

# **Seismic Attributes (Entropy and Instantaneous Frequency) and Well Data Integration to Fracture Detection Using 3-D Land Data in Miocene Carbonate of Tugu Field-Indonesia**

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The Miocene Carbonate of eq. Baturaja in Tugu field has been producing oil and gas from reef limestone reservoir with 150 m thickness. The body of reef is aligned NE-SW where several NE-SW and E-W normal faults occurred on it. A producing interval exists on the upper part of the reservoir where its porosity is developed by vugs and fractures. This reservoir was stated as oil and gas reservoir, where 45 m of the upper part is gas zone and 15 m below it, is an oil rim. The existence of fractures in reservoir was detected by logs, drilling data and production behaviors. By using seismic attributes, distribution of fractures and vugs has been intensely studied. A major aspect of this study is to compare the different seismic attributes and different analysis techniques on a common dataset for fracture detection. Our aim is to understand the merit of these different techniques, and to establish some basic guidelines for fracture detection using land 3-D attribute entropy and attribute instantaneous frequency seismic data.

One of our main findings is that during data analysis one should avoid the commonly-used narrow-azimuthal stacking technique, which may enhance the acquisition footprint. Instead, surface-fitting across all azimuths and offsets is recommended. Furthermore, in this dataset, the amplitude is not very reliable, and the final fracture orientation and intensity maps estimated from the instantaneous frequency and entropy attributes compare reasonably well with the fault and fracture patterns in the area.