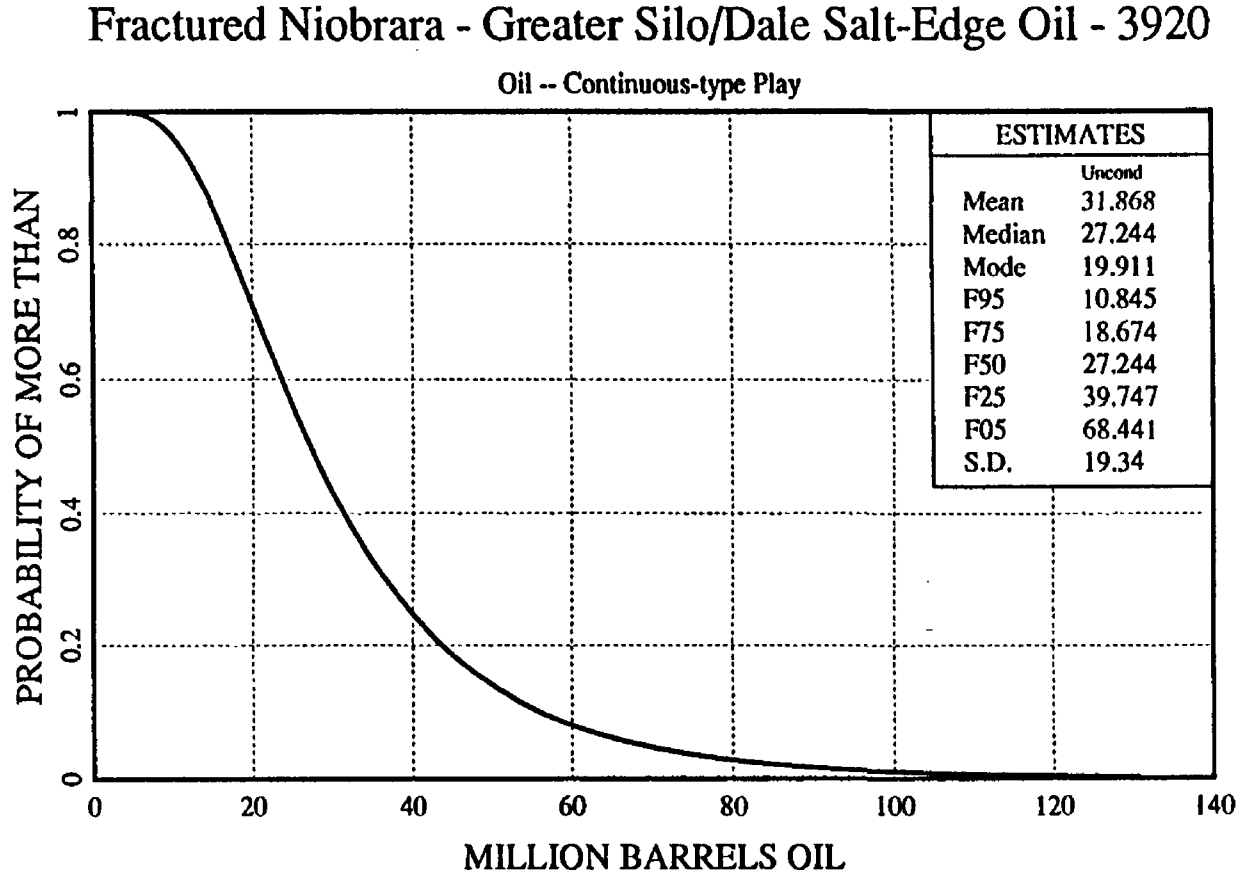
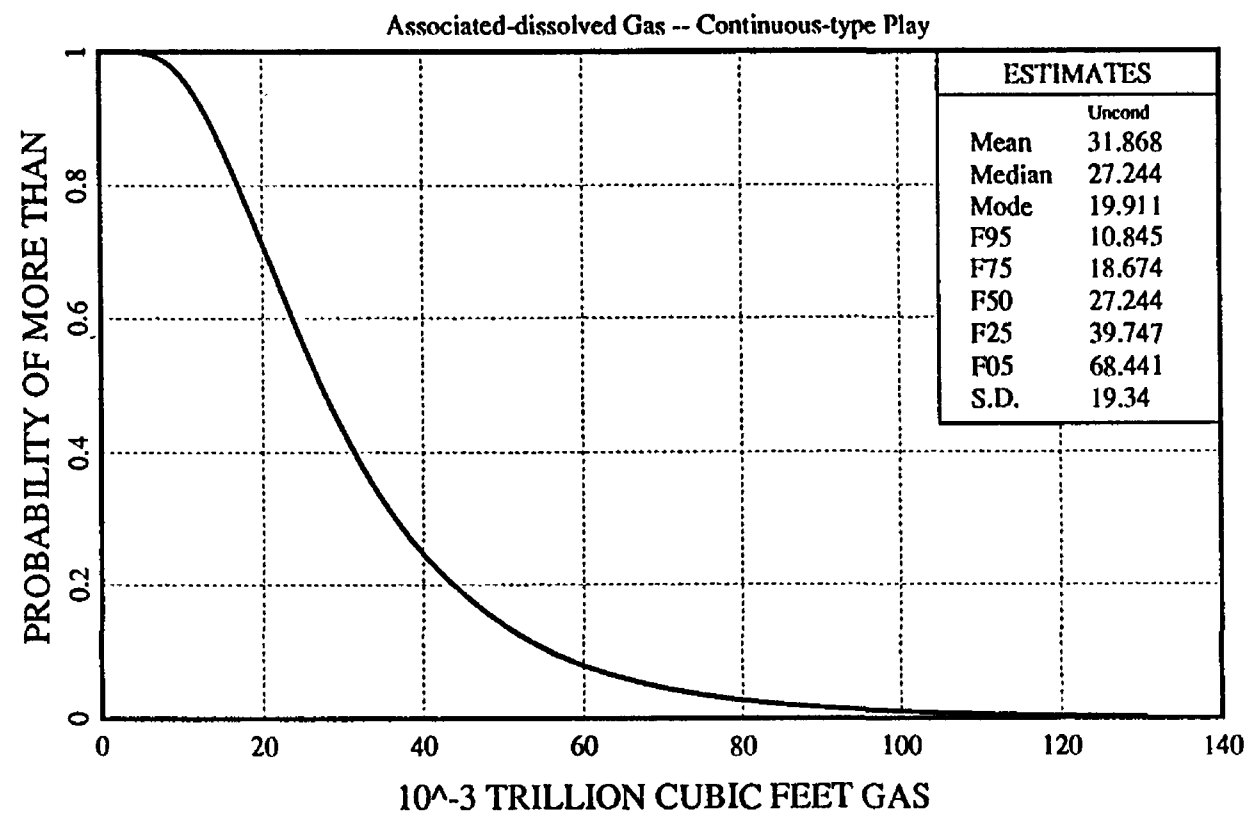


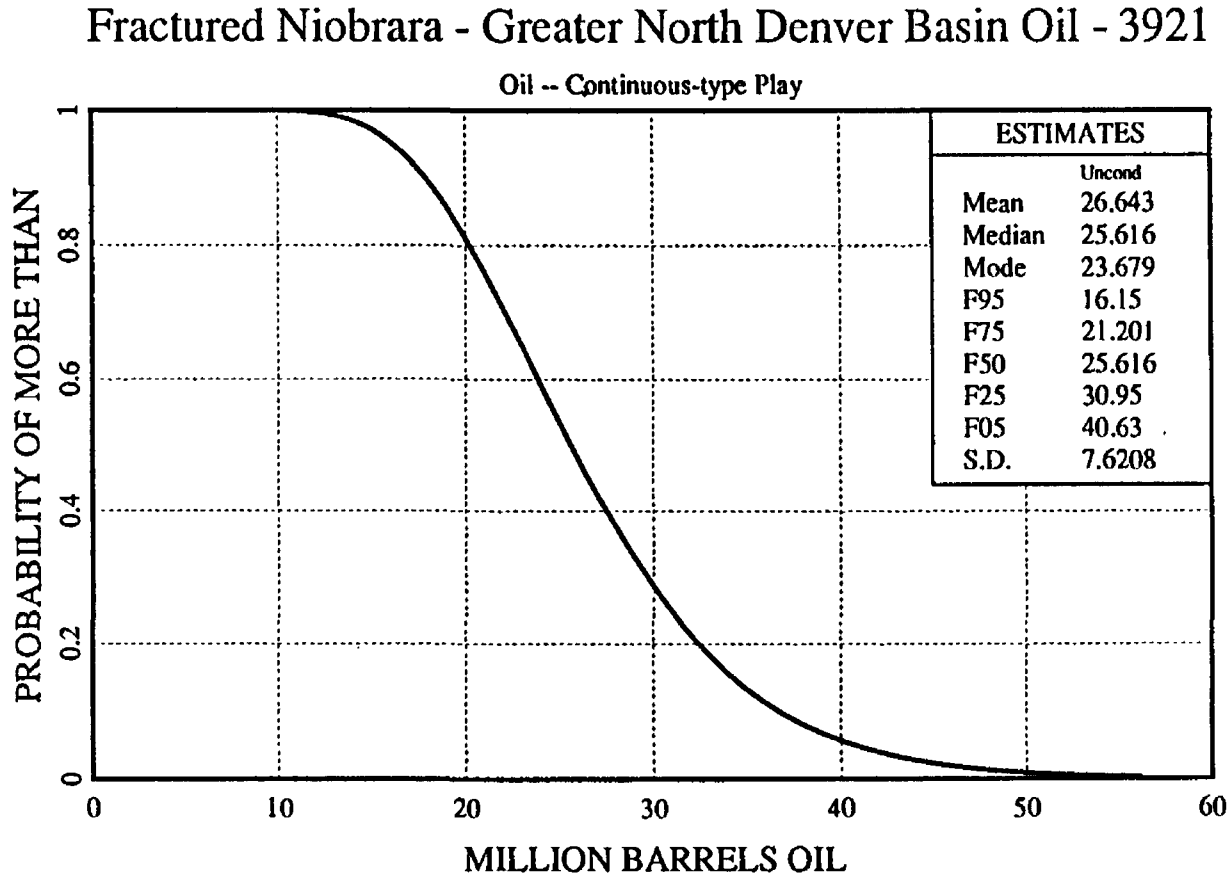
Figure 32. Potential additions to technically recoverable resources for Play 3906, J Sandstone Deep Gas (Wattenberg).





[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 33. Potential additions to technically recoverable resources for Play 3920, Fractured Niobrara - Greater Silo/Dale Salt-Edge Oil.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

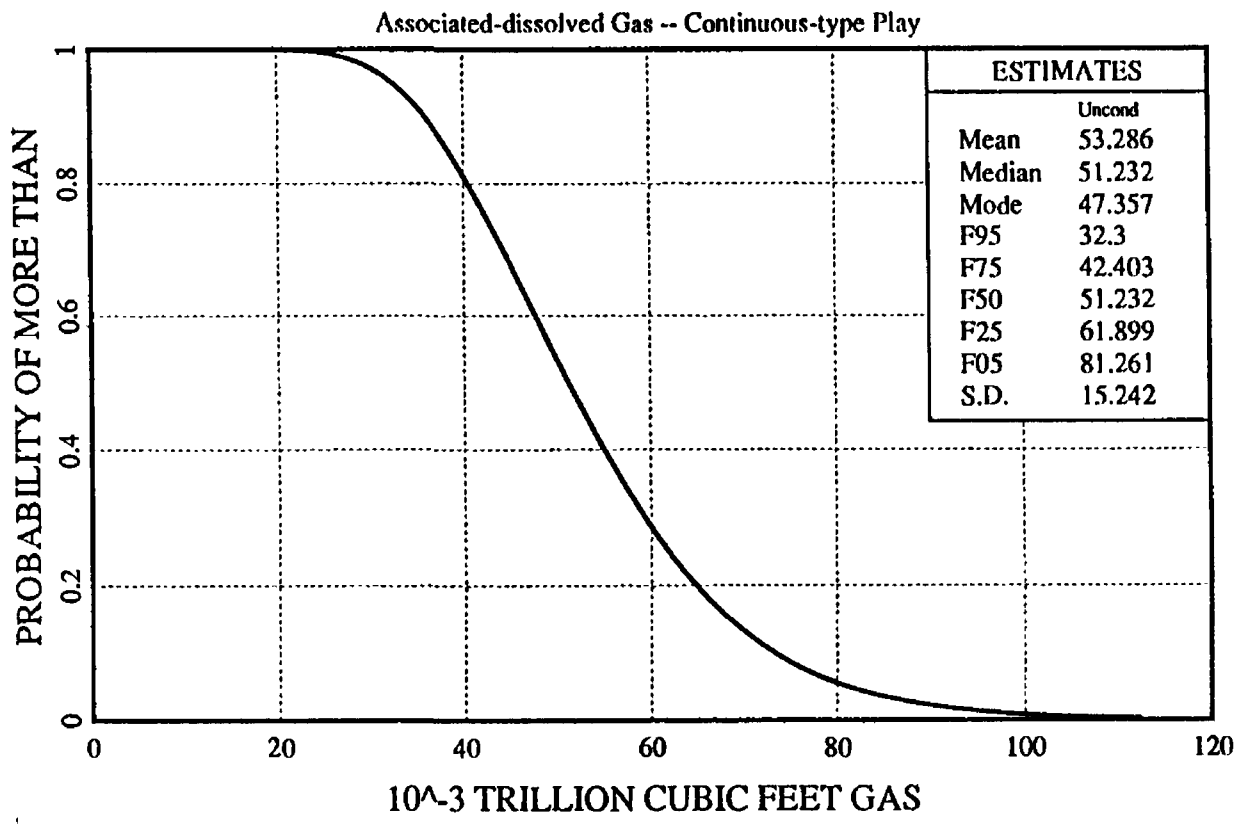
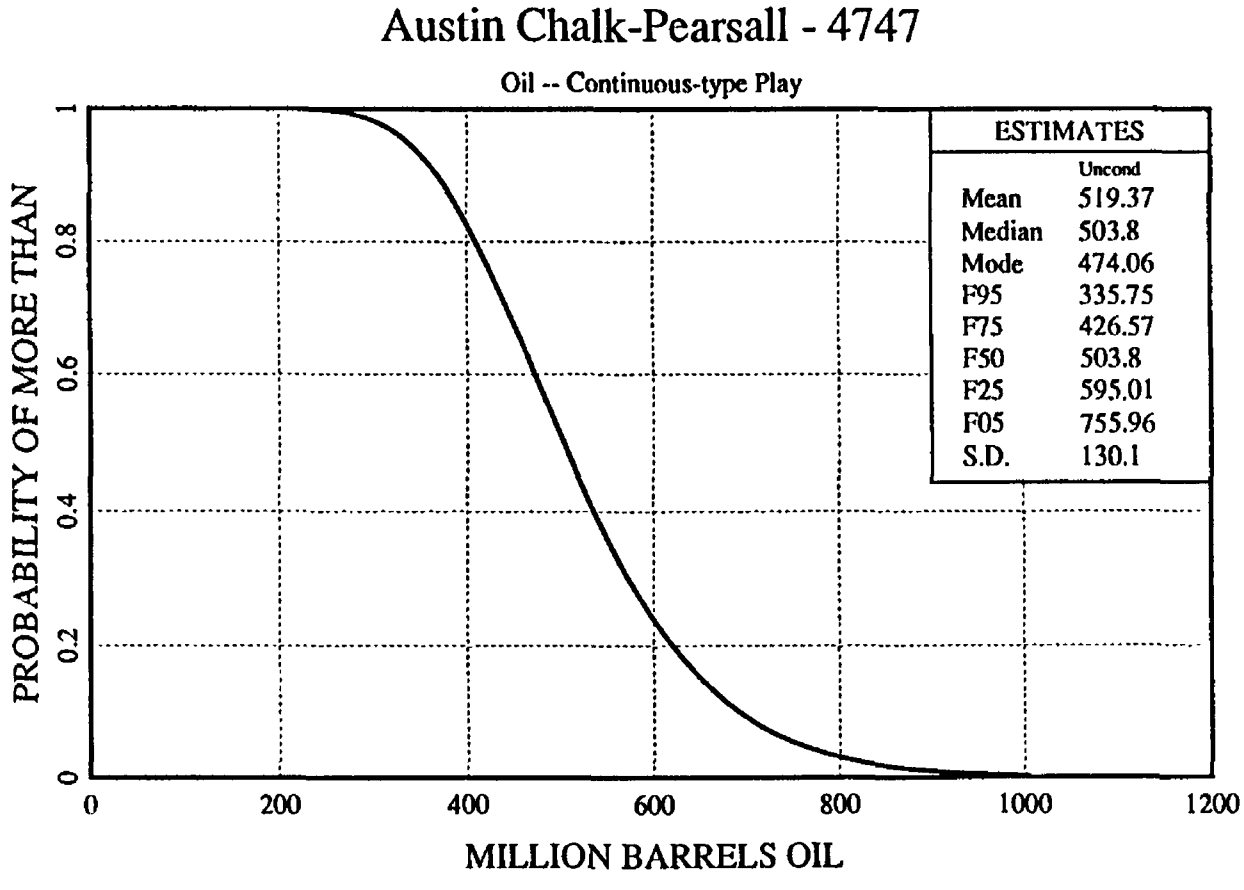
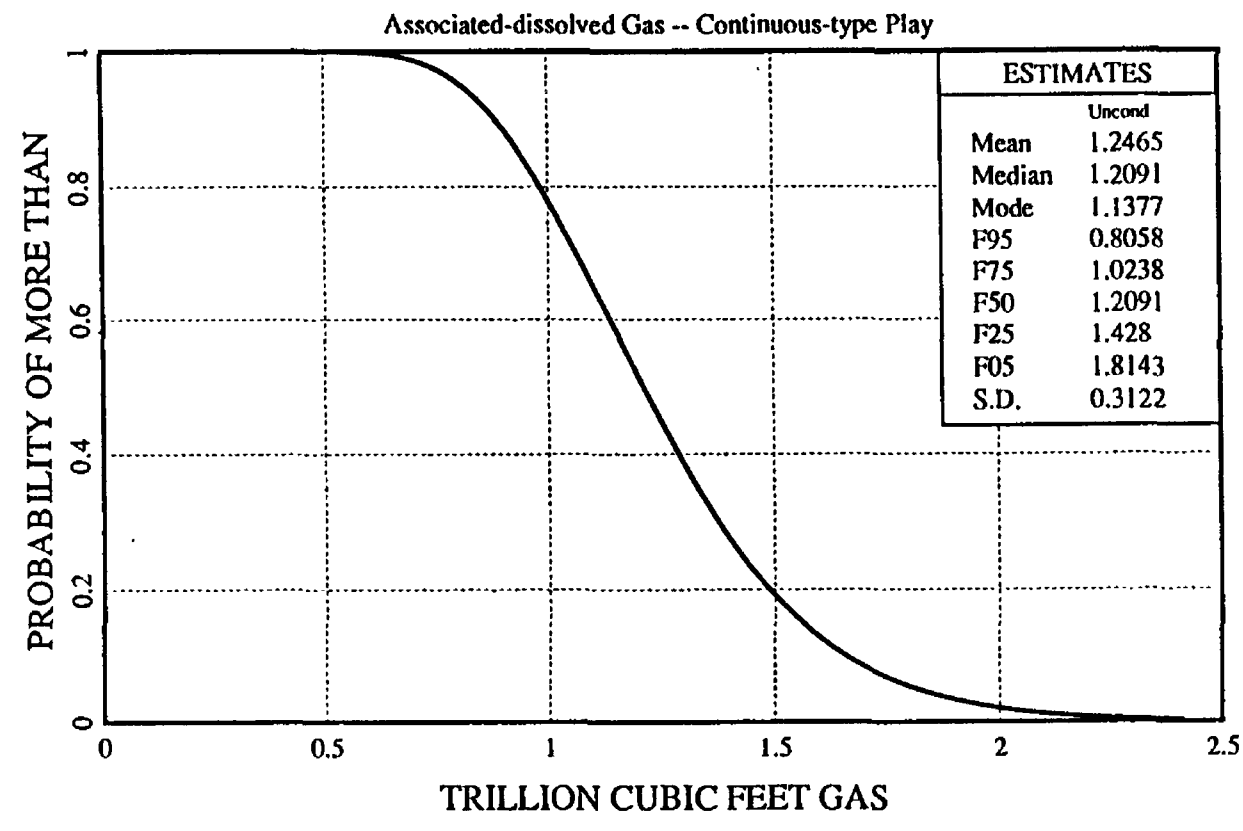


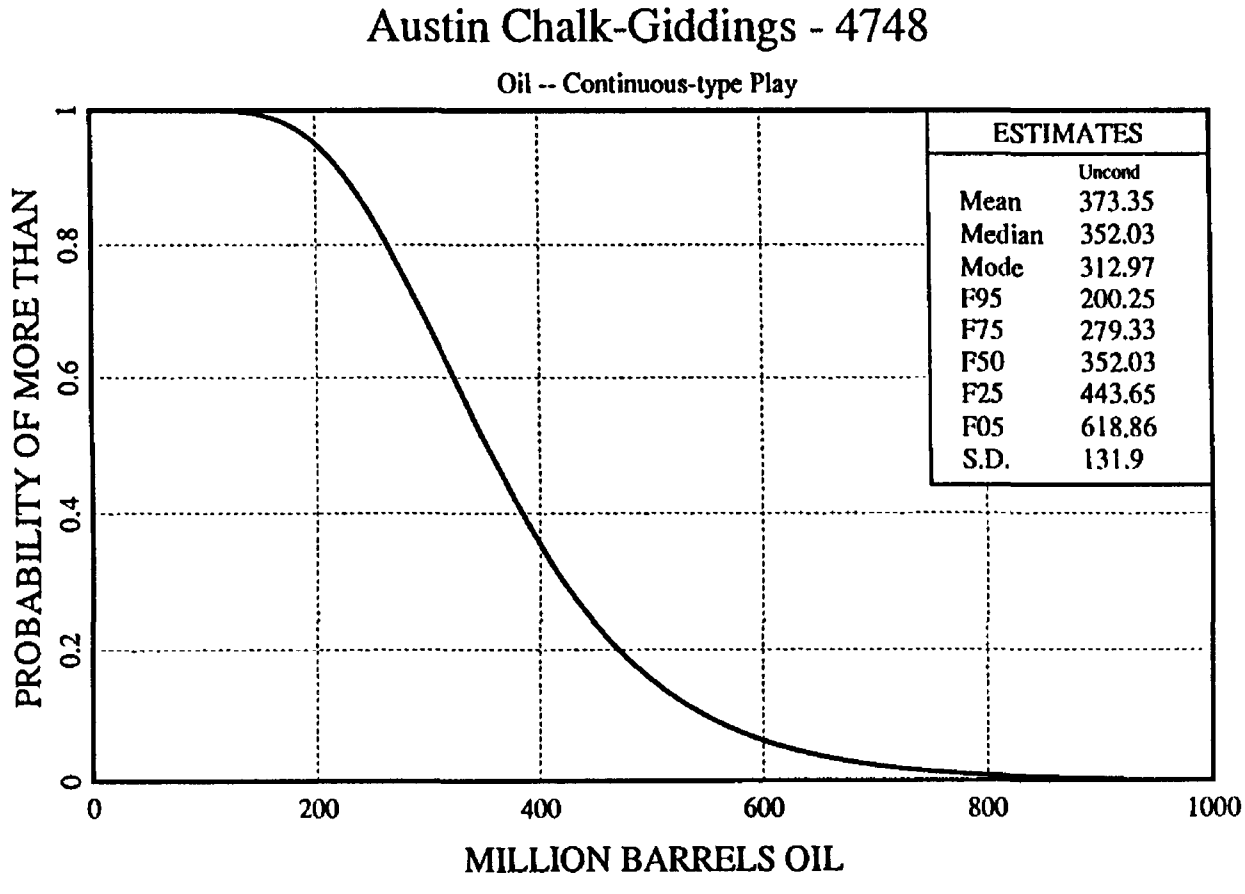
Figure 34. Potential additions to technically recoverable resources for Play 3921, Fractured Niobrara - Greater Northern Denver Basin Oil.

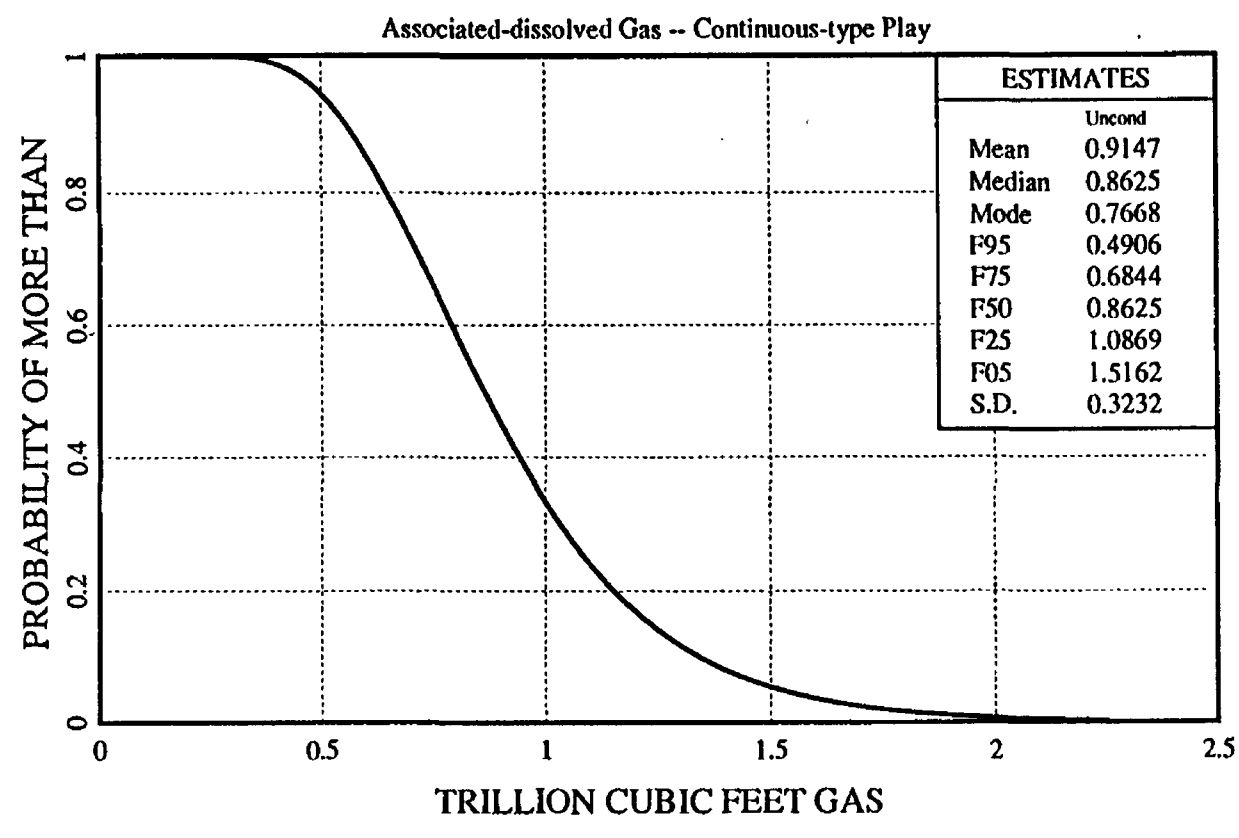




[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

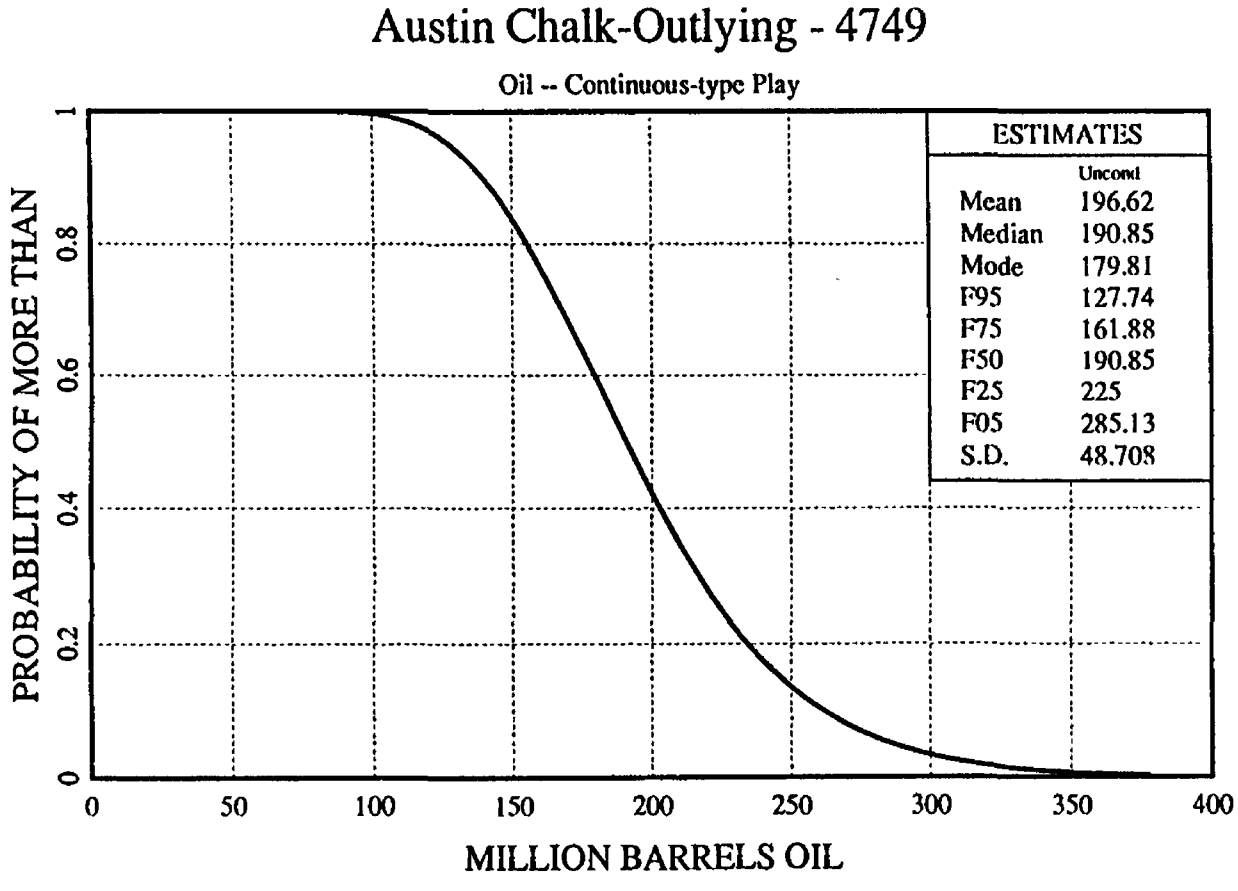
Figure 35. Potential additions to technically recoverable resources for Play 4747, Austin Chalk-Pearsall.





[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 36. Potential additions to technically recoverable resources for Play 4748, Austin Chalk-Giddings.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

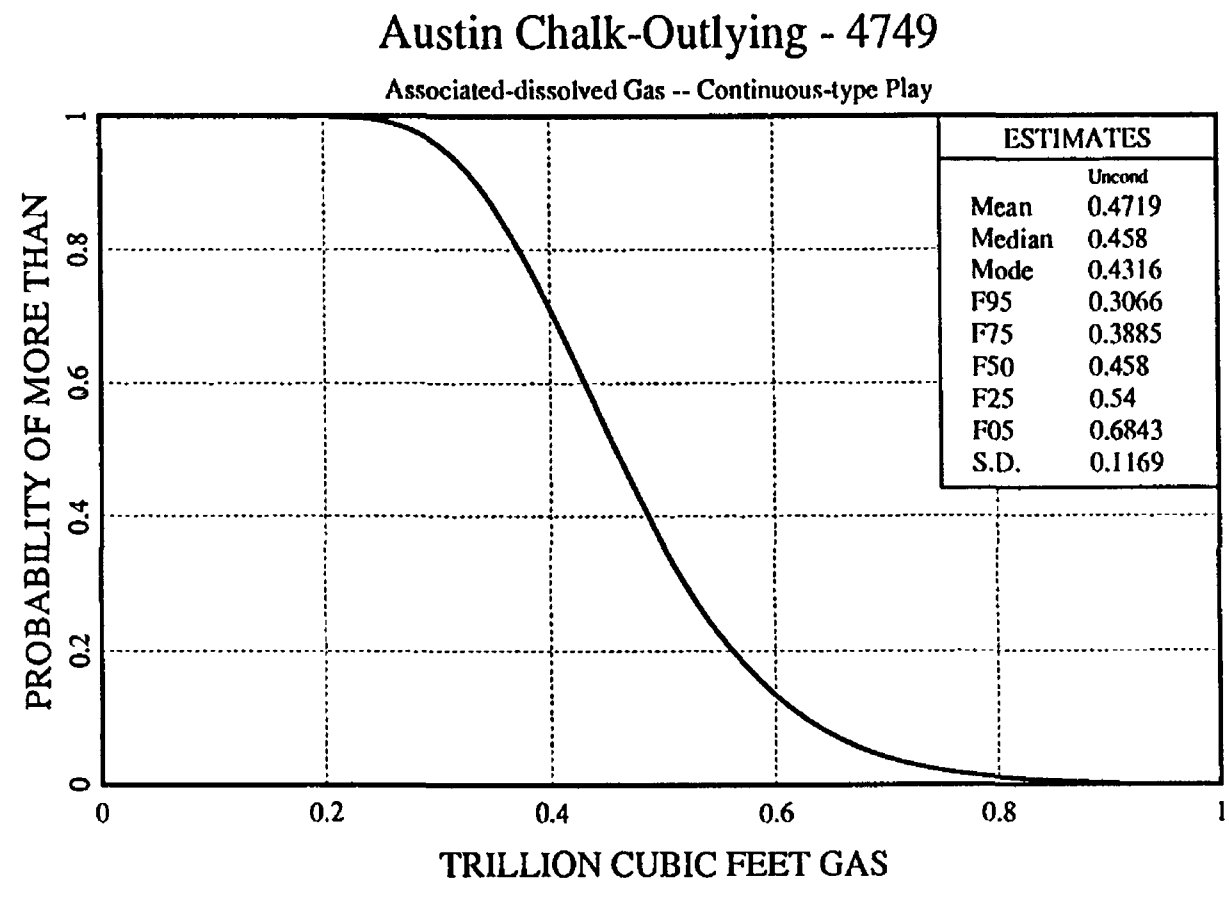
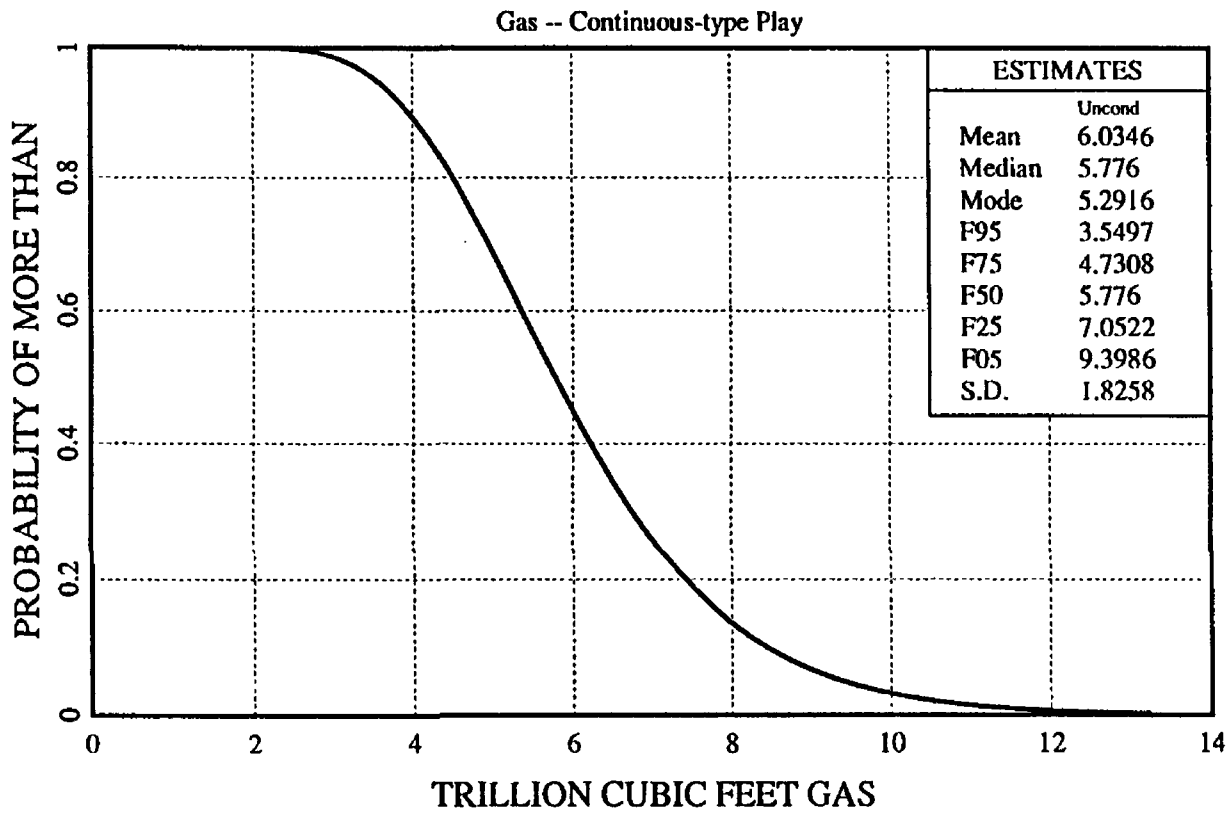


Figure 37. Potential additions to technically recoverable resources for Play 4749, Austin Chalk-Outlying.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

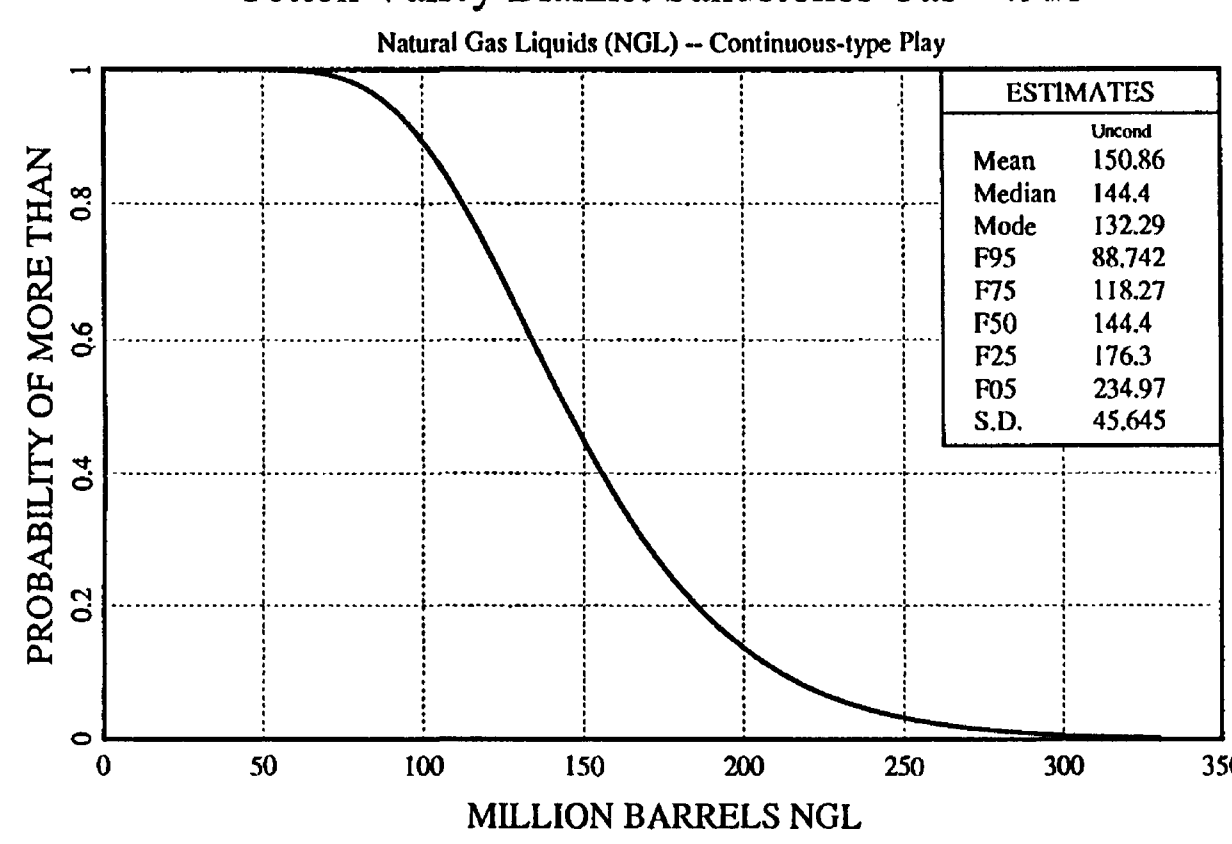
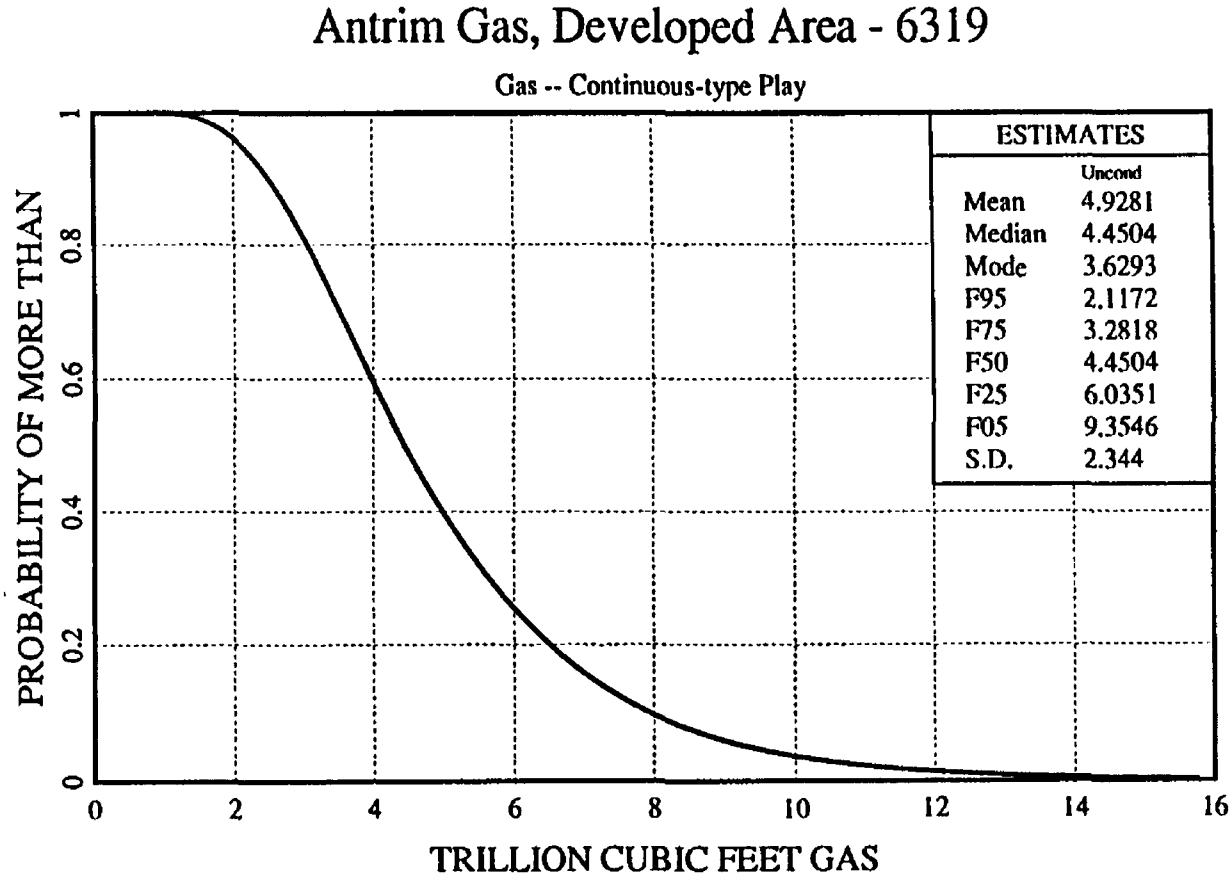
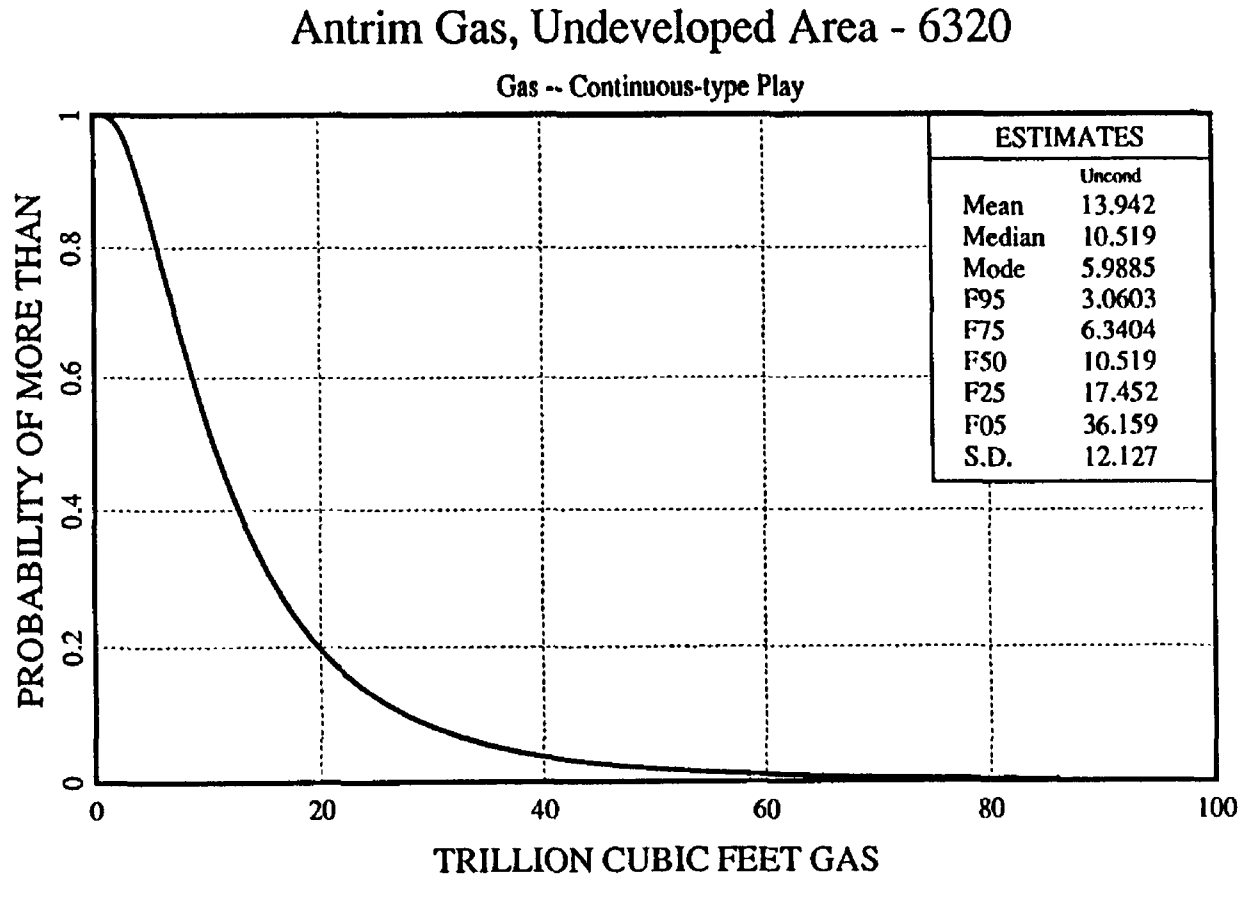


Figure 38. Potential additions to technically recoverable resources for Play 4923, Cotton Valley Blanket Sandstones Gas.



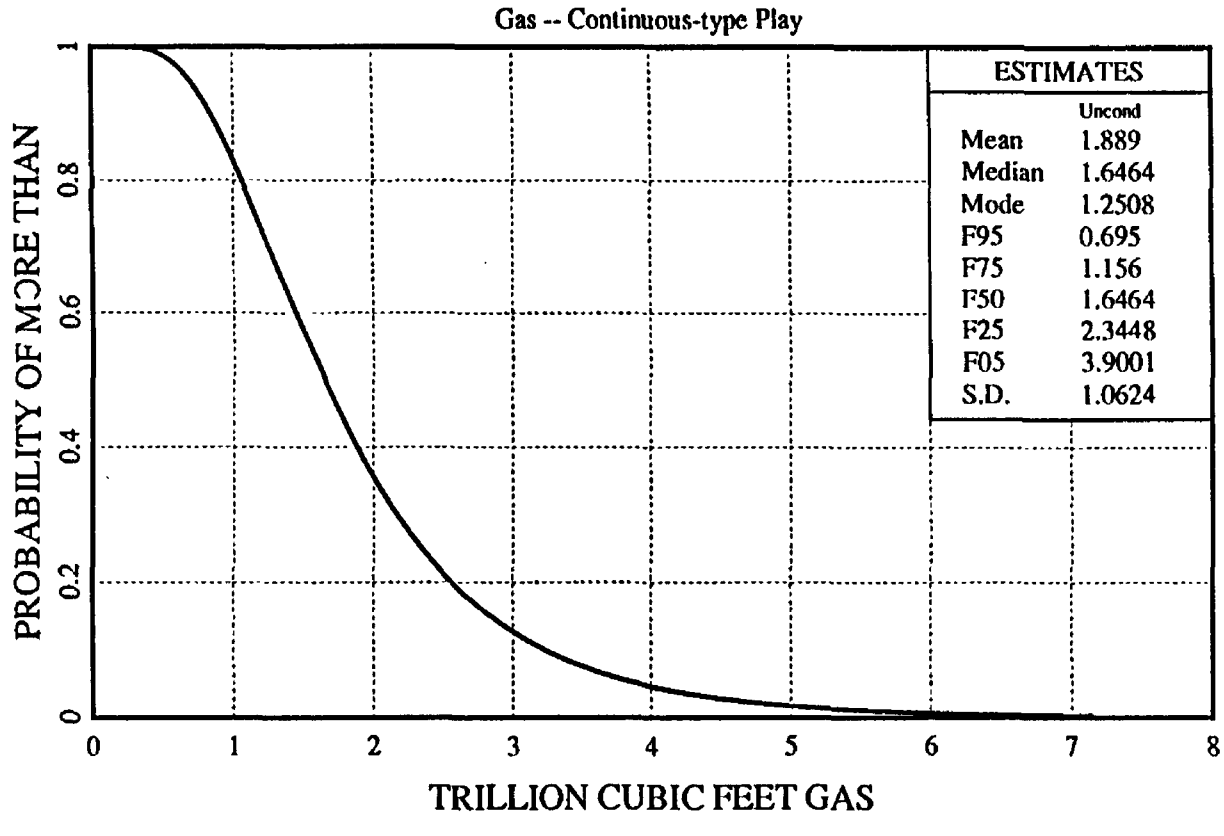
[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 39. Potential additions to technically recoverable resources for Play 6319, Antrim Shale Gas, Developed Area.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 40. Potential additions to technically recoverable resources for Play 6320, Antrim Shale Gas, Undeveloped Area.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

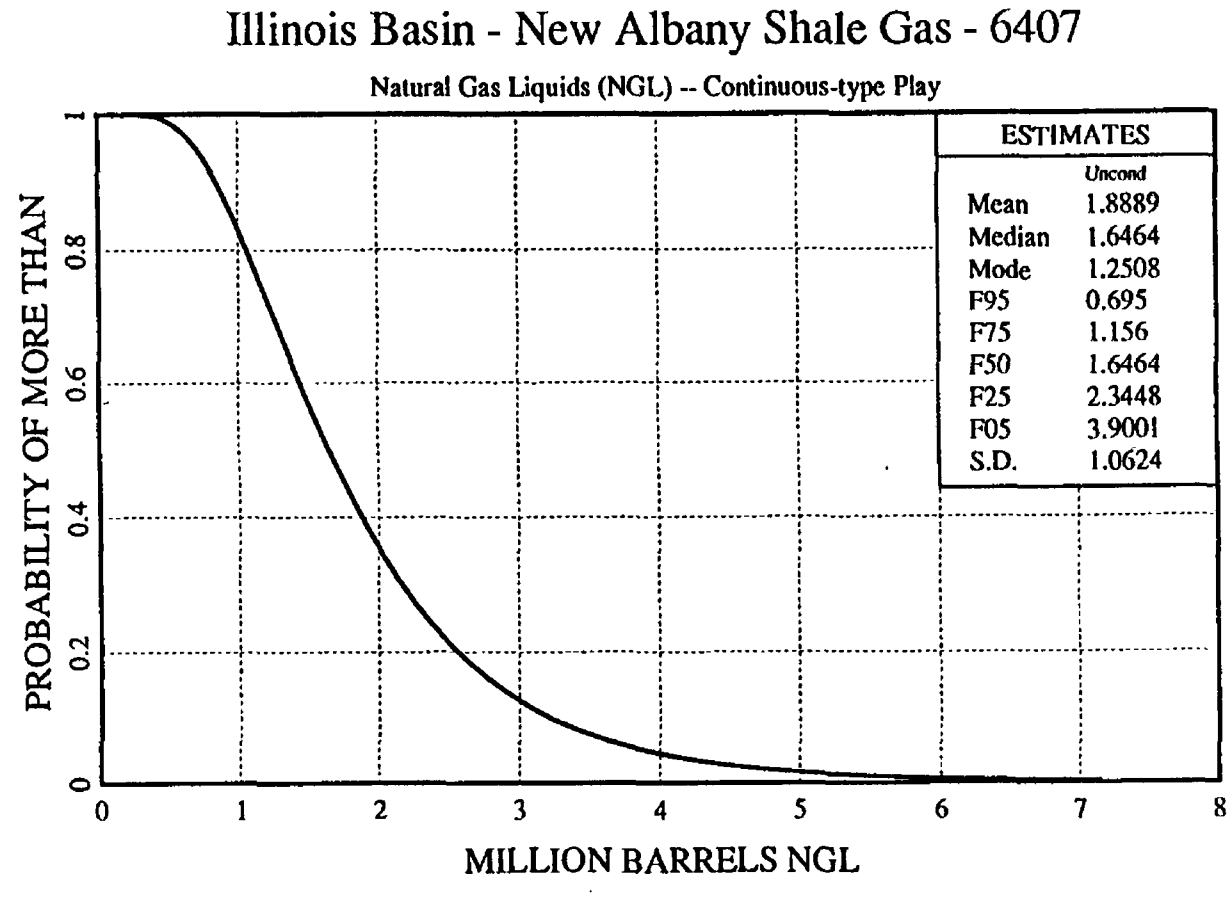
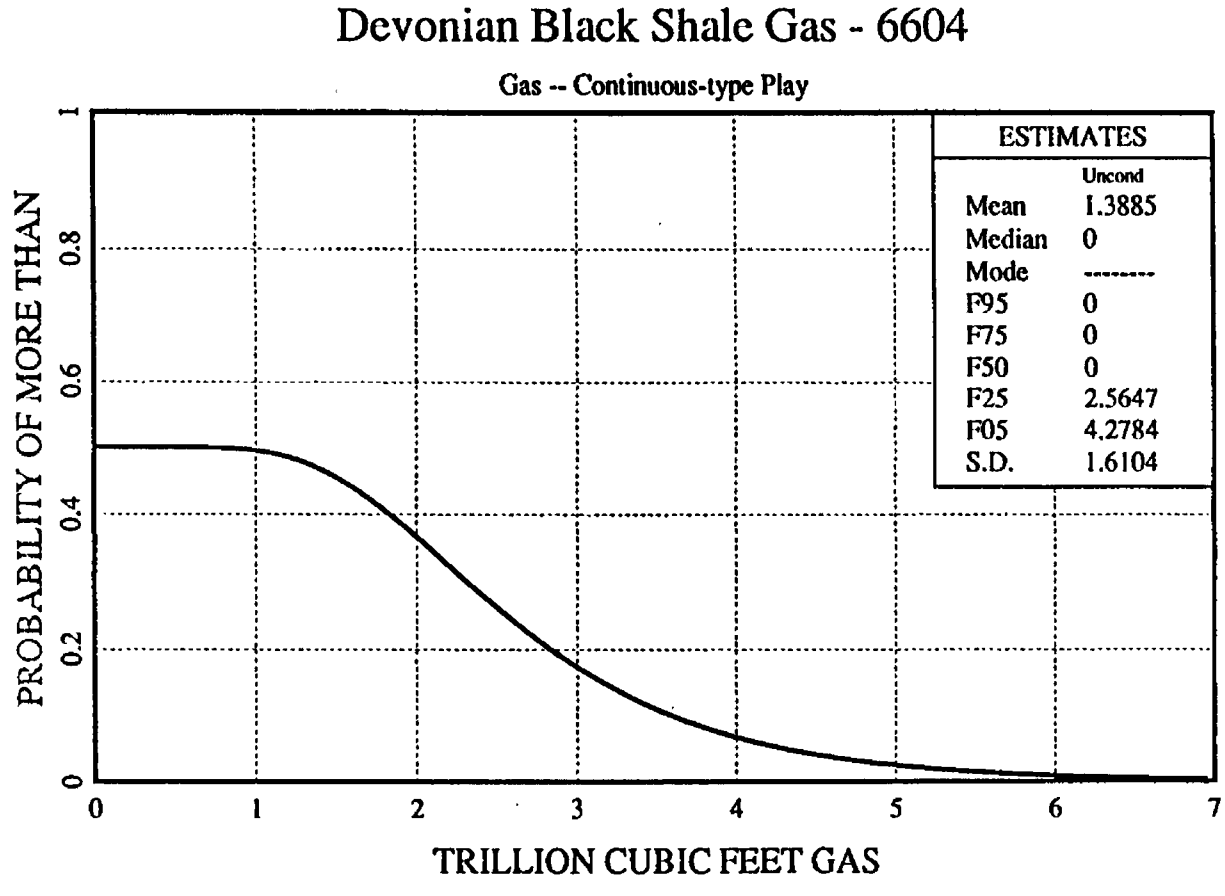


Figure 41. Potential additions to technically recoverable resources for Play 6407, Illinois Basin - New Albany Shale Gas.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

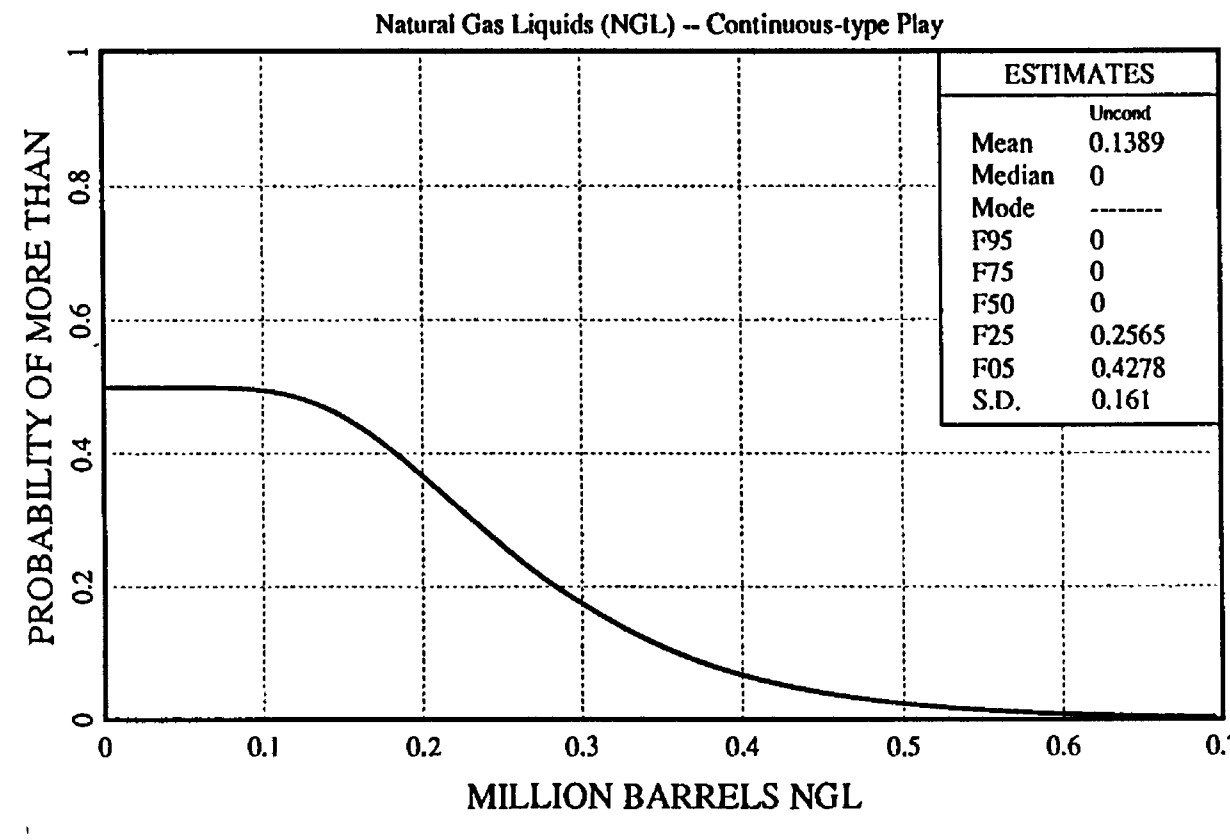
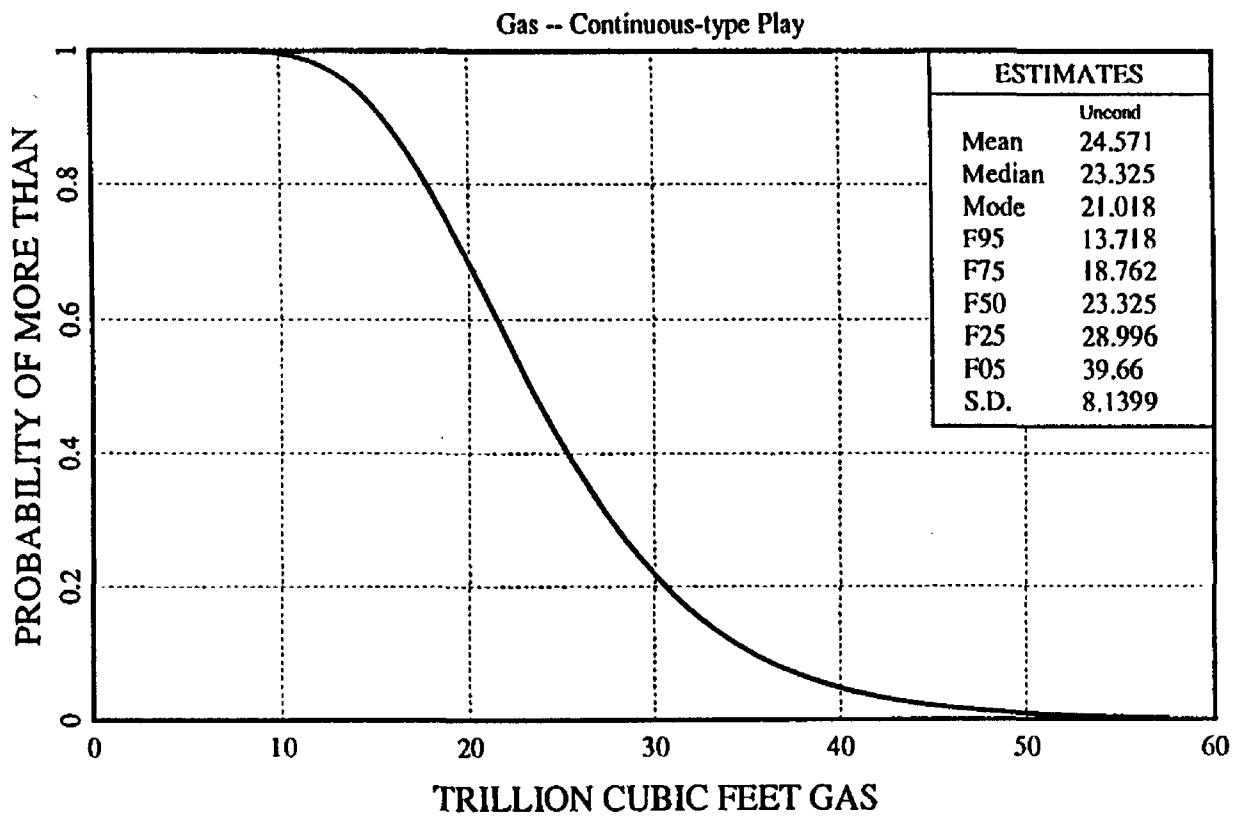


Figure 42. Potential additions to technically recoverable resources for Play 6604, Devonian Black Shale Gas.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

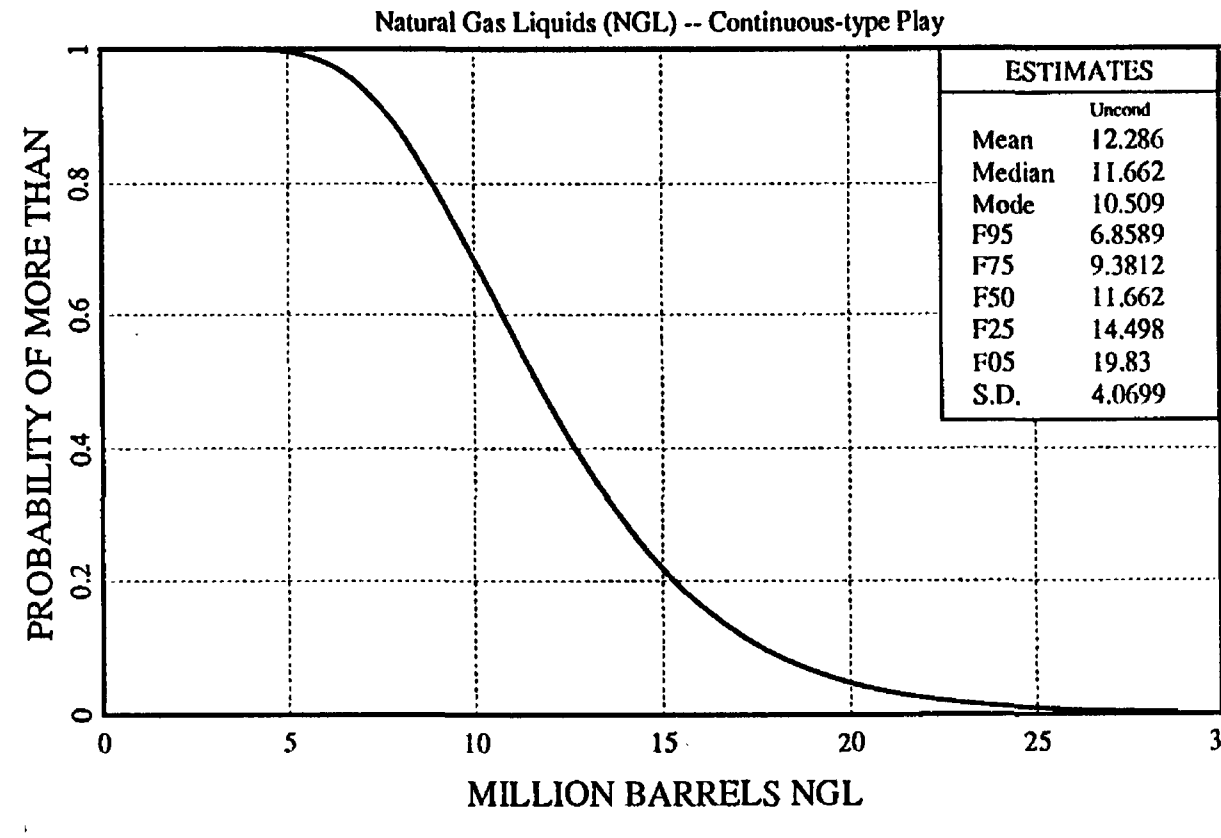
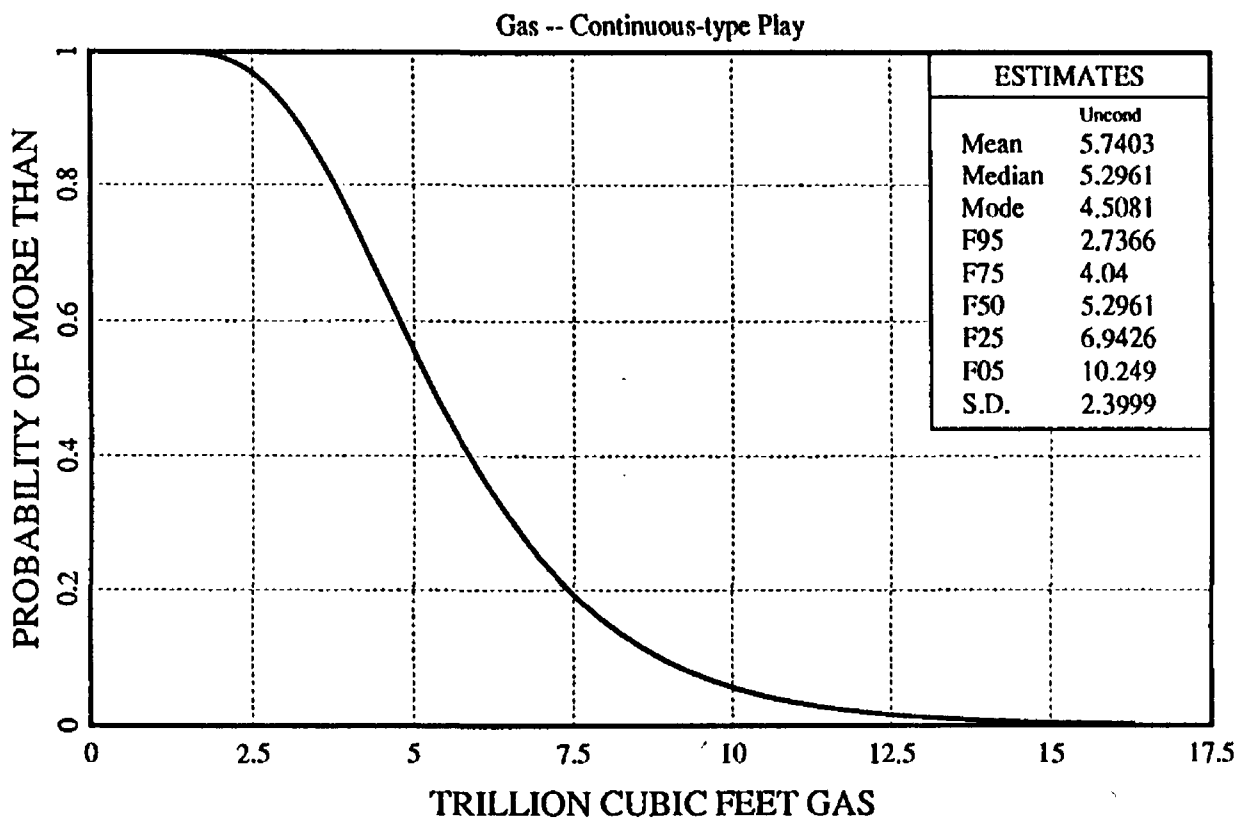
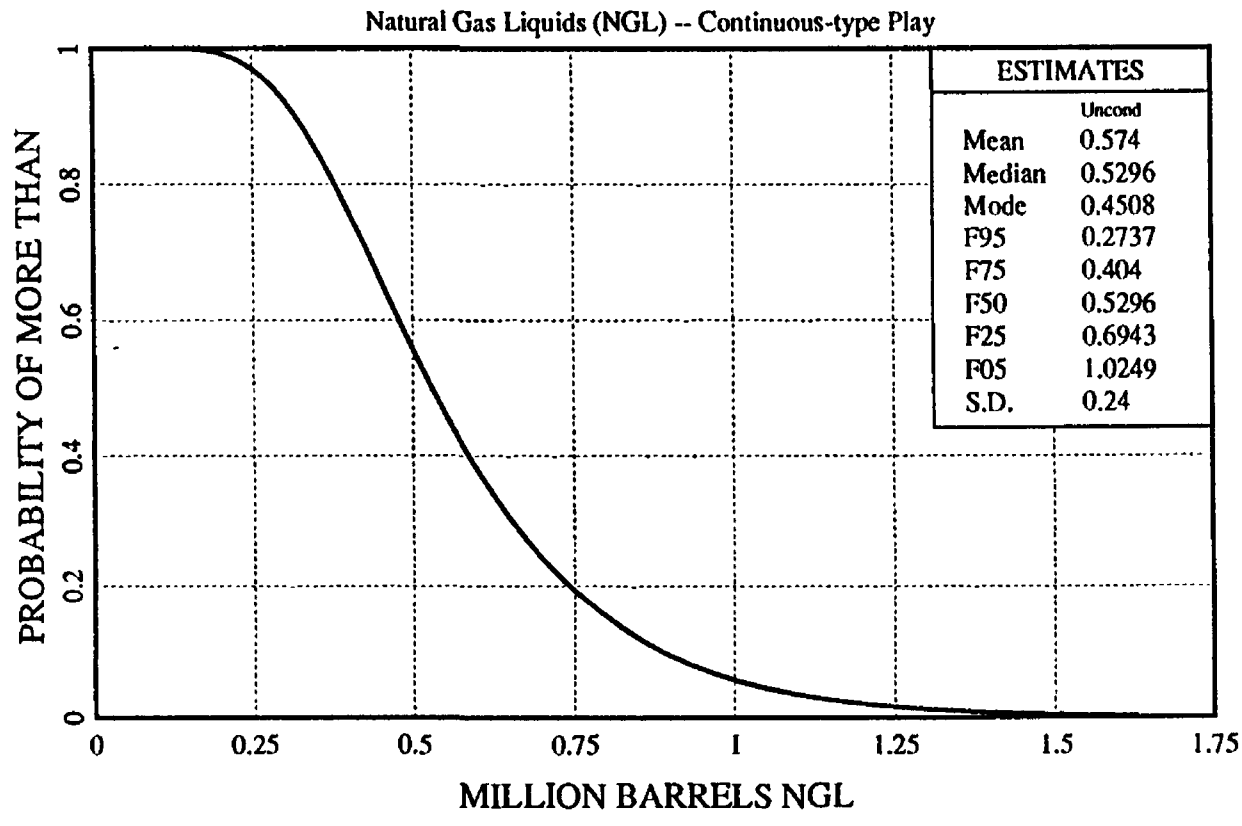


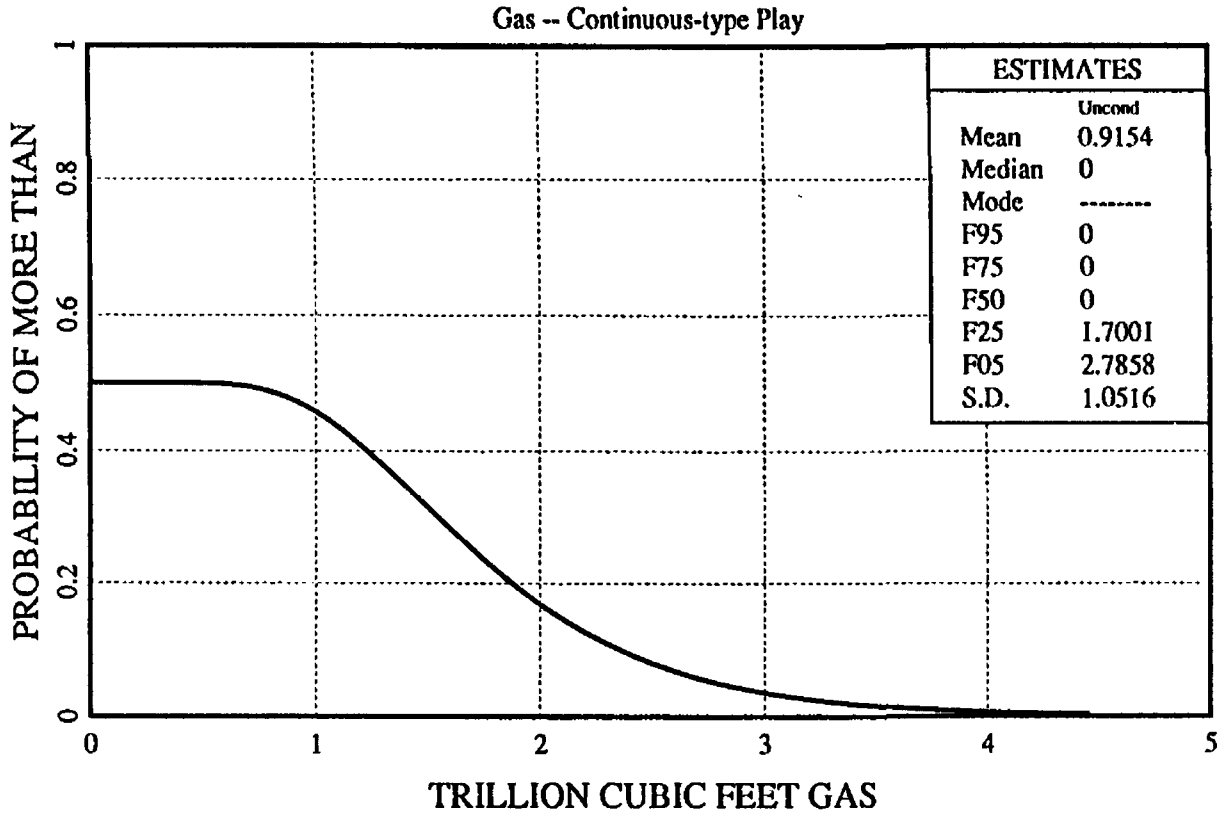
Figure 43. Potential additions to technically recoverable resources for Play 6728, Clinton/Medina Sandstone Gas High Potential.





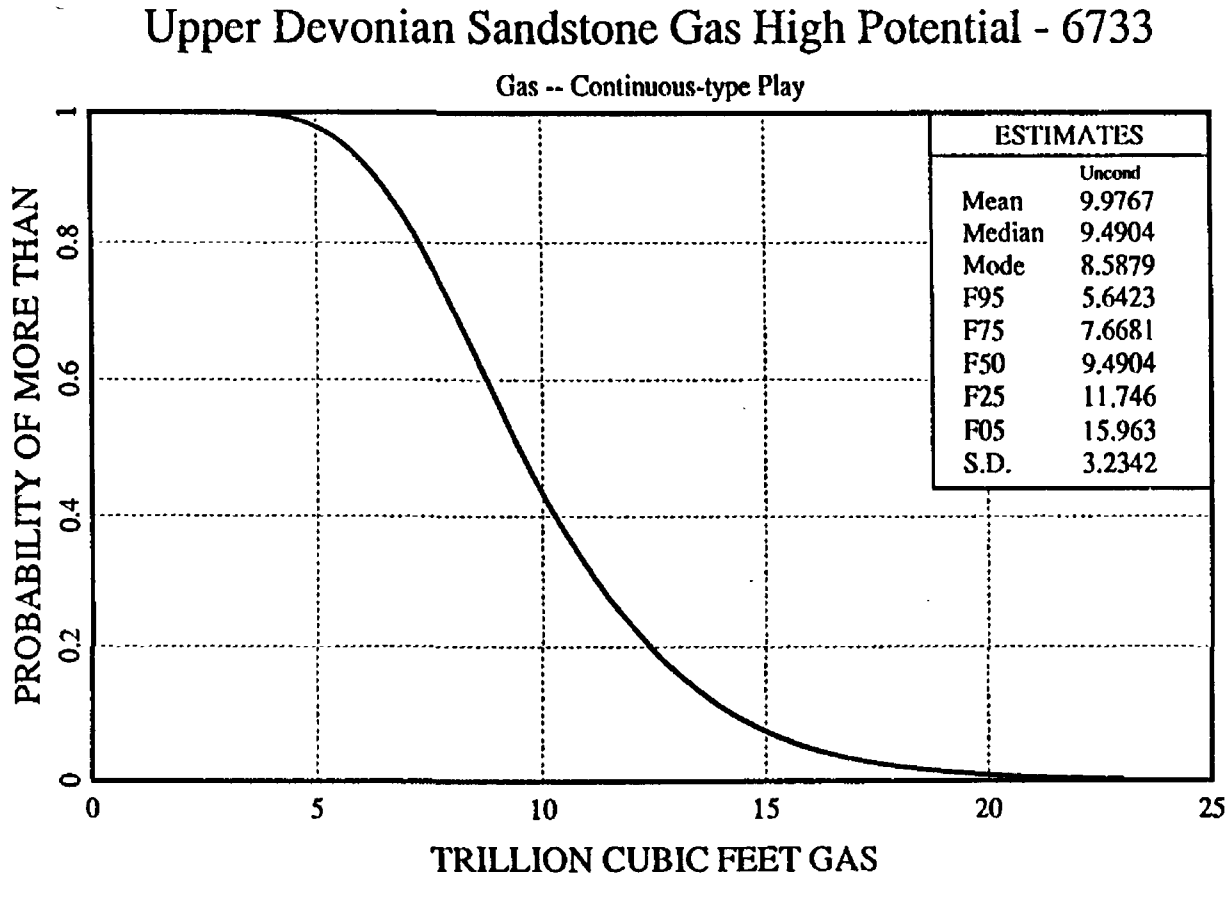
[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 44. Potential additions to technically recoverable resources for Play 6729, Clinton/Medina Sandstone Gas Medium Potential.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 45. Potential additions to technically recoverable resources for Play 6730, Clinton/Medina Sandstone Gas Medium-Low Potential.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

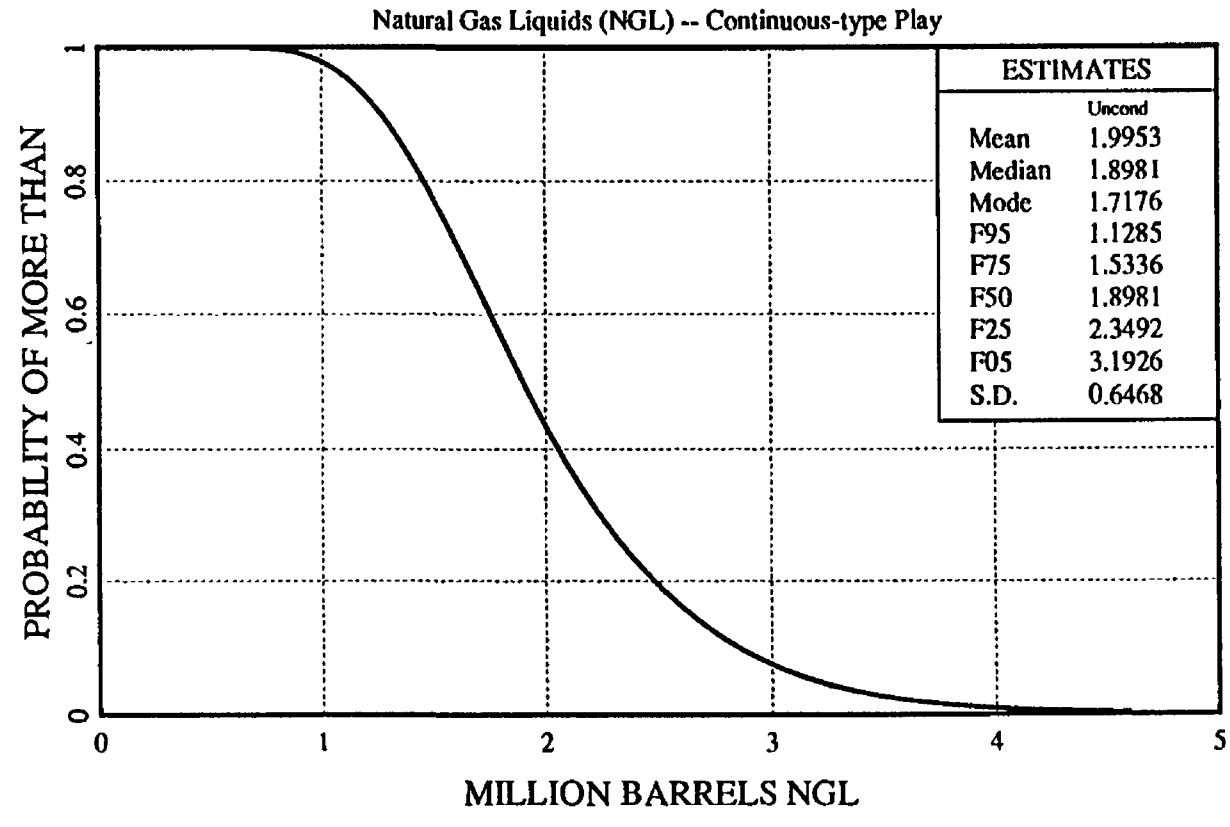
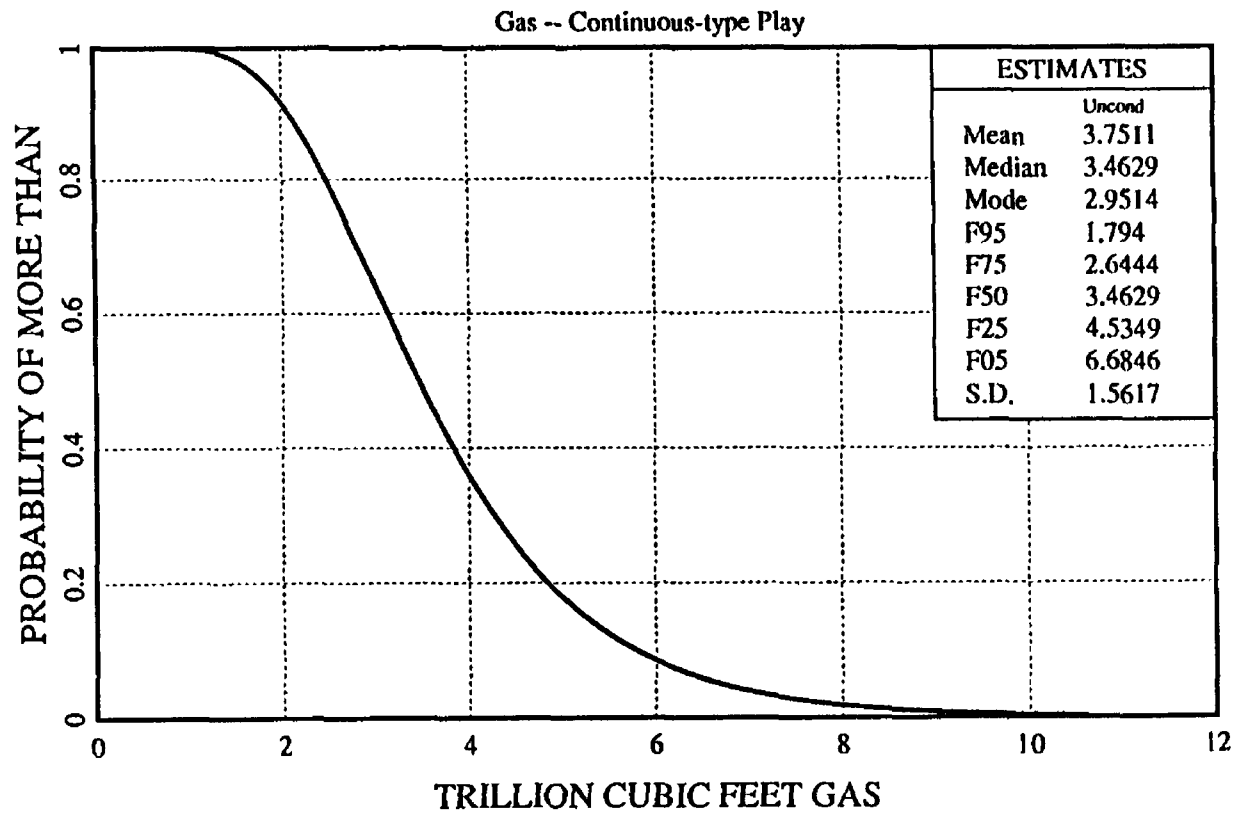
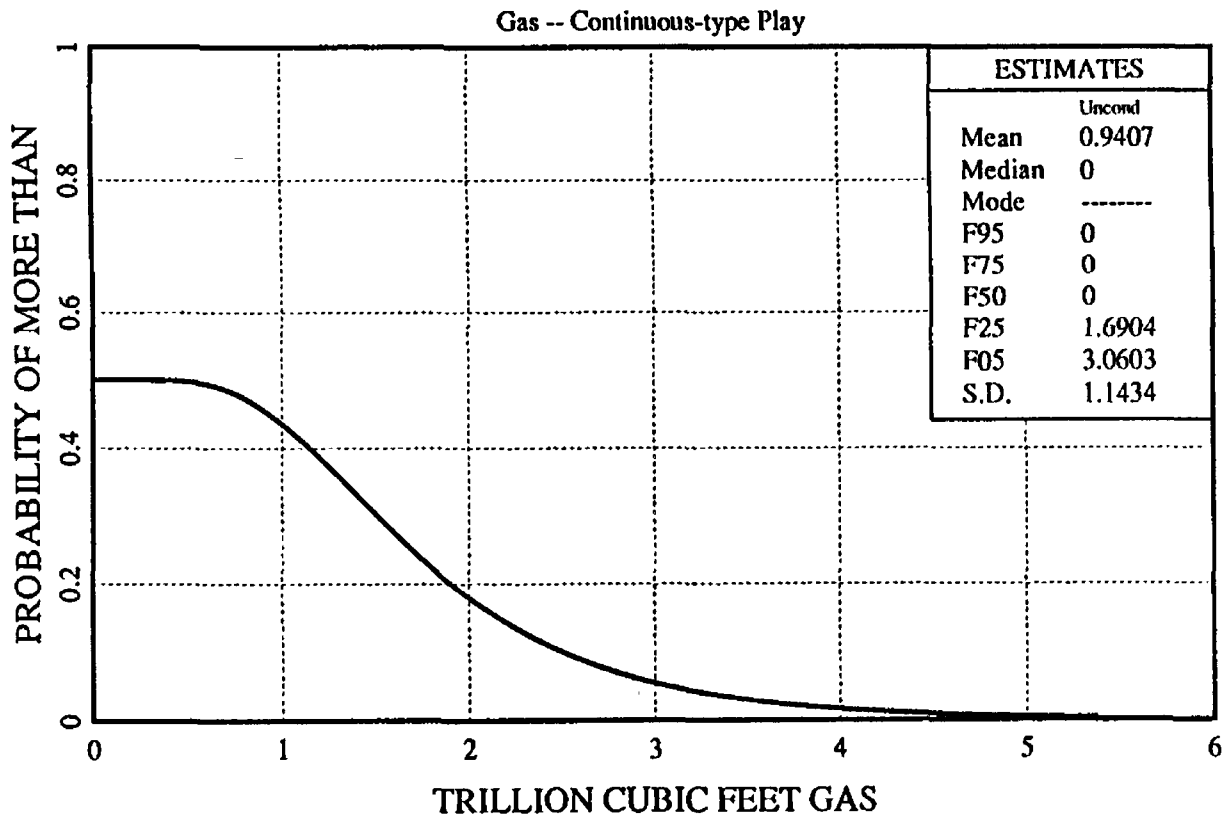


Figure 46. Potential additions to technically recoverable resources for Play 6733, Upper Devonian Sandstone Gas High Potential.



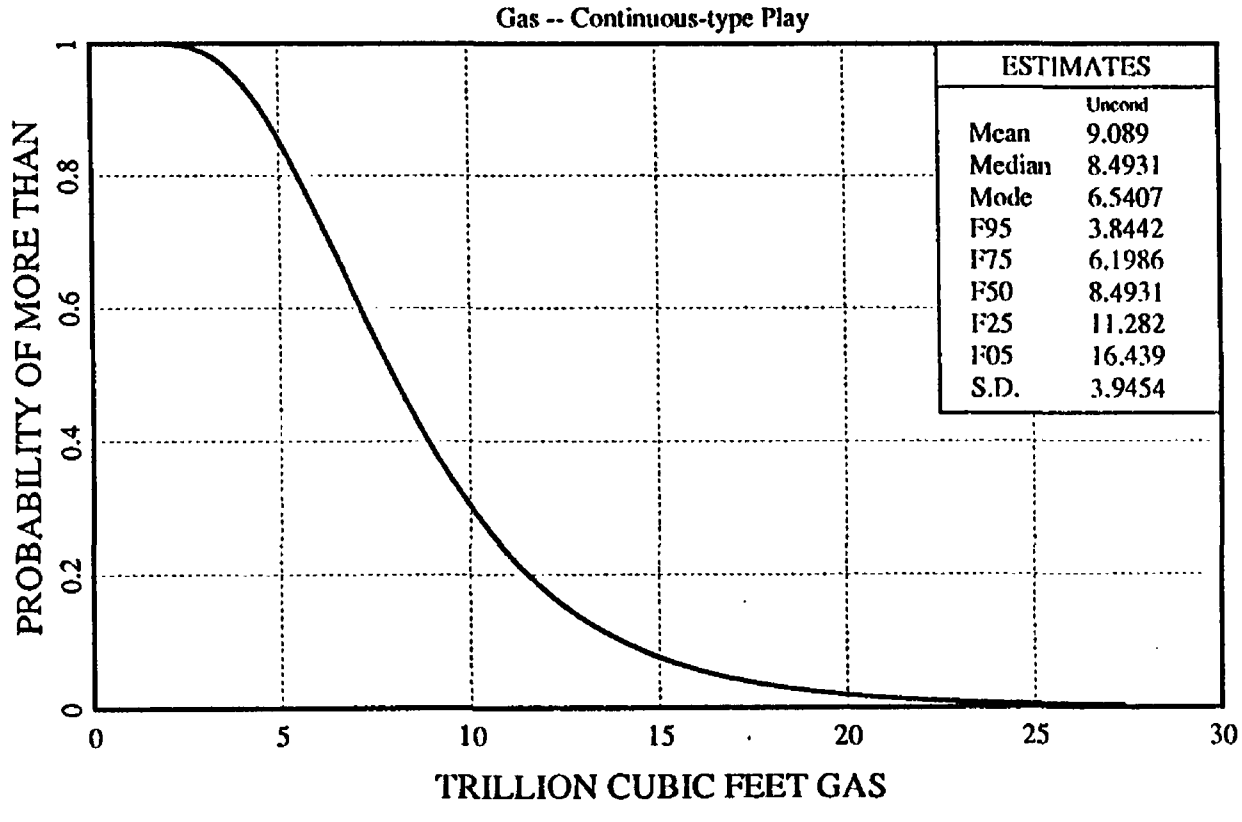
[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 47. Potential additions to technically recoverable resources for Play 6734, Upper Devonian Sandstone Gas Medium Potential.



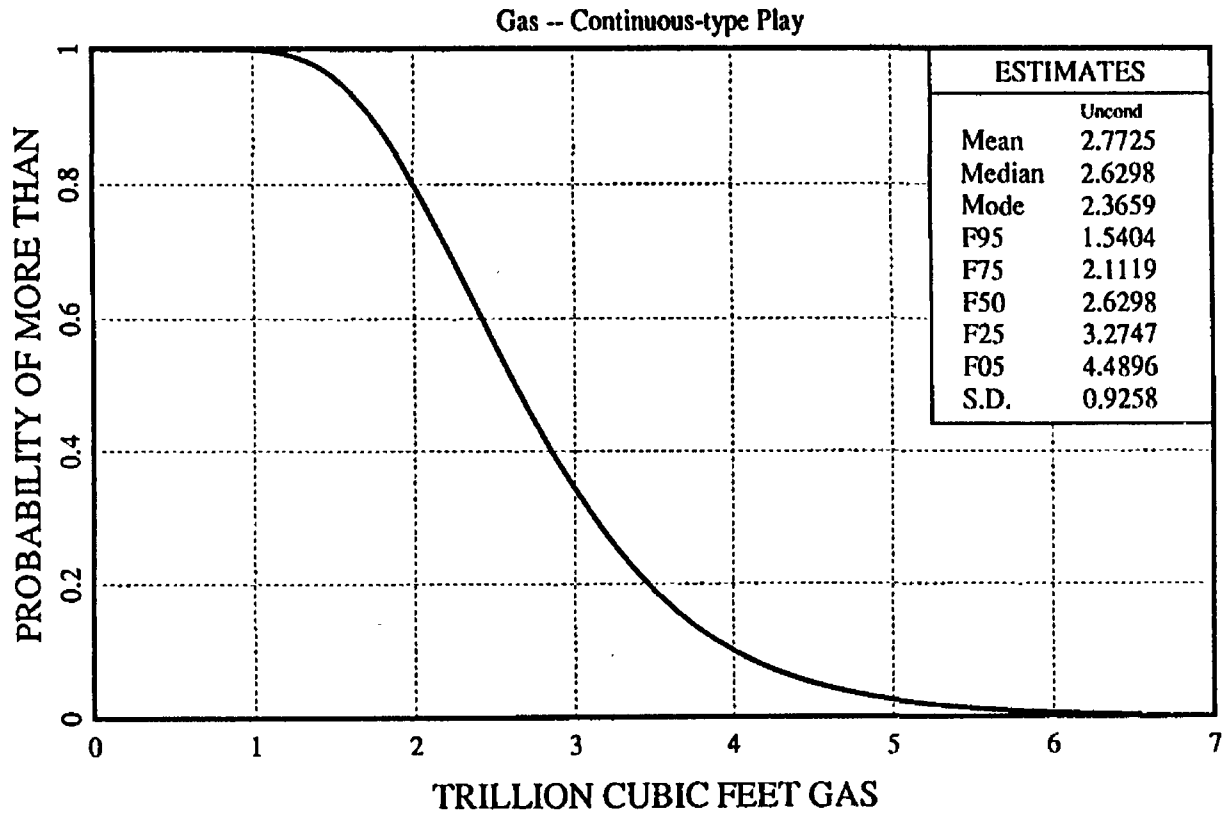
[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 48. Potential additions to technically recoverable resources for Play 6735, Upper Devonian Sandstone Gas Medium-Low Potential.



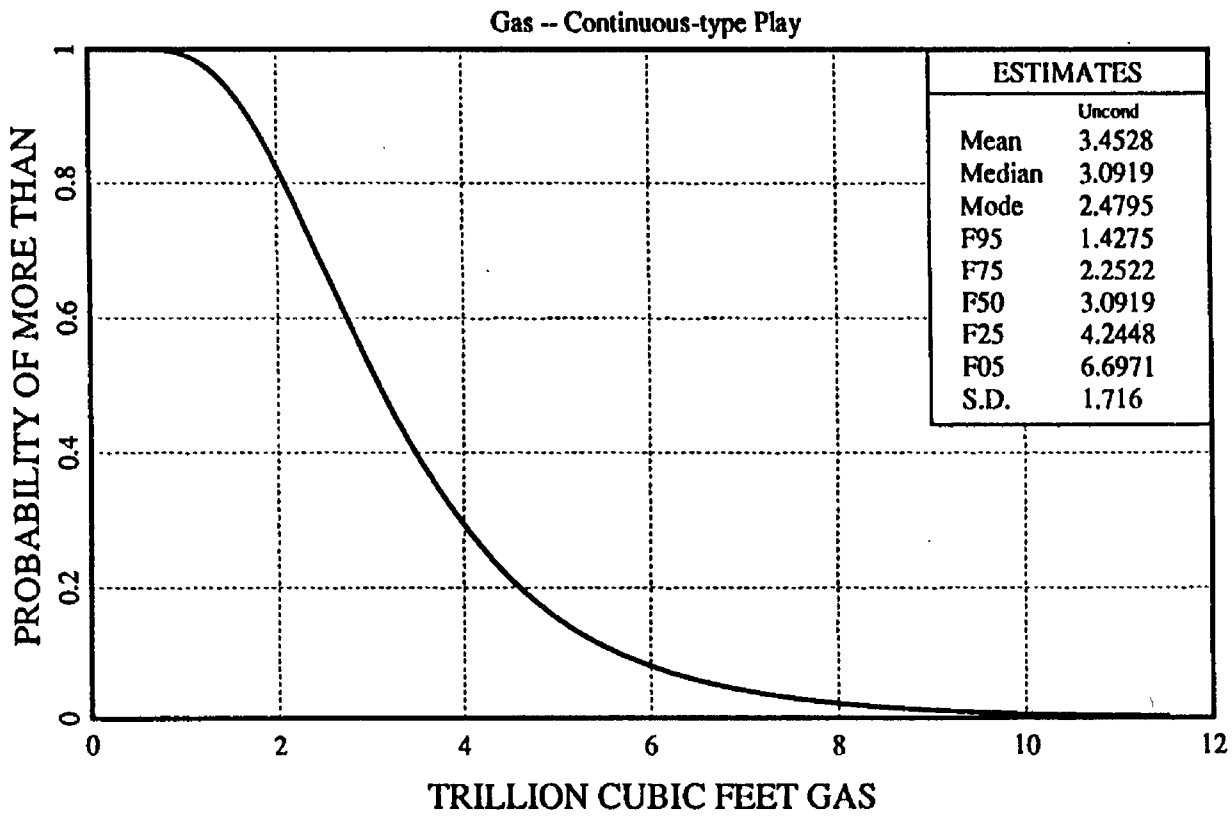
[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 49. Potential additions to technically recoverable resources for Play 6740, Devonian Black Shale - Greater Big Sandy.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 50. Potential additions to technically recoverable resources for Play 6741, Devonian Black Shale - Greater Siltstone Content.



[Upper chart represents primary commodity of play; lower chart represents secondary commodity. Absence of lower chart for some gas plays means that no natural gas liquids were assessed. Insets list selected parameters of unconditional probability distribution, including 95th, 75th, 50th, 25th, and 5th fractiles, and standard deviation. Parameter units are those of graph's horizontal axis.]

Figure 51. Potential additions to technically recoverable resources for Play 6742, Devonian Black Shale - Lower Thermal Maturity.