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Determination of Archie Parameters m and n by Combining Core Analysis with Dielectric Logs

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ABSTRACT

The determination of the Archie exponents m and n is critical to the proper calculation of oil in place. Due to variations in pore geometry in carbonate reservoirs, it is critical to determine cementation exponents (m) at all depths in the reservoir. Because carbonate reservoirs are not universally water wet saturation exponents (n) in carbonate reservoirs often differ from the standard value of 2.0. Therefore, to determine accurate water saturations, a combination of core analysis data together with dielectric log data was used to determine the Archie Parameters m and n.

Using core data and dielectric log data from the Permian Glorietta-Clearfork Dolomite in the Monahans field in Ward County, Texas, m and n were determined by the following procedure. First, 60 core-measured porosity and m values were cross plotted and curve-fit to derive a porosity versus m transform. Next, flushed zone water saturations (S_{xo}) were determined from the dielectric log data. Then n was determined by calculating the value of n giving the minimum error between S_{xo} obtained from a dielectric log and S_{xo} determined by the Archie equation using the least squares technique over all depths in the reservoir. When calculating the minimum error, m is calculated at each depth using the core-derived porosity versus m transform and n is varied to obtain the minimum saturation error. It is important to remember that the n value determined by least squares summation is the n value that results in the minimum error in the calculation of water saturation. The n value

determined by the above procedure using the Monahans field data is 2.45, thus indicating that the reservoir is predominately water wet.

The m and n values determined by the core-derived porosity versus m transform and least squares summation based on dielectric log data can then be used to calculate the Archie water saturations of the uninvaded zone (S_w). Archie water saturations calculated using m = 2.0 and n = 2.0 averaged 30.1 percent. However, Archie water saturations calculated using the core derived porosity versus m transform and n = 2.45 averaged 38.7 percent. Thus, the importance of using core data integrated with log data in formation evaluation is demonstrated.