

Thinly Bedded Pay in Clastic Reservoirs, Recognition, Geological Occurrence, Understanding, and Quantification

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Abstract

Thin bedded pay (TBP) refers to oil and gas in porous and permeable beds less than about 30 centimeters (1 ft.) thick interbedded with impermeable beds (shales) of similar thicknesses all of which are below standard log resolution. Recognition and quantification of hydrocarbon pore thickness requires better resolution data; cores, image logs, special logs (Rv:Rh, NMR, etc) combined with standard logs and mud logs.

Thin bedded pays are known to be associated with conventional reservoirs, but also occur associated with unconventional reservoirs. This study focused upon TBP associated with clastic conventional reservoirs but TBP probably occurs in carbonate and unconventional shale reservoirs as well. Thin bedded pay may also exist in various fluid scenarios; heavy, viscous, and light oils as well as gas and condensates reservoirs. Gas/condensate and lighter oils will be most easily recoverable but vast resources most likely exist with heavy and viscous oils.

Turbidite, Paralic(1*), and Fluvial reservoirs have all been shown to have TBP associated with the conventional pay (beds > 1 ft. thick), but TBP probably occurs in Aeolian and some other clastic environments as well in lesser amounts.

It is the job of the Petrophysicist to calculate hydrocarbon pore thickness (HPT) in these TBP intervals so that oil and gas inplace estimates can be made. The Geologist and Reservoir Engineer then must evaluate the likelihood of them being recoverable and what performance can be expected.

Historically, outcrop analogue studies have focused upon the object size of sand and shale bodies and rightfully so, to facilitate 3D modelling of different depositional environments/sub-environments. The sub-environments (i.e. Crevasse Splay, Distal Lower Shoreface, Overbank Levee, etc.) making up TBP and the understanding of their net-to-gross (NTG), and connectedness is critical to determining if they can be exploited (i.e. reserves). This study undertook a review of literature and examples to determine what percentages of these TBP sub-environments are to be expected associated with the conventional (thicker) pays since sizes of rock bodies and not percentages have been the focus of studies over the past several decades. No published global studies have been found summarizing these important data for estimating even in-place volume of TBP.

There is much written on the petrophysics of TBP (also historically called Low Resistivity Low Contrast pay, or Hard to Recover Resources) and petrophysical evaluation was reviewed but not the focus of this work. That said, detailed petrophysical evaluation with integration and collection of proper data to appraise TBP is critical to quantifying it. Additionally, testing, and dynamic data acquisition is critical to determining if and how it will perform and whether it is an economically viable resource.

Turbidites will have the most TBP (~30% ave), with Paralic (~20%), and Fluvial (~10%) the least (overall ~20% ave) based upon industry and published data reviewed by the author.

1*) Note Paralic includes lacustrine deltaics here in.