Effective porosity = PHIE

@wikipedia

A pore volume V_ϕ fraction of bulk rock volume V_r containing the hydrodynamically connected fluids (also called free fluids) within each pore element:

(1) $$\phi_e = \frac{V_\phi}{V_r}$$

The log name is PHIE.

The reason to introduce this concept is that a part of the actual inter-grain void is filled with shale thus reducing the actual volume available for fluids.

It splits into two components:

Open porosity ϕ_{opn}	**Closed porosity** ϕ_{cls}
with interconnected pores	with isolated pores

subject to condition:

(2) $$\phi_e = \phi_{\text{opn}} + \phi_{\text{cls}}$$

Effective porosity is a function of reservoir pressure at a given location $p(\mathbf{r})$:

(3) $$\phi_e(\mathbf{r},\ p) = \phi_{ei}(\mathbf{r}) \exp\left[\int_{p_i}^{p} c_\phi(p)\, dp\right]$$

where

$c_\phi(p)$	pore compressibility (see also Pore compressibility @model)
$\phi_{ei} = \phi_e(p_i)$	effective porosity at the initial formation pressure p_i
p_i	initial formation pressure

This leads to the effect of Porosity Shrinkage.

Since the pore compressibility is very low (~ c = 0.5 ÷ 1.5 GPa^{-1}) and has a weak dependence on reservoir pressure for subsurface rocks in petroleum reservoirs the (3) can be written as:

(4) $$\phi_e(\mathbf{r},\ p) = \phi_{ei}(\mathbf{r}) \cdot \left[1 + c_\phi\,(p - p_i) + 0.5\, c_\phi^2\,(p - p_i)^2\right]$$

Most Subsurface E&P Disciplines (except Petrophysics) usually omit index "$_e$" and denote Effective porosity as $\phi = \phi_e$.

See also

Petroleum Industry / Upstream / Subsurface E&P Disciplines / Petrophysics (PP) / Volumetric Rock Model

[Basic reservoir properties] [Pore volume] [Connected pore volume] [Closed pore volume] [Porosity] [Open porosity] [Closed porosity][Initial Porosity $_{i}$]

[Pore compressibility @model]