Acknowledging Structural Uncertainty of Gumai Sand Reservoir by Time-Depth Equation of 3D Velocity Modeling for Further Field Development in Tempino Structure, Jambi

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Abstract. Tempino structure is one of oil and gas structure in Jambi Field. Air Benakat Formation (ABF) have been known as main productive reservoirs. Presently, Gumai Formation (GUF) is main target of development since the latest drilling well showed a fascinating hydrocarbon potential. This managing structural uncertainty review is based on 3D seismic data, standard electrical log, vertical seismic profile, and mud log data.
Reservoir evaluation is often conducted in deterministic method thus the uncertainty of associated parameters is still unquantified. Previous subsurface evaluation of Tempino structure was also done in deterministic method, resulting single output of each interpretation then recognized that the new drilling T-204 well had indicating Gumai sand reservoir is 19 meters shallower than estimated. A prompt subsurface modelling then conducted considering parameters possibly causing uncertainty.
3D velocity model method is believed to be a main factor in producing 19 meters discrepancy of the latest drilling well result. Vertical seismic profile data is also informing difference velocity in near Gumai sand reservoir level. Latest 3D velocity model is conducted in two version, which are: constant velocity and time-depth equation. All velocity models being assessed by the residual map or the differences between well markers and the converted surfaces across the wells.
The constant velocity model is selected based on its smallest residuals value. This updated velocity model has been made consistent with static model of Gumai sand reservoir, concerning all possibly uncertainty of time to depth conversion parameters. In 2022, 4 wells will be drilled in Tempino about to confirm reliability of the selected velocity model, yet marker adjustment of new well data would be updated to reinforce the depth structure map.

Keywords: 3D velocity model, residual, Gumai sand, Tempino.

1. Introduction

Tempino structure is one of oil and gas structure in Jambi Field. Air Benakat Formation (ABF) have been known as main productive reservoirs. Presently, Gumai Formation (GUF) is main target of development since the latest drilling well showed a fascinating hydrocarbon potential. This managing structural uncertainty review is based on 3D seismic data, standard electrical log, vertical seismic profile, and mud log data.
The availability of 3D seismic data is advantageous in the development of the field since it reduces the possibility of errors in velocity analysis. In drilling development wells, velocity modeling or velocity analysis is critical in determining the target zone of the layer or formation depth that you want to penetrate. Depth conversion is a technique used to remove the structural uncertainty inherent in time and confirms the structure in depth, presenting it in a more relevant geological sense. Studies on engineering reservoirs and geology are always in-depth, allowing interpreters to combine seismic depth with geologic, petrophysical, and production data (Tieman, 1994). The Direct Time Depth Conversion Method and the Velocity Modeling Method are two major categories that can be used to divide depth conversion techniques. When applied properly, both techniques will successfully forecast depth and accurately tie existing wells.

A time horizon is translated to depth directly in a direct time-depth conversion, regardless of the structure of the velocity variation; hence, depth computed via the direct time-depth conversion method can only be examined by calculating the prediction error at known well location (1-Dimensional), but this is a potentially unreliable quality check (QC) method because the depths being predicted are the depths used to create the prediction equation (Schultz, 1999) but by the understanding of it can give us a method to reduce the uncertainty by controlling the residual of this method.

2. Data and Methodology

The first stage in time-depth conversion is to align seismic data and wireline log data from wells to the precise marker for each horizon or formation. After that, standardize the reflector in each line in both 2D and 3D seismic data using a line from a 2D seismic survey as a reference. However, we used well-seismic tie from previous process to select the appropriate reflector for each formation and produce seismic interpretation in time domain before converting to depth domain. All seismic interpretation results horizons are currently in time domain and need to be changed to depth domain.

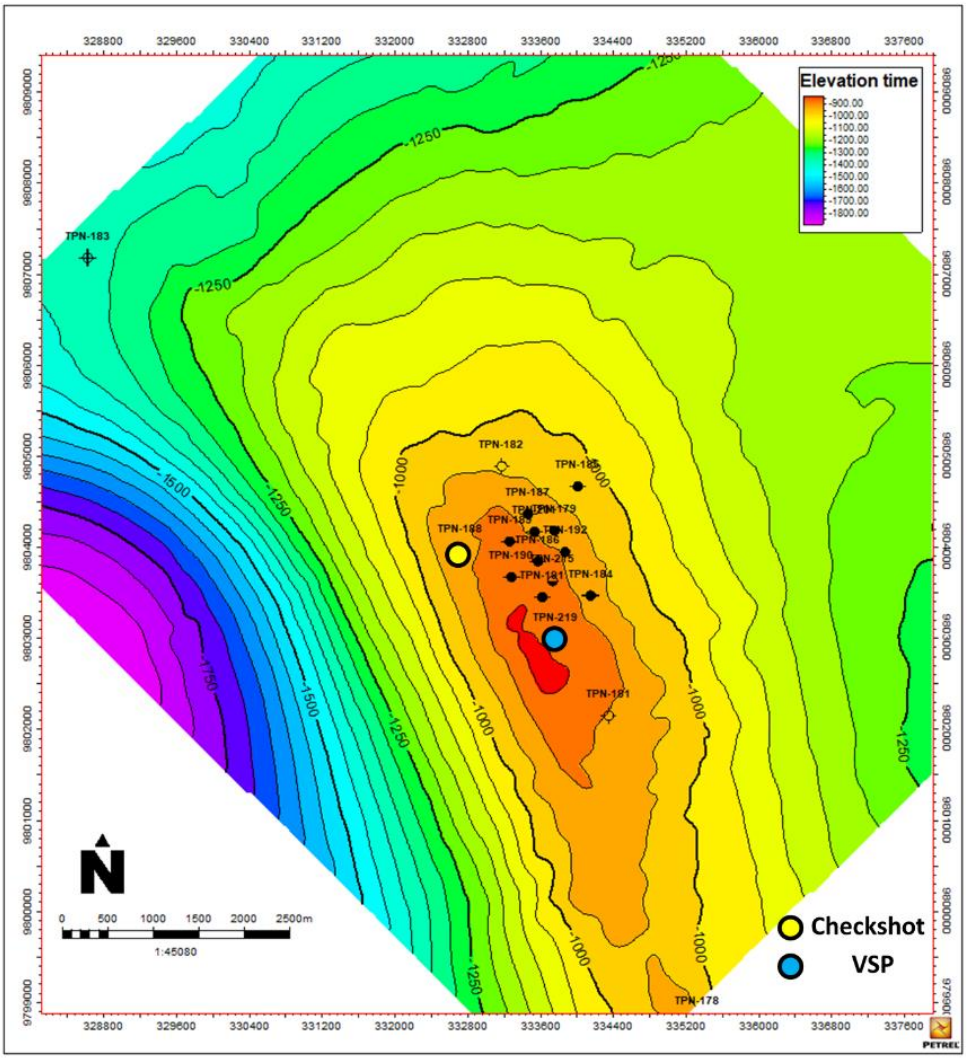

Figure 1. Data Availability

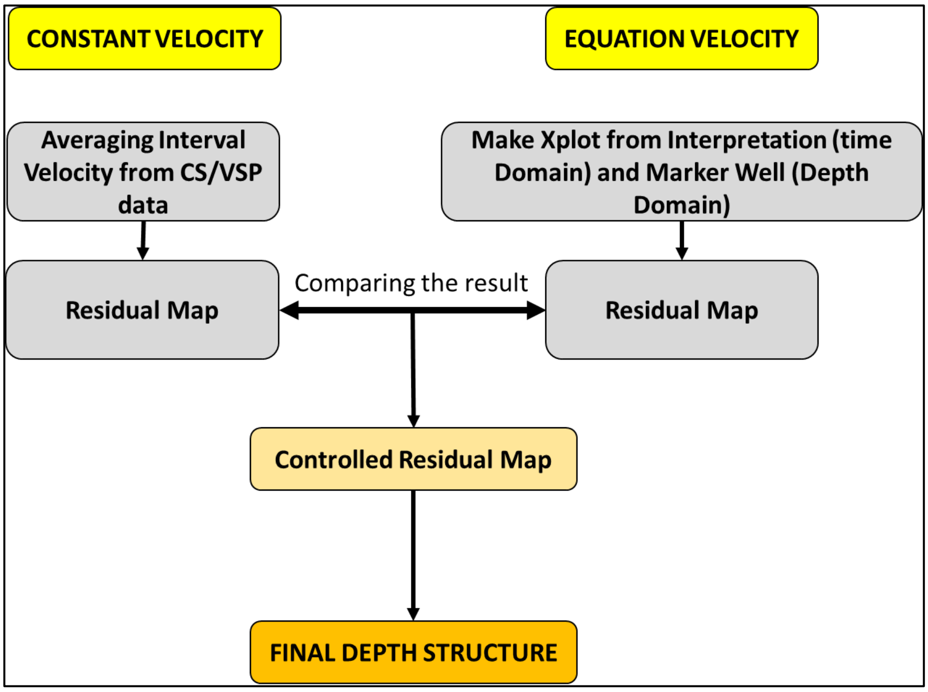

Figure 2. Workflow of the velocity model to build depth structure map.

In this study, two methodologies will be used: constant velocity value and equation based velocity. The first approach, "Constant Velocity" uses the average value of all available check shot and VSP data in each layer. The second method "Time-Depth Equation" involves creating a cross plot between time and depth in all existing wells and then deriving a linear equation from the cross plot.
The next step is to create a residual map of the two approaches to see which one produces the best results. Following improved findings, the next step is to regulate the distribution of the residual map by only spreading it across a relatively large number of wells, so that the final depth structure provides a more reliable picture for use in the following stage.

3. Results and Discussion

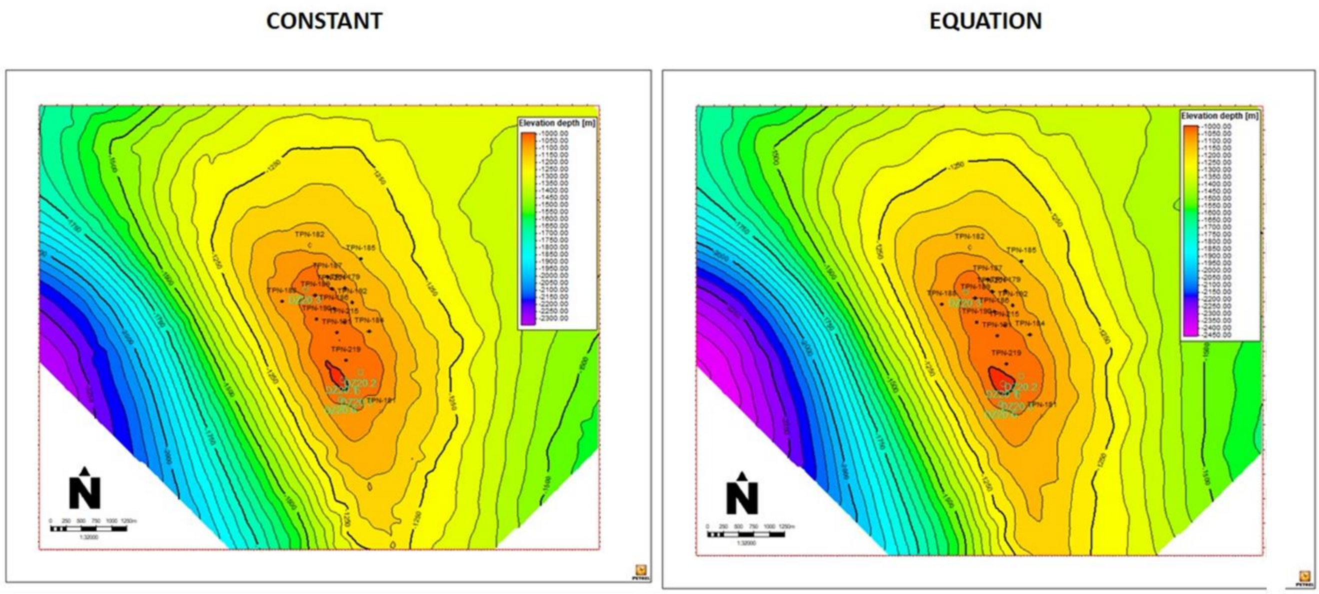

Figure 1. Top GUF Depth Structure Map made using constant and equation method (not adjusted).

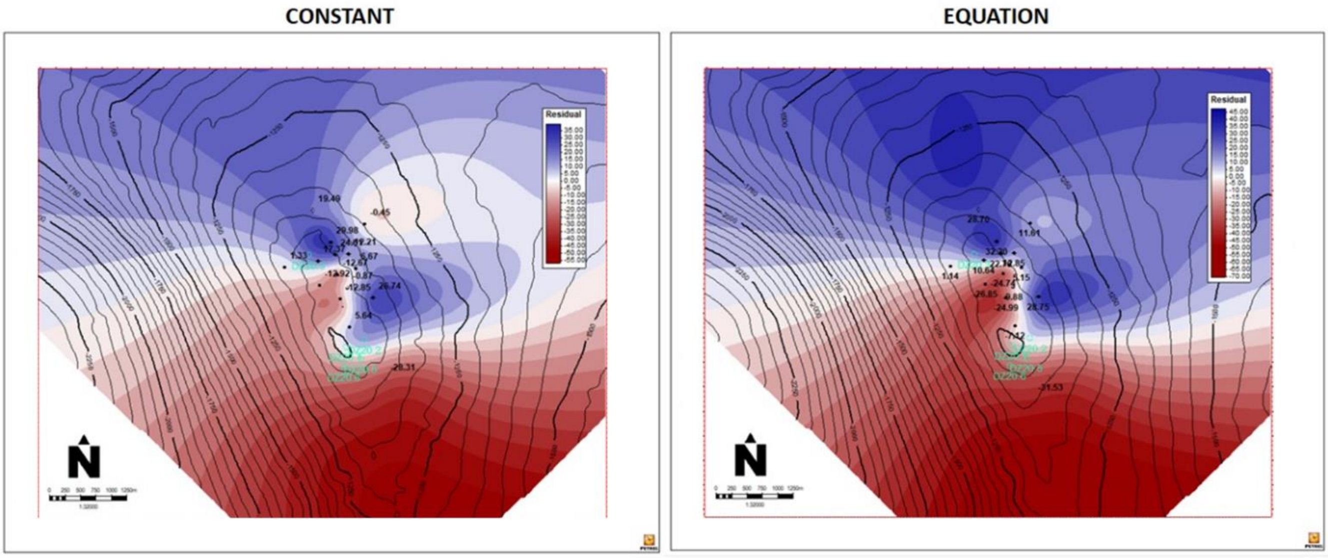

Figure 2. Residual map resulted from constant and equation method.

The initial phase in this research is to create a map of the time structure using both methods, followed by a map of the residuals. The next step is to compare the residual map results obtained by the two approaches and determine which is superior.

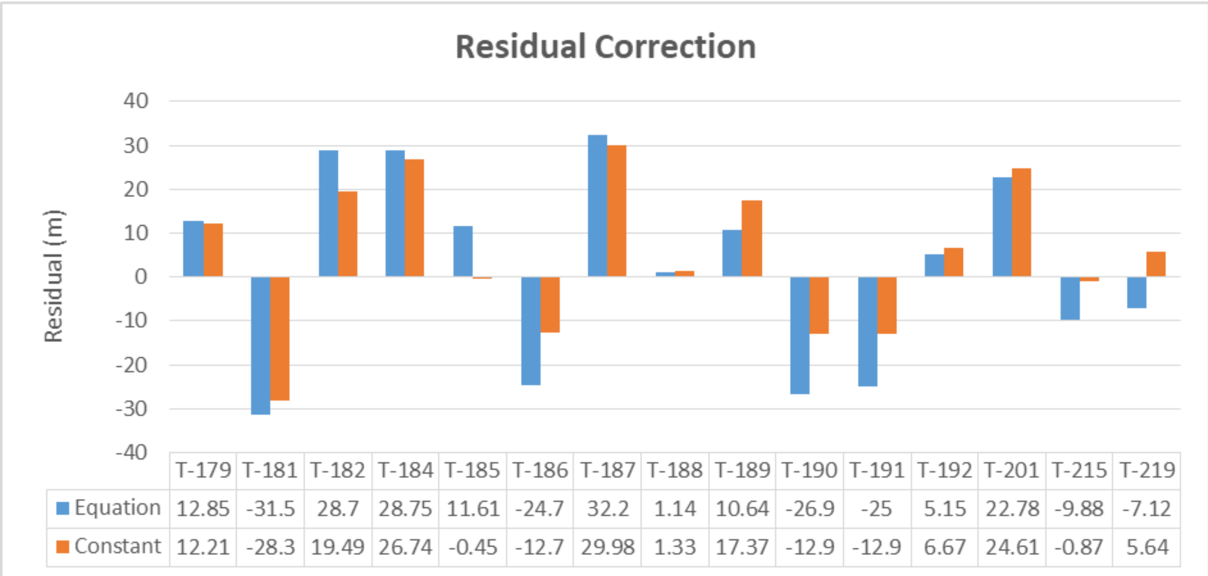

Figure 5. Bar graph Comparison of residuals using equation and the constant velocity method.

Based on the distribution of the residual map (Figure 4) and the bar chart (Figure 5), it can be demonstrated in this study that utilizing a constant value produces a superior output velocity node than using the Time-Depth Equation.

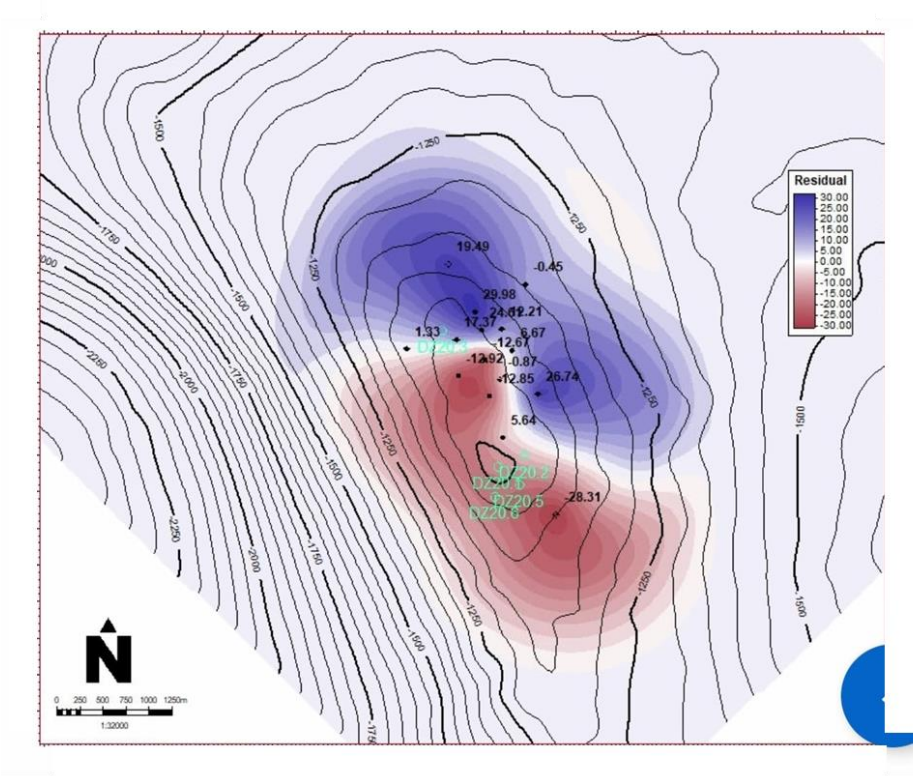

Figure 6. Controlled Residual Map from Constant Method.

After establishing which is superior, the residual map maker is controlled by spreading the residual value exclusively in the area surrounding the well to avoid overextrapolation. In order to generate a regulated residual map distribution in the well area only, the kriging approach is applied.

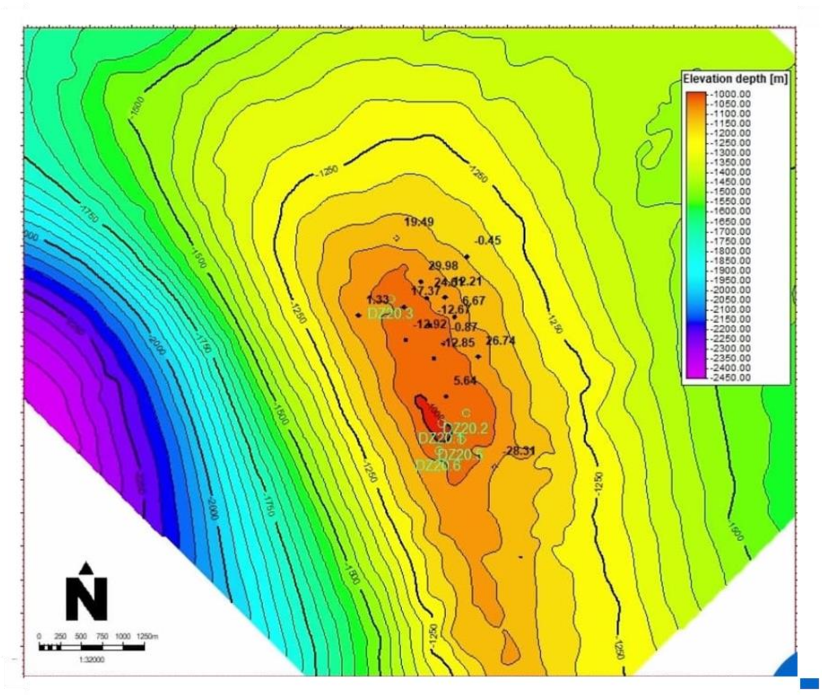

Figure 7. Final Depth Structure of TOP GUF using Constant Velocity Method and adjusted using controlled Residual Map.

The final stage is to combine a depth structure map that has not yet been connected to well data with a controlled residual map to create a depth structure map that has already been bound to wells.

4. Conclusions

Based on our study, we can summarize constant velocity model is selected based on its smallest residuals value. This updated velocity model has been made consistent with static model of Gumai sand reservoir, concerning all possibly uncertainty of time to depth conversion parameters. In 2022, 4 wells will be drilled in Tempino about to confirm reliability of the selected velocity model, yet marker adjustment of new well data would be updated to reinforce the depth structure map.

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