

## Mobile OOIP and OGIP by the Y-Method with New Mexico Case Studies

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Doll and Martin (1954) published a paper outlining a log analysis method using only resistivity logs  $R_{xo}$  and  $R_t$ , plus  $R_w$ ,  $R_{mf}$  and cementation exponent  $[m]$  to determine Mobile OOIP called the Y – Method. The value of Y represents the amount of oil per unit volume displaced by mud filtrate during invasion.

By using the Y-Method to determine OOIP the geologist/engineer can determine Mobile OOIP without knowing  $S_w$ , Porosity  $[\Phi]$ , ROS and Saturation Exponent  $[n]$ . Therefore, avoiding any potential errors in the determination of these values. Listed below are two versions of the Y – Method depending on log resistivity suite:

$$Y = (R_z/SFL)^{(1/m)} - (R_w/R_t)^{(1/m)} \quad \text{or} \quad Y = (R_{mf}/R_{xo})^{(1/m)} - (R_w/R_t)^{(1/m)}$$

The value of  $[m]$  is a function of lithology, pore type and/or clays minerals, which will be illustrated in the Six New Mexico Case Studies.

$$\text{Y-Method: Mobile OOIP}_{stb} = (7758 * Y * h * \text{Area}) / \text{BOI}$$

$$\text{Compared to: Mobile OOIP}_{stb} = \{7758 * \Phi * [(1.0 - S_w) - (1 - S_{xo})] * h * \text{Area}\} / \text{BOI}$$

Listed below are six New Mexico case studies, note that the value of  $[m]$  varies with each rock type. In five of these six case studies both Total and Mobile OOIP or OGIP are calculated by the traditional methods so that a comparison can be made to Mobile OOIP or OGIP by the Y-Method. In case study six Mobile OOIP is only calculated by the Y-Method because only resistivity logs are available.

Pennsylvanian Sandstone Southeast New Mexico [gas reservoir]  $[m=2.0]$

Permian Glorieta Vuggy Dolostone Permian Basin New Mexico  $[m>2.0]$

Picture Cliffs Shaly Sandstone San Juan Basin New Mexico  $[m<2.0]$

Devonian Low-Porosity Fractured Limestone Southeast New Mexico  $[m<2.0]$

Permian 3<sup>RD</sup> Bone Spring SS Permian Basin New Mexico  $[m<2.0]$

Permian Bone Spring Carbonate NW Self SE NM [“Old” E-Logs]  $[m=2.0?]$

The Y-Method is an important petrophysical tool, because the geologist/engineer can determine Mobile OOIP using only  $R_t$ ,  $R_w$ ,  $R_{xo}$ ,  $R_{mf}$  and cementation exponent  $[m]$ . Thus, avoiding any potential errors in determining Porosity,  $S_w$ , RHS, and Saturation Exponent  $[n]$ . In addition, the Y-Method can be applied in wells with only resistivity logs [“Old” E-Log Analysis].