THE EVALUATION OF WELL SAMPLES

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The fragments of rock recovered from a well drilled for oil, gas, or other fluid are commonly called well samples or well cuttings. Compiling lithologic logs from these samples is familiar practice today. In principle the process is not new but its application to stratigraphic interpretations is not old. The logs compiled today are vastly superior to those made during the first decade of the present century when this form of investigation had its infancy. The older logs were sketchy and of little scientific importance, except as showing the direction in which geology would acquire its "third dimension."

Because so many of the older samples are being reexamined, relogged, and reevaluated, it is pertinent to examine critically their true value as representatives of the formations they purport to represent. Such an examination involves the history of the drilling methods employed and the modes of collecting the samples. Samples from cable-tool operations were taken at an earlier date than those from rotary-tool operations. Cable-tool samples are relatively easy to interpret. Hence only those collected from rotary-tool operations are considered here.

It is not proposed to set up here specific rules for evaluating individual samples but rather to point out broad principles applicable to specific cases. Discussion is also limited to practices in Oklahoma.

In about 1912 the rotary drill made its first appearance in southern Oklahoma and one or two test wells were drilled with rotary tools in central and northern Oklahoma. The early rigs were crude affairs by comparison to those of today. They were small outfits with "single barrelled" steam engines driving small inefficient pumps and "draw work." Six-inch drill pipe, tipped with "fish-tail" bits, was rotated as fast as the small snorting engine and the strength of materials would permit. "Drill collars" were "entirely unnecessary" and weight indicators were still a dream. Mud was "made" while drilling the red shales usually found in the upper part of the hole and was "conditioned" periodically by stirring or jetting the pits. Wooden derricks were built alongside two parallel pits, midway between the ends, and so close to the pits that the pump was just off the derrick floor. Returned mud was flumed across the "suction pit" into the "mud pit." A ditch connected the ends of the two pits. Obviously this gave effective settling through only one half of each of the pits. If the hole was not too deep only one pit was used and the returned mud was merely ditched to the far end of the single pit. Pits were always small and promptly filled with cuttings that soon found their way to the pump suction. The abrasive action of rock solids in the mud on pump valves and seats was excessive. Jetting was not so difficult with steam and offered periods of relaxation so some crews kept pits fairly clean, but the crews usually failed to collect proper samples. Clean pits were exceptional, usually because of inadequate and improperly placed jets. Samples were most often trapped by a weir in the flume or in holes dug in the return ditch. Later, collecting boxes and other devices were used as auxiliaries. The fundamental principle of all these was to reduce the velocity of the mud sufficiently to allow cuttings to settle out of the mud. "Shale shakers" did not come into common use until the early 1930's.

Early wells were relatively shallow, relatively inexpensive, and drilled with one objective—to "make hole." Introduction of the cone type of bit, greatly facilitating the drilling of the harder rocks, inaugurated a wide expansion of the use of rotary tools. Depths of wells increased rapidly. These changes necessitated mechanical improvements in drilling rigs and improvements in drilling technique. Improvements continue but, by comparison to its predecessor of 25 years ago, the average rig of today is a precision instrument and a giant of power.

So far as samples are concerned, probably the most important development in drilling technique has been the control of drilling muds. The old driller's test of plunging his hand into the mud stream and then shaking his hand to see if the mud would "even off" (form a smooth film) or "clabber up" (segregate into irregular patches) had some scientific basis; as did the test of rubbing the mud between the thumb and forefinger to determine how far the mud would hold together as the thumb and finger were separated. Of course, a film of oil, or other extraneous matter, on the operator's hands was never considered as an influencing factor. Crude as these tests may seem, they were seldom applied to early muds. Caving of the hole was inevitable. The importance of mud control was realized as early as about 1925 but little was done about it until about 1930. Today's highly controlled specifications have been attained by successive improvements. Samples have improved concurrently.

The geologist has had no small part in all this progress. In the earliest stages he collected his own samples by whatever methods he could improvise. Comparisons of rotary- and cable-tool sample logs were often most confusing. Comparisons with surface sections were equally baffling. Ridicule and opposition was common but by about 1924 geologists began to "request" (very respectfully) samples from drilling wells. In a few instances cooperation from contractors and drilling superintendents was obtained. As his technique and knowledge improved, the geologist could offer more assistance to the drilling program and was soon in position to "direct" the collection of samples. The increase of geologic knowledge obtained from well cuttings has been tremendous. Early samples were often merely disconnected segments of the geologic column. Individual samples often represented only portions of the interval shown on their respective labels. Lazy and indifferent, and at times antagonistic, crews often collected samples at such infrequent intervals as to defy separation of the material into its components. "Bunching" samples was also a common practice of such crews. This consisted of collecting a sample from a relatively short interval, say ten feet, and then making several samples from this one to substitute for samples of intervals through which no samples were caught. Another practice was to substitute samples from the material in the "shale pit" for samples not collected. On occasion other substitutions were made, some of them quite ingenious, to fool the geologist. "Saving up hole" was a practice most difficult to detect. This consisted of reporting only a portion of the hole actually drilled each day and "saving" the remainder for some day when mechanical trouble, or the desire for sleep, would prevent the crew from making an average amount of hole. Samples were omitted here and there to compensate for the footage not reported and "bunched" to make up for footage not actually drilled when shut down. "Saving up" as much as 200 feet of hole was not uncommon. This practice had the effect of sliding formation data found in samples up and down the geologic column. It was most prevalent during the development of the Seminole Pool.

These are some of the many factors which must be recognized if a proper evaluation is to be put on old samples examined in the light of present day standards. Evaluation of all samples of all materials must include a consideration of the conditions under which the samples were collected. That these older samples have great value when properly interpreted is evinced by the fact that the geologic column of this State is as minutely divided in subsurface as it is on the surface, or more so, and correlations are carried from one end of the State to the other. Admitting that the earlier samples are generally of poorer quality does not prevent their use and correlation with later samples. It merely challenges the ingenuity and resourcefulness of the investigator.

To evaluate properly any set of samples all available information concerning them should be obtained. The following are valuable data.

When was the well drilled? After only a moderate amount of experience, an observing worker can closely "date" samples into periods during which the quality of samples is fairly well established.

Have the samples been washed? Careful washing of samples did not start until about 1928. If washed, were they washed by a commercial "sample-cut"? The first "sample-cut" that washed samples was established in the early 1930's. Burning samples was fully as common then as now. In general, samples were washed equally well. In many of the early samples washed at the Ardmore Sample Cut, very small, transparent, ostracods are to be found, derived from the water supply then in use.

In what kind of containers are the samples? Cloth bags were used generally until about 1927; afterwards, manila envelopes with metal tops were introduced.

Is the description written or printed? Printing descriptions started about 1929 and the samples of many companies and sample cuts are characterized by the size and style of type and the color of ink used.

What company or individual drilled the well and what was the policy of the operator at the time the well was drilled? Not all operators who enthusiastically embrace geology now have always been so affectionate. The policy of many has been vacillating. Judgment must be without favor.

Who was the contractor? This is important. The quality of samples is almost "a function of the contractor" because the policy of a contractor is most often reflected in the quality of samples saved by his workmen. Good drilling equipment does not necessarily assure good samples. Samples collected by some contractors were invariably poor. Samples collected by such contractors for indifferent operators are worthless, or worse.

Finally, is the description of the location on the samples correct? Many errors exist and cause much confusion.

Old and older samples contain much valuable information but their interpretation must be tempered with a generous portion of good judgment and a recognition of the differing conditions under which they were collected, if grotesque errors are not to result. This is sample evaluation.