

Feature Article

Is There a Resource Base in Lower 48 Frontiers?

By Mary Van Der Loop

"Everybody" knows that there are no frontiers left in the Lower 48, and that only small fields remain to be found. The Lower 48 is mature and overdrilled; if you drill a frontier idea in the Lower 48, your chances of finding something worth keeping are indescribably small compared to drilling in a well-known area. Is "everybody" correct in these assumptions?

How overdrilled are the Lower 48? What would be a frontier exploration area here? How large would the targets be? And how can we realistically assess the risk of exploring for those areas?

According to DOE data, the median discovery size in the Lower 48 is only 1 MMBOE. The Nehring database shows the median discovery size to be 2 MMBOE, because it deletes all fields smaller than 1 MMBOE. How can we realistically expect to find a field larger than 1 MMBOE? First, start where you can still find a large target. Since oil and gas field sizes are lognormally distributed, with many small fields and only a few large ones, the probability-weighted mean is a more accurate estimation of the field size which might be found. Therefore, large prospect sizes, and resulting large field sizes, at the high end of the lognormal distribution have to be targeted. Realistically speaking, where is a large prospect target? Are there frontiers in the Lower 48?

Let's define a Lower 48 frontier as follows (Figure 1):

1. A sparsely drilled area (less than 100 exploratory wells per 1/2 degree latitude/longitude grid, or about one well in 9 square miles).
2. An area that only recently became densely drilled (that is, had less than one exploratory well per 9 square miles prior to 1975, the advent of "modern" technology).
3. Deeper strata in mature areas (again, with less than 100 exploratory tests to the deeper horizons per 9 square miles).
4. Depths greater than 15,000' (only 3% of wells in the Lower 48 go below 15,000'; only grids with fewer than

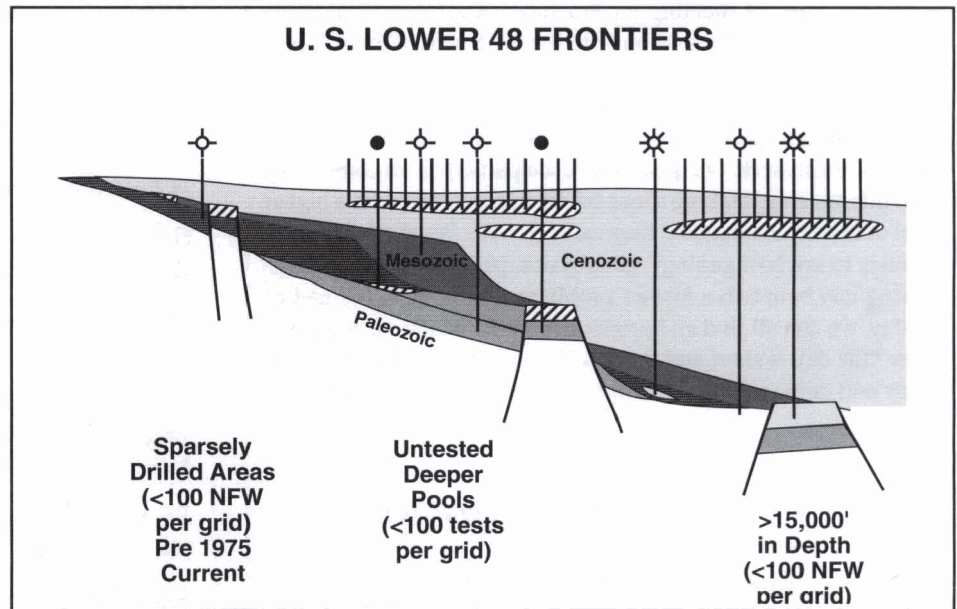


Figure 1. Cross-section sketch of frontier horizons.

100 exploratory tests >15,000').

How many reserves have been discovered in these frontiers compared to what has been found in the rest of the Lower 48, since 1975 (Figure 2)?

First, in the entire Lower 48 from 1975 to 1990, over 130,000 exploratory wells found 22 billion BOE, in median field sizes (Nehring database) of 2 MMBOE, (probability weighted mean field size about 9

MMBOE), with a 23% chance of completing the exploratory well, but only 1.9% chance of finding more than 1 MMBOE. How do the frontiers compare to this?

In sparsely drilled grids, about 13,000 exploratory wells (about 9% of total wells) found 5.5 billion BOE (24% of total reserves), in median field sizes of 5 MMBOE (probability weighted mean field size 17 MMBOE), at a 19% chance of completing the exploratory well, and a

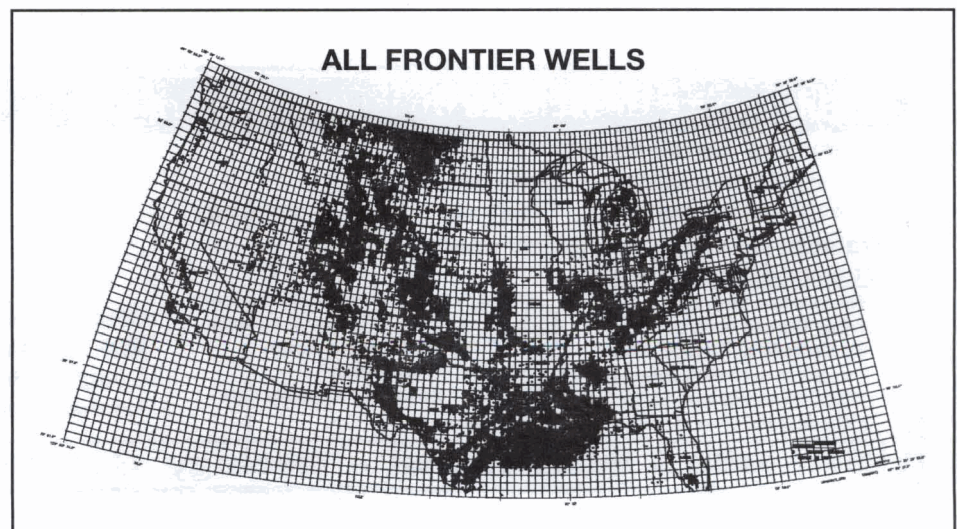


Figure 2. Gridded map of the U.S. showing all frontier wildcats.

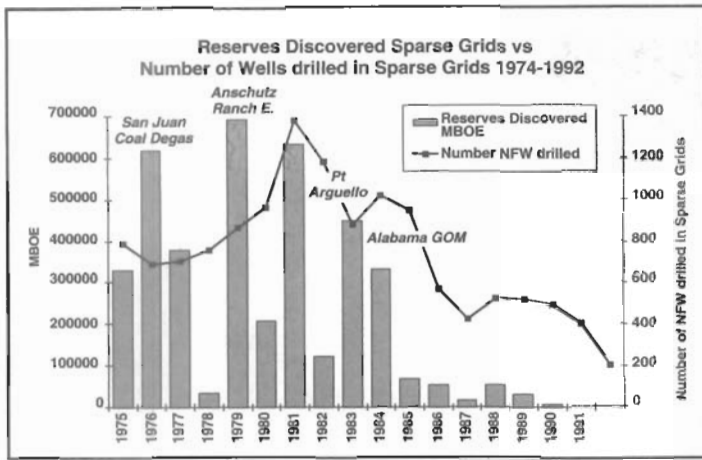


Figure 3. Performance of sparse-grid frontiers.

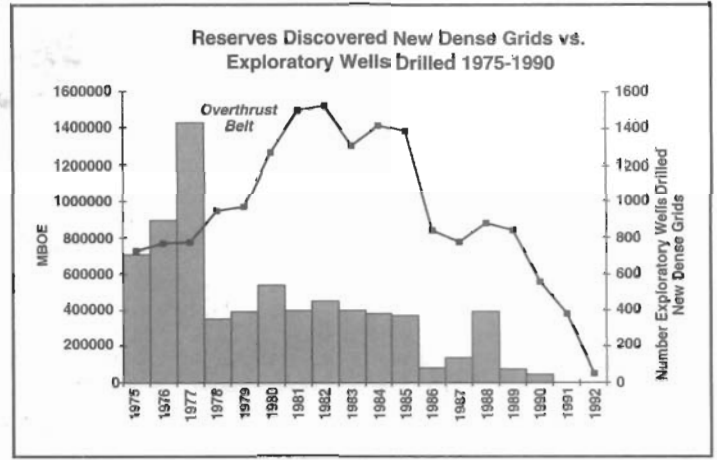


Figure 4. Performance of new dense-grid frontiers.

1.2% chance of finding more than 1 MMBOE. It is apparent that fewer wells found larger fields, with about the same risk as in a developed area. The largest finds were also in sparsely drilled grids—like Anschutz Ranch, Overthrust Belt, and Point Arguello, offshore California. Each was a risky frontier idea in its day, and each discovered over 500 MMBOE (Figure 3). What “way out” ideas do we have today in sparsely drilled areas—are they the Point Arguellos of tomorrow?

In the recently (since 1975) densely drilled grids, nearly 17,000 exploratory wells (about 12% of total wells) found 5.8 billion BOE (26% of total reserves), in median field sizes of 4 MMBOE (probability weighted mean field size 15 MMBOE), with a 27% chance of completing the exploratory well and 3% chance of finding more than 1MMBOE (Figure 4). Those were the hot trends that were drilled in the early 80’s boom, like the Overthrust Belt and the offshore Gulf of Mexico. Once again, fewer wells found bigger fields with a better chance of finding something worth keeping. In the deeper pool wildcat division defined by using the age at TD classification (Figure 5), about 11,000 exploratory wells (7% of the total) found 1.7 billion BOE (8% of total reserves) in median field sizes of 3 MMBOE (probability weighted mean field size of 12 MMBOE) and with a 16% chance of completing the exploratory well and a 3% chance of finding more than 1 MMBOE. The Rockies had much of this action and still have a lot of undrilled deeper horizons (Figure 6). In fact, while the entire U.S. map looks covered with wells, you see that huge volumes of sediments in the old producing areas are relatively untouched when you strip off all wells less than 10,000’ deep (Figure 7). Again, fewer overall wells in this category found larger than average

FREQUENCY OF AGE AT TD BY GRID FOR NON-SPARSE GRIDS, 1975 - CURRENT

GRID = 31.50 - 103.50
N Latitude W Longitude

AGETD	FREQUENCY	PERCENT	CUMULATIVE FREQUENCY	CUMULATIVE PERCENT
310	2	1.9	2	1.9
312	1	0.9	3	2.8
313	62	58.5	65	61.3
318	2	1.9	67	63.2
319	2	1.9	69	65.1
320	2	1.9	71	67.0
326	1	0.9	72	67.9
328	2	1.9	74	69.8
330	3	2.8	77	72.6
340	1	0.9	78	73.6
350	6	5.7	84	79.2
354	7	6.6	91	85.8
361	4	3.8	95	89.6
367	11	10.4	106	100.0

FREQUENCY MISSING = 7

RED BLUFF WOLFCAMP 7 MMBOE
SLASH RANCH ELLENBURGER 12.5 MMBOE

Figure 5. How deeper pool wildcats were defined.

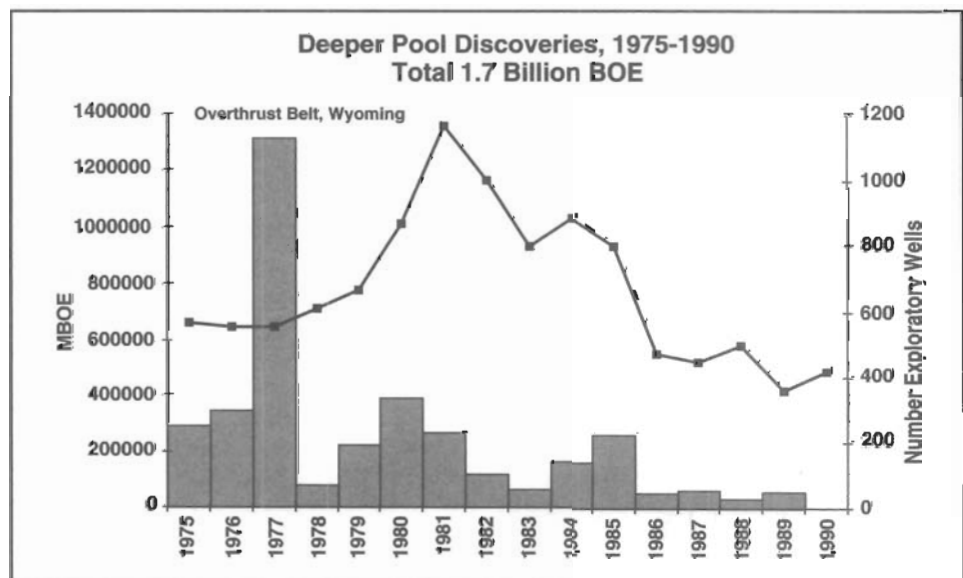


Figure 6. Performance of deeper pool frontiers.

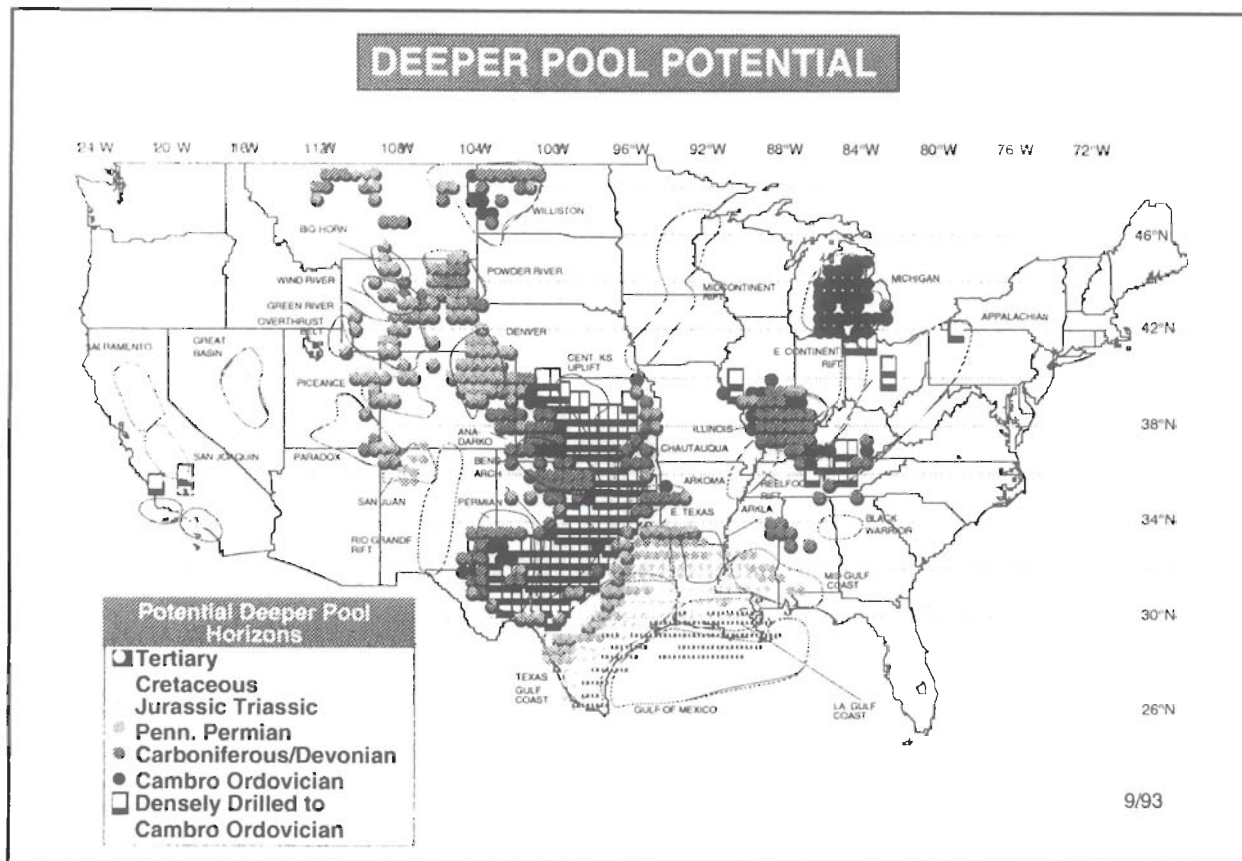


Figure 7. Deeper pool potential in the U.S.

fields, with a better chance of finding something worth keeping.

In the >15,000' depth arena, almost 4,000 exploratory wells (only 3% of total wells) found 2 billion BOE (9% of total reserves) in median field sizes of 6 MMBOE (probability weighted mean field size of 18 MMBOE), with a 35% chance of completing the exploratory well and a 4% chance of finding more than 1 MMBOE (Figure 8). These discoveries are mostly in the Gulf of Mexico and are more than 80% gas. Fewer companies compete at these depths. This category outranks the others for dis-

coveries of fields larger than the norm, the most reserves found per well drilled, the best chance of finding gas, less competition, and something worth keeping!

In conventional, highly drilled areas, over 90,000 exploratory wells (70% of total wells) in this same time period found 7.25 Billion BOE, or only 33% of total reserves discovered (Figure 9). The remaining exploratory wells (30%), drilled in frontiers, found 67% of the reserves (Figures 10, 11). Every significant peak in the reserves chart is due to a discovery in a frontier area (Figure 12, 13).

There are frontier opportunities in the Lower 48 in the categories described above. If you drill them consistently, you will find larger fields than in the old producing areas, and you will, overall, have to drill fewer wells to find them. The Lower 48 is mature only in selected parts of the well-known basins; in deeper pools and below 15,000', many frontiers remain. Even when drilling collapsed in 1986, the largest percentage of reserves found were in frontier areas. The chance of finding something worth keeping in frontiers like these is not indescribably small; it is 1.2 to 4%, which is both describable and better than the norm.

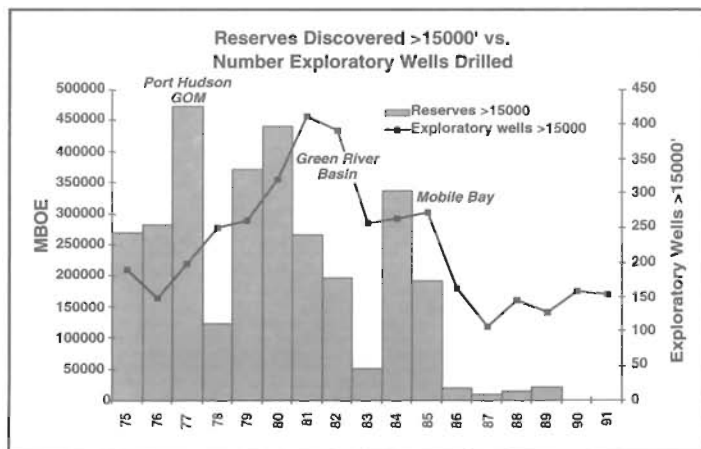


Figure 8. Performance of deep wells in >15,000' frontiers.

	Sparse Grids	New Dense	> 15,000'	Deeper Pool	Total Frontier	
Number Exploratory Wells 1975 - 1990	130,583 (100%)	13,280 (10%)*	17,727 (14%)*	3,946 (3%)*	11,297 (9%)*	39,644 (30% of total exploratory (no duplicat
% Success	23%	19%	27%	35%	16%	24%
% Economic Success	1.9%	1.2%	3%	4%	3%	2.8%
Median Field Size (Nehring)	25 MMBOE	5 MMBOE	4 MMBOE	6 MMBOE	3 MMBOE	4.5 MMBOE
Probability weighted mean	9 MMBOE	17 MMBOE	15 MMBOE	18 MMBOE	12 MMBOE	15 MMBOE
Number of Fields	1,224	148	533	148	301	1,000 (no dup. 40% of field
Reserves discovered 1975 - including Deepwater Gulf	22 B BOE (110%)	5.2 B BOE (24%)	5.8 B BOE (26%)	2 B BOE (9%)	1.7 B BOE (8%)	1.7 B BOE (8%)

Figure 9. Summary table of frontier performance.

And if you do find something in a Lower 48 frontier, chances that it will be big enough to keep are better than if you'd found something in a mature trend.

Everybody knows that the biggest fields in any trend are usually the first ones found, whether in a new geographic trend, a new technological trend, or a new trend in interpretation. Giant fields have been found in the Lower 48 in the last 20 years using new ideas, new interpretations, and new technology. There are more giant fields remaining to be found in the Lower 48 on some equally risky ideas, interpretations, and technology.

After all, everybody knows that oil is found with ideas.

Acknowledgements

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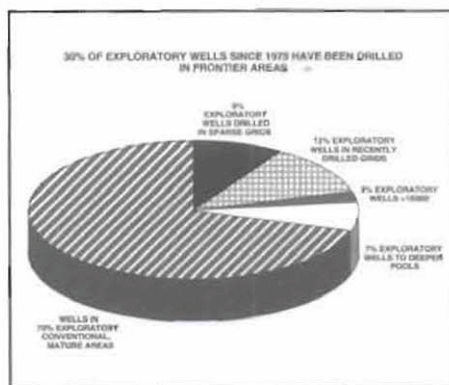


Figure 10.
30% of wells drilled in frontiers.

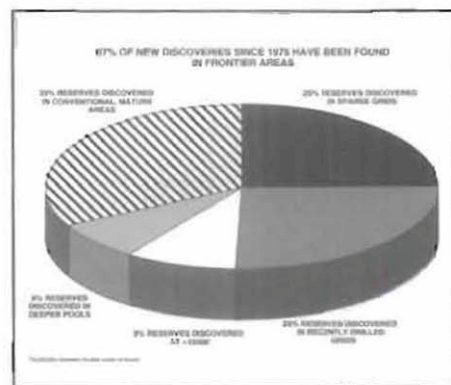


Figure 11.
67% of reserves found in frontiers.

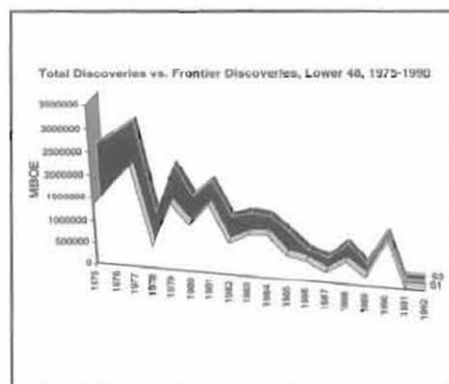


Figure 12. Historical chart of frontier performance vs. overall performance.

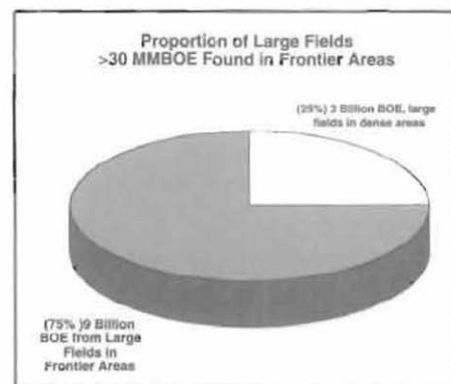


Figure 13. Most large fields are found in frontier areas.