Using Fractals to Determine a Reservoir's Hydrocarbon Distribution

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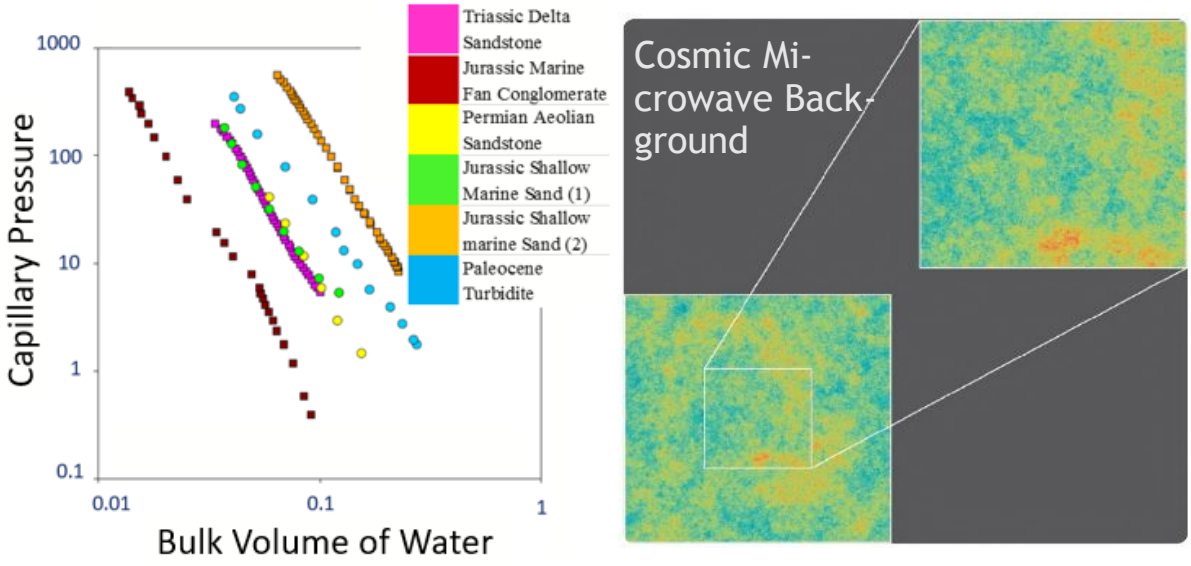
The petrophysicist's contribution to maintaining and prolonging the lifetime of the oil and gas fields is to ensure the reservoir's 3D geomodel is accurately initialised with properties that include porosity, permeability, water saturations and net cut-off. This is challenging as there is only limited core and electrical log data available at the well locations.

The petrophysicist helps to determine a field's hydrocarbon in place by modelling the distribution of fluids using a water saturation vs. height (Swh) function. A good Swh function ensures the three independent sources of fluid distribution data are consistent. These being the formation pressure, core and electrical log data. The Swh function must be simple to apply, especially in reservoirs where it is difficult to map permeability or where there appears to be multiple contacts. It must accurately upscale the log and core derived water saturations to the reservoir model cell sizes.

Using capillary pressure theory and the concept of fractals, a practical Swh function has been derived. Several case studies are presented showing the match between this function and well data. The function gives an accurate prediction of water saturations, even in wells where **a** resistivity log was not run due to well conditions.

Logs and core data from eleven North Sea fields, with very different porosity and permeability characteristics, depositional environments and geological age, are compared. This study demonstrates how this Swh function is independent of permeability and litho-facies type**s.** A method is presented to identify swept and by-passed hydrocarbon and to normalise true vertical depths between wells.

The fractal function defines the free water level, the hydrocarbon to water contact, net reservoir and the irreducible water saturation. The function provides a simple way to quality control electrical log and core data and justifies using core plug sized samples to model water saturations on the reservoir scale**.**



ABOUT THE AUTHOR

Steve Cuddy is a Principal Petrophysicist with Baker Hughes and an Honorary Research Fellow at Aberdeen University where he holds a PhD in petrophysics. He also holds a BSc in physics and a BSc in astrophysics and philosophy. He has 40 years industry experience in formation evaluation and reservoir description. He has authored several SPE and SPWLA papers and carried out more than 200 reservoir studies. He has been selected as a Distinguished Speaker for the SPWLA for 2017/18 season.