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Microstructure Analyze of Carbonate Reservoir Rock at Parigi Formation (Area Palimanan-Cirebon)

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Abstract

Limestone reservoir rock or carbonate rock is one of sedimentary rock which comprise calcite ($CaCO_3$), dolomite ($CaMg(CO_3)_2$) and aragonite mineral. This carbonate rock becomes very important in carbonate reservoir because more than 50% oil reservoir and gas in the world are carbonate reservoir. But its challenge is irregularity and complexity of pore structures as well as frame which can be altered.

In diagenetic process, physical parameter of carbonate rock especially permeability is depend on pore structures and frame's mineral. Furthermore, porosity of carbonate is very dependent to the depositional condition and diagenetic process. This diagenetic affects to pore's condition, such as filling pore mechanism with the carbonate cements and dissolve of matrix. Therefore, diagenetic process may cause the porosity of carbonate rock can have two possibilities porosity type: primary porosity (matrix porosity) and secondary porosity which formed from diagenetic process.

In this paper, we would like to present various type microstructure in carbonate rock, especially from Palimanan Cirebon in Parigi Formation. Various analysis will be present, to image the pore structure condition as well as the effect of carbonate diagenetic to the pore structure, from 0,1 mm scale using thin slice to nano to micro scale using SEM (Scanning Electron Microscope). This study is very useful for fluid flow modeling and also for elastic wave propagation analysis in irregular media.

Keywords : *Carbonate rock, Porosity, Microstructure, thin slice.*

I. Introduction

Carbonates are strange rocks to most exploration geophysicists although they hold more than half of the world's petroleum reserves. Geophysical applications in carbonate reservoirs, however, are less mature and abundant than those associated with clastic reservoir. Carbonate reservoirs are notoriously more difficult to characterize than siliciclastic reservoirs. Compared to siliciclastic reservoirs, carbonate reservoirs offer unique geophysical challenges with respect to reservoir characterization. These include: (1) tight rock fabric resulting in problematic and not widely accepted rock physics models; (2) greater heterogeneity due to rapid vertical and lateral facies variation; (3) lower seismic resolution due to higher velocities; and (4) physical and chemical alterations causing fracturing and diagenesis.

In this paper, we analyzed the seismic rock physics of Parigi carbonate in West Java. The samples was collected in Palimanan, Cirebon, West Java, near carbonate mining of cement industry.



Figure 1. Parigi carbonate in Palimanan, Cirebon

These carbonates samples are believed as hydrocarbon reservoir's rock due to the existence of oil seeps surrounding the collected sample's area. Carbonates samples are predicted as reef carbonate and it is dominated by calcite mineral. The dominant porosity is vuggy porosity and mixed by intercrystaline porosity of dolomite.

II. Theory

Pore systems and petrophysical properties of carbonates are more complex than clastics due to significant differences in composition, deposition and effects of diagenesis. Carbonate sediments suffer

major compaction, dissolution, precipitation and cementation during diagenesis; modifying the geometry of the pore space and mineralogy. This results in a complex relationship between diagenesis, pore type, porosity and elastic properties; making impossible to establish porosity-permeability relations and model seismic response from petrophysical properties without taking into account the effect of microstructure.

Velocity of carbonates is mainly controlled by porosity and pore types [1],[2]. Measurement properties are porosity, permeability, and pore type have be done [3], [4], [5],[6]. Rock's elastic modulus are influenced by three factors are pore fluid, rock frame, and pore space. Addition by sedimentation area and diagenetic history. Sementation process and solubility (increase porosity) can change mineral compounded and frame texture, grain contact, and pore space [8].

In consequence, in analysing this microstructure some gaugings and analysis must be done:

- Analysis Thin Slice
- Digital microscope

III. Methodology

The main objectives addressed in this study are 1) to identify, classify and study the effects of microstructure, and 2) to analyze petrography.

To figure 2, there is a big carbonate sample which collected in location area.



Figure 2. Carbonate rock before thin slice process

And we have get a little sample with cutting this sample. And then, this sample is patched in preparat sample like figure 3.

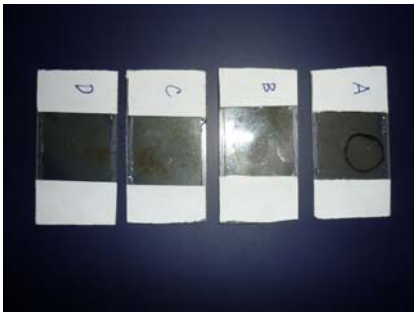
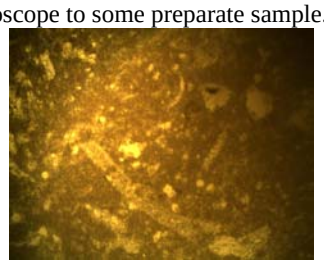


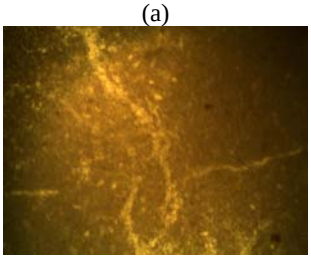
Figure 3. Preparate sample

IV. Measurement Result

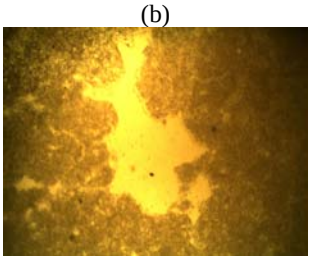
To see pore fluid is applied by thin slice and digital microscope to some preparate sample.



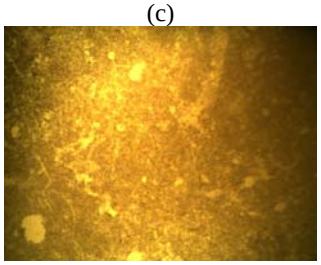
(a)



(b)



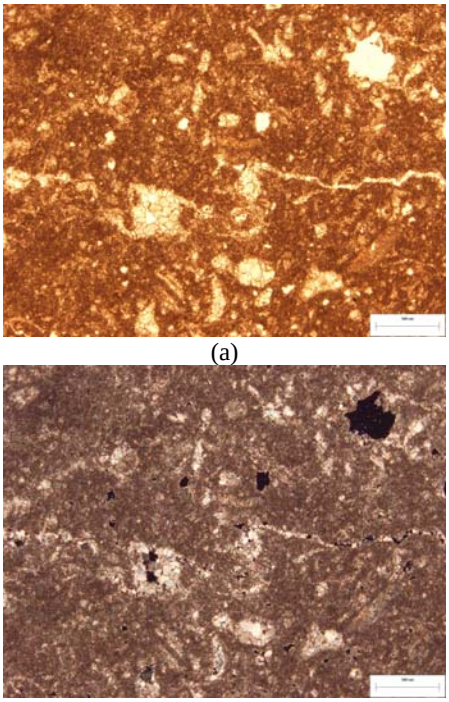
(c)



(d)

Figure 4. Image of result from preparate sample using digital microscope (A, B, C, and D)

With using thin slice, the result obtained is like the one shown to drawing following:



(a) (b)

Figure 5. Photomicro from thin slice with (a) parallel-nicols (b) cross-nicols

From figure 5, type carbonate rocks is bioclastic wackestone with carbonate sludge 45% (matrix), bioclastic 18% and intraclastic 2% (grain), orthosparite 3% (cement), microsparite 28% and pseudosparite 3% (neomorphism), and vug 1% (porosity).

V. Conclusions

Component from carbonate rock with type bioclastic wackestone very dominant by carbonate sludge matrix 45%, with massive structure, fragmental bioclastic texture, opened and supported sludge; grain size 0,05-1,4 mm, and floating grain contact.

Pore system is vuggy with 1 % affected solubility. Diagenetic character is substituted matrix and fosil, cementation what started by crack.

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