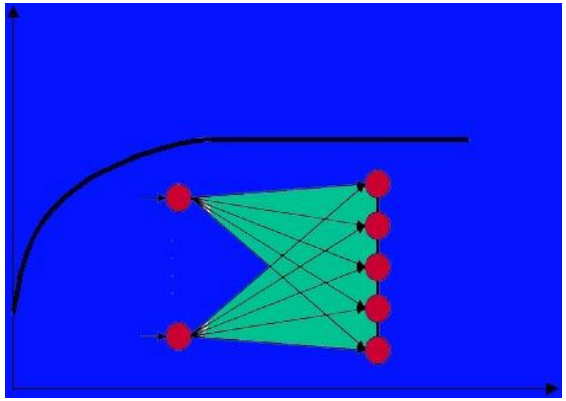


GeoNeurale Newsletter

Double Duty with **The Old** and **The New**

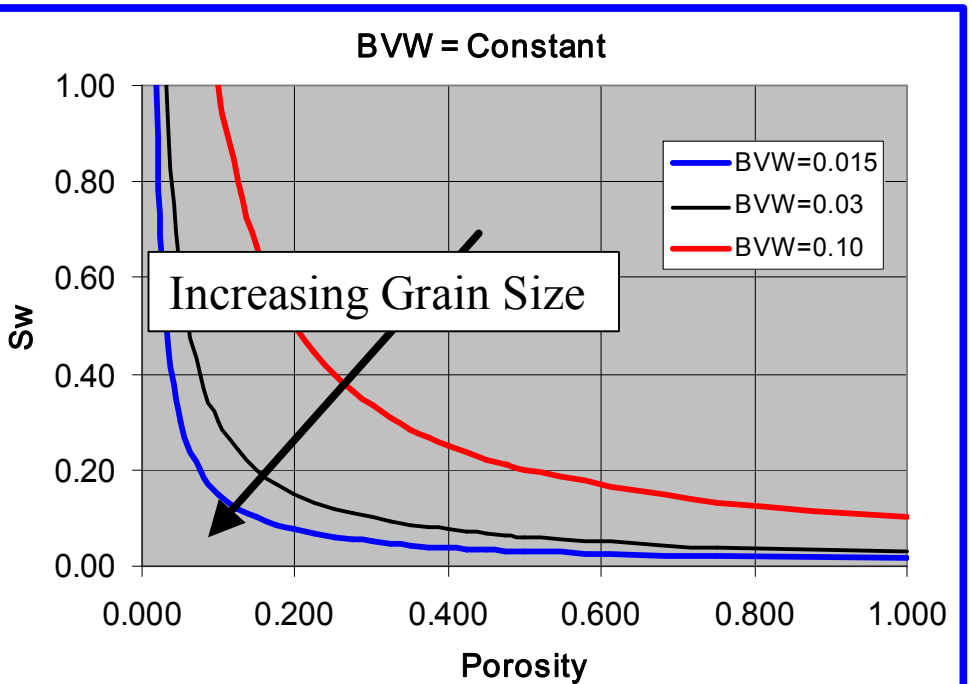
R. E. (Gene) Ballay, PhD

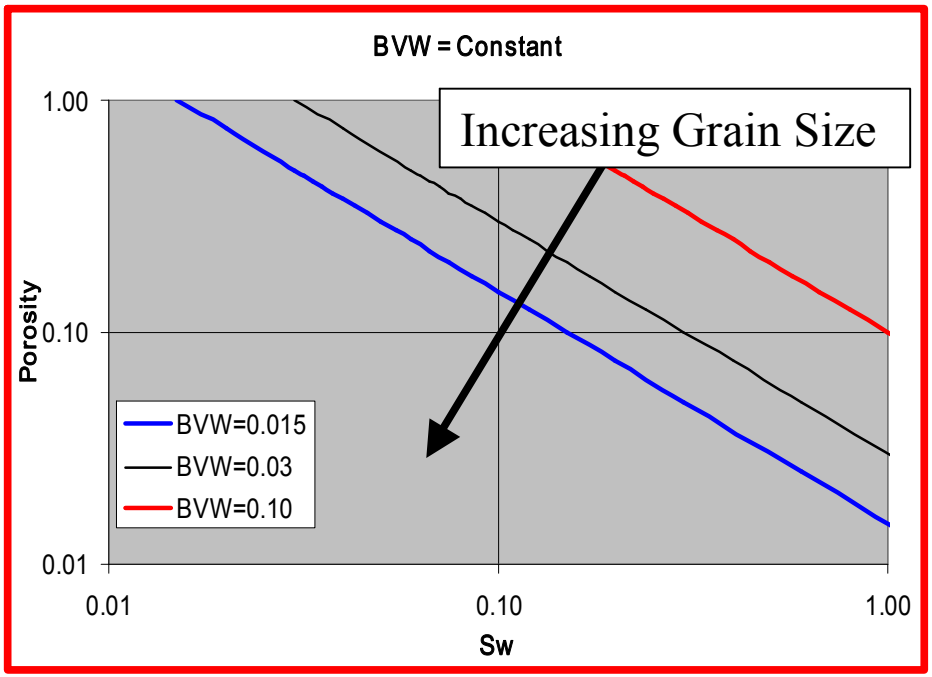
Bulk Volume Water

- Reservoir performance can often be evaluated in terms of the Bulk Volume Water

$$BVW = Sw * \phi$$

- Contour lines of ***constant bulk volume water may be used as cut-off boundaries***
- ***Permeability estimates may also be possible*** in favorable situations
- The graphic consists of Water Saturation versus Porosity. Depending upon local conventions, *either attribute* (porosity or water saturation) *may be along the vertical axis, with the other being along the horizontal*
- In the *Log-Log world* (such as used in a Pickett Plot), these *BVW trends are straight lines*

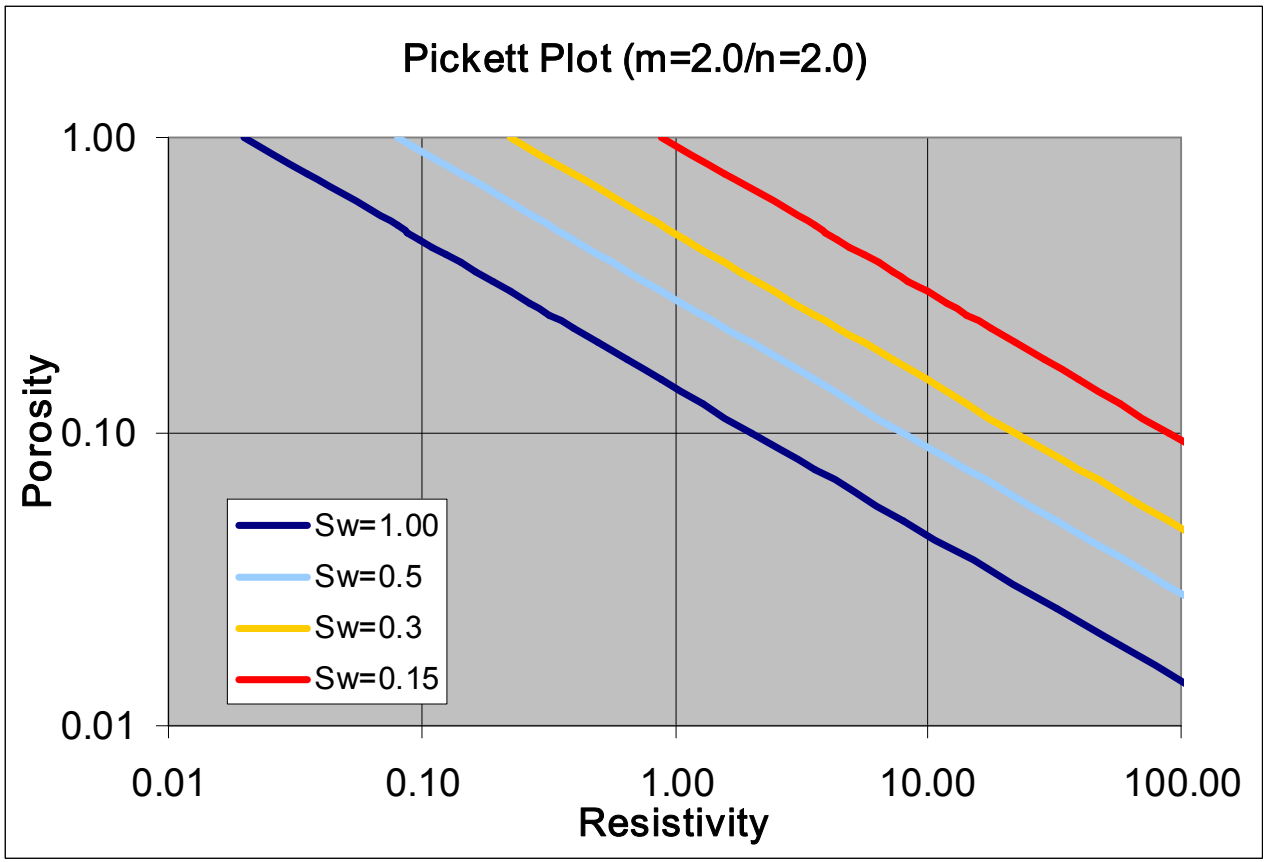




Pickett Plot

- *Points of constant water saturation* will *plot on a straight line* with *slope related to cementation exponent "m"*
- *Saturation exponent "n"* determines the *separation of the Sw=constant grids*
- *Rw @ FT can be deduced from graphic*
- The *same technique can be applied to the flushed zones*, using flushed-zone measurements

G R Pickett "A Review of Current Techniques for Determination of Water Saturation from Logs," paper SPE 1446, presented at the SPE Rocky Mountain Regional Meeting, Denver, Colorado, USA, May 23-24, 1966; *SPE Journal of Petroleum Technology* (November 1966): 1425-1435.

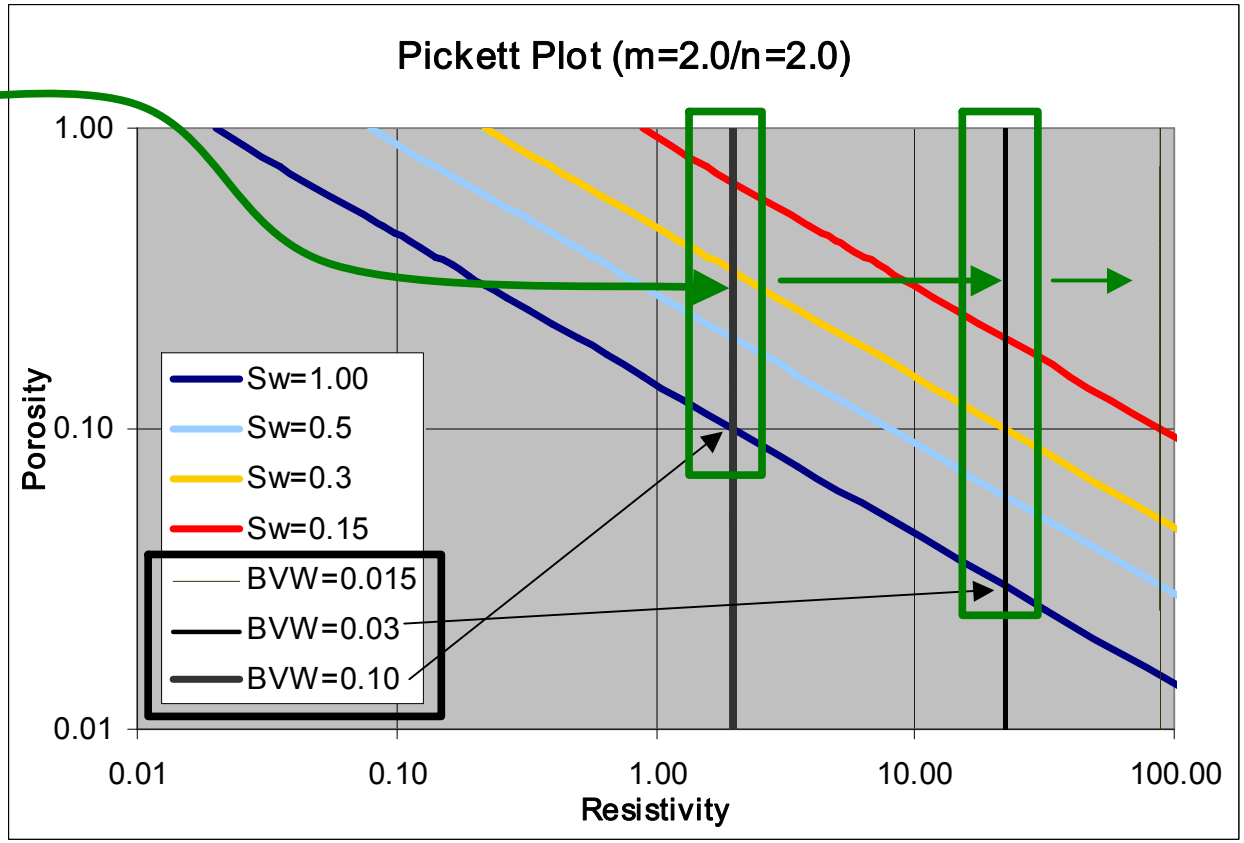


Double Duty

- *In the case of m = n*, the porosity term [(m - n)*Log(ϕ)] drops out leaving

$$Log(Rt) = Log(Rw) - n*Log(BVW) = Constant$$

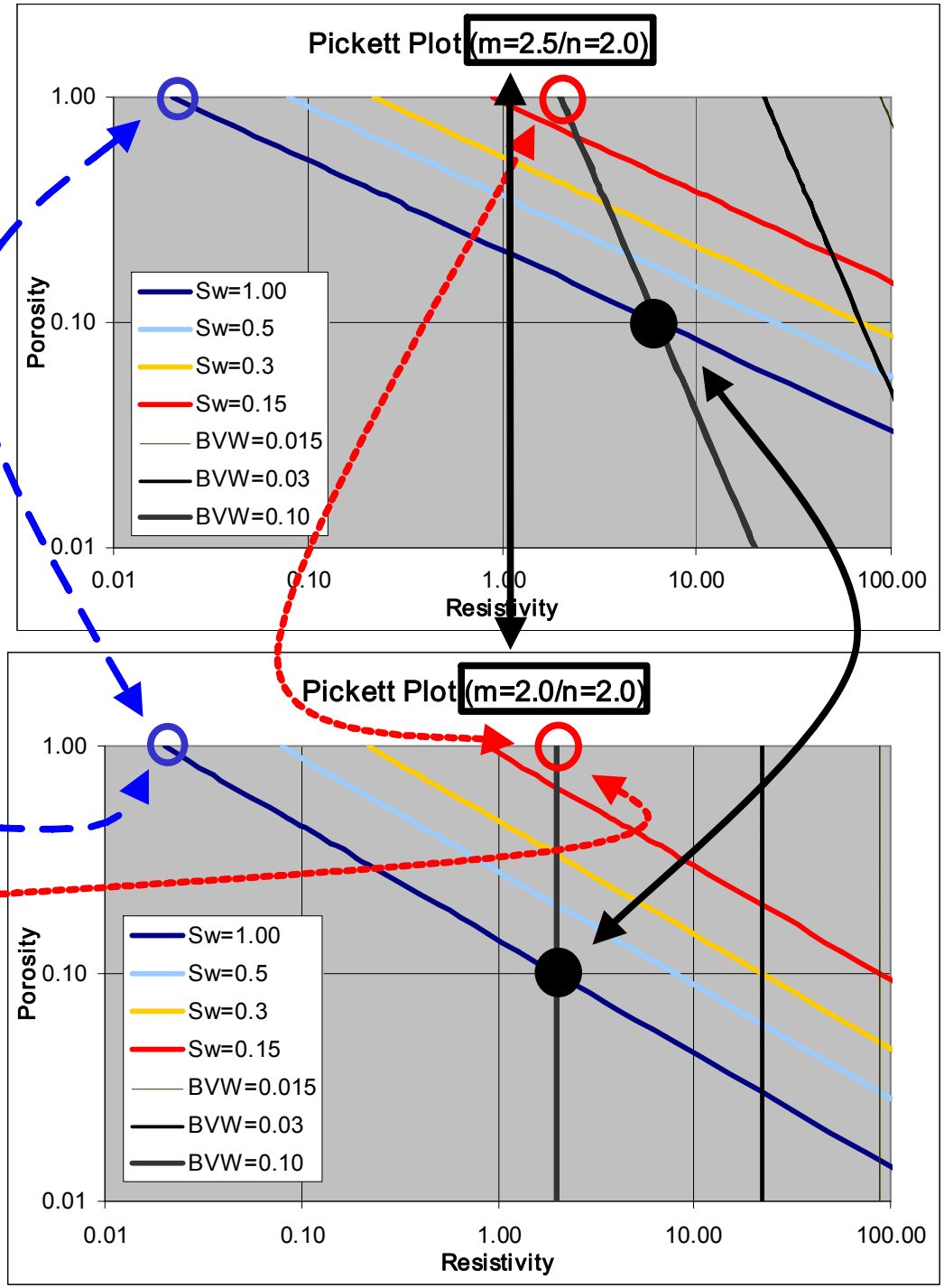
- BVW = Constant grids are vertical
- BVW lines below Sw = 100 % line are a mathematical extrapolation (for visual reference) and not physically realistic



Double Duty

"m" Not Equal To "n"

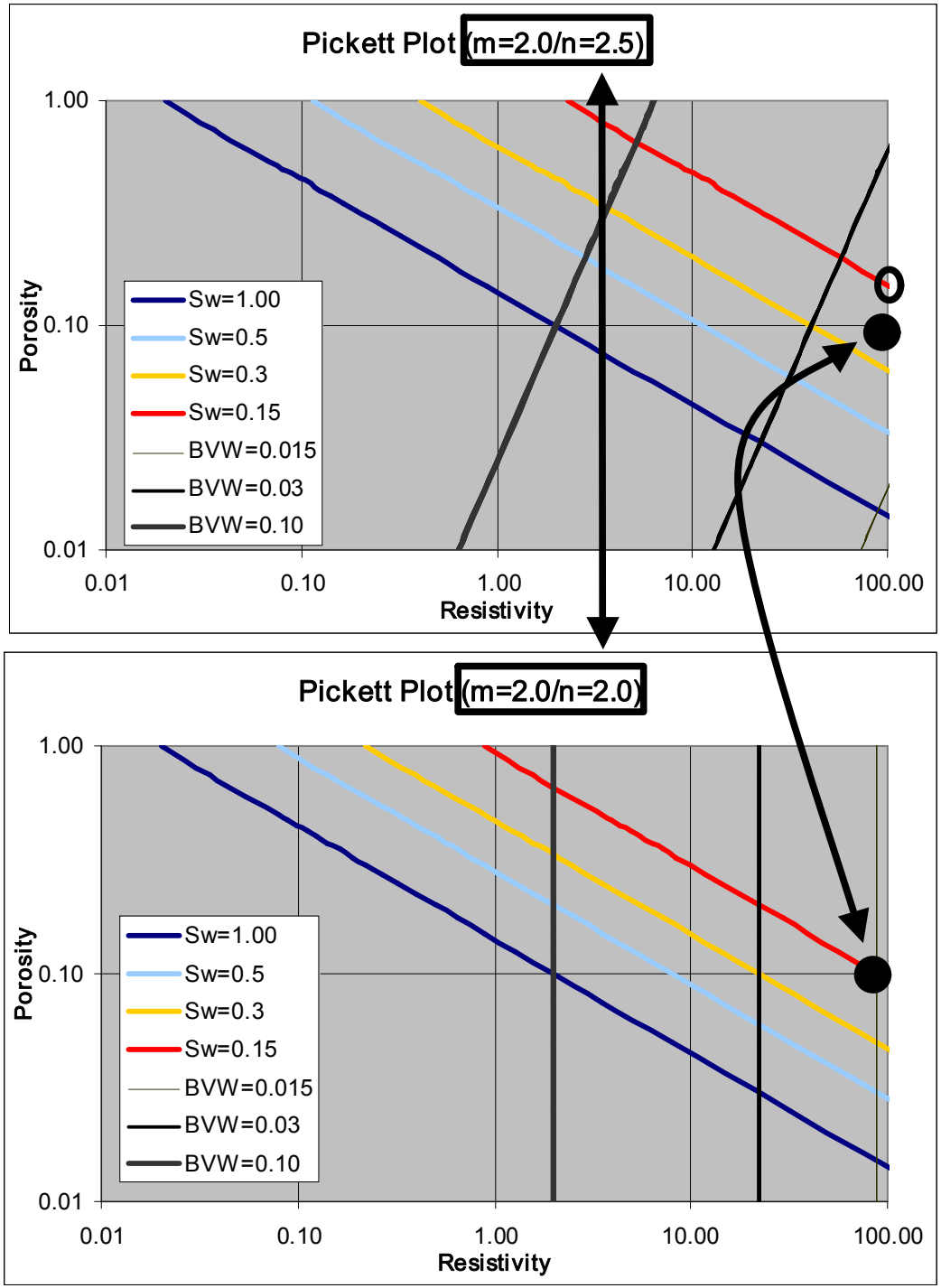
- m=2.0 / n=2.0 vs m=2.5 / n=2.0
- 'm' relates to pore system tortuosity, and **as 'm' increases**, the resistivity of a specific porosity (10 pu in the graphic) at Sw = 100 % also increases
- Rw @ FT remains the same
- Grids of constant BVW shift
- BVW lines below Sw = 100 % are a mathematical extrapolation (for visual reference) and not physically realistic



Double Duty

"m" Not Equal To "n"

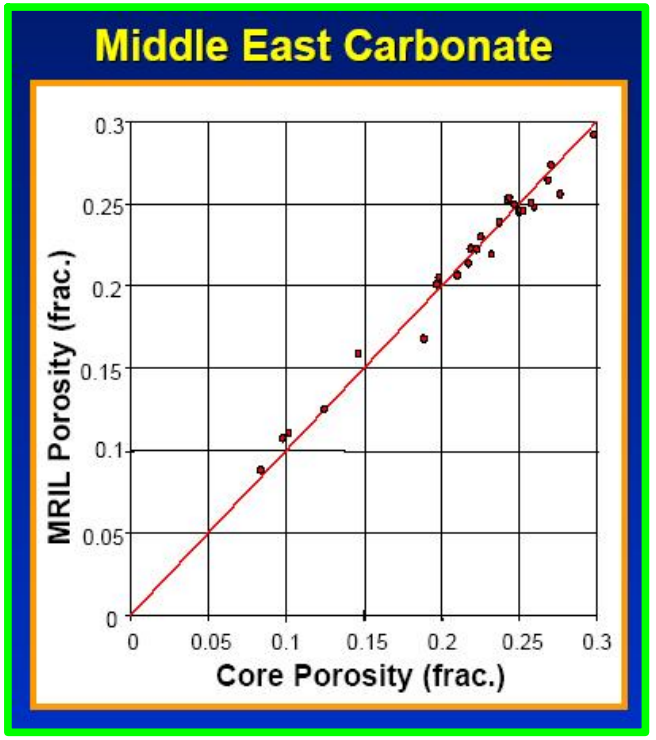
- **m=2.0 / n=2.0 vs m=2.0 / n=2.5**
- 'n' relates to the tortuosity of the conductive phase and as Sw decreases the associated rise in resistivity of a specific porosity is greater than what would have occurred at a lower 'n' value.
- Alternatively, **the Sw associated with a specific porosity & resistivity increases as 'n' increases**

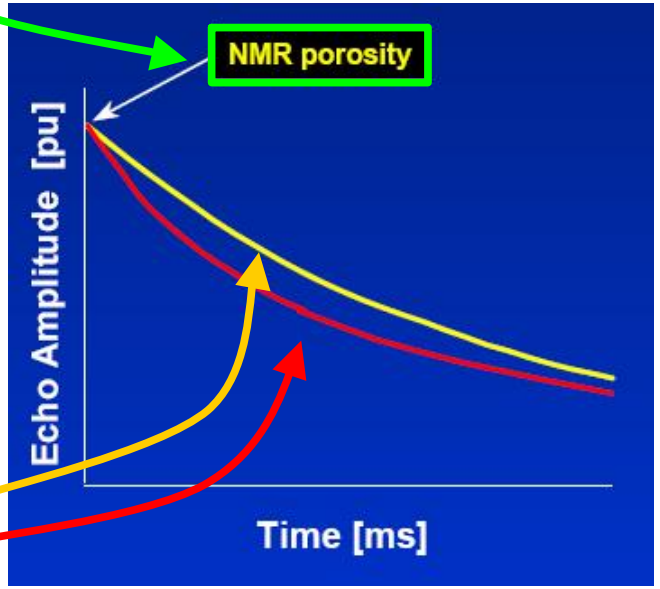


Nuclear Magnetic Resonance

- *Mineral Independent Porosity*
- ***BVI - Bulk Volume Irreducible*** water which includes ***water retained by capillary forces in small pores***, and water wetting pore surfaces.
- ***BVM - Bulk Volume Moveable***, (Free Fluid Volume) which is ***porosity available for hydrocarbon storage and fluid flow***.
- *Exhibit following*

With proper calibration, the NMR provides both the *total porosity*, and the pore size distribution



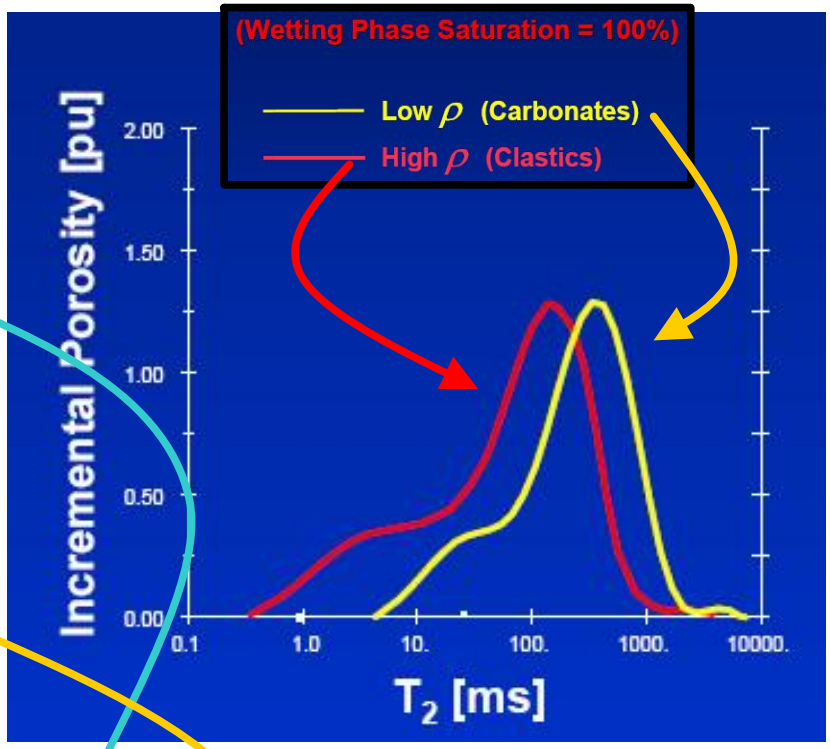


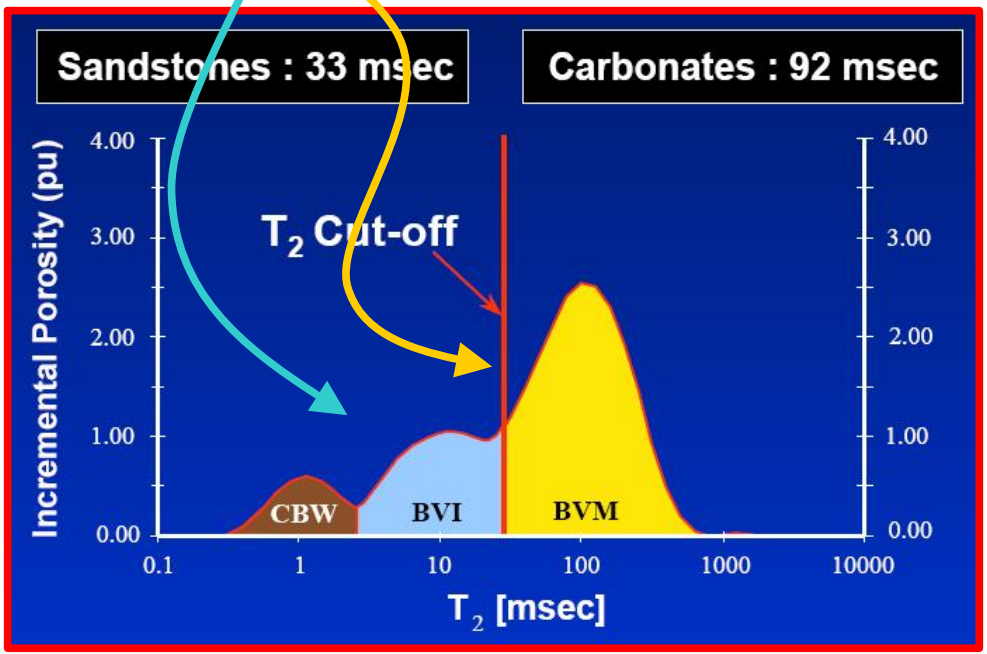
Carlos Torres-Verdin, University of Texas
adapted from Baker Hughes

Nuclear Magnetic Resonance

- *Mineral Independent Porosity*
- *BVI - Bulk Volume Irreducible* water which includes *water retained by capillary forces in small pores*, and water wetting pore surfaces.
- *BVM - Bulk Volume Moveable*, (Free Fluid Volume) which is *porosity available for hydrocarbon storage and fluid flow.*

With proper calibration, the NMR provides both the *total porosity, and* the *pore size distribution*





Carlos Torres-Verdin, University of Texas
adapted from Baker Hughes

GeoNeurale

Lichtenbergstrasse 8

85748 Munich-Garching

T +49 (0) 89 5484 0

T +49 (0) 89 5484 2240

Am Nymphenbad 8
81245 Munich

Germany

T +49 (0)89 89 69 1118
F +49 (0)89 89 69 1117

www.GeoNeurale.com