Implied Covenants in Oil & Gas Development

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Introduction

Geology is the study of the Earth, from its nickel iron core at the center to the atmosphere that surrounds and supports life, from its origin 4.5 billion years ago to present day. Most people have had at least some exposure to geology in high school earth science class.

Similar to the study of medicine and its many specialized fields of practice such as orthopedics, cardiology, neurology and so on, the science of geology consists of a multitude of specialties and sub-specialties. The atmosphere: studied by meteorologists was created and sustained by the outpouring of gasses associated with volcanic activity. The shape, size, depth, and distribution of the world's oceans are determined by tectonic process, covered by the science of oceanography. Geomorphology is the study of the origin, size, shape, and distribution of landforms such as mountains, valleys, and plains. Sedimentology, the origin, transport and deposition of sediments, and stratigraphy, the study of the rocks formed by those sediments are just a few of the specialties.

Geology is a science where the specialties have subspecialties and the subspecialties have special subspecialties. For example, paleontology, the study of life preserved in the fossil record can be divided into macro-paleontology, fossils that can be seen with the naked eye and micro-paleontology which is the study of fossils that need a microscope to be seen. Micro-paleontology is used to age date sedimentary rocks. Many micro-paleontologists specialize in just one type of microfossil or just one narrow geologic age.

Other major domains in geology include tectonophysics, the study of the creation, motion and destruction of the major plates that make up the surface of the earth, geophysics, the study of the physical properties of the earth, seismology, the study of earthquakes and volcanology.

Geologists are employed in a vast variety of industries, operating in hazard- rich domains often subject to litigation. Some of the major industries include the environment, water resources, construction, including offshore construction and installation, mining and oil and gas. Of these industries, oil and gas is the granddaddy. The oil and gas industry poses more risks, greater hazards, collects more data, and has done more to contribute to the world's knowledge of the earth than all the other previously mentioned industries combined. The oil and gas geoscientist is, in short, the brain surgeon and rocket scientist of the geologic profession.

Geology and Geophysics in Oil and Gas:

Geologists and geophysicists in the oil and gas industry are charged with the identification of oil and gas deposits below the surface of the earth, or subsurface. They are also responsible for estimating the volume of oil and gas (reserves) found in these deposits and the identification of any hazards that might be encountered during drilling. This is no small feat, as most reserves are generally found at depths of 5,000 to 20,000 feet below the surface. This is done by the collection and analysis of massive quantities of data using advanced technology to investigate the structure, stratigraphy, and fluid content of the rocks below the surface of the earth.Geologists primarily focus on data collected from oil and gas wells (a/k/a well data). Data is collected from vertical wells used to tap into conventional reserves, and horizonal wells used for the development of unconventional reservoirs (Figure 1a). Well data are collected by a process known as wireline logging. Sophisticated measuring instruments or logging tools (Figure 1b) are lowered into the well bore. Measurement of the rock properties in the well bore are made as the tool is pulled out of the well (Figure 1c). These tools measure the physical properties of the rocks such as density, resistivity, conductivity, natural gamma radiation, and a variety of other complex properties. The measurements are then analyzed to calculate the rock's lithology, porosity, permeability, and the presence and quantity of oil and gas (Figure 1d). It is also possible to retrieve rock samples from below the earth's surface, commonly referred to as Core (Figure 1e). This allows geologists to analyze the rock samples and calibrate them with the wireline measurements.

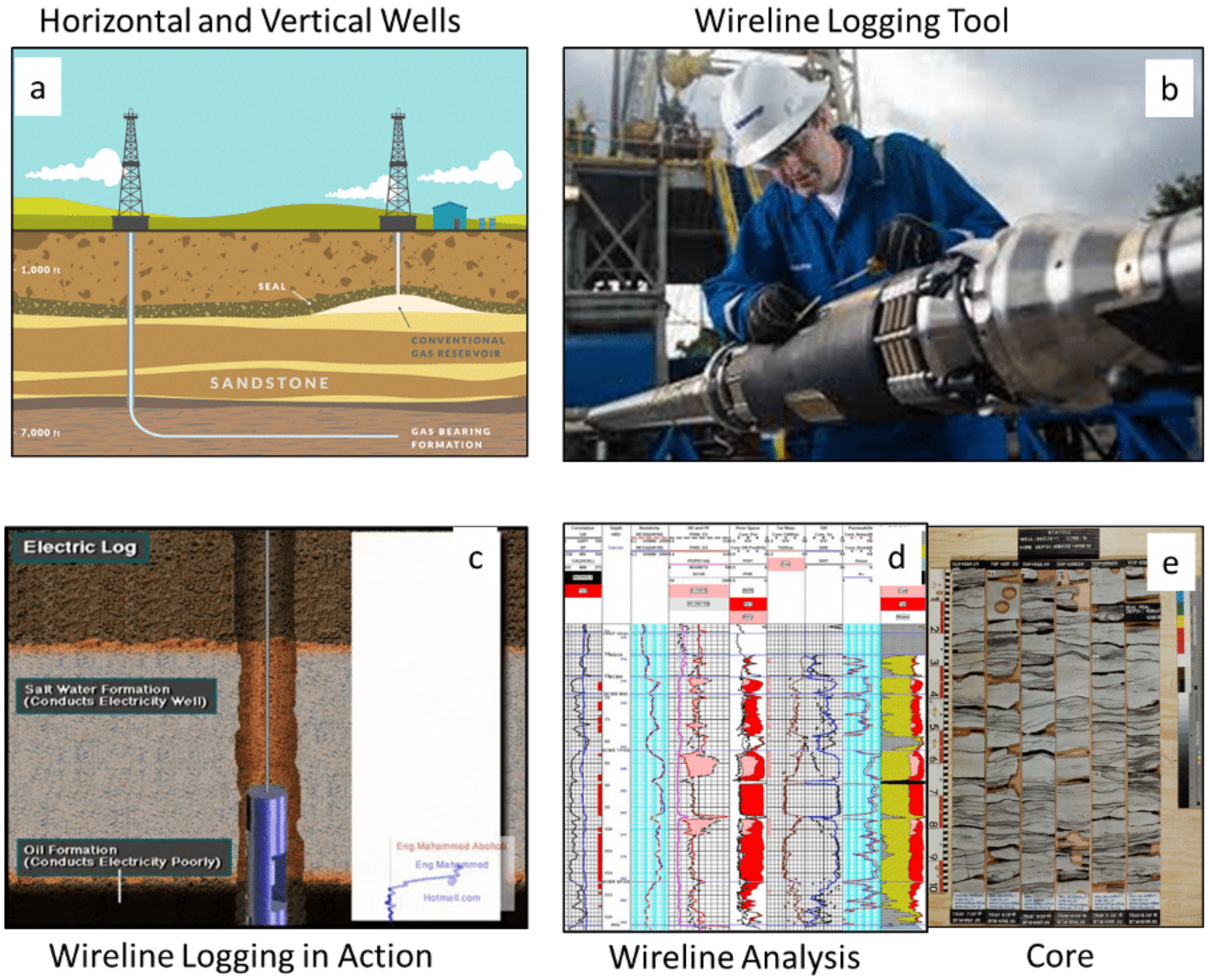

Figure 1: a) Illustration of vertical and horizontal wells b) Photo of a wireline logging tool c) Illustration of the wireline logging process d) Example of wireline log data and analytic output e) Example of well core

Geophysicists in the oil and gas industry primarily focus on the acquisition, processing, and interpretation of seismic data. Seismic data as used here are images of the subsurface created through the recording of sound waves. It is similar to the way ultrasound is used to see images of a baby in the mother’s womb, or how bats use sound to “see.”

Figure 2a shows an illustration of seismic acquisition in a marine environment with a ship towing a sound source and listening array. Sound waves are sent through the water into the underlying sediments and rocks. These sound waves are reflected back up from the rock layers and other interfaces deep in the earth. Reflected sound waves are recorded by sensitive devices called hydrophones. Figure 2b shows a picture of a seismic acquisition vessel. The hydrophones are encased in the cables streaming out behind the ship. These cables can extend anywhere from 6 to 12 km or more in length.

The sound recorded by the hydrophones are converted to digital data. Next the digital data are processed by massive super computers (Figure 2c) to generate three-dimensional images of the rocks in the subsurface (Figure 2d). These images are commonly referred to as 3D seismic data. Similar processes are used to acquire 3D seismic data on land.

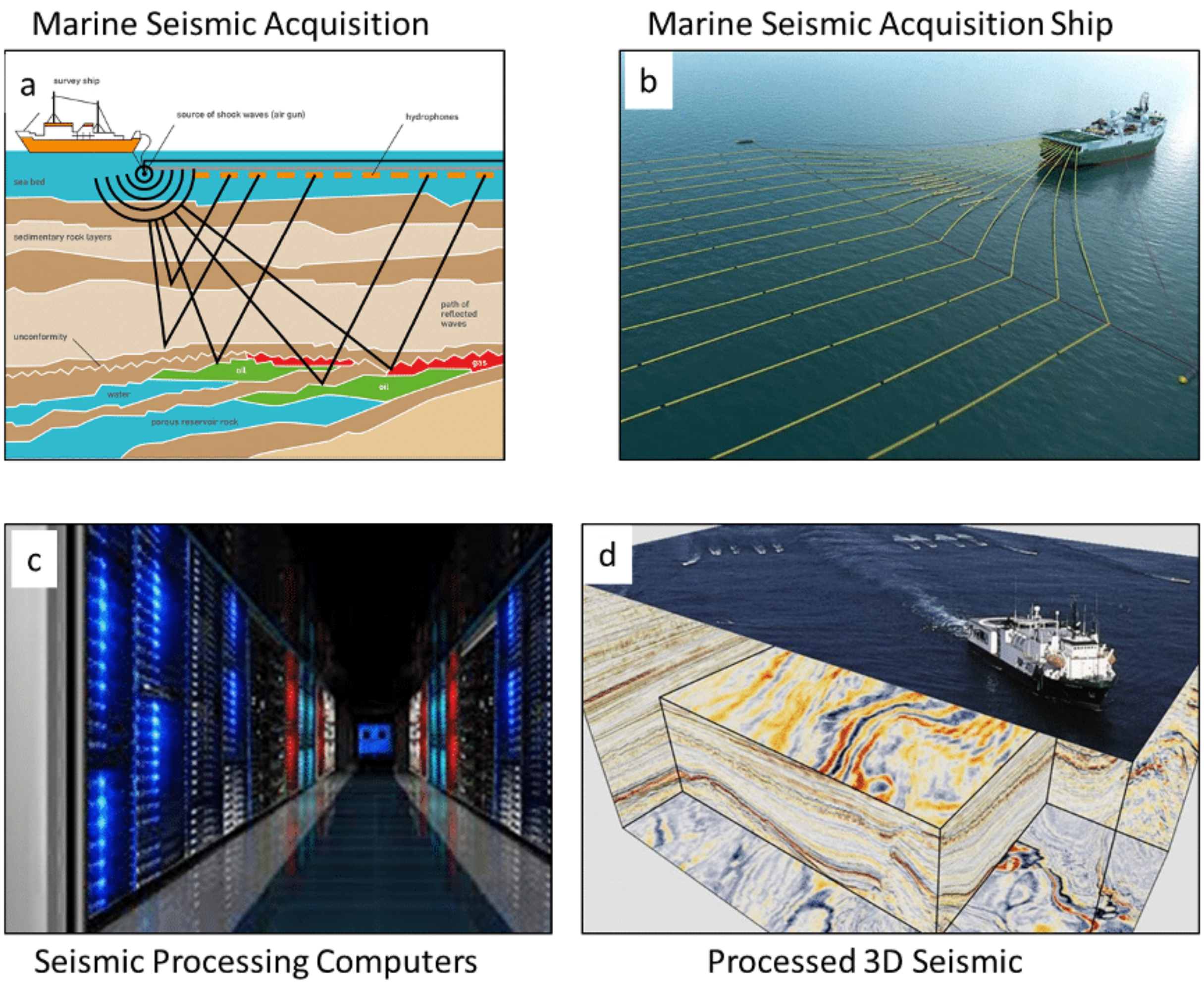

Figure 2: a) Illustration of seismic acquisition principles b) seismic acquisition ship c) seismic processing computers d) processed 3D seismic

Geoscience in Oil and Gas Forensic Consulting

To the extent that the majority of oil and gas exploration and production is focused on resources that are literally thousands of feet below the earth's surface, a significant number of disputes that arise in the oil and gas industry have a geologic component. Some examples include:

- Earthquakes Related to Injection Wells and Fracking Operations: Injection wells used for the disposal of wastewater related to oil and gas operations and fracking operations have been blamed for earthquakes. Geology and geophysics can be used to determine if there were faults in the area that might have reasonably been expected to move as a result of injection, and if the earthquake occurred in the vicinity of the well bore.
- Aquifer Contamination Related to Injection Wells and Fracking Operations: Injection wells and fracking operations have also been blamed for aquifer contamination. Geology can be used to determine if there were pathways for contaminants deep in the subsurface to reach the aquifer, if contaminants in the aquifer have the same composition as the injection fluids, or if there are potential sources of contamination other than the well.
- Reservoir Damage Related to Wastewater Disposal Injection: Cases have been documented where wells used for wastewater injection have contaminated oil fields and resulted in lost production from oil and gas wells.
- Security and Exchange Violations and Fraud in the Sale of Exploration and Development Programs: Oil and gas exploration and development programs are inherently risky. Most operators are honest principled businesses. Unfortunately, there may be a few bad apples, that put unwitting investors into programs with egregiously low potential for economic success. There are also operators that despite diligent efforts find themselves in financial difficulty. An understanding of the risks and potential rewards of exploration and development programs are the bread and butter of the oil and gas geologist and geophysicist.
- Valuation of Oil and Gas Assets for Tax Related Disputes: The value of any given oil and gas asset is dynamic. As wells are drilled and new data are acquired, reserves may be added or lost, increasing or decreasing the value of the asset. Disagreements over reserves are common and often a source of vigorous debate, much of it resolved by focusing on the geology and geophysics.
- Operator Implied Covenant of Reasonable Development of an Oil and Gas Lease and to Protect Drainage: Did the operator act reasonably in the development of reserves in a given lease based on the available data and market conditions at the time of the dispute? The answer to this question is to a large extent determined by geology of the subsurface.

Examples of Operator Implied Covenant of Reasonable Development

Example 1: Onshore Gulf of Mexico

It is a fact of business that operators do not always act to reasonably develop an oil and gas holding. There may be a number of reasons for this such as financial constraints or other investment opportunities that have potentially greater returns. The following case example involves an operator’s breach of implied covenant of reasonable development in the Gulf Coast. An oil and gas operating company leased 10,000 acres of the Jones Brothers’ Ranch. The operator went on to discover an oil field on the leased property. The oil field was located on a

1,000-acre tract of land in the corner of the ranch. Over the term of the lease, the field produced over 100 million barrels of oil and 100 billion cubic feet of gas. Royalties from the field provided an average income of $10,000 per day. However, the remaining 9,000 acres of the ranch remained undeveloped. The Jones Brothers sued the operator, alleging that the operator breached the implied covenant by failing to develop and reasonably explore the portion of the leased property outside of the oil producing field. The plaintiff's consultant testified that there were up to five additional prospects with the potential for oil and gas accumulations.

Figure 3 shows a series of hypothetical maps and cross sections of the leased property on the Jones Brothers' Ranch. Figure 3a shows a map with an oil field in the lower left-hand corner. The hypothetical oilfield is shown in green with oil wells represented by black dots.

A geologic cross section is a representation or model of a vertical slice through the earth. Since no one can actually see inside the earth, by necessity, the cross section is an interpretation of the structure and stratigraphy below the earth's surface. Figure 3b is a hypothetical cross section though the parcel of land shown in Figure 3a, the diagonal dashed line on Figure 3a shows the location of the cross section.

The cross section in Figure 3b shows a sandstone layer in yellow and a fault in black. The sandstone body has been deformed by the fault into an arch, referred to by geologists as an anticline. At the crest of the anticline is an oil field shown in green. Generally geologic structures show limited or no expression at the surface. To know what is happening in the subsurface requires acquisition and analysis of subsurface data, most commonly well data and seismic data.

Figure 3c and 3d show alternate versions for the same area. The cross-section (Figure 3d) shows three faults and three anticlines. Each of the anticlines are shown as having an oil accumulation at the crest of the structure. The oil accumulation to the left has a well and would therefore be a proven accumulation, while the other accumulations would be unproven prospects. The map (Figure 3c) reflects the hypothetical accumulations displayed in green.

The earth's subsurface is a world of mystery, unknown and unknowable to the casual observer at the surface. It is only through an understanding of the geologic history of the area, and the application of geologic principles to the acquisition and analysis of geologic and geophysical data that we can begin to understand what is happening below our feet.

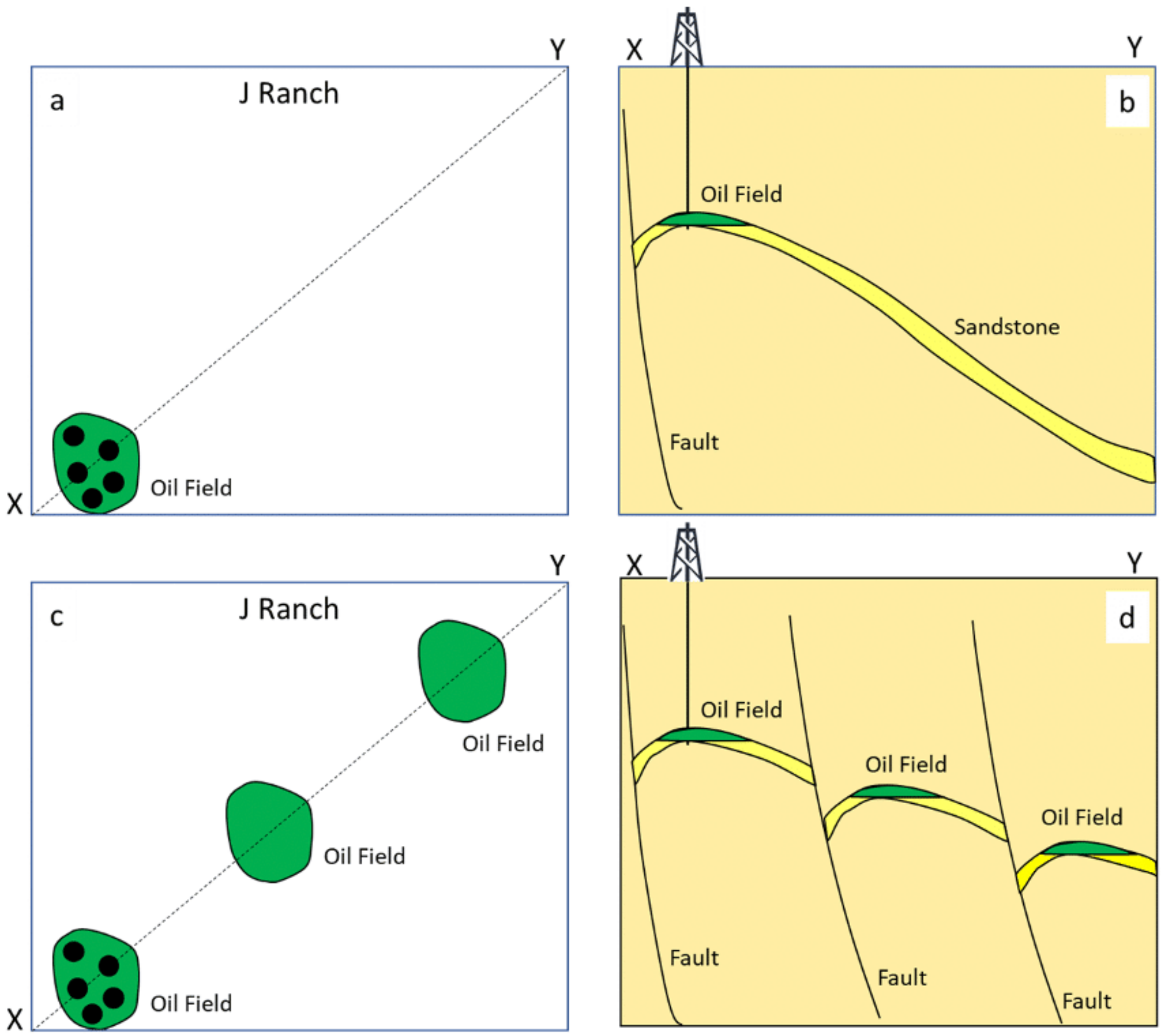

Figure 3: a) Hypothetical Map with a single oil field. b) Hypothetical cross section with a single oil field. c) Hypothetical Map with three oil fields. d) Hypothetical cross section with three oil fields.

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Example 2: Arkansas Fayetville Shale

The Smiths owned four sections of land which they leased to an oil and gas operator (one section equals 640 acres). The operator drilled one well into the Fayetteville Shale on each section and then stopped. The Smiths observed that other operators in the Fayetteville Shale trend drilled on a tighter well spacing. The Smiths brought suit against the lessee for abandonment and failure of their implied covenant to develop the lease.

Figures 4a and 4b are a hypothetical map and cross section through the Smith's leases. The map shows one gas well in each of the 4 sections with additional gas wells at a tighter spacing in the other leases. On both the map and cross section the wells are shown as vertical for ease of drafting, as the Fayetville Shale is an unconventional reservoir and producing wells are commonly horizontal.

What valuable service could the geoscientist provide in this case? Testing could have indicated that the Smith leases contained less, the same or more gas than other Fayetteville Shale leases. Testing data could have been corroborated by analysis of well logs, well cuttings and core data. Seismic data could also have provided important indicators. Figure 5 is a seismic section through the Spraberry Formation from the Permian Basin[1]. The figure shows both a colored seismic section and maps derived from the seismic data. The seismic section shows two horizontal wells going through the Spraberry Formation, one above the other. The maps show the well paths for both the upper and lower wells. Colors show the shear stress and can be used to predict potential production and frack design. For the example in Figure 5, the upper zone (orange) has greater stress due to higher shale content requiring more frack stages. The lower zone (purple) has lower stress due to lower clay and increased carbonate content requiring fewer frack stages.

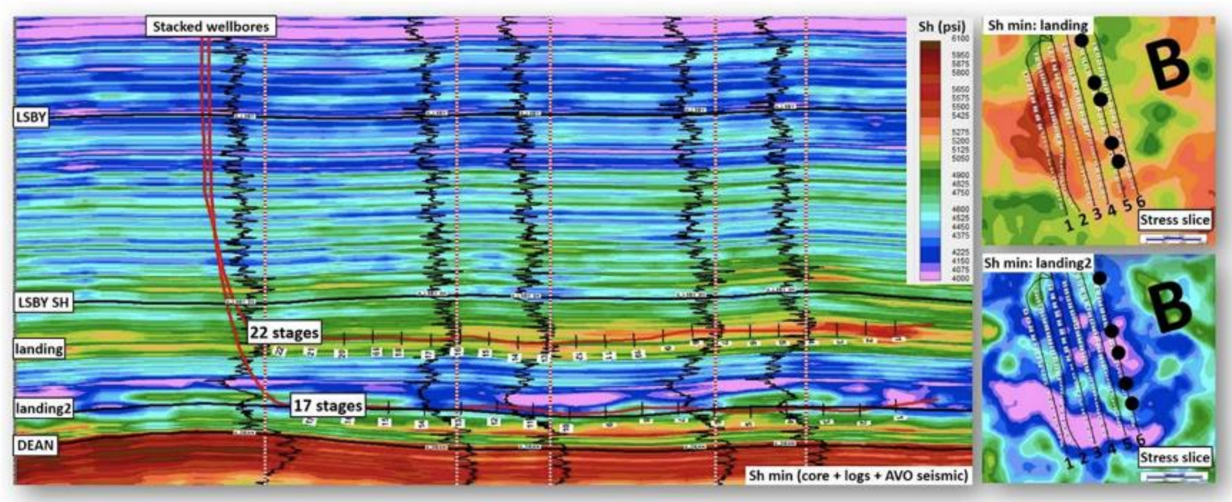

Figure 5: Left, Seismic data, colors show shale pressure which is related to potential well production. Right, maps derived from seismic data used for well planning

Example 3: Texas

A well, hypothetically called h “Unit No. 1” was the focus of one claim, in a multi-claim suit filed by the lessee against an oil and gas operator. The plaintiffs contended that the well was drilled in the wrong location. To even contemplate this type of suit one would need to have some quantity of geologic and/or geophysical data, and a fairly strong understanding of the subsurface structure and stratigraphy. Obviously, if a well failed to find any hydrocarbons, it was drilled in the wrong location. However, there are instances where a well could find hydrocarbons and still not be in the optimal location. A hypothetical scenario is shown in Figure 6.

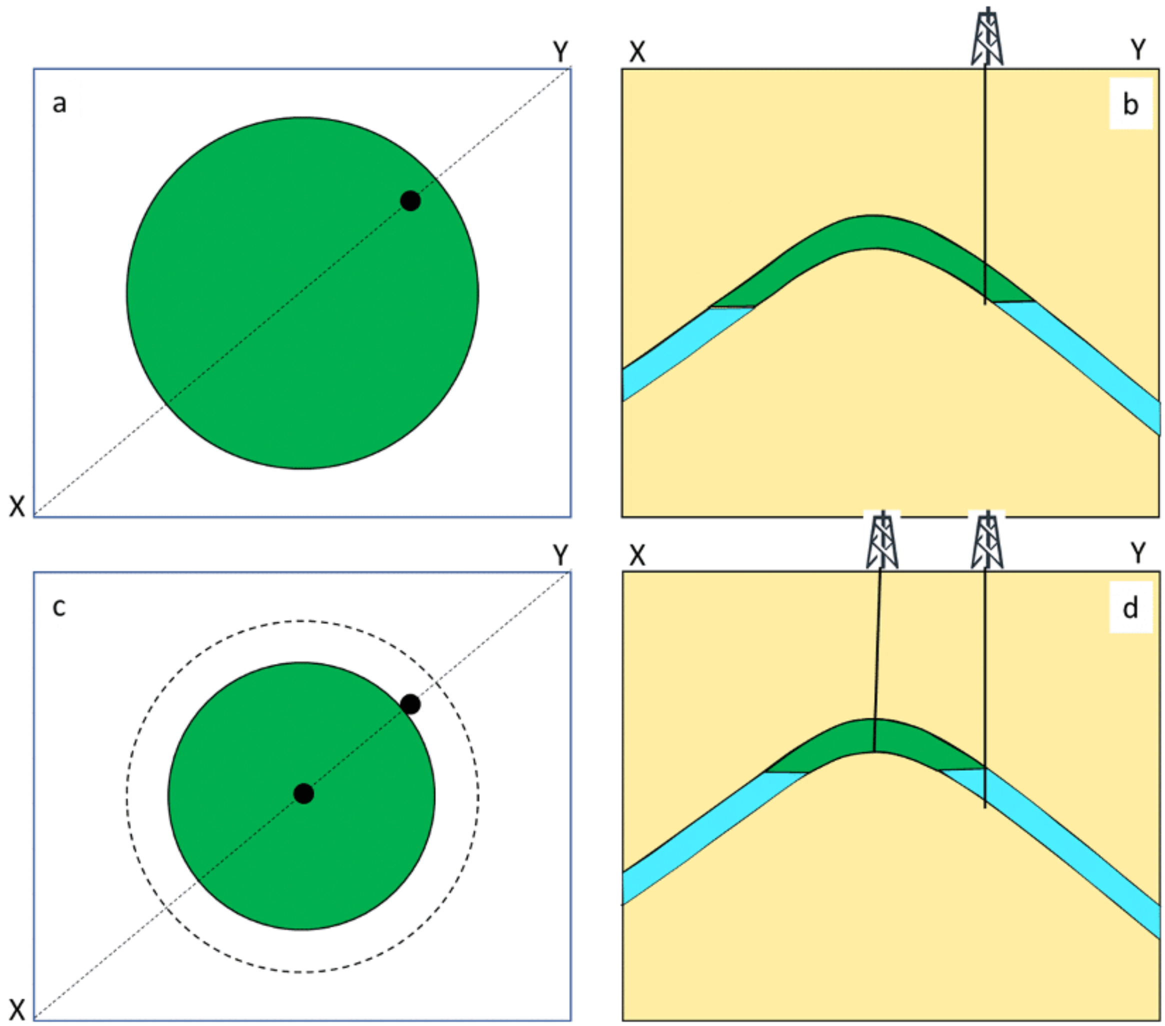

Figure 6: a) Hypothetical oil field with a well drilled near the edge of the field. b) Cross section with well drilled near the edge of the field. c) Map of the same hypothetical oil field after production with the first well now in water and a well at the crest of the structure. d) Cross section with the first well after production in water and a well at the crest of the structure.

Figure 6a is a map showing a hypothetical oil field. Figure 6b shows a cross section through the hypothetical field. The oil field is formed by a porous rock such as a sandstone that has been deformed into an anticline and then filled with oil (shown in green). Below the oil the porous rock is filled with water. On both the map and the cross section a well is shown at the edge of the field.

The position of the well in Figure 6a and 6b is clearly non-optimum. As oil is produced the water rises until at some point the well waters out. The optimum position to maximize production is at the crest of the structure (Figure 6c and 6d). However, there are multiple reasons why a well may be drilled in a non-optimum position. The subsurface data may be ambiguous, leading geologists to arrive at different interpretations. Hydrodynamic effects caused by movement of subsurface water may shift the location of maximum pressure leading to a shift in the ideal well location. Many companies will choose to drill the first well of an exploration program off structure. They calculate the amount of oil in the structure and economics of the prospect. The well is then drilled in a location on the flank of the anticline above which the field would not be economical. If the well encounters less reserves than expected, such as a thinner sand or an oil water contact, they may choose not to develop the field further.

Operator Implied Covenant to Protect Drainage

Another area where operators may fail to honor their implied covenants is to protect drainage between leases. This specifically refers to the migratory properties of fluids in the subsurface. Oil and gas flow through porous and permeable rocks from areas of high pressure to areas of low pressure. Neither the rocks nor the fluids have any respect for lease boundaries or any other contrivance of man. Figure 7 illustrates how a single well can drain the hydrocarbons from another lease.

Figure 7a is a map showing two lease holdings with a well drilled on Ranch A. Figure 7b is a cross section through Ranch A and Ranch B. An oil field is illustrated on the cross section (green), formed by a porous rock that thins and then disappears up-dip below Ranch A. Below Ranch B the porous rock is shown thickening, with the oil continuing down-dip until it is replaced by water (blue). The quantity of oil under Ranch B is significantly greater than that under Ranch A. However, based on the geometry of the field, a single well drilled by Operator A could drain the oil under Ranch B. The only way to reduce the loss of oil to Ranch B is for Operator B to immediately drill a well as close as legally permitted to the lease line (Figure 7c and 7d), although this is not a perfect solution.

There are a number of reasons an operator may fail to protect drainage:

- Asset Valuation: The operator may not perceive the drilling of a well to protect drainage as economically beneficial to the company.
- Negligence: Many operators, especially the large ones, are monitoring thousands of leases. A lack of resources and/or human error may result in missed threats to assets under lease.
- Rig Availability: At the writing of this paper, oil prices are low and there are hundreds of rigs available to drill oil and gas wells. However, at times of high oil prices, rig availability is often scarce and it may take an extended period of time to get a drilling rig on location.

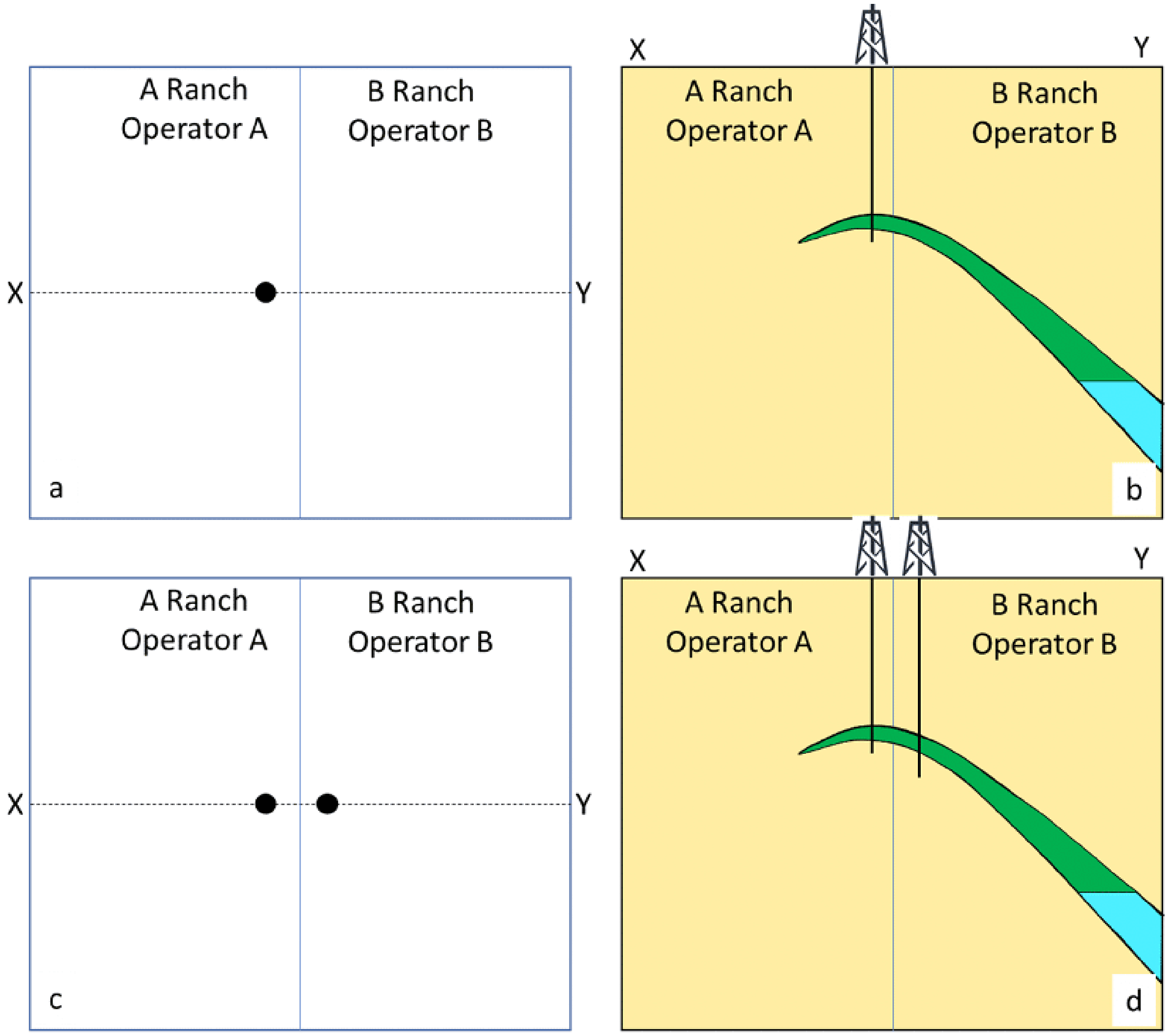

Figure 7: a) Map with two leases and well on Ranch A lease. b) Cross section showing a scenario in which a single well can drain oil from an adjacent lease. c) Map with well to protect drainage. d) Cross section with a well to protect drainage.

- Finances: An operator may be experiencing financial difficulties and may not be in a financial position to protect their leases from threats. This is especially true during the current economic downturn associated with the COVID19 pandemic.
- Conflicting Priorities: Many operators have diverse portfolios with a variety of different assets. An operator may choose to invest in assets that have higher potential returns.
- Intentional Disregard: This happens when a single operator owns two or more adjacent leases and a single optimally placed well can drain multiple properties. Simply put, it may be worth risking a breach of covenant lawsuit to avoid drilling a $10 or $20 million dollar well.

Map Based Example

Studying a man can reveal areas where operators developed leases differently, and perhaps suggest areas where the implied covenants of reasonable development and to protect drainage may not have been honored. Figure 8 is a map from the Texas Railroad Commission showing leases and wells drilled in the Eagleford Trend in Texas. Vertical wells are shown as circles, green for oil wells and red for gas. Horizontal wells are shown as lines connecting an open circle and a color filled circle. Again, green for oil and red for gas. Four areas are highlighted with large red circles. These are areas where well density is significantly lower than surrounding leases. There could be a variety of reasons for this: The operator has not yet finished developing those leases, existing wells in those leases show that production was not economic, or prevented drilling new wells in an optimal orientation, or geologic analysis indicates that the rocks in those areas are not as hydrocarbon rich as other areas. On the other hand, the operator may have breached their covenant of reasonable development and drainage protection.

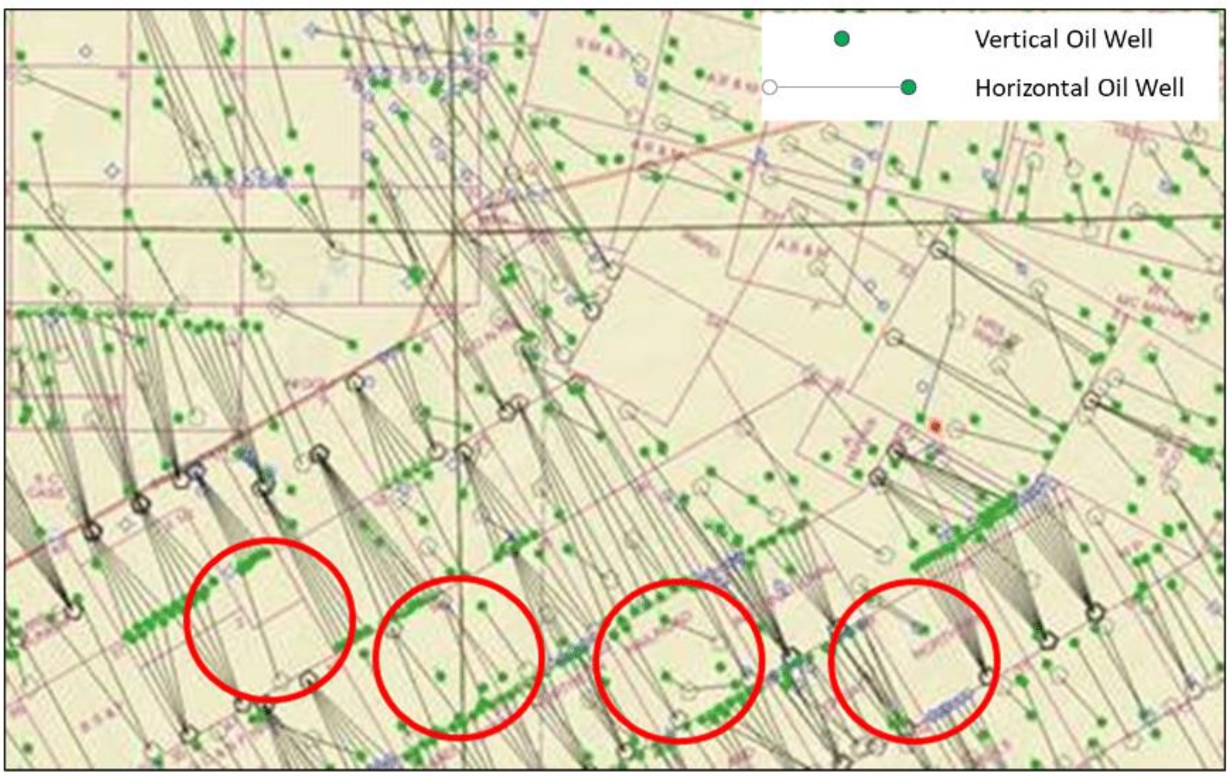

Figure 8: Oil and Gas Map from the Texas Railroad commission showing leases and vertical and horizontal wells. Red circles show areas of low well density surrounded by areas of higher well density.

Operators Implied Covenant and COVID-19

The COVID 19 pandemic has affected many industries across America. Travel bans, nationwide and statewide shutdowns, implementation of work from home policies and office shutdowns have combined to produce a significant reduction in fossil fuel demand and a historic drop in oil prices. The results have devastated oil companies with over 36 bankruptcies in 2020 and resulting liquidation of assets. The practice of reserve-based lending (RBL) has forced many more oil companies to put additional assets up for sale in an already flooded market.

Contemporaneous with these liquidations and RBL asset sales, the general public and activist investors have put pressure on major oil companies to increase their commitment to renewable energy resources. To honor these commitments, many companies are responding by selling non-core assets to fund renewable energy projects, further flooding the market. The result is historically low prices for oil and gas producing assets, with savvy investors acquiring productive assets for pennies on the dollar.

Most of these acquisitions are made by responsible operators. Some are acquired by operators who, with the best of intentions, don't have the knowledge or expertise to operate and develop the properties. Others are acquired by investors who simply hope to flip the reserves and production when the price has appreciated. In the latter two cases, the lessor may be adversely impacted and justified in seeking relief from the operator for breach of implied covenants.

[1] https://scicatoil.com/ Provide courtesy of Michael Shoemaker, CEO, SciCat Oil