Notes on Post Wellington Faulting in the North Garber Field, Garfield County, Oklahoma

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Oil well drilling operations have been quite active in eastern Garfield County during the past two years. Much of this activity is the result of completion of numerous good wells from relatively shallow, lense type sands of Upper Pennsylvanian and Lower Permian age. These sands, encountered at depths ranging from 1200 to 2500 feet, are usually highly lenticular and difficult to find covering a very large area. In only a few localities is a single sand known to be productive over an area in excess of 40 acres and in numerous cases one well fields define the limits of the producing sand. Accumulation and trapping seem to be due primarily to stratigraphic type traps in shallow marine to lagoonal sediments of very rapid facies changes. Structural control seems to be of relatively minor importance as long as some consideration is given to regional structure.

As a result of these activities, operators have been reworking the flanks and in some cases inside locations of the long known Garber-Covington Field. Here shallow accumulation is due to the presence of definite anticlinal structure associated with lenticular conditions within the sands. Fracture treatment and better completion methods have presented a favorable economic picture for these activities.

Some 25 shallow wells have been drilled recently in the North Garber area, centered one mile south of the town of Garber, Oklahoma. The North Garber Field is located between the Garber-Covington Field and the Sara Whipple Field on the axis of the Nemaha Ridge. Deeper production in this field has been from the Layton, Wilcox and Arbuckle zones with only scattered shallow production until recently. The axis of the deep structure is about one half mile east of the present trend of shallow operations.

Contrasted to the poor records available for the shallow formations in the older drilling logs, most present operators are keeping accurate sample records and the majority are running electric or radioactive logs. Study of these data has revealed several interesting conditions.

Several wells were completed on the Hermanski Lease, (SE ¼, Section 36, T23N, R4W), in the 1400 and 1500 foot sands. Here only expected structural conditions were encountered and the major problem seemed to be discovering a well developed sand section in any one of several productive zones. However, in the No. 3 Hermanski well, (NE, SE, SW, SE, Section 36, T23N, R4W), the interval between the Wellington anhydrite zone and the Winfield Lime thinned with the omission of approximately 120 feet of section. Also it was noted that the Herington Lime was absent in this well. This is extremely unusual, since the Herington Lime is a very consistent bed throughout this general region and is used extensively for correlation purposes. A possible unconformity was postulated and used to explain this omission.

In watching the No. 1-A Hermanski well, (NW, SW, SE, SE, Section 36, T23N, R4W), which was drilled 330 feet east of the No. 3 well, the writer was surprised to find that the Wellington anhydrites were running structurally approximately 120 feet low, referenced to the No. 3 well. This well ran low until below the Florence Lime, however, at a depth of about 1450 feet it also lost approximately 120 feet of section. Shallow faulting was immediately suspected.

A detailed restudy of all shallow wells in the region was made with little satisfaction due to the inaccuracy of the old cable tool logs and the fact that only two of them later proved to be located in a position to be cut by this fault.

Study of the electric logs of several deep wells to the east indicated that they also lost about 120 feet of section at increasing depths to the east.

An east-west cross section of wells located one mile south, along the south edge of Section 1, T22N, R4W, was constructed from driller's logs and one existing electric log. This cross section indicated an assymetrical anticline with possible normal faulting, with the downthrown block to the east, however, was very incomplete due to lack of data.

Subsequent drilling on the Ebert Lease, (SE¼, Section 1, T22N, R4W), has allowed correct positioning of the fault in that area. The No. 1 Ebert well, (SW, NE, SE, Section 1, T22N, R4W), drilled a normal section and encountered commercial production in a lensing sand at 2350 feet. However, the No. 2 Ebert well, (SE, NW, SE, Section 1, T22N, R4W), ran about 120 feet low, with respect to the No. 1 well 660 feet to the west, until below the Florence Lime, about 1450 feet, at which depth it lost about 120 feet of section and continued to run higher than the No. 1 well to a total depth of about 2350'. The 1-A Ebert well, (NW, SE, SE, Section 1, T22N, R4W), drilled one location east of the No. 2 Ebert well, ran structurally low until below the base of the Foraker. At this position it also lost about 120 feet of section and ran higher than the No. 2 well to a total depth of 2380 feet, however, it was completed as a dry hole due to lack of sand development in the 2350 foot zone.

It is now established that a Post Wellington, normal fault, striking approximately North-7 degrees East and dipping approximately 50 degrees east exists. The fault can be traced in subsurface studies across Section 1, T22N, R4W, and part way across the SE¼ of Section 36, T23N, R4W. Two wells, the No. 2 Ebert (SE, NW, SE, Section 1, T22N, R4W), and the No. 1-A Hermanski, (NW, SW, SE, SE, Section 36, T23N, R4W), cut the fault at about 1450 feet and as such indicate the general strike. The downthrown (east) block has a displacement of about 165 feet.

Surface outcrops of the Garber Formation are almost entirely absent in the area due to extensive covering by approximately 30 to 60 feet of Quaternary river gravel and recent soils. The topographic surface is very flat and no suggestion of shallow faulting of this magnitude is observed.

It is not determined whether the fault can be traced up into the Garber Formation due to lack of good sample markers or definite "kicks" on the electric logs. However, all beds below the base of the Garber shales, Hayward Member, have been displaced between the No. 3 and No. 5 Hermanski wells. A rather inconsistent sandy zone present in the No. 5 well at a depth of 420 feet, approximately 150 feet above the base of the Garber shales, seems to be displaced in the No. 3 well.

The areal extent of the fault is not determined because of lack of control to the north and to the south. It seems likely that this structural feature should be related to the Garber-Covington structure to the south and may tie into the Sara Whipple structure to the north. Middle Pennsylvanian faulting is reported in that area and careful study may reveal later faulting.

Construction of an east-west cross section from the center of Section 2, T22N, R4W across the south side of Section 36, T23N, R4W and on to the NW¼ of Section 6, T22N, R3W shows this fault to continue with depth, cutting the Nemaha Ridge anticline somewhere below the Post Mississippian unconformity and slightly to the west of the steep dipping east flank of the asymmetrical fold.

Additional wells drilled in this area, subsequent to the interpretation of this fault, have fitted into this structural picture with surprising accuracy.

It is of interest to note that shallow production in this area is almost entirely confined to the west side of the fault. This is the result of accumulation within developed sands as a result of a structural trap formed by the beds, dipping west at about 80 feet to the mile, abutting against the fault in a slight drag anticline on the upthrown side. Oil present in or migrating into the sands on the east or downthrow side would tend to migrate on up dip to the east.

In the deeper sands this condition is altered in that the deep Nemaha Ridge structure is reflected for some distance above the Post Mississippian unconformity.

Oil produced from the shallow sands in this area has a remarkable similarity in gravity, but not in color, irrespective of the depth of the sand. Vertical as well as horizontal migration has been considered for many years as a possible explanation of the similarity of gravity of oil produced from sands of varying depth within the Garber-Covington Field to the south of this area. It is possible that this fault, as well as others that may exist, may account for the vertical migration of oil from deeper sources up into sands at shallower depth.

Several points of general interest are concluded: 1. Normal faulting of Post Wellington time is shown to exist; 2. Structure, as well as condition of development of sand zones, plays a very important part in oil accumulation in this area; and 3. It is possible that vertical migration along this fault could account for the similarity of gravity of oil produced from sands of varying depth in this area.