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The suggested type section for the Queen formation is located 5 miles S. 75° E. from the site of the Queen Post Office on the west wall of Dark Canyon, in the SW¼ of Sec. 36, T. 24 S., R. 22 E., where 421' of alternating sandstone and sandy dolomite are exposed. Here the Queen underlies the Seven Rivers formation and overlies the Grayburg. The Shattuck member of the Queen formation proposed by Newell (1953) has been recognized as the uppermost 100' of this section.

The proposed surface type section of the Grayburg formation is located on a spur and in an unnamed canyon above Sitting Bull Spring, in the NE¼ of Sec. 9, T. 24 S., 4. 22 E., where a total thickness of 475' of alternating sandstone and dolomites is exposed.

Editor's Note:

The above abstract and Illustrations by William B. Moran, Union Oil Company of California, are included through the courtesy of the Geological Society of America to which the paper has been submitted for publication. A clarification of the "Queen – Grayburg" by redefinition is long overdue. Mr. Moran's work represents a valuable contribution to the stratigraphy of this region.

OIL PRODUCTION FROM THE GUADALUPE SERIES IN EDDY COUNTY, NEW MEXICO

by
Vilas P. Sheldon

The Guadalupe Series is sub-divided into seven formations, the names and approximate thicknesses being as presented in the following tabulation. Separate names are used for the basin and the back-reef facies due to common practice and usage among geologists working in the area.

Back-Reef	Thickness in Back-Reef	Basin
Tansill	200	
Yates	400	
Seven Rivers	600	Bell Canyon
Queen	300	
Grayburg	400	
Upper San Andres	800	Cherry Canyon
Lower San Andres	600	

Lower San Andres – Cherry Canyon

At the opening of Guadalupe time about the southeastern two-thirds of Eddy County was within the sedimentary environment of the Delaware basin. The entire county was covered by a shallow sea but the subsiding basin was partially cut off from the shallow bordering area by a lime bank-reef complex. The basin proper was receiving deposition of sand and silt which is usually dark grey to black in color. There are a few layers of limestone in the basin and the sand and silt is often calcareous but for the most part, the sedimentation is sand and silt. It is probable that the water was deep enough to have a high carbon dioxide content which would tend to dissolve the carbonates. There are layers of clean and sorted sand throughout the section and these layers are porous. Where the sand is clean and free of silt it has a light grey color, appearing a buff-orange in outcrops, probably due to oxidation. Bordering the basin there was a rather wide, very shallow lime bank which was too high to receive the sand and silt deposition. This bank was possibly due to a living organic algal reef, in that the reef acted as a catalyst in precipitation of carbonates. The writer does not view the San Andres lime bank as a barrier reef, but visualizes it as a chain of low relief debris mounds lined up by wave and current action. Very possibly the oolitic and granular material is debris created by the waves from a living reef, however, that source need not be the only possible source. The situation was that this lime bank was a high platform area and wave action piled up a lime debris chain of keys which shut off the sea behind it from the subsiding basin. The barrier was so effective that the broad expanse of shallow water behind it was evaporated faster than fresh water entered and apparently but little clastic material was entering from the low land masses bordering the sea. These reef-locked lagoons, or evaporative basins, existed all through the Permian and the sequence of of deposition is always the same. Most of the water that did enter the lagoons came from the open basin through the barrier and the concentration of salts in the water became progressively greater as the distance behind the barrier increased. There was a continuous inward flow of water from the basin to the lagoon to compensate for the evaporative loss. As this water moved, it was continuously evaporating, the silicates precipitating first, then the carbonates, both limestone and dolomite, then the sulphates, followed by the chlorides. There are many critical points of super-saturation involved and often several salts would precipitate in the same area resulting in intergranular mixtures. And then too, changes in fresh water inflow changed the chemical balance resulting in laminated layers of the several salts. Since carbonates were thus chemically precipitated behind the barrier, it is reasonable to postulate that the oolites could be formed by such chemically precipitated carbonates and later piled up on the barrier.

During Lower San Andres – Cherry Canyon time, the basin received black and grey sands and silts with a few clean and sorted sand layers which are porous. The barrier was built of carbonate debris. So far as Eddy County is concerned, the deposition behind the barrier was all carbonate material as the anhydrites do not occur in Eddy but do come into the section farther north. Porosity in the carbonates is of a primary nature, being the spaces between the grains and fragments of the debris making up the rock. It is sometimes of an oolitic nature but more often has irregular granular texture rather than spherical. Porosity does not occur in blanket formations but rather seems to be in relatively low mounds which were formed by waves and currents. These mounds tend to line up like a chain of keys, however, porous material also occurs well behind the barrier front.

The barrier front has been described by several writers as a hinge line. On the basin side the land was subsiding while behind the front it was not. Such may not necessarily be the case, however, deposition on the lime bank was fast enough to keep pace with subsidence and maintain the shallowness of depth which promoted carbonate deposition. Basinward of the front sands and silts were deposited. Behind the front carbonates were being deposited. Right at the front the carbonate and sand layers are interfingered, this being caused by slight lateral shifting of the front both ingressive and regressive. The sand layers appear in the subsurface as wedges into the carbonate and are sometimes porous. Directly behind the front, the carbonates are usually dark tan to brown and of a decidedly crystalline structure and associated with abundant chert. The carbonates near the front are normally limestones and are not generally porous. In the case of the Lower San Andres, this zone of limestone and chert extends laterally for several miles where it gradually gives way to a buff granular dolomite, sometimes having broken fossil fragments, oolites, and granular carbonate debris.

There is no production in Eddy County from the Lower San Andres. Conditions of sedimentation were similar to the later Guadalupe periods. There was a lime bank and in front of it basinal deposition of Cherry Canyon sands. The lime bank was much wider than they were in later periods, yet mounds of dolomitic debris are known in the Lower San Andres. One prominent one which appears as a vague ridge when contoured on top of the Upper San Andres falls on the Eddy and Chaves County line north of the High Lonesome Field.

Upper San Andres – Cherry Canyon

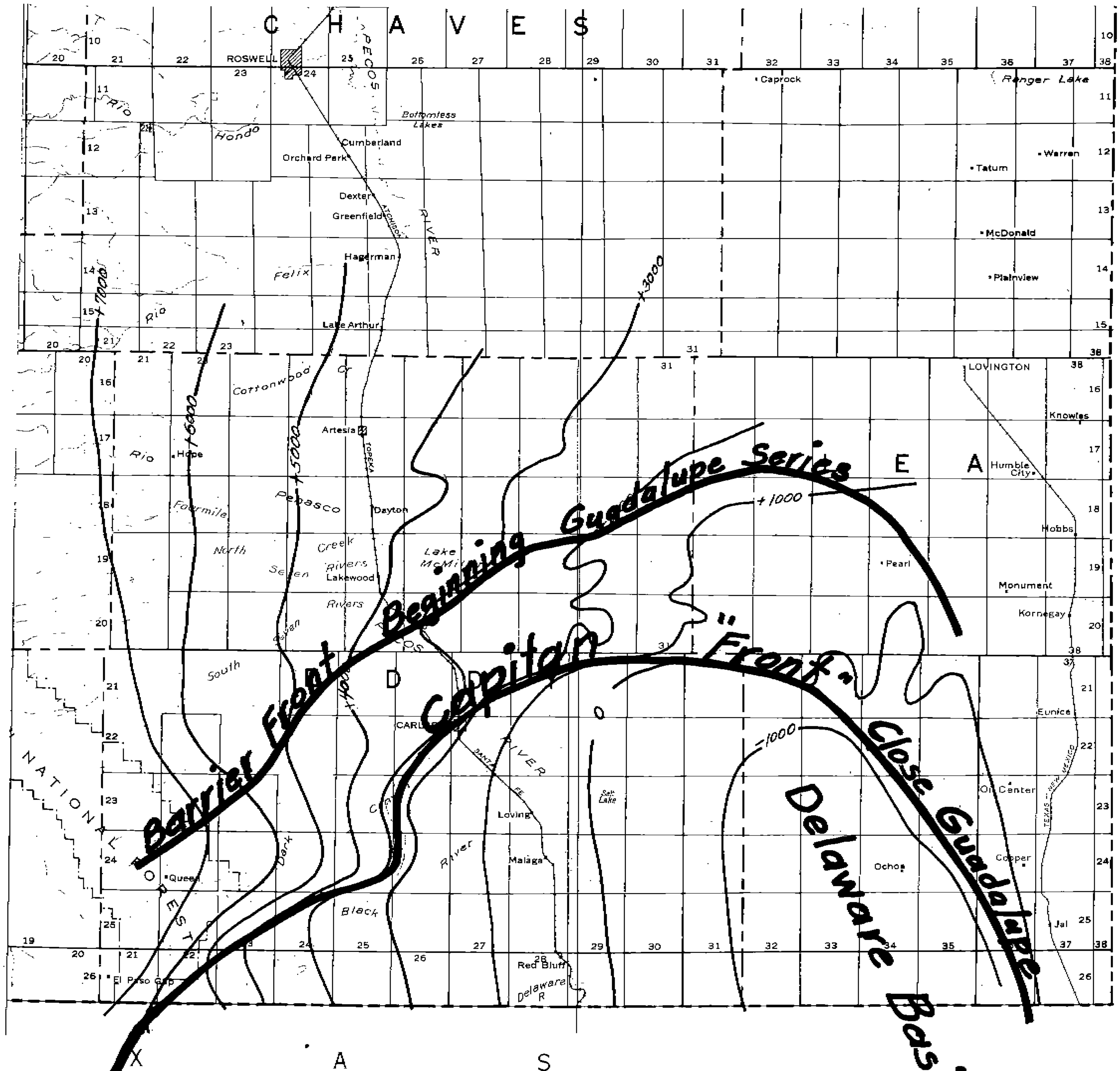
After some 600 feet of dolomites had been deposited in Guadalupe time, some disturbance considerably altered sedimentation, as an easily recognizable break in the carbonate facies is present. The writer is not familiar enough with the Cherry Canyon sand facies to divide that formation.

At the opening of the Upper San Andres time, deposition in the basin was much the same as in the preceeding period. The front moved forward a short distance, not much over a mile. Deposition on the front was the same, sand and silt basinward with brown crystalline limestones and cherts directly adjacent. The sand wedges are sometimes porous.

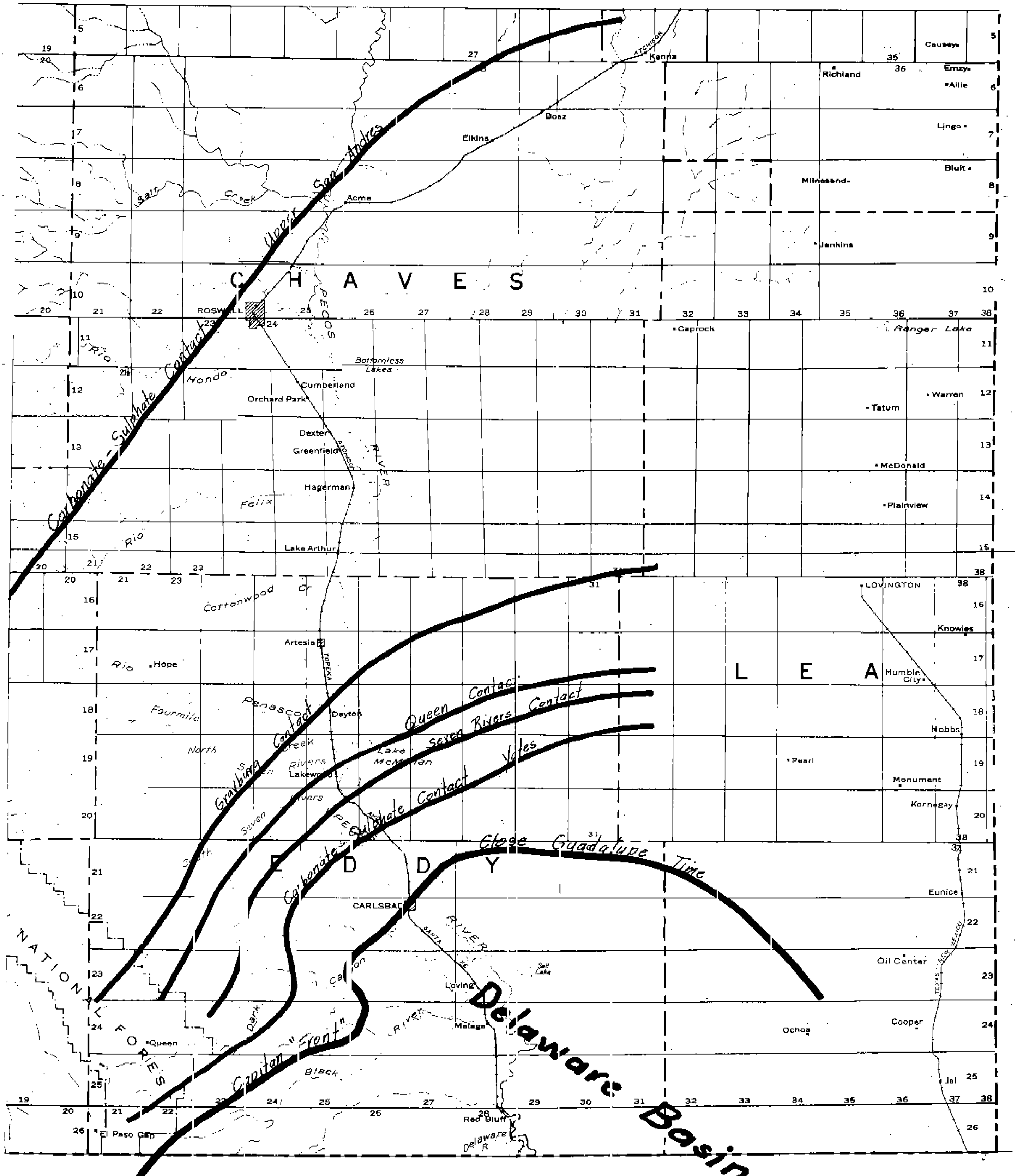
Possible due to re-activated up-warping, the zone of limestone and cherts in the Upper San Andres is much narrower, probably due to a steeper slope. The carbonates of the lime bank proper consist of buff, finely granular to oolitic and detrital dolomites. Living reefs were undoubtedly present on the bank and perhaps largely contributed to the carbonate precipitation. The dolomite as the sub-surface geologist sees it, however, appears to have been laid down as carbonate muds forming finely granular, sometimes lithographic rock. Scattered over the bank, usually lined up like keys, there are low relief mounds of oolitic and granular detrital material. These mounds of material resemble sand dunes and were very probably formed by wave and current action eroding, breaking up and rounding the fragments and then piling them up. The porosity in the Upper San Andres is primary porosity and consists of the space between the oolites and granular pieces. It is usually cemented with carbonate muds and sometimes with anhydrite.

In Eddy County the Upper San Andres is never represented by a true section of either sulphates or chlorides, however, the area north and west of Artesia was far enough from the barrier so that evaporation had increased the salt content of the water and there is considerable anhydrite in the section. There are a few layers of anhydrite several feet thick and much of intergranular nature. The carbonate is a very fine grained to lithographic dolomite.

In Eddy County, the Upper San Andres produces oil and gas from oolitic dolomite in a trend some 24 miles long. As described at some length in the discussion on



Top Guadalupe Contour Map



Carbonate - Sulphate Contacts

the Grayburg formation, the upper San Andres lime bank formed a ridge paralleling the various other reef complex contacts. This ridge was very instrumental in later deposition and contours on the sub-surface markers as a plunging nose. It is known as the Artesia-Grayburg nose. The Upper San Andres is some 800 feet thick and at the crest of the ridge, the entire section consists of dolomite. It is very oolitic in parts and appears to be granular and composed of dolomite debris. The entire mass is a potential reservoir but the oil has either partially escaped or there simply wasn't enough oil to fill the voids.

The ridge itself is easily traceable from the Lea County line to the Guadalupe foothills, but no oil has been found in it west of the Artesia field. It remains porous and is full of water which has perhaps flushed the oil out.

In Lea County, the Vacuum and Maljamar Fields produce from the Upper San Andres, the oil accumulation extending very nearly to the Cherry Canyon interface. In Eddy the oil accumulations are as much as 6 miles back of the Cherry Canyon interface. Probably due to the steep regional tilt caused by the up-warping, the oil has partially escaped. What is left is trapped by depositional characteristics up against the crest of the ridge. The farther west the accumulation, and thus the farther up the regional tilt, the poorer the accumulation. From east to west the pools are: Jackson, Grayburg, Loco Hills, Nichols and Artesia. The Jackson Field has been much the best of the group.

Near the top of the San Andres, there is one sandy bed persistent over the entire lime bank. This is called the Lovington sand. It is commonly silty and appears related to the Delaware and not the sands of the later Guadalupe formations. North of the main San Andres ridge, the Lovington sand has been found to have an accumulation of oil in the Forest Field and along the south edge of Square Lake. The oil is trapped by silting out of the sand. South of the main ridge one well in the Artesia Field produces from the Lovington sand, the exact reason being vague.

In the basal part of the Upper San Andres, the dolomite is brown and granular, sometimes with small oolites. This zone is an independent reservoir from the upper oolitic zones already discussed and is not affected by the same oil-water contacts. It ordinarily is full of water, but on the crest of the main San Andres ridge, it produces in the Grayburg-Keely and Atoka pools and also in the northwest corner of Township 18-27. Shows of oil have also been noted in the Daugherty and Henshaw pools.

Cherry Canyon

The Cherry Canyon is the basinal San Andres equivalent. There have been but very few tests well located to test this formation. Several wells in the San-to Nino field produce from a Cherry Canyon sand and they are geographically located near the lime bank front. Productivity is poor and after several nearby wells were also disappointing, development ceased.

A quite logical place to look for the accumulation is along the rim of the basin on the wedge pinch-outs.

Bell Canyon

At the close of the San Andres period, renewed up-warping caused the barrier front to regress a number of miles and also the increased slope caused considerable regression of the shallow sea behind the barrier. The sea still covered all of Eddy County but retreated a great many miles in the area northward from Eddy. The lime bank was also greatly reduced in width. The reason for the reduction in the width of the lime bank is sometimes attributed solely to the great barrier organic reef which did form along the front of the lime bank and did nearly isolate the back-reef lagoon from the open sea. Offering this as the sole cause fails to explain the regression of the back-reef sea. The slope of the platform did increase, narrowing the lagoon and the organic reef did form a barrier. Apparently but very little fresh water entered the lagoon, it being dependent upon sea water to maintain sea level elevation.

During Bell Canyon time, a series of major reactivations of up-warping and many minor changes in relative sea levels occured. The major disturbances form breaks distinct enough so that the Bell Canyon has been subdivided, insofar as back-reef facies are concerned, into the Grayburg, Queen, Seven Rivers, Yates and Tansill. The reef itself is generally called the Capitan reef and it is impossible to sub-divide it is sub-surface work.

The Bell Canyon itself is the basin facies and consists of sand and silt. It is usually dark grey to black, however, in places sand is sorted and clean, being a light grey in color. The sand is often argillaceous and sometimes calcareous, and there are a few limestone layers. As in the case of the Cherry Canyon it is probable that the carbon dioxide of the deep water dissolved any carbonates precipitated. When sorted and clean the sand is porous.

The sand and silt of the Bell Canyon wedge into the Capital Reef which forms the front of the lime bank. As there were many ingressive and regressive changes in the relative sea level, the actual front of the reef moved backward and forward, thus, wedges of sand go well back into the reef body. The general trend throughout Bell Canyon time was that of a fluctuating regression and after each major disturbance the reef front moved basinward slightly. More pronounced than the movement of the reef front after each disturbance, was the narrowing of the lime bank. The lagoon became progressively smaller due to up-warping and the bank of carbonate deposition narrowed. Along the eastern boundary of Eddy County, in cross-section, the Grayburg carbonate zone is some 30 miles wide. The Yates carbonate zone is less than 6 miles wide. At the close of Bell Canyon time, the up-warping backed the reef builders clear out of the Delaware sea and no more carbonates were deposited.

Some drilling has been done through the years testing the top of the Bell Canyon, but in comparison to the lime bank regions, exploration has not been intensive. Wells drilled on the western slope of the basin very often have logged oil shows in the top several hundred feet of Bell Canyon sand. Exploration thus far has revealed but little structural anomaly. Oil production has been developed in a one well pool in Township 23-26 just south of Carlsbad, in the Black River and Fenton pools, and to a greater extent in the Malaga Field. Across the Texas line in Reeves County, the Mason and Tunstill Fields have yielded considerable oil. The producing formation is a fine grained sandstone. The oil is very light in color and does not show up at all well in sample well cuttings. Permeability is low and before the advent of formation fracturing by the injection of viscous fluids, some potential producers were likely abandoned. Formation fracturing is quite sensational on the Bell Canyon wells.

There is but very little, if any, structural closure in the productive areas above outlined. The traps are stratigraphic, probably due to depositional characteristics.

The wedge sands entering and against the reef front offer potential traps for accumulation, especially those of older Bell Canyon age which will lie under the younger reef fronts. Exploration for such older Bell Canyon sand wedges has been very slight.

Grayburg

The back-reef equivalent to the lowermost Bell Canyon has been named Grayburg. Back of the reef, in the evaporative basin or lagoon, there was a shallow-water lime bank receiving dolomitic carbonate deposition. Evaporation caused precipitation of the carbonate salts forming a lime mud which formed the lithographic, very finely grained dolomites typical of the Grayburg. In places the lime mud was formed into oolites and pisolites. The broad lime bank was ideal for many sea animals. The resultant shells were broken into fragments and rounded. Wave and current action moved the oolites, the pisolites, the shell fragments, and broken fragments from the organic reef, piling them up in mounds and lining them up as keys. These mounds have primary porosity. These mounds are usually on the flank of underlying highs, but not necessarily.

Behind the lime bank zone, the precipitation was of anhydrite, the Grayburg in the northwest one third of Eddy County having been anhydrite. The lateral break between the dolomitic and anhydritic facies is not sharp and oftentimes chemical analysis is necessary to accurately determine the true composition of a sub-surface sample. The dolomites near the anhydrite contact are very finely grained and are not porous.

There is another basic characteristic of the Grayburg that was not present in the San Andres, such characteristic being the many sand bodies within both the dolomite and the anhydrite facies. The sand moved into the lagoon from the slightly re-juvenated and up-warped land mass, being transported in by streams. The time was an arid one for apparently the sediments being emptied into the lagoon were red sands and red shales, and these materials were brought in sporadically. During extreme drouth the sedimentation in the lagoon was solely from chemical precipitation of water coming in across the barrier reef. A wet period started the streams from the land mass running and clastics were washed in, and were laid down in the lagoon, widely distributed over the lagoon. Water currents were different in these periods and the clastics tended to fill up low spots on the lime banks and they also drifted up on the slopes of any irregularities in the lagoon surface. Not only did the clastics come in, but the fresh water reduced the concentration of the brine and a stringer of dolomite is often found on top of a sand body within a general anhydrite section.

The Grayburg sands, and to some extent, oolitic dolomites are deposited on the flanks of and over the older San Andres high. The ridge remained a high throughout Grayburg and Queen times, the various formations thinning and some dropping out on the crest of the structure.

There is some 300 feet of thinning in the Queen and Grayburg formations between the outer edge and the crest of the Upper San Andres lime bank. On the crest the combined thickness of the two formations is approximately 680 feet. At the trough they are at least 980 feet thick. As the various formations thin, they tend to have reduced porosity. Some sands and quite probably oolitic dolomite members simply do not reach the top. Local depressions in the San Andres ridge such as channels and bays tended to fill with sediments. The lagoon of highly saline waters behind the ridge also tended to fill with sands at a rate greater than sedimentation on the ridge. The same type sedimentary conditions prevailed on into the Queen, however, thus far the Queen has not yielded major oil fields.

On the southerly, or basinward, side of the Artesia-Maljamar ridge, the various Grayburg sands produce oil in the Dayton, East Dayton, Artesia, Red Lake, Loco Hills, Grayburg-Jackson, Premier and Maljamar Fields. Actually it is almost a continuous trend of production, however, it is far from a continuous reservoir. Some of the sands seem to be fairly persistent and can be fairly well traced the length of the trend, however, porosity varies rapidly and to a great degree due to calcareous cementation, probably of primary nature and due to carbonate muds. Some of the sands do not have wide lateral distribution.

On the northerly or lagoonal side of the Artesia-Maljamar ridge, there are also sands in the section. They do not show oil staining as consistently as do the south flank sands, but in several cases oil has accumulated in them. The trap is formed by the carbonate-sulphate contact. The producing fields and Red Lake, South High Lonesome, Anderson, Square Lake, Robinson, North Maljamar and Roberts, the latter two fields being in Lea County but part of the same trend. Porosity in these north flank fields in equally as erratic as it is on the south flank. The general quality of production is inferior to the south flank Grayburg sand wells.

Queen

The Queen in Eddy County is very similar to the Grayburg of Eddy County. The organic reef may have moved slightly forward and the lime bank zone of carbonate deposition did narrow, the anhydrite coming in closer to the reef. The sand and silt influx into the lagoon was considerably greater than it was during the Grayburg. About one-third of the Queen section consists of sand. Early Queen time apparently was a period of great silt influx as the basal 100 feet of section is mostly sand.

At the close of Queen time, another storm occurred resulting in the widespread deposition of a consistent sand layer much used for correlatikn purposes. It is known as the "Artesia Red Sand" in Eddy County and much used as it is the first really thick sand body below the Yates sands and is easily recognizable by the presence of many large frosted quartz grains. The frosted quartz grains are sometimes found in all the sands of the back-reef facies equivalents to the Bell Canyon formation, however, they are especially prominent in the "Artesia Red Sand".

The sand formations were deposited within the normal anhydrite facies as well as the normal carbonate facies. When the sand formations within the anhydrite phase are thin, they are apt to be cemented with evaporites, however, when the formations are thicker, some primary porosity has been preserved. When primary porosity is present these sands are a potential oil reservoir. Oil and gas accumulations within the anhydrite phase are abnormal, but do occur. The uppermost sand of the Queen, commonly referred to as the "Artesia Red Sand", produces in Section 16 of Township 17 South, Range 30 East, the trap being the sand flanked up on the north side of an underlying high with a porosity pinch-out. The same sand produces from a few scattered wells on the south side of the same high about 3 or 4 miles south of those in Section 16. These accumulations are well behind the normal lime bank.

Another very persistent sandy phase nearly 100 feet thick occurs in basal Queen. In the area behind the normal lime bank, oil and gas staining is often noted in this sand and scattered over the area are small pools and isolated wells producing from it. The High Lonesome pool, and the gas pool in Section 3, 4, 5, 9 and 10 of Township 17 South, Range 28 East marks the major trend of produtcion. The productivity is low and development has been non-commercial. Other scattered wells produce from the sand; one in Section 7-18-28, one in Section 12-18-28, and one in Section 32-17-30.

On the lime bank itself, the uppermost Queen sand persistently carries oil and gas staining and produces in spots for 30 miles across Eddy County, yet it has not yielded a major field. The Queen on the lime bank has many sand horizons and it has many oolitic dolomite horizons. The oil and gas that is being produced comes from the sands and the dolomites are not producing in Eddy, but just south of Lake McMillan, the Queen oolitic dolomite is saturated with oil. This is very near the outcrop and the oil has apparently escaped. The sands in the upper Queen produce oil in the McMillan, Turkey Track, Shugart, North Shugart and Culwin pools of Eddy and the trend continues on to the Watkins, Young, Corbin and Pearsall pools in Lea County. The oil accumulations are in stratigraphic traps closed by cementation of the sand pores. The relationship of structure to the accumulations is extremely vague, however, detailed study indicates that the accumulations are on the flanks of small under-lying highs.

Seven Rivers

The back-reef facies Seven Rivers formation indicates a further narrowing of the area of carbonate deposition. The reef again moved very slightly forward. In contrast to the Queen, there are but few sand bodies within the Seven Rivers and they are quite thin. This indicates a more arid condition. With the narrowing of the carbonate area of deposition is the compensating encroachment of anhydrite toward the reef. During the Seven Rivers period anhydrite was deposited within 12 miles of the reef front in contrast to the 30 miles during Grayburg time.

As in the other formations the sand bodies are porous and the oolitic mounds sometimes have primary porosity. In most cases, the primary porosity is filled with lime mud cementation.

The surface of the Seven Rivers lagoon apparently was dotted by mounds of debris. Individual mounds did not exist through the various periods, but would be buried for some reason. Several mounds that were built and buried in Seven Rivers time have been found and produce. Tonto in Lea County, and the lower pays in the Wilson Field also of Lea County, produce from the top of oolitic dolomite structures of Seven Rivers age. Mound structures of equivalent age have not been found in Eddy. Their existance is probable.

The second type reservoir, those created by isolated dolomite layers behind the lime bank, produce most of the Seven Rivers oil in Eddy County. The contact between carbonates and sulphates moved laterally considerable distances many times during Seven Rivers time, sometimes for as much as 5 or 6 miles. As a result oil and gas has moved up structure in these granular dolomites until it is finally trapped by the facies change. As the dolomite layers are thin, the wells are small, but a good number have been drilled along the south flank of the Grayburg-Jackson field.

The Seven Rivers formation does not have as many sand phases as the Yates or the underlying Queen, however, there are a few sand bodies and the small East Turkey Track pool produces from a sand pay in the lower part of the Seven Rivers section. This same sand body can be traced along the strike but no other production has been found.

A favorite place for the accumulation of oil in all of the Guadalupe formations is near the vertical top of the carbonate facies in any given location. Regardless of the age of the dolomite top in any well, the first porous zone below the top is a fair prospect. Such a trap is closely related to the ones formed by the carbonate tongues behind the lime bank as the oil and gas has moved laterally up-dip as far as it can go. It is trapped by the carbonate-sulphate facies change. In the Seven Rivers, an oolitic dolomite produces oil in the Turkey Track Seven Rivers pool of Township 19 South Range 29 East. Such a condition theoretically can exist just about anywhere on the lime bank.

Yates

At the close of Seven Rivers time, the reef front again advanced slightly and the carbonate zone narrowed down to about 6 miles. Renewed up-warping caused an increased rate in the influx of clastics into the lagoon. the resultant sand bodies are wide spread over all of Eddy County and are known as the Yates sands. The uppermost of the Yates sands happens to be the last sand body in the Guadalupe series and is, to the driller, the first sand encountered below the Ochoa evaporites. It is easily recognizable due to frosted quartz grains and probably is the most used correlation zone in the Permian period.

It would seem that the reef front, where porous, would offer a good trap. The oil must have been flushed out, however, as only the very tops of local closures have produced oil and gas. The Barber, Cedar Hills, Getty and P.C.A., a few wells in the Russel pool and some of the wells in the Lusk pools produce from porous dolomite. These structures are mound-like anomalies composed of oolitic and granular dolomite and tend to line up like a chain of islands, which is very likely what they were. There are several more of these producing structures on east in Lea County, Halfway, Salt Lake, Lynch, West Wilson and Wilson. West of Cedar Hills pool, the Yates comes to the surface, but several mounds are discernible in the outcrop.

The sand bodies flanking on a dolomite mound, or piled in a low and subsequently tilted by regional up-warping, also can be reservoirs. The Russel field and the Burton pool, produce from a sand piled up on the north flank of a reef mound. The Lusk pools near the Eddy-Lea County line produce from sand apparently draped over such a mound, the dolomite also producing. Likewise in Lea County, the Yates sands produce draped over a reef mound in the Wilson, Teas, Lea, North Lynch and San Simon pools.

The trend of pools mentioned in the above paragraphs are often called reef pools. They are not strictly reef front pools in that there doesn't seem to be much evidence that the structures are exactly fossil organic reefs. They are slightly behind the reef front and are debris mounds build up from oolitic and granular carbonate pieces by wave and current action. Lagoonal sand practically always is on the flanks and very often draped over the mound. In the outcrops, these sands do not appear in the very front of the reefs, but behind them. The result of such building is a complex mound of oolitic dolomite and sand lenses. Offset wells are difficult to correlate, one possible being a dolomite well and the next a sand well. The Lusk fields have both dolomite and sand pays of about the same age. The Wilson field has a few Yates sand wells, the sand draping over and wedging into the underlying dolomite mound.

The mounds do not necessarily have to line up near the reef front. There were water currents behind the reef rolling the oolitic dolomite particles around and mounds could build up most anywhere on the lime bank. The Benson pool produces from oolitic dolomite of Yates age, but is well behind the front. The mound type pools heretofore discussed depend to a considerable extent on structural closure to make the reservoir.

The pools heretofore discussed as producing from the Yates are all on the lime bank. It is almost a requisite of Guadalupe age oil accumulation that the reservoir be on the lime bank. The sands which entered the lagoon from the land mass are also within the anhydrite facies of the lagoon deposition, however, they almost never have oil and gas because the sand is cemented with evaporites. The condition is true in all the Guadalupe formations and is almost a requisite but not quite. Just a few producing wells ruin such a convenient rule. It cannot be stressed too strongly, however, that for really commercial accumulations, the reservoir must be on the lime bank. The difficulty is that the arbitrary breaking down of the Guadalupe series into seven sub-divisions doesn't have much to support such a simplification. The salinity of the lagoon changed very often the geographical position of the carbonate — sulphate contact changed very many more times than seven.

In the Yates, for example, there are several thin beds of granular dolomite reaching back nearly as far as does the normal Queen lime bank. Likewise, the Seven Rivers and Queen have dolomite beds reaching back farther than normally. Sometimes, in fact usually, these beds are associated with a sand body. Such is logical as it was probably the fresh water bringing in the sand that forced the sulphate deposition farther back into the lagoon. The granular dolomite beds and the sand beds associated with the thin dolomite layers, even though they are far behind the normal lime bank offer reservoirs for oil and gas. The Empire and Aid pools just east of Artesia produce oil from thin brown and granular dolomite stringers that are definitely of Yates age. A now plugged-out gas field in Sections 4 and 5 of Township 19 South, Range 28 East produced from a Yates sand. Both the dolomite and sand accumulations oil and gas depend upon porosity pinch-out to form the reservoir. The porosity pinch-out is due to change in sedimentation.

A third type reservoir of Yates age occurs along the normal carbonate-sulphate contact. A trough sort of anomaly can be contoured just south of the facies change entirely across Eddy Coutny, except in the western portion where the rocks are eroded. The northern slope of this trough coincides with the facies change and several oil and gas traps have been discovered, namely the Shugart and Watkins pools. The trend has by no means been fully explored.

Tansill

At the opening of Tansill, the reef front moved forward slightly. No clastics entered the lagoon from the land mass. Up-warping apparently continued and caused a further narrowing of the lime bank. At the close of Tansill time, the entire Delaware basin was cut off from the open sea, causing it to become the evaporative basin. This killed the organic reef.

There are two small uneconomical gas pools producing from the Tansill. These are: the Hale Pool in Section 12 and 13 of Township 20 South, Range 30 East; and the Scanlon Pool of Sections 29 and 30 of Township 20 South, Range 29 East. No gas has been sold from these pools, the wells having been shut in since completion. The potentials are small. Both pools appear to be small closures, upon the main Capitan Reef, the reservoir rock being a porous dolomite.

The Tansill lime bank is only a few miles wide and the dolomite phase is usually a very fine grained lithographic rock with no hint of porosity. Right at the reef front it is sometimes porous and when drilling through the section a puff of gas often is detected. It would seem that since this Tansill dolomite is the top of the Capitan reef and since the lithographic dolomite facies would serve as a barrier to the migration of oil, that it would be an oil trap. This is likewise true of the older Yates and Seven Rivers reefs, however, many wells have been drilled along the reef front and have produced only water. Undoubtedly the porous reef front has been flushed out with water. There are no sand bodies within the Tansill to act as traps or reservoirs for the accumulation of oil. The possibliity of production from the Tansill would be from small mounds of porous dolomite built up on the main barrier reef. Many wells have been drilled along the trend but most have possibly been slightly too far lagoonward for maximum Tansill potentiality.

RESUME OF OIL & GAS EXPLORATION OF THE SACRAMENTO MOUNTAIN AREA

by

David A. Dunn

In that portion of Lincoln, Chaves, and Otero Counties lying south of U.S. Highway No. 70 and west of Longitude 105 a number of tests for oil have been drilled. Sixteen of these tests are shown on the Index Map accompanying this Guide Book. The following tabulation gives the name of the well, the elevation, total depth, the depth to the top of the pre-Mississippian if pre-Mississippian formations were encountered, and the formation at total depth.

ELEVATION T.D. TOP PRE-MISS.

NAME	ELEVATION	T.D.	DEPTH TO TOP PRE-MISS	FORMATION AT T.D.
Stanolind #1 Picacho	5958	2843	None	Granite Pre-C.?
Humble #1 N State	5733	4014	None	Metamorphics
Southern Prod. #1 Cloudcroft	9370	4701	3490	Granite Pre-C.
Texas Prod. #1 Wilson	5340	4900	4860?	Miss. or Fusselman
Gulf #1 Chaves	6264	3147	?	Granite Pre-C.?
Kewanee #1 4-mile Unit	5169	6562	6424	Fusselman
Sun #1 Pinon	6544	1911	None	Granite Pre-C.?
Sun #2 Pinon	6314	1650	None	Granite Pre-C ?
Plymouth #1 Federal	–	–	–	–
Stanolind #1 Thorne	6310	4646	–	Pennsylvanian
Standard of Texas #1 Scarp Unit	5340	2664	1090	Granite Pre-C.
Turner #1 Everett	4715	3945	2310	Bliss
Turner #1 Evans	5002	3763	1890	El Paso
F.W. & Y. #1 Donahue	4275	1692	–	Intrusive?
Union #1 McMillan	4990	5215	3487	El Paso
Hunt #1 McMillan-Turner	4165	2175	–	Granite Wash

No attempt has been made to correlate the surface exposures at the locations or to make a breakdown of all of the formations encountered since so many formational changes occur that correlation over this wide area is extremely difficult and controversial. In general from north to south the pre-Mississippian formations, i.e. Percha, Fusselman, Montoya, El Paso, and Bliss formations of the Devonian, Silurian, Ordovician, and Cambrian thicken rather uniformly. Control is scattered and many of the indicated granite tops are questionable in age.

Of the many wells drilled only a few encountered shows of oil and gas. These include the Southern Production No. 1 Cloudcroft which encountered a minor show in the Pennsylvanian, the Turner No. 1 Evans which encountered minor shows in the Pennsylvanian, the Kewanee No. 1 Four Mile Unit which encountered a show in the Fusselman and the Union No. 1 McMillan which encountered minor shows in the Pennsylvanian and El Paso formations.