HOW TO DO QUICK-LOOK SHALY SAND LOG ANALYSIS WITH CONFIDENCE

Mark Deakin

Petrophysics Pty Ltd

This paper was prepared for presentation at the SPWLA Asia-Pacific Regional Conference held in Bangkok, Thailand, March 1-4, 2020.

ABSTRACT

The operations petrophysicist faced with the daunting task of producing fit-for-purpose Quick-Look results in the freshwater, stacked shaly sands of S.E. Asia will understandably feel challenged. The methods he/she adopts typically fail to provide the necessary information to distinguish hydrocarbon zones and permeability. Rather than using porosity/conductivity log analysis - a tool intrinsically unsuited to the task at hand - this paper sets out simple, cross-disciplinary techniques which cross-check and harden Quick-Look log analysis. Commonly available special log, non-log and generic data are employed with the method to harden results, with or without core.

A variable fluid density porosity is used to compute an apparent salinity curve from standard Archie and the maximum salinities used in a manner analogous to a Pickett plot.

Zones above FWLs, if any, are established by a single valid pressure; mudgas, shale corrected density-neutron separation or subtle departures of logged *Rt* over *Ro,* the water saturated resistivity. If FWLs remain uncertain the most promising zone can be assumed to be above a FWL.

With salinity and FWLs fixed the apparent standard Archie *m* and *Rwa* curves are computed below FWLs which quantify the presence of non-Archie (excess) conductivity. These are now predicted from conventional logs and used in this paper's quick look Shaly Archie formulae. The variable *m* and *Rw* are also used to compute the continuous Waxman Smits *Qv* and Dual Water Model shaly sand inputs, similarly to Juhasz's Qvn (Juhasz 1981). If available, standard output NMR curves may be employed to compute these inputs. We have now established *Ro,* a critical but usually neglected requirement.

Standard output NMR is now used for *Swi*, independent of *Rt, Rw, m, n* or shaly sand effects. Alternatively, sidewall, offset or generic rock typed core data provide *Swi* via established relationships. If neither NMR or core is available generic vshale, porosity and tvdss provide permeability, *Swi* and full Saturation Height functions, where *Sw>Swi.* Under certain conditions dielectric curves may be used.

With a resistivity independent *Sw* now available the Quick-Look process adjusts the saturation exponent *n* for the saturation equation. If *n* values are non-feasible the assumption of FWL is revisited.

A final pass allows interactive adjustment of salinity, FWL, *Qv* and *n* for *Sw*. Bulk volume water then calculates Timur Coates permeability which allows full circle reconciliation of the entire process against any available permeability, core, sidewall, offset or generic.

This process is coded to a log analysis command file and completed within 3-4 hours. The diversity of inputs used affords a degree of confidence simply not possible with shaly sand log analysis.

The paper recommends optimal data acquisition to enhance these Quick-Look techniques.

INTRODUCTION

This paper explains simple techniques used by the author in stacked shaly sands which quickly and easily harden results. The data are typically available to the operations petrophysicist but the processes are not written into push button modules and so are rarely used. Once their principles and utility are understood they become indispensable to quick look and all evaluations. This paper steps through a quick look evaluation invoking these extras in sequence.

Generally, this paper alludes to oven dried core (total) porosity. Humidity dried is OK if that is your offset data base - the ultimate objective being to import SCAL to