Lecture#4 Building a Porosity Model for Buzurgan Oil Field

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Porosity Definition

- Porosity is defined as the ratio of the pore space volume to the bulk volume of reservoir rock, It is a dimensional parameter and can be expressed in fraction or percent.

- Moreover, in spite of such a simple definition, porosity can be a difficult parameter to quantify, since the porous volume of a reservoir rock is often a complex network of spaces of different shape, dimension and origin- As a consequence of this complexity, several classification systems can be considered.

Types of Porosity

- A general and simple classification of the pore system can be based on the genetic process responsible for the formation of porosity. From this point of review can distinguish fundamental types of porosity, primary and secondary.

- Primary porosity is the original porosity preserved in the sediments after deposition and initial compaction. It is strongly dependent on the textural characteristics of the sediments (grain size, shape and sorting) and tends to decrease with time and depth of burial, Sometimes it is preserved by early migrations of hydrocarbons.

- Secondary porosity is related to tectonic stresses that affected the sediments after the burial and/or to the circulation of underground waters. The former processes tend to generate fractures, stylolites and joints, while the latter are responsible for dissolution, deposition, recrystallisation leaching and dolomitization processes that may affect the reservoir rock after the deposition. Secondary porosity is normally more important in carbonate rocks than in siliciclastic sediments, due to the fragility of these minerals and their relatively high solubility.

Types of Porosity (cont.)

- Another popular and simple way to classify the porosity of reservoir rocks makes use of the image of connected and isolated pores, which leads to the distinction between total and interconnected, or effective porosity.

- The situation is shown in Fig. 4.6, which illustrates the idealized pore system of a clean sandstone that underwent a simple diagenetic history. Reservoir rocks often show some degree of isolated porosity due to the presence of cementing materials that seal off some portions of the pore space. The main issue concerning these isolated pores is that they do not contribute to fluid flow.

- Where carbonate rocks are concerned, the description of the gore system can be even more complicated. In the majority of cases, several types of porosity coexist and can be identified in the same carbonate rock.

Types of Porosity (cont.)

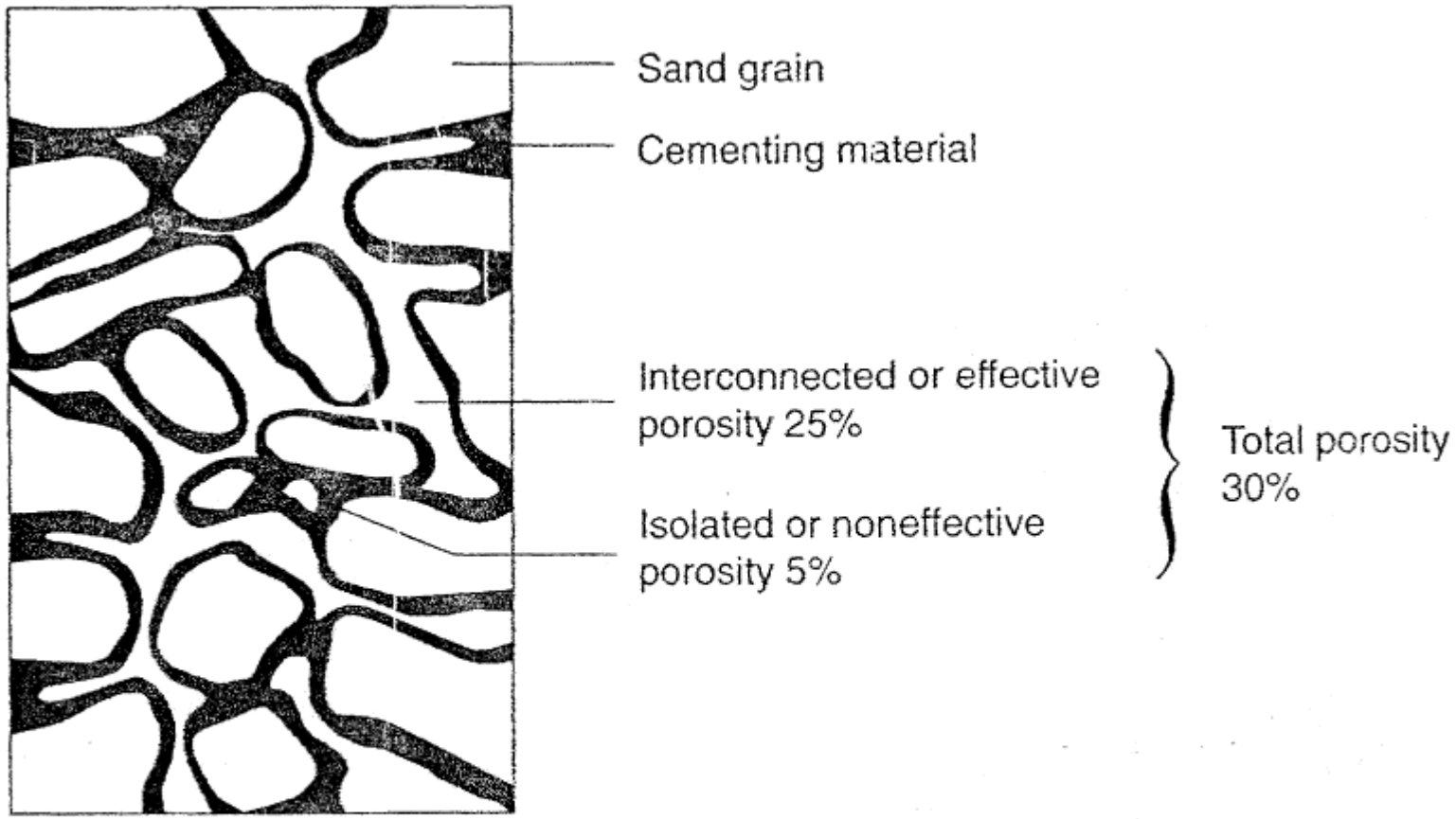


Figure 4.6 Effective, isolated and total porosity of a clean sandstone [9].

Core Porosity

- Porosity is routinely measurand in the laboratory using small plugs of reservoir rock, sampled in a more or less systematic way from a core.

- Historically, several methods have been used to measure porosity, based on the determination of two of the three basic volumetric parameters: bulk volume, grain volume and pore volume.

- Currently, most of the techniques that are used in the laboratories are based on the measurement of pore volume, which yields an estimation of effective, or interconnected, porosity. These techniques are based on either the extraction of a fluid from the rock sample or the introduction of a fluid in the pore volume of the rock. Other types of analyses, based on computing the volume of a sample crushed to grain size, can provide measurements of total porosity.

Core Porosity

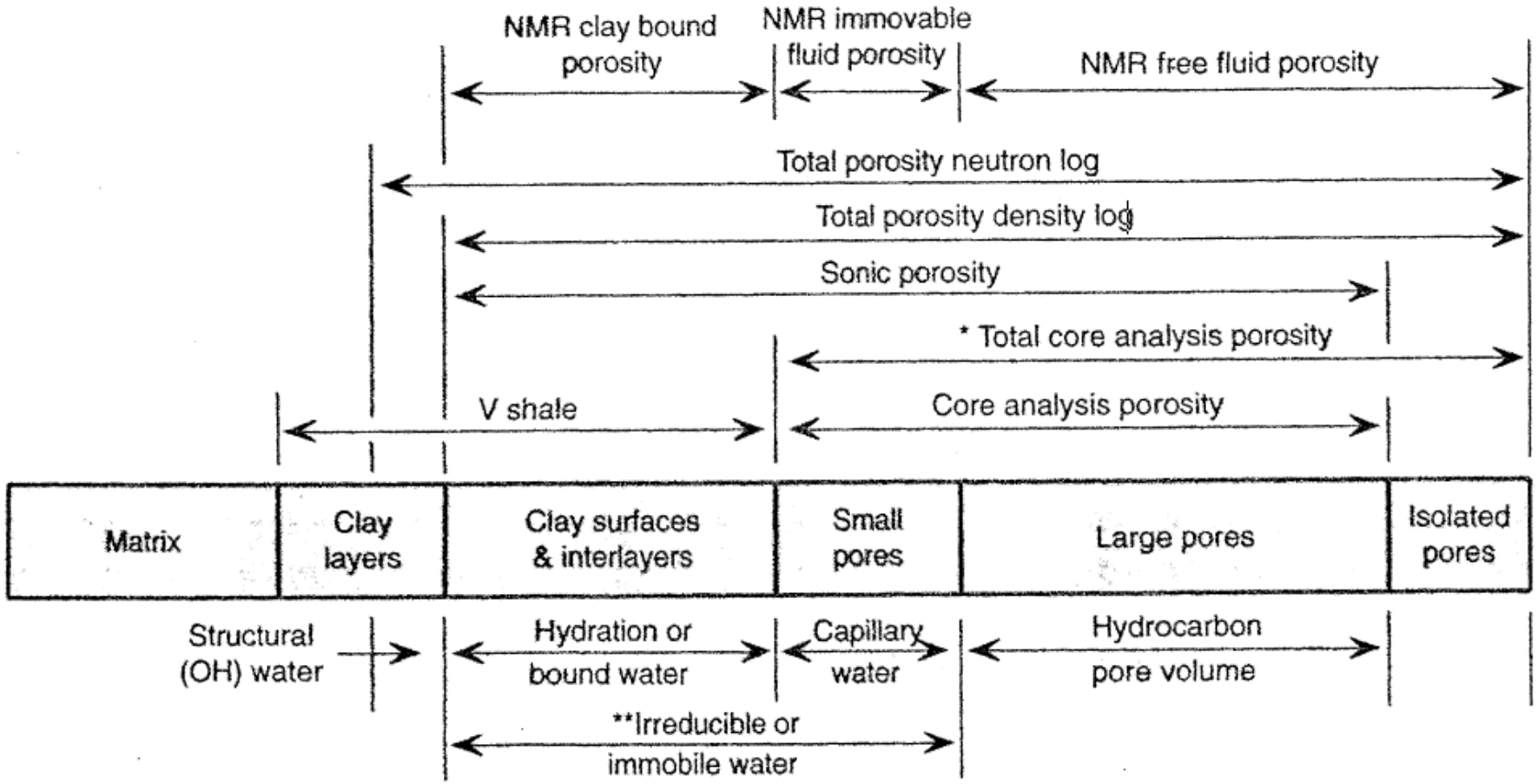
- Extraction techniques make use of devices based on Boyle's law. The most commonly used fluids are gases that have negligible adsorption on rock surfaces, like nitrogen or helium. The samples must be cleaned and dried before the measurements bat can normally be utilized for further analyses. These techniques have been in use for over 40 years now, and they are still probably the most widespread. They usually provide very reliable results and can be applied in measurement at reservoir conditions.

Log Porosity

- The most common procedure to evaluate the porosity of a reservoir is through tog interpretation, since the data required are normally available in the majority of the wells.

- Nowadays, a number of logging tools are available that can provide an (indirect) estimate of porosity, through the measurers of some physical properties of the reservoir rock. They normally work in an open hole environment, but some tools can also be run in cased holes

Integrating Core and Log Porosity



* If sample is completely disaggregated during measurement.

** Varies as a function of height above the free water level.

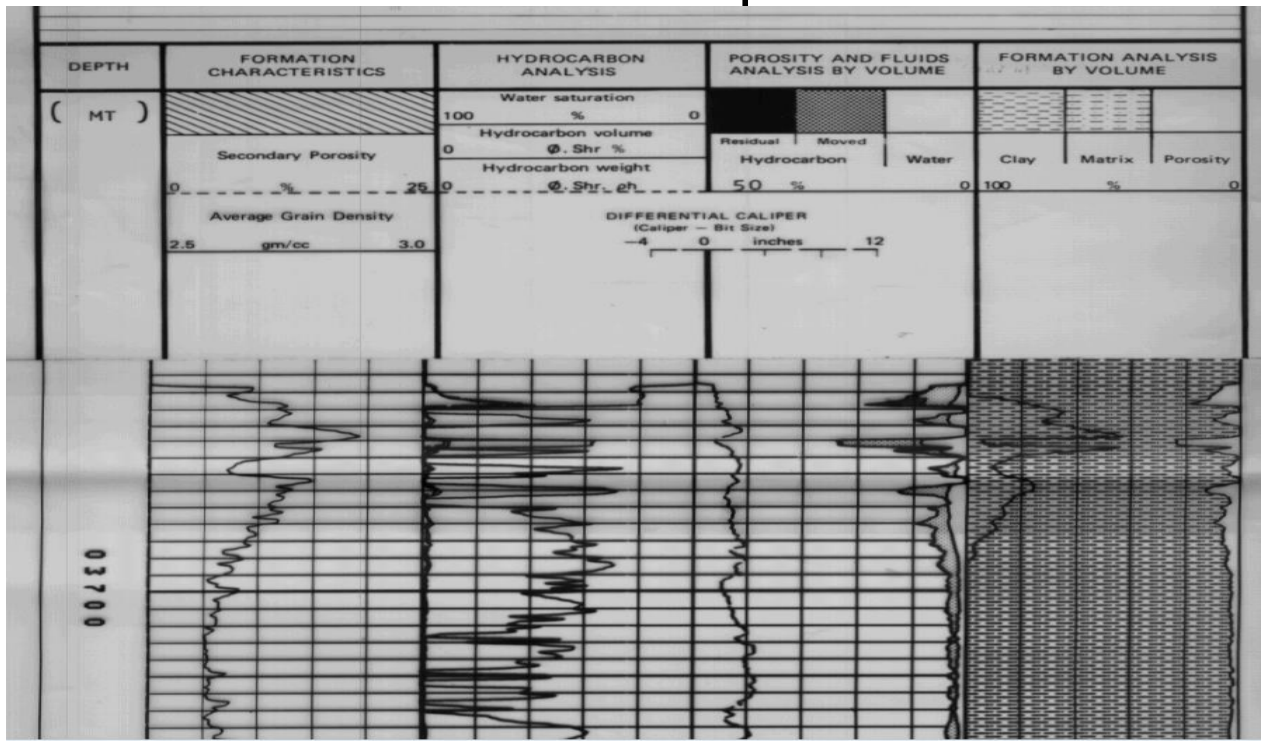
Figure 4.9 Standard rock porosity model for a shaly sandstone.

Model Design Workflow:

- 1.Read and transfer the porosity values from the CPI (figure.1), by Didger software.

- 2.Copy the porosity values from routine core lab analysis report

Data Given Vs. Output: Part I: CPI logs +Lab test to Porosity values



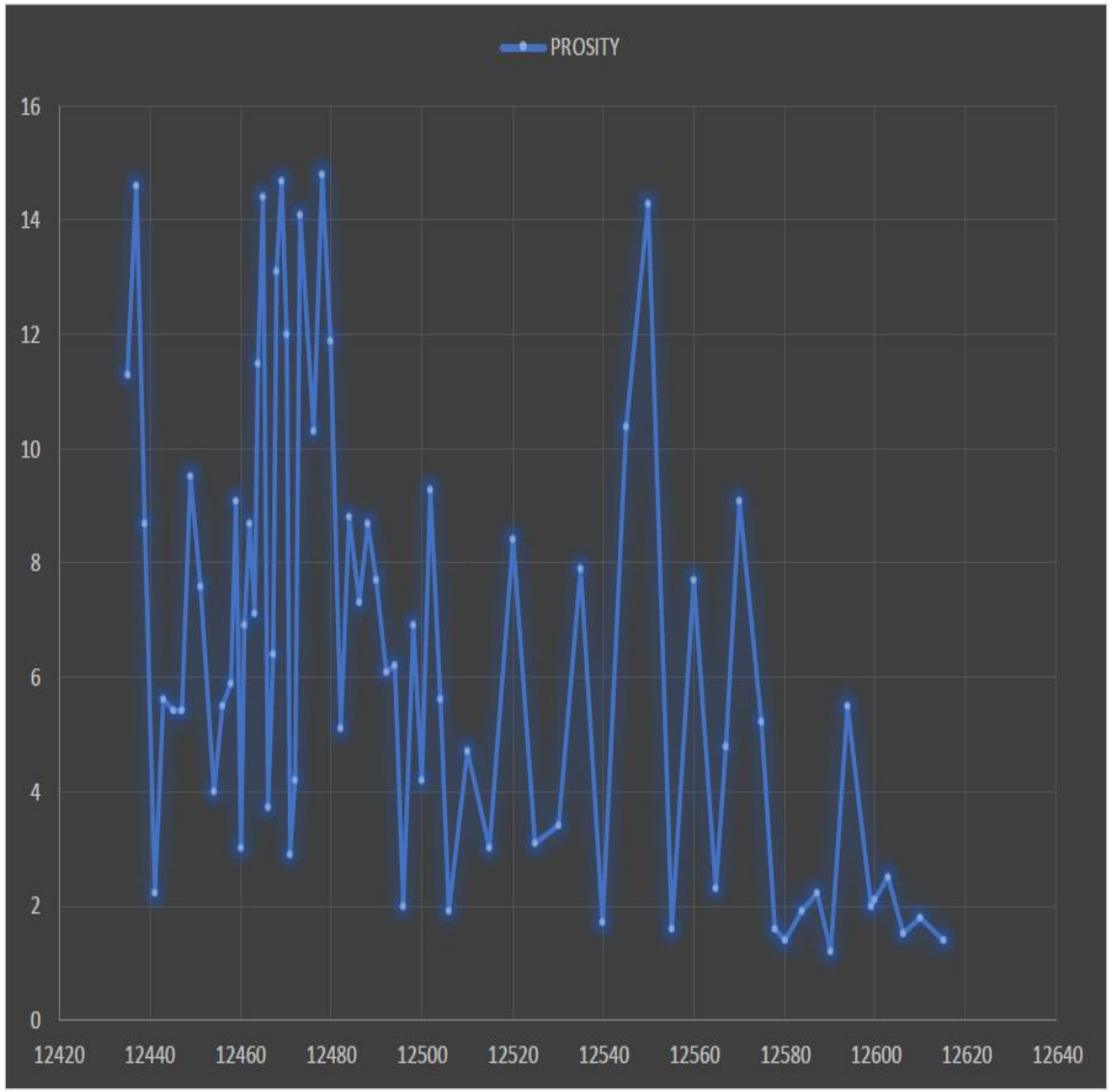
Shape

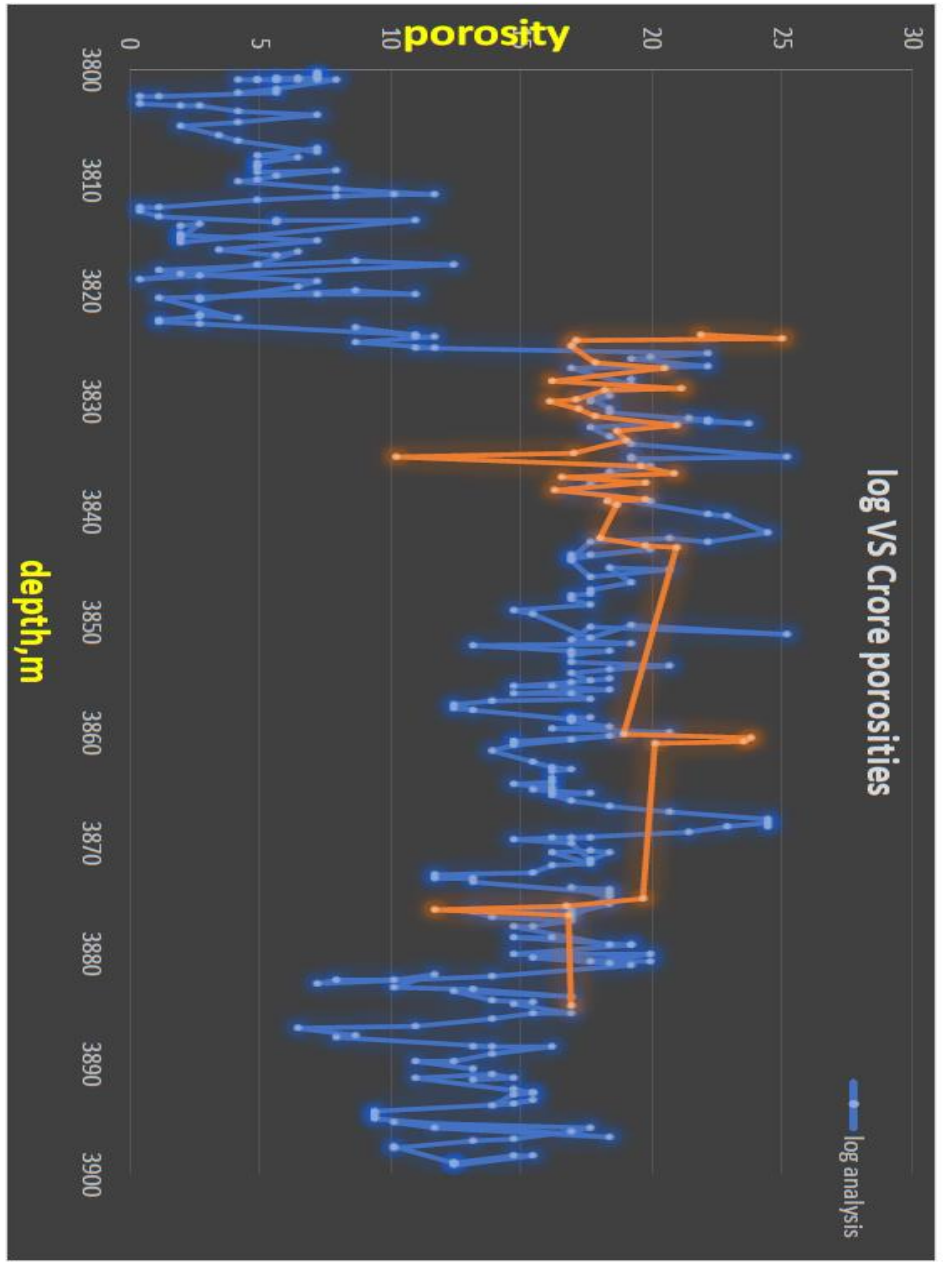
Digitizing

BU-2				
LOG DATA			CORE DATA	
D	ø		D	ø
12340.55	4.132883		12595	2
12340.55	4.017168		12596	3.3
12340.55	4.364314		12597	2.6
12354.71	5.753203		12598	3.2
12356.99	5.984634		12599	2.2

Numbers

You Need to Show me the Results in your Report in such Way





Using Petrel to Construct the 3D Structural Map with Porosity Property

- Using the following Youtube link