V - RELATION OF OIL AND GAS PRODUCTION TO STRUCTURE IN THE DEVONIAN OF SOUTHWESTERN NEW YORK

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The horizons which have produced the greater part of the oil and gas in southwestern New York in their descending order are as follows:

Chipmunk
Scio
Bradford Second
Penny
Richburg
Bradford Third
Clarksville
Waugh and Porter
Oriskany

The position of the shallow sands and their relation to each other are shown in chart 1. The Bradford second sand of the Bradford, Pennsylvania and Limestone, New York area is probably very near the time equivalent of the Scio sand of Allegany County, New York. The Bradford third sand is also considered by many to be approximately the same time equivalent as the Richburg sand of Allegany County, New York.

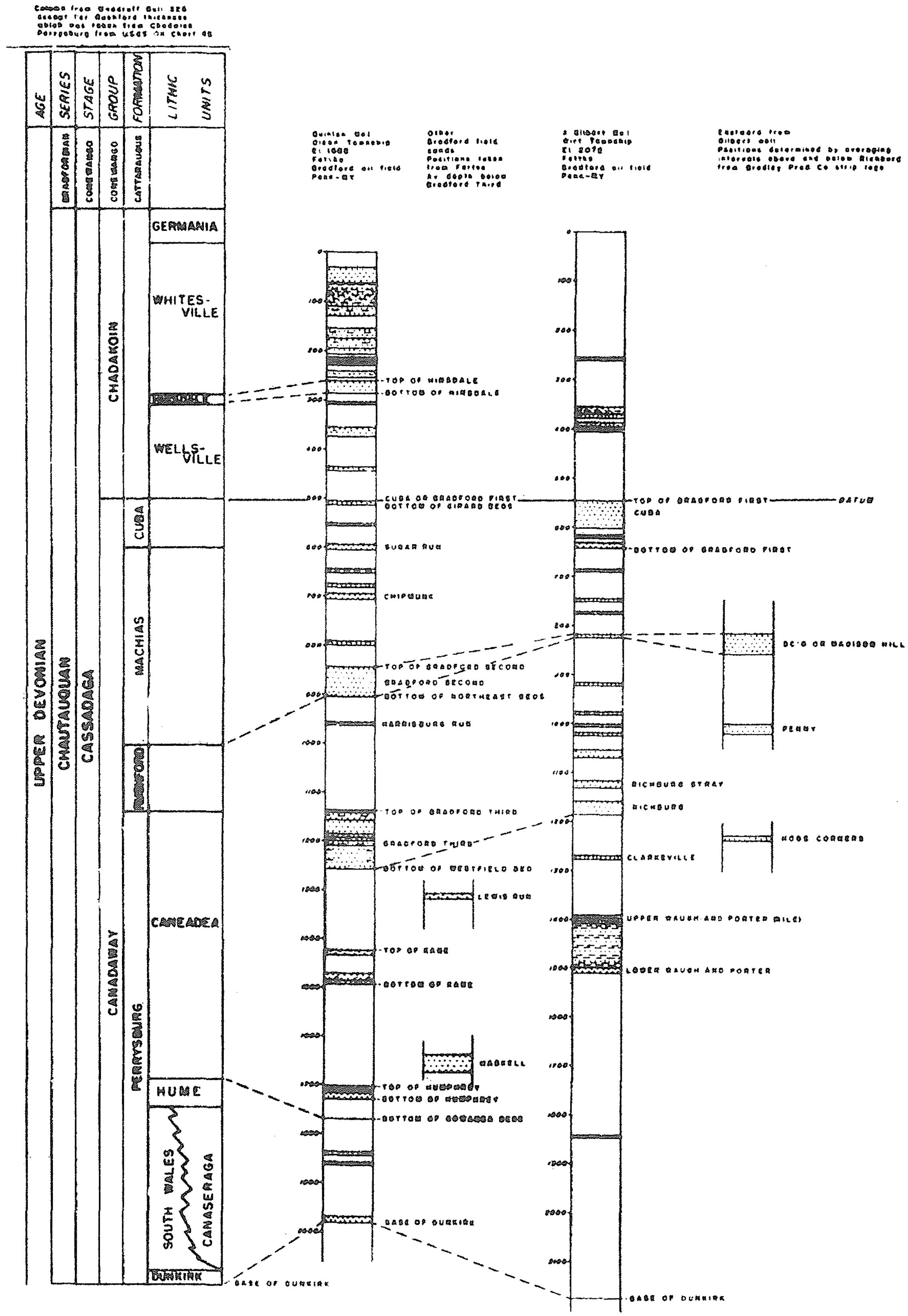
The relation of oil and gas production in all the commonly called shallow sands to structure can be discussed together as they have generally the same characteristics.

The traps in which production (both oil and gas) is found are in the main stratigraphic traps. These are in many cases sand lenses in which the accumulations are controlled either by the permeability and porosity of the sand or changes in the deposition. Some of these areas are large in extent as the case of the Bradford field (Bradford third sand) and the Allegany field (Richburg sand). Both of these fields have areas within the limits of the oil production which produce gas only. In general this gas production occupies the highest structural part of the sand lense.

The northern part of the Appalachian Synclinorium is made up of a series of rather prominent anticlinal and synclinal folds with their axes trending approximately parallel to the long axis of the Synclinorium. These folds die out gradually northwestward. The oil pools of this area are located along the northwestern margin of this belt where the folds have become broad and gentle. The structure of both the Bradford field and the Allegany field is partially anticlinal. The regional dip of the surface beds is slightly west of south at the rate of about forty feet per mile. In the Allegany field the main pool lies on the top and south flank of the northeast-southwest trending Fir Tree anticline and extends across the syncline into considerable reversal of dip at the southern edge of the pool. In the Bradford field there is some down dip water, however, the oil-water contact does not maintain a structural level, as this contact rises structurally up regional dip. In the Allegany field there is less evidence of any distinct relationship between structure and oil-water contact.

The smaller pools in the Allegany area occupy many different relationships with regard to the folds mentioned above. The Fulmer Valley and Greenwood pools are lenses on the north flank of the Sharon-Watkins anticline, southeast of the main Allegany pool, while the Marsh pool lies over the crest on the southeast limb of this fold. The Cryder Creek pool, a small sand lens, is farther down the flank near the axis of the Oswayo Syncline. The main Scio pool lies across the top of the Fir Tree anticline, the same anticline which runs through the main pool of the Allegany field, but the long axis of the sand lens forming this pool is at right angles to the anticlinal axis. This, however, is the exception rather than the rule as the axes of these small pool sand lenses are usually parallel with the regional folds. Generally as producing sand lenses

CHART NO. 1 SAMPLE CORRELATION SHOWING APPROXIMATE POSITIONS OF OIL HORIZONS



occur succeedingly higher on the flanks of the folds they produce gas instead of oil. As stated abcve, even though production in the sand lenses is affected by the regional structure, the controlling factor of both shallow oil and gas traps is lenticularity and physical variations of the sands.

The occurrence of gas in the Oriskany sandstone of lower Devonian age in southern New York and Pennsylvania is due to accumulation in structural traps. The gas pools mainly occupy elongated domes along the prominent anticlines running through this area. As mentioned earlier the axes of these folds approximately parallel the axis of the Appalachian Synclinorium and run in general northeast and southwest. These folds have their steepest limb on the southeast flank. They diminish in intensity progressively toward the northwest or in the direction away from the Allegany Front. The last fold easily recognized from surface dips is known as the Sharon-Watkins anticline (see map 3).

The location of the pools along these folds is controlled by saddles along the axis, faults, porosity and permeability of the sand and by the sand pinching out up dip. The most common type of traps are elongated domes which are almost always accompanied by faulting on the southeast or steep limb side. Faulting may occur in almost any place on these structures in the areas of greater intensity. These faults, however, usually parallel the long axis of the major folds. They are usually underthrusts or upthrusts. Faulting has in many cases divided the main domes into two or more separate accumulation areas. Lack of porosity and permeability in the sand and in up dip direction or a pinchout of the sand will give the same effect as saddling or cross faulting. In some cases it has been noted that saddling along a fold is often accompanied by the sand having less porosity and permeability. The pools are always surrounded by salt water except where production is cut off by a fault, pinchout, or an area of no porosity at a point higher on the structure than the water-gas contact. The water-gas contact is structurally constant around a given pool.

In a few instances pools have been found in which the trap is a pinchout of the sand up dip across a structural nosing. The Allegany State Park pool, which was discovered late in 1955, is the best example of this type of structure. This pool also has salt water on the down dip side. To date very few pinchout pools have been found in New York and Pennsylvania. It must be pointed out, however, that neither surface structure nor any of the known geophysical methods can be used effectively in searching for this type of trap. The geologist can only be guided by the general knowledge of the line of pinchout, which is often very erratic, plus any nosing which can be found across the pinchout. It can readily be seen that the oods against locating this type of pool are great. It is very possible that further search will result in the discovery of more of this type of pool, particularly along the main Oriskany sand pinchout in New York State.

All of the surface structures of any appreciable size in southwestern New York State have had at least one Oriskany sand test. It is not intended to suggest that other small structures will not be found that may produce Oriskany gas but there are certainly none left untested which could develop into major pools. It is the writer's opinion that any large future gas production in southwestern New York State must either come from the Oriskany sand pinchout type of structure or from deeper horizons. It is very unlikely that new oil production of any size will be found above the Oriskany horizon.