KEY PARAMETERS FOR ECONOMIC SUCCESS OF HORIZONTAL WELLS

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ABSTRACT

The objective of this paper is to review applications of horizontal wells, discuss their successes and failures, and summarize the key parameters for economic success.

Horizontal wells have been used in 1) thin payzones, 2) naturally fractured reservoirs, 3) formations with gas and/or water coning problems, 4) gas reservoirs and 5) EOR applications. Based upon field results, the paper summarizes the following key parameters for economic success: 1) fracture intensity and direction, 2) hydrocarbon payzone thickness, 3) well spacing, 4) areal anisotropy, 5) vertical permeability, 6) formation damage and post drilling clean-up, 7) necessity of multiwell prospect and, 8) geological control. This paper includes discussions on these parameters. Also, whenever possible, pertinent field histories are presented. Available field results indicate that the success rate of horizontal wells in reducing water coning is much higher than in reducing gas coning, especially in low permeability reservoirs.

INTRODUCTION

Horizontal wells have become an effective tool to reach and produce hydrocarbons.[1-6] The large reservoir contact area (large sandface area open to flow) allows high production rates. Currently, 3000- to 4000-ft-long horizontal wells can be drilled. These long wells provide significant productivity increases over a vertical well. Long horizontal wells, in the case of naturally fractured reservoirs, are likely to intersect many fractures, and subsequently increase production rates. For a given production rate, as compared to vertical wells, horizontal wells exhibit a low fluid velocity in the near-wellbore region because of a large sandface area open to flow. In high permeability reservoirs, reduced velocity minimizes near-wellbore turbulence effects. The reduced velocity may also help to minimize sand control problems in unconsolidated formations. Additionally, horizontal wells show a low pressure drawdown near the wellbore. The reduced pressure drawdown will reduce the coning tendency for reservoirs overlying an aquifer and/or underlying a gas cap. This paper includes discussion about the applications of horizontal wells and a summary of the key parameters for economic success.[1-37]

HORIZONTAL WELL APPLICATIONS

Horizontal well projects have been successful in the following types of reservoirs: 1) reservoirs with thin payzone, 2) naturally fractured reservoirs, 3) formations with gas and/or water coning,

and 4) gas reservoirs. Horizontal wells have also been effectively used in EOR projects. Each of these applications is discussed in this section, and pertinent field examples are listed.

Reservoirs With Thin Payzone

Horizontal wells drilled in thin reservoirs are more effective than those drilled in thick reservoirs.[1,2,7] The success of horizontal well projects is measured by the productivity increase as compared to the vertical wells drilled in the same reservoir. For a given horizontal well length, the increase in well contact area with the reservoir in a thin formation is much larger than that in a thick formation. For example, a 1000-ft-long horizontal well is considered in two possible target zones, one with a thickness of 50 ft and the other with a thickness of 200 ft. The contact area is increased by 20 times by drilling a 1000-ft-long horizontal well in a 50-ft-thick reservoir. In contrast, a 1000-ft-long horizontal well drilled in a 200-ft-thick reservoir will only increase the contact area by 5 times as compared to a vertical well. This example clearly shows that significantly more gain in contact area can be achieved in a thin reservoir than in a thick reservoir.

Figure 1 demonstrates the effects of reservoir thickness on productivity ratio, J_h/J_v, for different well lengths, where J_h is the horizontal well steady-state productivity index, and J_v is the vertical well steady-state productivity index. The results of Figure 1 are for an isotropic reservoir ($k_h = k_v$) with drainage area equal to 160 acres. Figure 1 clearly shows that the productivity ratio J_h/J_v, at a fixed well length, decreases with the increase in reservoir thickness. The figure also shows that well length is the most important parameter in determining well productivity.

Horizontal wells have been successfully drilled in the Bakken Shale formation,[8,9] North Dakota, where typical formation thickness is 10 ft to 35 ft. The Bakken Shale formation is 9500 to 11000 ft deep, and does not have a gas cap or bottom water. Tests showed a fivefold increase in the initial potential as compared with vertical wells.[8]

Naturally Fractured Reservoirs

In naturally fractured reservoirs, horizontal wells offer a higher probability of intersecting natural fractures and draining them effectively.[1,2] This practice has been very successful in Austin Chalk formation,[10,11] Texas, Bakken Shale formation,[8,9] North Dakota, and Devonian Shale formation,[12,13] West Virginia. These reservoirs are highly fractured, matrix permeability is very low and major production is through the fractures.

Austin Chalk formation is an Upper Cretaceous fractured limestone reservoir. It produces along a 25-mile wide and 250-mile long trend.[10] The formation thickness varies from 50 ft to 160 ft. Giddings Field[10] is located in central Texas. The performances of vertical wells drilled in this field in the late 70's and early 80's ranged from highly prolific to exceptionally poor. The poor performance of some vertical wells is probably because the wellbore intersected only limited fracture system, and fractures and matrices away from the wellbore were undrained. In 1986, Amoco started horizontal well program in the Giddings Field. Ten horizontal wells were drilled within the next three years. The well lengths varied from 500 ft to 2200 ft. The production rates were 2.5 to 7 times as high as a typical vertical production rate (In this comparison, pressure depletion over time is taken into consideration). Figure 2 shows productivity improvement in the Giddings area.[12]

In Austin Chalk formation of Pearsall Field, West Texas, more than 50 horizontal wells have been drilled. Well lengths vary from 1000 ft to 3000 ft.[37]

Water and Gas Coning

Water and gas coning is a serious problem in many oil fields. It significantly reduces oil production and poses waste-water treatment problems. One of the main reasons for coning is pressure drawdown. As is well known, a vertical well exhibits a large pressure drawdown near the wellbore. This large pressure drawdown in the vicinity of the wellbore causes coning. In contrast, a lower pressure drawdown exhibits less coning tendency. Thus, coning can be avoided, or at least mitigated, by reducing pressure drawdown. This practice, however, presents a practical problem. The production rate is proportional to the pressure drawdown, and reducing the pressure drawdown will result in a reduced oil production rate, which may be uneconomical.

Horizontal wells provide an option not only to minimize pressure drawdown but also to reduce water and gas coning. Pressure drawdown near a long horizontal well is lower than the pressure drawdown near a vertical wellbore, as long as the production per unit well length of the horizontal well is smaller than that of the vertical well. Because of a long wellbore, a high production rate can be obtained even though the production per unit well length is small. Thus, by drilling a long horizontal well, pressure drawdown near the wellbore can be reduced, coning tendency can be minimized, and a relatively high production rate can be sustained. Note a large standoff between a horizontal well and oil-water/oil-gas contacts also helps reducing coning.

Horizontal wells have been drilled to prevent water and gas coning in different parts of the world. Successful field examples in sandstone reservoirs are the following: Prudhoe Bay,[14] Alaska, where reservoir thickness is 200 ft and permeability is 200 md; Bima Field,[15,16] Indonesia, where reservoir thickness is approximately 100 ft; Helder Field,[17,18] North Sea, where oil column thickness varies from 45 ft to 90 ft and permeability is 1 to 6 Darcies; Troll Field,[19,20] North Sea, where oil column thickness is about 90 ft and permeability is close to 10 Darcies; North Herald, South Pepper and Chervil Fields,[21] Australia, where oil column thickness varies from 25 ft to 81 ft and permeability is in the order of Darcies. Horizontal wells have also been drilled in the following limestone and reef reservoirs, in limestone reservoir: Rospo Mare Field,[22,23] Italy, in Reef reservoir: Empire Abo Unit,[24] New Mexico and

Elk Hills,[25] California.

Rospo Mare Field,[22,23] located offshore Italy at a depth of 4523 ft, is a highly fractured limestone reservoir underlain by a thick water zone. The gross reservoir thickness is 230 ft. Oil gravity is 12 °API, and viscosity is 300 cp. This heavy-oil reservoir with high mobility contrast was considered uneconomical by conventional means because of a high possibility of water coning. Vertical, slant and horizontal wells were drilled to develop this field. Originally, no water treating facilities were available on the platform, therefore, all wells were produced at or near the critical rates. Figure 3 presents production histories for a vertical well, a slant well and a horizontal well, where the 2000-ft-long horizontal well was completed with a slotted liner. The figure shows that the production rate (or critical rate) of the horizontal well is much higher than those of the vertical and slant wells. It is interesting to note that the vertical well's production increased temporarily after an acid treatment and then dropped sharply. This is probably caused by the enhancement of vertical communication between the well and bottom water, resulting in high water production. As time progresses, the horizontal well rate decreases, and after a certain time it could become comparable to a vertical well rate. The cumulative production, however, is much higher than those of the vertical or the slant wells.

One of a few field examples where horizontal wells have reduced gas coning is in Empire Abo Unit,[24] which is located in the Empire Abo Pool of Eddy County, New Mexico. The unit covers approximately 11,000 acres and produces from the Permian Abo Reef dolomite at a depth of approximately 6200 ft. The oil column thickness is about 90 ft and permeability is 25 md. Gravity drainage, later supplemented by injecting the residue gas into the gas cap, is the main driving mechanism. The Empire Abo Unit was originally developed with vertical wells. By the early 70's, some of the vertical wells were producing a significant amount of free gas. The production of free gas has two effects: 1) it reduces oil relative permeability around the wellbore and thus reduces the oil production rate; 2) it depletes the reservoir pressure which results in reduced ultimate recovery. To minimize gas coning problems, ARCO started drilling horizontal drainholes in the late 70's and early 80's. The performance of one of the drainholes is shown in Figures 4 and 5. Three vertical well performances are also shown in the same figures for comparison purposes. Note that the drainhole is located closer to the gas-oil contact than the perforations of the surrounding vertical wells. In spite of this smaller standoff, the produced gas-oil ratio of the drainhole is substantially lower than the produced gas-oil ratios of the vertical wells, and the cumulative production is 1.6 times as high as the surrounding vertical wells. Figures 4 and 5 clearly show the success of a horizontal drainhole drilled in a reservoir with a gas coning problem.

Another field example is a horizontal well sidetracked from an existing vertical well in Elk Hills,[25] California, where the driving mechanism is solution gas drive and gravity drainage supplemented by a peripheral waterflood and crestal gas injection. This field is still fairly young, and pressure maintenance is a high priority. The strict pressure maintenance requires that high GOR wells be curtailed or shut in. Well 372-35R, a good producing well with a GOR of 19283, was shut in during March 1988 with an oil rate of 180 BOPD. It was decided to sidetrack this well so that gas production can be reduced and oil production can be maximized.

The gas/oil and oil/water contacts are located approximately at 7050 ft and 7350 ft, respectively. Using numerical simulation, an optimal horizontal well placement was determined to be at 62 ft above the oil/water contact. The well was completed with a cemented and perforated liner. Initial test shows a production rate of 663 BOPD with a GOR of 673 SCF/STB.

It is important to note that the Empire Abo Unit as well as Elk Hills have fairly thick oil columns, 90 ft and 300 ft, respectively.

Gas Reservoir

Horizontal wells are an effective means of producing gas reservoirs. They are applicable in both low-permeability and high-permeability reservoirs.

In low-permeability reservoirs, it is difficult to drain large volumes using vertical wells. For example, for reservoirs with permeability less than 0.01 md, a 40-acre (or less) spacing may be needed for vertical wells to efficiently drain the reservoir within a reasonable time frame. Fracture stimulation treatment does help drainage, creating a long fracture, however, is not an easy task. A horizontal well, with its long wellbore, provides an alternative for effectively draining low-permeability gas reservoirs. Limited information on horizontal wells drilled in tight reservoir is available.[38]

In high-permeability reservoirs, due to high gas velocity near the wellbore, pressure drop caused by turbulence effects (NonDarcy flow effects) accounts for a significant portion of the total pressure drawdown, which severely restricts gas production. Turbulence effects can be reduced by reducing gas velocity in the near-wellbore region. This can be achieved, of course, by fracturing a vertical well. However, due to fracturing fluid leak-off and proppant settlement, it is difficult to create a long fracture. The most effective way to reduce gas velocity around the wellbore is to reduce the amount of gas produced per unit well length. This can be easily accomplished by using horizontal wells. The unit length production of a horizontal well may be lower than a vertical well, its total production is much higher than a vertical well because of a long wellbore. Therefore, horizontal wells provide an excellent method to reduce near-wellbore turbulence effects and thus enhance gas production.

The Zuidwal gas field,[26] found in the lower Cretaceous, is located in the middle of an inland sea, the Waddenzee, the Netherlands. The reservoir is at a depth of 6037 ft and consists of an approximately 328-ft-thick clay-sandstone series. Porosity is about 10-15% and permeability ranges from 1 md to 10 md. Due to the relatively high permeability, deviated and horizontal wells were drilled to develop this field so that near-wellbore turbulence effects could be reduced. Figure 6 is a proposed profile for one of the horizontal wells in the Zuidwal Field. Note that 80% production is from two 20-ft-thick sandstone layers, IIA and IIF, at different elevations (see Figure 6). The horizontal wells were designed to penetrate these two layers and stay in these two layers as much as possible. These horizontal wells are found to reduce near-wellbore turbulence effects and enhance productivities.

EOR Applications

The use of horizontal wells has been suggested to increase the effectiveness of water flooding.[27] Regulatory rules require water to be injected at less than the formation parting pressure to avoid contaminating drinking water. This may prevent injecting water through a vertical well at a desired rate and affect the economical results of water flooding projects. Horizontal wells provide large reservoir contact areas, and thus, high injection rates can be maintained through horizontal wells without fracturing the formations. Properly designed horizontal injection wells can also increase sweep efficiency. A combination of horizontal and vertical wells would be necessary to improve project economics.

The use of horizontal wells has also been suggested to increase thermal oil recovery efficiency.[28,29,30,31] With horizontal wells, steam drive, cyclic steam stimulation and steam assisted gravity drainage have been used to produce heavy oil and tar sand reservoirs in pilot projects. The success of these pilot tests shows the potential of horizontal well applications in thermal recovery. Reference 28 includes review of theoretical, experimental and field results on thermal oil recovery projects up to 1987.

Horizontal wells can also be used to increase the efficiency of miscible flood. A successful field example has been reported.[32] In Canada, Husky[32] drilled and completed a horizontal well in a mature vertical hydrocarbon miscible flood reservoir of Rainbow Keg River G Pool, which is a Keg River pinnacle reef located approximately in the center of the Middle Devonian age Rainbow Basin of Northern Alberta. The reef, with a maximum thickness of 614 ft, was originally filled with 39.1 °API oil. Initially, there was no gas cap in the reservoir and the bottom water was relatively inactive. G Pool had been under miscible flood since 1972. The pool production reached its peak of 400 m^3/day (2516 BOPD) in 1974 and gradually declined to 150 m^3/day (944 BOPD) in 1985. In order to increase oil production rate and ultimate recovery, a horizontal well was drilled and completed. The well was placed close to the current oil/water contact while still being able to avoid coning. Initial production shows that horizontal well productivity is more than three times the productivity of the best vertical well in the pool. Figure 7 shows that the horizontal well increased the pool production and reduced GOR.

Other applications of horizontal wells are mainly to overcome drilling or drilling-related cost problems. In offshore operations, platform costs are proportional to the number of wells to be drilled. Long horizontal wells can reduce the number of wells required to drain a given reservoir, and thus reduce the costs of offshore projects. Similarly, in environmentally sensitive areas, horizontal wells can be used to drain a large reservoir volume with minimum surface disturbance.

One of the disadvantages of horizontal wells is that only one payzone can be drained. Recently, however, horizontal wells have been used to drain multiple payzones. This can be accomplished by two methods: 1) drill a "staircase" type well where the horizontal portion are completed in different layers (see Figure 6); 2) cement the horizontal well and create fractures which could propagate to payzones above or below and thereby drain multilayers at different elevations. Figure 8 shows a horizontal well drilled in the lower Spraberry formation,[33] West Texas. Typical vertical wells in the Spraberry Trend Area are commingled in the Upper Spraberry, Lower Spraberry and the Dean Wolfcomp formations. All three formations require fracture treatments. Part of the horizontal well (from 8320 to 9905 ft) was completed with a cemented liner and part (from 9905 to 9948 ft) was open hole because of difficulties in inserting a 5 1/2 in. liner into an 8 1/2 in. hole. Using 20-40 Brady sand and resin-coated sand at the tail end, five fractures were created (see Figure 8). A total 1,408,000 pounds of sand was pumped into the well. The initial test showed rates of 69 BOPD, 326 BWPD, and 64 MCFD. The low rates could be attributed to the fact that portions of the well were drilled in partially depleted zones.

KEY PARAMETERS FOR SUCCESS

As mentioned earlier, the main advantage of horizontal wells is large contact areas with reservoir and high productivities. The main disadvantage is their costs. Typically, a horizontal well costs 1.4 to 3 times more than a conventional vertical well, depending upon the drilling and completion techniques employed. Because of its high cost, a horizontal well should be planned carefully. The following parameters need to be considered to ensure economic success of a horizontal well project:

1. Fracture Intensity and Direction

As noted earlier, horizontal wells are effective in naturally fractured reservoirs. A long horizontal well may intersect many fractures and produce at a high rate. The number of fractures the well intersects, however, depends on the fracture intensity and orientation. A horizontal well drilled in highly fractured reservoirs perpendicular to the fractures is the most effective.

2. Payzone Thickness

Horizontal wells are more effective in thin reservoirs than in thick reservoirs. However, there is a low limit required by horizontal drilling. For reservoirs without a gas cap or bottom water, at least 10 ft is required (Note horizontal wells have been successfully drilled in 10-ft-thick reservoirs in Bakken Shale formation, North Dakota). The available field histories indicate that for reservoirs with a gas cap or bottom water, using the present technology, at least 20 ft of payzone thickness is required to obtain acceptable economics for incremental drilling cost of a horizontal well.

3. Well Spacing

Drilling a horizontal well costs 1.4 to 3 times more than drilling a conventional vertical well. Consequently, from an economic standpoint, producible reserves for a horizontal well should be at least proportionally larger and should be produced in a shorter time span. This requires horizontal wells to be drilled with a larger well spacing than vertical wells. The actual spacing depends, among many other factors, upon reservoir properties. As a rule of thumb, a 1000-ft-long horizontal well drains twice as much as a vertical well, and a 2000-ft-long horizontal well drains three times as much. Areal anisotropy should also be taken into account. In fractured reservoirs, for example, spacing along the fracture trend should be greater than that perpendicular to the fracture tread.[34]

4. Vertical Permeability

Vertical permeability is one of the key parameters which determine the productivity of a horizontal well. Good vertical communication in the reservoir is essential for the success of a horizontal well. Drilling a horizontal well in a reservoir with low vertical permeability has almost the same effect as drilling a horizontal well in thick reservoir, where productivity ratio J_h/J_v decreases as the reservoir thickness increases. The effects of vertical permeability on steady-state horizontal well productivities are shown in Figure 9, where reservoir thickness is 100 ft and drainage area is 160 acres. The top curve in the figure represents the productivity ratio for an isotropic reservoir where the vertical permeability is equal to the horizontal permeability. The bottom three curves present the results for k_v/k_h values of 0.5, 0.25 and 0.1. Figure 9 clearly shows that the reduction of horizontal well productivities caused by low vertical permeabilities. In the extreme case, where vertical permeability is equal to zero, i.e., there is no vertical communication within the reservoir, a horizontal well would only drain a reservoir thickness which is equal to the wellbore diameter. If a horizontal well has to be drilled in a low vertical permeability reservoir (with no gas cap or bottom water), fracturing treatment should be considered to create a reasonable vertical communication and thus increase the productivity. Fracturing a horizontal well, however, requires the medium or long radius drilling technique to be used so that small portions of a long well can be isolated for an effective treatment.

For reservoirs with top gas and bottom water, a reduction in vertical permeability will reduce coning tendency for vertical wells. This, however, is not necessarily true for horizontal wells. On one hand, the low vertical permeability minimizes coning. On the other hand, a high pressure drawdown needs to be maintained in order to produce at a desired rate, which will accelerate coning. Therefore, in low vertical permeability reservoirs with a gas cap and bottom water, horizontal wells may not necessarily perform better than vertical wells.

5. Formation Damage and Post Drilling Cleanup

Formation damage is a serious problem, especially for horizontal wells drilled in low permeability formations. Drilling a horizontal well takes significantly longer time than drilling a vertical well, and thus, the producing formation is exposed to drilling fluid for a significantly longer time than in vertical well case. Thus, mud invasion and other drilling related formation damage are more severe than for a vertical well, significantly reducing horizontal well productivity. To minimize the damage, one can drill under balance or use special muds which contain minimal or no solids. Another alternative is to work out a cleanup scheme. For horizontal wells completed as open hole or with a slotted liner, it is difficult, if not impossible, to effectively clean up the damage. For a well with a large turning radius, swab tools can reach only partially into the curve. Stage acidization treatment can also be used to stimulate and clean up horizontal wells. In this case an alternate stage of acid and a diverter load is pumped into the formation and the well damage is cleaned up section by section. Another way of cleaning up formation damage is to cement the horizontal well and perforate it. Perforation beyond the formation damage will increase the well's productivity. It should be pointed out that for some high flow rate horizontal wells (wells drilled in high permeability formations), self cleanup may be sufficient.

6. Necessity of Multiwell Prospect

Horizontal well drilling costs more than conventional vertical well drilling. In the late 70's and early 80's, the costs were six to eight times more. As time progresses and technology advances, the costs have been reduced significantly. By the mid 80's, the typical horizontal drilling costs were only two to three times more than the vertical well drilling costs.

Drilling costs also depends on the experience in a particular area. The second well usually costs much less than the first one. The cost decreases as more and more wells are drilled. Published results on horizontal well costs in Cold Lake,[6] Canada; Prudhoe Bay,[35] Alaska; offshore Indonesia[15]; offshore the Netherlands[26]; Austin Chalk,[36] Texas, and Bakken Shale,[8] North Dakota indicate a significant reduction in drilling cost over time as more experience is gained. As reported, the first horizontal well typically costs two to three times as much as a vertical well. After drilling a few wells, the typical cost ratio (horizontal well cost/vertical well cost) is only 1.4. It has been reported that, in some cases with extensive drilling experience, horizontal drilling costs are comparable with vertical well costs. This tells us that, from an economic standpoint, a multi-horizontal well program has a better chance for success.

Figure 10 shows the costs[35] of 16 horizontal wells drilled in Prudhoe Bay, Alaska, and Figure 11 shows the costs[36] of 13 horizontal wells drilled on the Austin Chalk, Texas. Both figures show significant reductions in the cost as more wells were drilled.

7. Geological Control

Geological information is essential to keep a long horizontal well within a certain location of the payzone. On some occasions, certain portions of horizontal wells were drilled outside of the producing formation because of unexpected pinchout of the formation, encountering a fault with large vertical displacement, or poor estimate of formation dip. Highly developed areas with good geological information may not have space large enough for horizontal drilling. On the other hand, in an undeveloped area where large acreage is available for drilling horizontal wells, lack of geological information may risk the success of a horizontal well project.

CONCLUDING REMARKS

This paper briefly discussed the applications of horizontal wells in different types of reservoirs and summarized the key parameters needed to be considered for planning horizontal well projects. Some pertinent field examples were reviewed. Horizontal well projects are much more complicated than vertical well projects. The productivity depends on well length, and the well length is determined by the drilling technique used. The type of completion also affects horizontal well performance, and certain completion options are only possible for certain drilling methods. Therefore, to ensure the success of a horizontal well program, multidisciplinary efforts are required. Geologists, reservoir engineers, drilling engineers and production engineers must cooperate with each other, understand and appreciate different factors that affect horizontal well performance, and work out the most appropriate plan.

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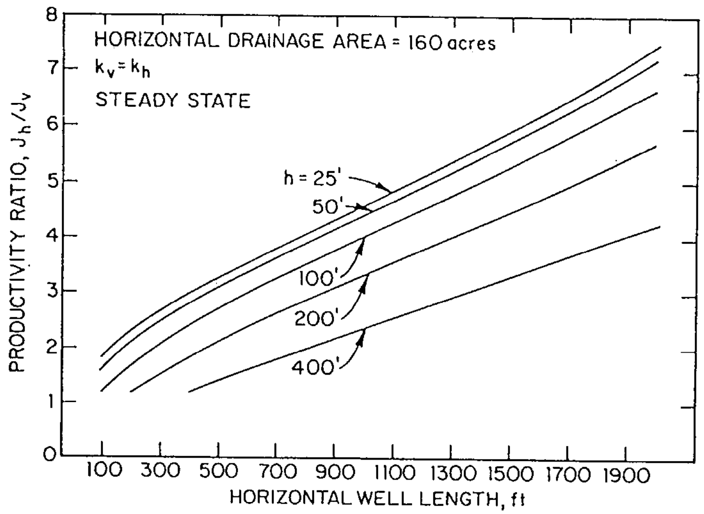

Figure 1 - The effects of reservoir thickness on horizontal well productivity

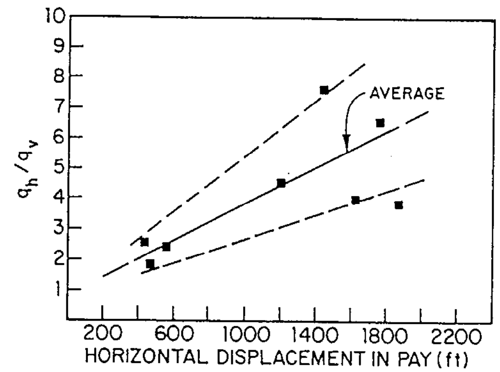

Figure 2 - Productivity improvement in the Giddings Area

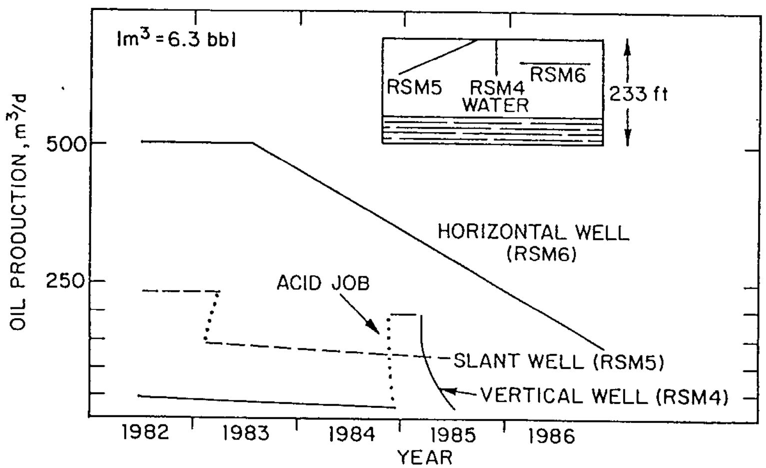

Figure 3 - A comparison of horizontal, slant and vertical well performances, Rospo Mare Field, offshore Italy

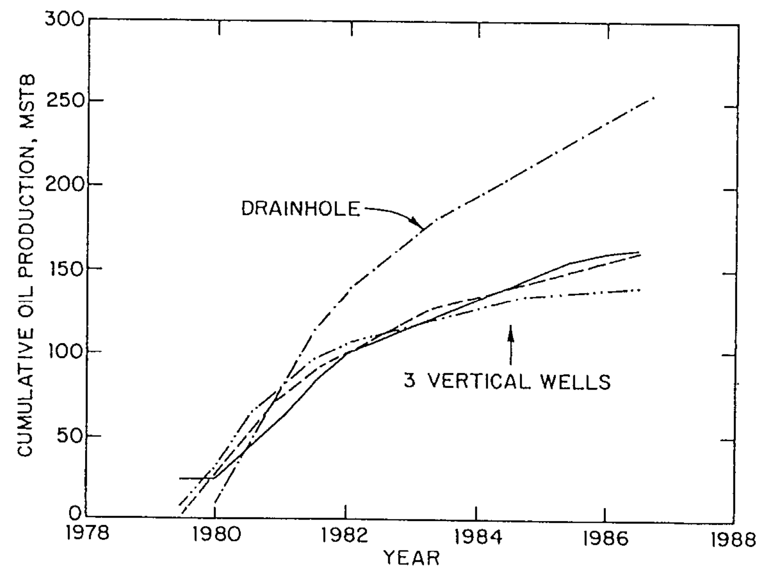

Figure 4 - Cumulative productions from a drainhole and a nearby vertical well, Empire Abo Reef, New Mexico

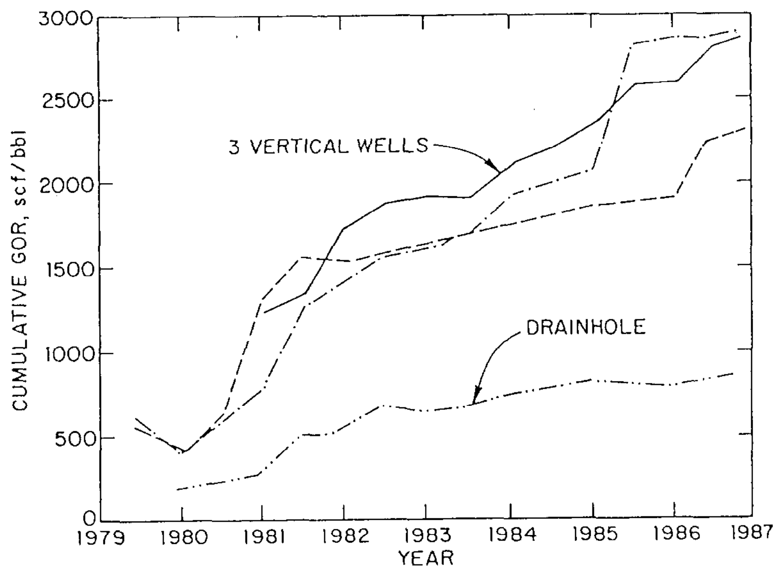

Figure 5 - Cumulative GOR from a drainhole and a nearby vertical well, Empire Abo Reef, New Mexico

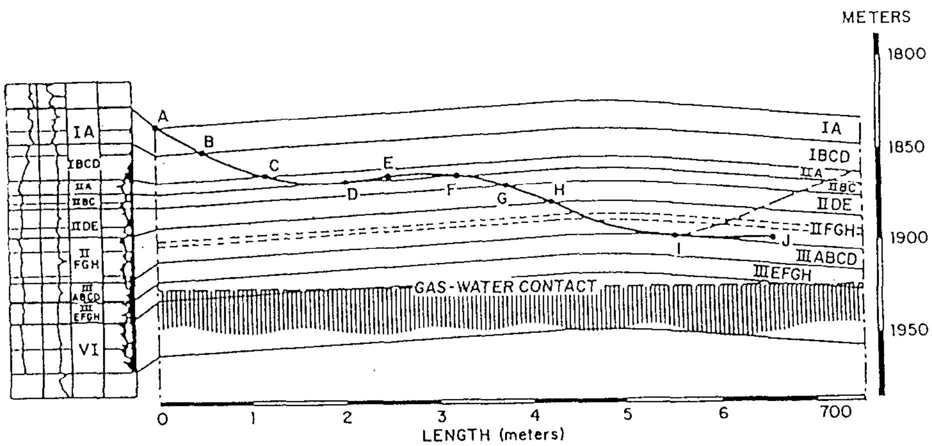

Figure 6 - A proposed horizontal well profile, Zuidwal Field, the Netherlands

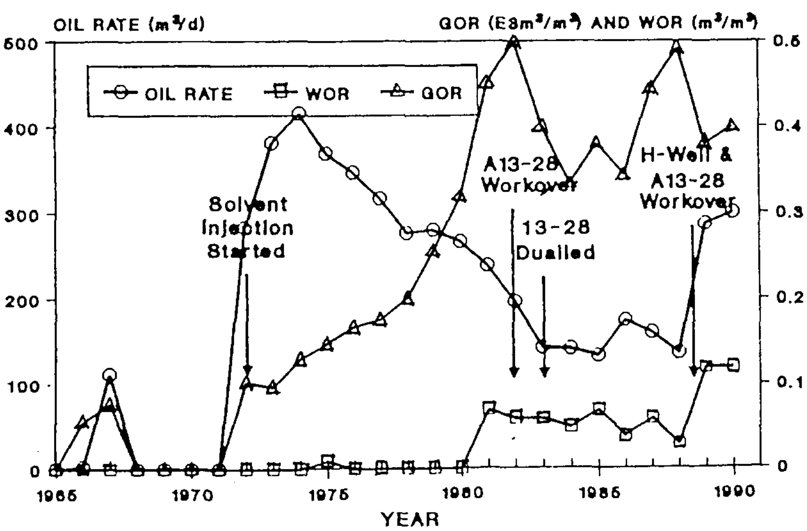

Figure 7 - Rainbow G Pool production history

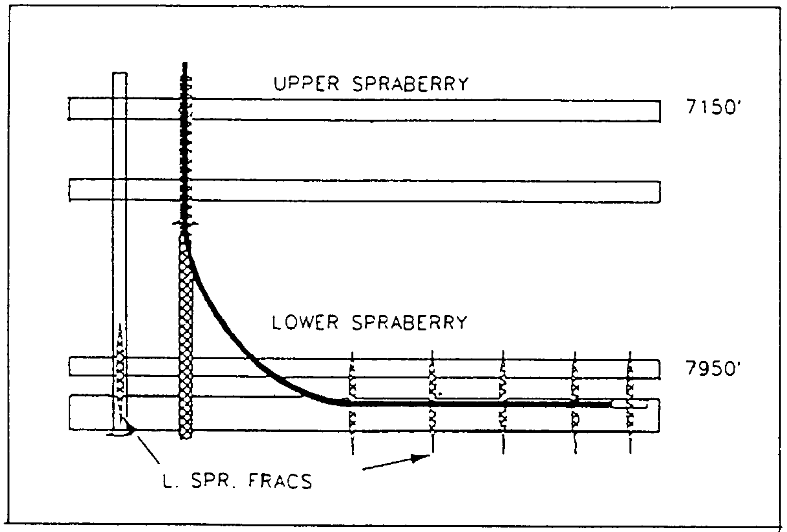

Figure 8 - A schematic diagram of a fracture horizontal well in the Spraberry formation, Texas

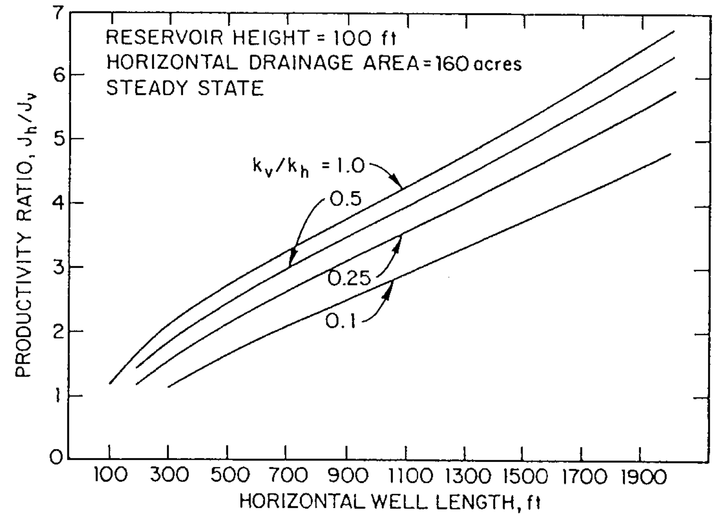

Figure 9 - The effects of vertical permeability on horizontal well productivity

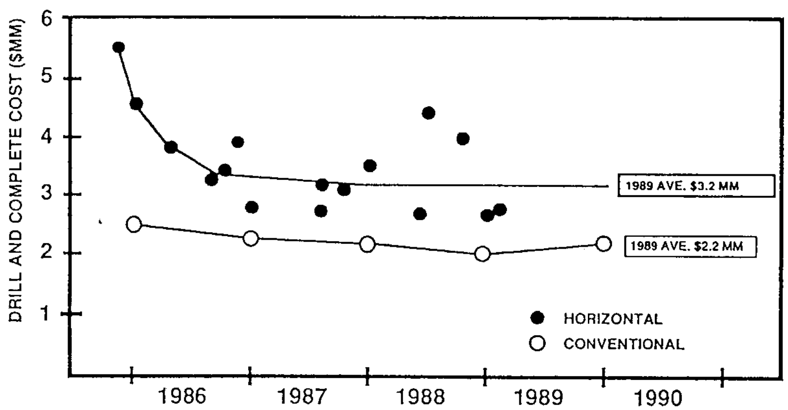

Figure 10 - A comparison of horizontal and vertical well costs, Prudhoe Bay, Alaska

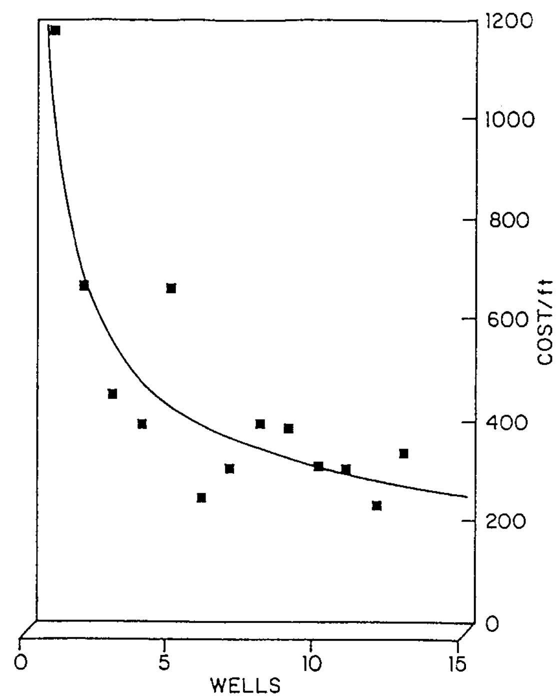

Figure 11 - Horizontal well costs, Austin Chalk, Texas