

Geological Controls on Net Pay in Reservoirs

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ABSTRACT

Net pay can be defined as the formation thickness within the hydrocarbon column that can be produced economically. The most common methods for determining net pay include the use of wireline log cut-offs eg gamma ray (sand vs shale percentage), resistivity (hydrocarbon vs water saturation) and porosity (rock vs pore volume). Well tests and production data are commonly used to confirm these methods for net pay determination. This presentation details case histories from around the world that highlight various problems with each of these methodologies. First, wireline logs sometimes “lie”. They don’t really “lie”, but too simplistic assumptions of what the logs are telling us, and a lack of understanding of the fundamental rock properties and fluids in the formation, cause us to misinterpret their response. Examples include incorrect v-shale cut-offs due to shale clasts in the formation, incorrect density porosity calculations caused by extreme mineral densities, incorrect neutron porosity cut-offs due to microporous reservoirs, and misinterpreted fluid compositions (on resistivity logs) due to conductive minerals in the formation. Second, when core data are available, empirical assessments of sand shale ratios, precise measurements of core porosity and permeability (absolute and relative) and capillary pressure are commonly used to augment or support net pay determination. However, even with the availability of core, there are potential errors in these determinations. Most common of these is core plug sampling bias. This bias could be due to poor core and/or core plug recovery eg if the potentially best reservoir rock is unconsolidated, it is commonly unsampled, even possibly ending up being swept off the rig floor. In addition, human sampling bias such as sampling by prescribed interval rather than rock type, results in over or under representation of particular rock types. Third, production mechanism and net pay interpretation are not always considered together. Net pay on primary production, may not equate to net pay on waterflood, if the flooded formation is discontinuous. Similarly, actual production or injection zone tests (PLT, microseismic or fibreoptic) are rarely correlated to rock types in a formation, thus leading to potential mismatch between actual and interpreted net pay zones. In conclusion, better pay determination in our industry should include: the use of rock types as a basis of net pay classification; tying the definition of net pay to field-specific production mechanism and making the judicious use of core an integral part of data collection.