LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : JURNAL ILMIAH

Judul Jurnal Ilmiah (Artikel)	:	Shale Gas Potential In Jambi Sub-Basin, Indonesia: Insights From Geochemical and Geomechanical Studies		
Jumlah Penulis	:	5 orang (**Reddy Setyawan,** Edy Ariyono Subroto, Benyamin Sapiie, Randy Condronegoro, Beiruny Syam)		
Status Pengusul	:	penulis ke-1		
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   Kebutuhan data untuk analisis sudah sesuai standar minimal yang dibutuhkan untuk analisis tersebut. Metode yang digunakan sudah sesuai standar untuk dapat menjawab tujuan penelitian. Data yang dibutuhkan untuk analisis geomekanika masih belum mencukupi, tetapi dapat dipenuhi dengan metode analisis tambahan untuk memenuhi kekurangan data.

4. **Kelengkapan unsur dan kualitas terbitan:**

Link sudah dapat diakses. Kualitas telah sesuai dengan kategori Sinta 2.

Semarang, 22 Juli 2022
Reviewer 1

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   Isi makalah sudah lengkap, meliputi abstrak, pendahuluan, dasar teori, metode, hasil dan pembahasan, kesimpulan dan daftar pustaka. Hasil penelitian sudah menjelaskan tentang level kematangan source rock, sifat mekanik shale dan kualitas source rock dari hidrokarbon di Sub Basin Jambi, Sumatra Selatan.

2. **Ruang lingkup dan kedalaman pembahasan:**

   Pembahasan tentang level kematangan source rock, sifat mekanik shale dan kualitas source rock dari hidrokarbon di lokasi penelitian sudah baik. Akan tetapi, pembahasan bisa lebih diperdalam lagi dengan mengelaborasi hasil penelitian sebelumnya baik yang ada di lokasi penelitian atau dari lokasi lain yang temanya sejenis. Hal ini penting untuk bisa melihat persamaan atau perbedaan dengan penelitian-penelitian sebelumnya maupun bagaimana kontribusi penelitian yang sudah dihasilkan kepada pengetahuan.

3. **Kecukupan dan kemutakhiran data/informasi dan metodologi:**

   Penggunaan data seperti TOC, S1, S2, S3, Tmax, and Ro (vitrinite reflectance), XRD dan data log sumur, Swave dan Pwave sudah cukup dalam menjawab tujuan penelitian yang dilakukan.
   Dari aspek data/ informasi, data yang dikumpulkan sudah baik dan dapat untuk menjawab tujuan penelitian.

4. **Kelengkapan unsur dan kualitas terbitan:**

Link sudah lengkap dan dapat diakses. Kualitas terbitan masuk dalam kategori Sinta 2.

Semarang, 21 Juli 2022
Reviewer 2

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SERTIFIKAT

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RESEARCH ARTICLE

Shale Gas Potential In Jambi Sub-Basin, Indonesia: Insights From Geochemical And Geomechanical Studies

Reddy Setyawan[1], Edy Ariyono Subroto[2], Benyamin Sapiie[2], Randy Condronegoro[3], Beiruny Syam[3]

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Abstract

Jambi sub-basin, which is located in South Sumatra, Indonesia has enormous potential of shale gas play. Yet, detailed geological studies are rarely undertaken to understand this relatively new hydrocarbon play concept. This paper presents a combination of geochemical and geomechanical studies with the aim to better understand: (1) the maturity level of source rock; (2) the mechanical properties of shale; and (3) the quality of hydrocarbon source rock. This research began with determination of wells that penetrate the Talangakar and Gumai Formations that have shale in it. Source rock analysis was done by using TOC (total organic carbon), S1, S2, S3, Tmax, and Ro (vitrinite reflectance) data. Geomechanical evaluation was done by using XRD and well logs data. Brittleness index was obtained by using Jarvie et al. (2007) formula, based on the XRD data. S-wave and P-wave are used to calculate the rock strength, Young's modulus and Poisson's ratio with UCS-To methods.Source rock in the Geragai belongs to the of moderate-to-good category because it has more than 0.5% TOC and potentially forms gas because it has a type III kerogen. JTBS-2 well is the only well in the Geragai area which already mature and has been able to produce hydrocarbons, because it passed the oil and gas windows. Source rock in the Betara belongs to moderate-to-good category because it has more than 0.5% TOC potentially forms gas because it has a type III kerogen. Most formations in the Betara are not yet mature based on the value of Ro and Tmax. In wells that have not reached the oil window nor gas windows, the prediction line drawn on the Petroleum Source Rock Summary chart, estimated that they would pass the gas window at Lower Talangakar Formation or Lahat Formation at depth of more than 8000 feet. The results of XRD analysis showed that the Betara had a high brittleness index with an average of 0.809. Talangakar Formation has a higher rock strength values than Gumai Formation, both in Betara high and Geragai deep. The principle that say the rocks which have high TOC values will have a high value of BI can be proven in the study area, the rocks that have high Ro will have a high value of BI, cannot be identified in the study area. With sufficient high value of rock strength and low abundance of clay minerals, the rocks at Talangakar Formation is good for hydraulic stimulation.

Keywords: Gumai Formation, Talangakar Formation, source rock, Young's modulus, Poisson's ratio, brittleness index

1. Introduction

1.1 Background

The Jambi sub-basin is part of the Tertiary sedimentation basin of South Sumatra, which is currently one of the locations for oil and gas exploration. In the Jambi Sub-basin there is a Gumai Formation which is composed of quite thick deep marine shale (Salim et.al., 1995). The opportunity for shale gas exploration requires a better understanding of the geological, geophysical and geochemical aspects to get positive results.Main object for this research are Geragai Deep and Betara Deep, which located in Jambi Sub-Basin. Those two deeps are two of four deeps in Jambi Sub-Basin (Figure 1).

Indonesia has started to develop shale gas since 2009. The potential for shale gas in Indonesia is estimated to reach 574 TCF or greater than coal methane gas (CBM) 453.3 TCF and conventional gas 153 TCF. Indonesia's shale gas reserves are located in Sumatra, Kalimantan, Java and Papua. Studies related to shale gas have been carried out in the North Sumatra Basin and the Central Sumatra Basin.

The purpose of this study is to determine the level of maturity of the Talangakar and Gumai Formations, to determine the mechanical properties of shale both of these formations, and to determine the potential of shale gas from the Talangakar and Gumai Formations.

Table 1. List of abbreviation used in this article

Abbreviation	Meaning
TOC	Total Organic Carbon
PY	Potential Yield
Ro	Vitrinite Reflectance
XRD	X-Ray Diffraction
S_1	The amount of free hydrocarbons (gas and oil) in the sample
S_2	The amount of hydrocarbons generated through thermal cracking of nonvolatile organic matter
S_3	The amount of CO2 (in milligrams CO2 per gram of rock) produced during pyrolysis of kerogen
Tmax	Maximum Temperature when S_2 was obtained
HI	Hydrogen Index
OI	Oxygen Index
Pr	Pristane
Ph	Phytane
nC_{17}	Carbon atom number 17
nC_{18}	Carbon atom number 18
LAS	Log ASCII Standard

1.2 Geological Setting and Stratigraphical Framework

1.2.1 Geology of South Sumatra Basin

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RESEARCH ARTICLE

Rock Physics Formula and RMS Stacking Velocity Calculation to Assist Acoustic Impedance Inversion that Constrain Well Data

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Abstract

This research ilustrate the generation of acoustic impedance inversion in the absence of well log using stacking velocity input in Salawati Basin, Papua, Indonesia using data obtained from seismic lines and stacking velocity section. Initial acoustic impedance models were first before the inversion process and were created by spreading the value of well log data to the all seismic CDP. The calculated acoustic impedance logs from standard sonic and density logs were used to build the initial model of acoustic impedance. First, the stacking velocities was first interpolated on a grid that has the same size as the seismic data using by means of Polynomial algorithm. This was closely followed by the conversion of the stacking velocities to interval velocities using Dix's equation. The matrix densities were estimated by simple rock physics approach i.e. Gardner's equation as a velocity function. The initial model of acoustic impedance was calculated by multiplying the densities section and interval velocities section. The resulting initial model of acoustic impedance was inverted to obtain the best of acoustic impedance section based on reflectivity.

Keywords: Acoustic Impedance, Rock Physics, Stacking Velocity, Wellog

1. Introduction

To conduct an acoustic-impedance inversion using band-limited seismic data, the elastic parameters information must be given from the other data than the seismic reflectivity estimate. Well logs are commonly used for this purpose (Lindseth, 1979); however, stacking velocities can also be used to provide the low-frequency component (Oldenburg et al, 1984).

In this paper, an attempt was made to carry out seismic inversion using interval velocity model from stacking velocity due to non-availability of well log data. We also used the Gardner's relationship to calculate the density. Thus, we get the initial model of acoustic impedance section by multiplying the interval velocity and the density that resulted from Gardner relationship. This initial model was inverted to obtain the acoustic impedance volume based on the seismic reflectivity.

2. Data and Method

2.1 Data

Salawati Basin is a foreland basin trending East–West and located in the northern part of Indo–Australia Plate (Figure 1). This basin is bounded by deformation zone of Sorong Fault in the northernand western part. In the southern part, the basin is bounded by Misool–Onin High, while the eastern boundary is the Ayamaru Plateau. Salawati Basin records the stratigraphy and tectonic histories from Paleozoic until recent (Satyana, 2003).

Generally, the stratigraphy of Salawati Basin can be divided into two parts base on age, pre-Tertiary and Tertiary (Figure 2). The oldest stratigraphic sequence in Salawati Basin is metamorphosed continental bedrock of Kemum Formation with age of Silurian–Devonian. Mesozoic sediments (Tipuma and Kembelangan Group) were deposited only in the south because of uplifting or non-deposition in the nort (Satyana, 2003). There are three exploration wells in the western part of Salawati Island which that penetrated to Cretaceous granitic rocks intruding Paleozoic metamorphics (Situmeang, 2012).

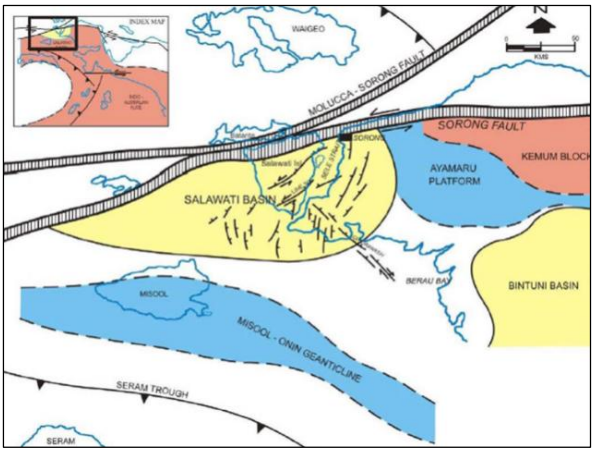

Fig1. Geologic setting of Salawati Basin south of Sorong Fault. Sorong Fault major control for geologic configuration of the basin (Satyana, 2003).

2.2 Method

Stacking velocities are generated during the processing of the seismic data in velocity analysis step. For this paper we used the Hussar data set as described in Lloyd and Margrave [2],[3]. The method of this study follow the steps: (1) Extract the stacking (RMS) velocity trace from stacking velocity section; (2) Make the selected stacking velocity trace as velocity log data; (3) Horizon picking and create the stacking (RMS) velocity model; (4) Convert the stacking (RMS) velocity section into interval velocity section; (5) Create the density section from interval velocity section using Gardner

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RESEARCH ARTICLE

Geophysical Survey on Open Dumping Landfill for Monitoring Spread of Leachate: A Case Study In Pekanbaru, Riau, Indonesia

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Abstract

Pekanbaru is a city in Indonesia with high population growth. The increasing amount of the population has a parallel relationship with the increasing quantity of waste disposal. This study has been conducted on an open dumping landfill at Pekanbaru that surrounded by residential areas. Waste disposal produces leachate as a threat to surface water and groundwater resources. This study aims to investigate the contamination spread formed by leachate using the geophysical method. Direct Current Resistivity (DCR) has been used to produce 2 D Resistivity subsurface Models. Data acquisition has been done using multi-electrodes (32 electrodes) with spacing 2 m between electrodes. 2D Resistivity model produced, a contaminant from leachate represented by low resistivity value 26.1 - 870 Ωm. The deepest penetration of leachate that detected is around 3 m from the surface. It has been understood that leachate from the landfill of the study area is not contaminated groundwater yet. It confirmed by groundwater analysis at residential around the landfill area. By knowing the spreading of leachate, preventive action can be made to maintain the quality of groundwater resources.

Keywords: *Contamination, Groundwater, Landfill, Leachate, Pekanbaru, Resistivity*

1. Introduction

Geo-electrical survey is a survey that looking the physical parameters which is resistivity value to differentiate subsurface material. Recently, the interest of underground sources of water is increasing rapidly to fulfill the water demand. Pekanbaru is a city that use groundwater as main source of clean water. Parallel with increasing of population in Pekanbaru, waste production also increasing.

The study area is an open dumping landfill at Marpoyan that have potential to produce leachate. As we known that open dumping landfill is a primitive way to dispose the waste without any technology to prevent the contamination through subsurface. The location of landfill become a big problem because it surrounded by residence area (Figure 1). So the aim of this study is to detect the probability of groundwater contamination from leachate leaded by open dumping landfill.

Fig 1. Study area is an open dumping landfill that.

Electrical Resistivity Imaging (ERI) is the most common and successfully used especially in groundwater exploration and environmental problem like soil or groundwater contamination (Azhar et al., 2016; Hamzah et al., 2007, 2008; Jumary et al., 2002; Saad et al., 2012; Adi Suryadi et al., 2019) .By using ERI, resistivity distribution of subsurface will be modelled into two-dimensional image. The model that resulted is showing the apparent resistivity value which can be interpreted as contaminant depend on the value (Akankpo, 2011; N. Nwankwo and O. Emujakporue, 2012; Okereke and Harcourt, 2012; Surface et al., 2011; A. Suryadi et al., 2019).

2. Methods

ABEM SAS1000 resistivity meter and ABEM Lund ES464 selector system is the equipment that used to collect the resistivity data. The survey employed 61 multi-electrodes with 5 m minimum electrode spacing. The line survey length is reach 400 m that arranged in a straight line. The selector system was connected with all electrodes through multi-core cable (Figure 2) (Hamzah et al., 2008; Loke and Barker, 1995; A. Suryadi et al., 2019). In each measurement the resistivity meter only select four electrodes to activate. Beside of that, coordinate of line survey must be recorded to correlate all the lines taken (Kausarian et al., 2018; Lubis et al., n.d.; Suryadi, 2016).

Apparent resistivity (ρa) calculated by multiple of geometry factor (k) with Voltage (V) and divided by Current (I) injected.

$$\rho a = k\, V/I \qquad (1)$$

Geometry factor (k) is depend on configuration electrode that utilized. In this study configuration used id pole-dipole (Figure 5) that k calculated with formula:

$$k = 2\pi\,(b(a+b))/a \qquad (2)$$