Gas in place of reservoir X uses dynamic data and geology data in ND structure, South Sumatera

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Abstract. ND Field is a mature field, whose production has decreased. This field has considerable hydrocarbon potential. With such a large potential, it is possible that in reservoir X which is in the Telisa Formation there is still the potential for hydrocarbons in the un-drainage area outside the area of the producing wells. The reservoir X compartmentalization analysis is carried out using the fault seal analysis method, mapping the reservoir X property combined with the analysis of pressure data between compartments. Reservoir X, production and pressure data are used to analyse the amount of connected gas in place (CGIP) using the P/Z method. Reservoir X connectivity is divided into 4 compartments. CGIP volume analysis using the P/Z method shows CGIP compartment 1 of 1400 MMSCF and for compartment 2 of 350 MMSCF, whereas with volumetric it is found that compartment 3 in place is 261.4 MMSCF and compartment 4 is 413.9 MMSCF.

1. Introduction
The ND Structure is located in the South Sumatra Basin, which is located in the ND Block. The ND Structure is located in the South Sumatra Basin, South Sumatra Province. This Structure is the southern part of the South Sumatra Basin onshore. The ND structure is on the eastern flank of Palembang's regional height. During the Plio-Pleistocene period, compression tectonics formed faults northeast and northwest, forming a catch structure of the type that is fault dependent closure. The reservoir X is a part of stratigraphic interval Telisa Sandstone Formation of Middle Miocene - Late Miocene which was deposited during regional transgression with the depositional environment is shallow-open marine. Telisa sandstone is fine-grained, calcareous, highly argillaceous and glauconitic.

2. Methodology
This workflow was developed in order to save time and be more effective. This workflow combines dynamic data analysis and sequences from production history, and P/Z analysis for pressure reduction modeling, and all of them are integrated in a static model. This static model then becomes a reference tool in the framework of collaborative geology and reservoirs [1].
3. Results and discussion

3.1. PVT analysis and physical properties of reservoir fluids

The first analysis is to find out the type of reservoir X fluid using gas composition data and reservoir P&T [2]. The data is entered into the PVT software and by using the equations of the approach of Peng Robinson obtained a picture of the form of a phase envelope of fluid reservoir X (Figure 2). From the phase envelope image it can be seen that the cricondentherm (69°F) temperature value is smaller than the reservoir temperature value (135°F), so it can be concluded that the fluid sample from reservoir x from the ND-1A well is a type of dry gas.
In addition, calculations to find the value of compressibility factor (Z) and Gas Formation Volume Factor (Bg) using the pressure correlation equation from the results of Medco's internal data analysis. Gas Formation Volume Factor (Bg) can be determined using the pressure correlation equation from the results of Medco's internal data analysis.

3.2. Compartment analysis with fault seal analysis, reservoir data and geological subsurface data

The lithology composition of reservoir X is based on interpretation of drilling mud log data consisting of sand and clay components. Based on the Shale Gouge Ratio (SGR) method [3], the composition of the two materials if there is a fracture will form a byproduct that is the fault gouge zone. In addition, if the gouge zone is formed intensively, it will form the phyllosilicate component (clay). This phyllosilicate material will form a zone with low permeability and zones become disconnected from each other (sealing). The SGR value calculation is divided into 3 (three) parts according to the fracture to see the characteristics of each of the fractures based on Talisa’s top sand reservoir structure map. SGR calculation of 3 (three) faults performed using well log data around the fault, obtained SGR value of 3 (three) faults greater than 15% so that it can be stated that each of the fault zones is a fluid sealing zone (sealing fault).
Table 1. Calculation of Shale Gouge Ratio (SGR) reservoir X.

| Well               | VSH | Thickness (Z) | Throw | SGR |
|--------------------|-----|---------------|-------|-----|
| ND-4 and ND-31     | 0.4 | -1672.1 ft    | 110.7 | 16% |
|                    |     | -1717.3 ft    |       |     |
| (South Fault)      |     |               |       |     |
| ND-1A and ND-22    | 0.52| -1686.2       | 29.7  | 78% |
| (North Fault)      |     | -1730.7       |       |     |
| ND-1A and ND-33    | 0.52| -1672.1       | 43.8  | 54% |
| (Middle Fault)     |     | -1717.3       |       |     |

From the reservoir X data pressure that has been datum at a certain depth. From the graph between the reservoir pressure X with the time shown in Figure 4, there are differences in reservoir pressure trends between ND-1A and ND-33. This illustrates that there are compartments in reservoir X. Therefore, it can be concluded that the reservoir X zone is compartmentalized between around the ND-1A and ND-33 areas (Middle Fault).

![Data History Pressure](image)

**Figure 4.** Comparison of history of reservoir pressure X between pressure in well ND-33 (B) and pressure in well ND-1A (A).

Compartment conditions of a reservoir can also be caused by the presence of a property barrier, so this study also analyzes the subsurface geology to see the possibility of a compartment due to properties. The geological subsurface map (VSH, porosity and permeability) shows that there is a property barrier between the western and eastern areas which is shown with a property value that is smaller than its surroundings.
Based on the analysis of the property map from the subsurface and the SGR analysis above, reservoir X has compartmentalization due to sealing faults and different reservoir properties (property barrier). The division of compartments based on these two things, reservoir X is divided into 4 (four) compartments as in Figure 6.

**Figure 5.** Geological Subsurface Reservoir Map X. A), B), Comparison of Porosity Maps and Volume of Shale Maps. C), D), Comparison of Porosity Maps and Permeability Maps.

**Figure 6.** Reservoir X Compartment from a Combination of Structural Maps and Permeability Maps.
3.3. In place Calculations (CGIP) and compartment reserves

Estimation of how much reserves and estimated recovery factor values of reservoir X in the ND field. Generally the calculation of the amount of in place, reserves, and recovery factors uses volumetric methods, material balance [4,5], and reservoir simulation.

Calculation of in place in compartment 1 is done by analyzing the P/Z curve of material balance method which is made using production history data and pressure from the ND-1A Well, from the analysis of P / Z curve, it is found that the hydrocarbon in place value of compartment 1 is 1400 MMSCF (Figure 7).

![Figure 7. P/Z material balance from compartment 1.](image1)

Calculation of in place in compartment 2 is done by analyzing the P / Z curve of material balance method which is made using production history data and pressure from the ND-33 Well, from the analysis of the P / Z curve obtained in place hydrocarbon value from compartment 2 is 350 MMSCF (Figure 8).

![Figure 8. P/Z Material balance of compartment 2.](image2)
The result of in place calculation in compartment 3 using the volumetric formula is 261.4 MMSCF. Then, for the calculation results in place in compartment 4 using the volumetric formula is 413.9 MMSCF.

| Compartment 3 | In place Tank (MMSCF) | 261.4 |
|---------------|------------------------|-------|
| Compartment 4 | In place Tank (MMSCF)  | 413.9 |

4. Conclusion

- Reservoir connectivity is separated by faults and property barriers in ND Field, so that reservoir x is divided into 4 (four) compartments.
- Compartment 1 based on the P / Z (material balance) method analysis, the in place volume is 1400 MMSCF and EUR 1284.94 MMSCF.
- Compartment 2 based on the P / Z (material balance) method analysis, in place volume values obtained values of 350 MMSCF and EUR of 293.4 MMSCF.
- Compartment 3 based on volumetric analysis, in place volume values obtained value of 261.4 MMSCF.
- Compartment 4 based on volumetric analysis, in place volume obtained value obtained value of 413.9 MMSCF.

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