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ABSTRACT

Lithology of Semilir Formation consist of tufaceous sandstone, lapili tuff, sandstone, tuff, claystone, siltstone and shale. The age of Semilir Formation is Early Miocene and deposited by the mechanism of turbidite current in the deepwater environment as a deposition of gravity flow.

Based on described value of Hydrogen Index (HI) to Total Organic Carbon (TOC) shows Quality Source of Rock is poor to good; value of S2 to TOC shows source richness and quantity is good; value of Hydrogen Index (HI) to Temperature Maximum (Tmax) shows Immature; value of Hydrogen Index (HI) to Oxygen Index (OI) shows kerogen typw III (gas prone). The vitrinite reflectance mean (Ro Mean) value from 3 samples (BYTN A-2 = 0.47%, BYTN B-2 = 0.5%, and MGRI–2 = 0.64%) Semilir Formation shale are 0.47% - 0.64% all samples belong immature to mature category. Mostly organic material composition Shale hydrocarbon Semilir Formation consist of Vitrinite as precursor gas.

Keywords: *Semilir Formation, shale, Ro, immature, mature, vitrinite, gas prone.*

INTRODUCTION

Semilir formation is one of the rock formation in western region of Southern Mountains great expanse. It is well exposed at Semilir Mountain around Baturagung, consists of interbedded Tuff, lapilli tuff, tuffaceous sandstone, claystone, shale and siltstone with intercalated breccia, as a deposition of gravity flow in the deepwater environment of early Miocene - Middle Miocene. Lignite was found in the central part, which is associated with calcareous tuffaceous sandstone and calcareous fragment in volcanic breccia. Claystone and shale was found at the top, with turbidite structure and 15 – 25 cm layer thickness (Surono et al., 1992). The research location is located in Buyutan Village, Klaten, Central Java, Indonesia (Fig 1). The presence of shale in Buyutan area as source rock in Semilir Formation is interesting to investigate its hydrocarbon potential.

Fig. 1 Research area location

SAMPLING AND METHODS

Sampling with channeling method, performed directly in shales outcrop in the Buyutan area, consists of 3 layers (3 samples, samples code BYTN A-2; BYTN B-2 and MGRI-2). Shale thickness around 15 – 25 cm. Laboratory analysis conducted to determine the hydrocarbon potensial is: Petrology organic analysis using reflective and fluorescene rays, supported with geochemical analysis include TOC and Rock Eval Pyrolysis from Dispersed Organic Matter (DOM).

Fig. 2 Outcrop of sample code MGRI-2 Buyutan area.

GEOLOGICAL SETTING

Semilir formation is one of the rock formation in western region of Southern Mountains great expanse (Van Bemmelen, 1949). Java Southern Mountains Zone extends from Central Java, in the south of Yogyakarta with approximate width 55 km to East Java and 25 km to the south of Blitar (Fig. 1). This Zone is formed by two large groups of rock, volcanic rock and limestone (Surono dkk, 1992). Southern Mountains Zone bounded by Yogyakarta-Surakarta Plains to the west and north, while on the east by the Gajahmungkur Dam, Wonogiri, and in the south by the Indian Ocean. To the west, between the Southern Mountains and Yogyakarta Plain limited by Opak river stream, while in the northern part of Baturagung scarp

Based on morphological appearance, the Southern Mountain Zone can be separated into 3 sub zones, namely:

1. Baturagung Sub Zone, characterized by steep hill in the north, composed by volcanic rocks, whether in the form of intrusions, breccias, volcanic clastic sediments and carbonates. The dip generally to the south. The research is located in Baturagung Zone (Fig. 1).
2. Wonosari Sub Zone, is plateau in Wonosari and surrounding area, and to the east along with the area around Baturetno. This Highlands is a quarter sediment basin consisting of black clay sediments and lacustrine.
3. Gunung Sewu Sub Zone, is a karst hill, characterized by the presence of karst morphology with conical hill elongated from west of Parangtritis to east side of Pacitan, with thousand of hills.

The Tertiary stratigraphy in west side of Southern Mountain from old to young is as follow (Fig. 3): Kebo-Butak, Nglanggran, Semilir, Sambipitu, Oyo and Wonosari Formations.

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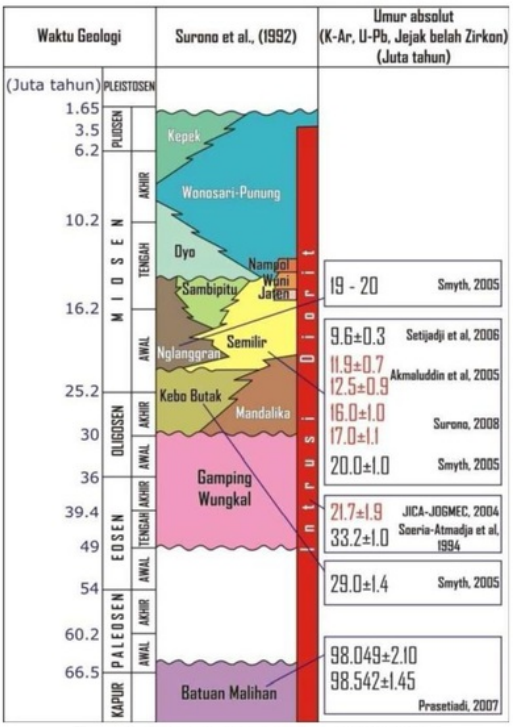

Fig . 3 Stratigraphy of Research Area.

RESULT AND DISCUSSION (ORGANIC MATURITY AND SOURCE ROCK POTENTIAL)

ORGANIC PETROLOGY

Organic petrology analysis was focused on maceral identification, especially liptinite macerals and vitrinite reflectance.

Microscopic analysis was performed on 3 samples of shale from Semilir Formation (Sample code BYTN A-2; BYTN B-2 and MGRI-2). The rock samples analyzed from Semilir Formation consisted of microscopic shale containing high organic matter dispersed in rock and or accumulated into thin layers.

The liptinite maceral content very significant, especially sporinite and cutinite ranges from 20 – 30 % or more. Vitrinite maceral content is formed very little, generally in almost emry observed samples, the vitrinite presence is much smaller than liptinite and inertinite, on the contrary liptinite content is very dominant reached 70%. The more vitrinite content , then so does the gas content (Yen and Chilingarian, 1976; Hutton 1987).

Sporinite and cutinite is a very fine sheet and crisscrossing with mineral matter. This maceral is seen as a base mass-forming component.

Sporinite and cutinite is commonly associated with phytoplankton which is "alongate" on the polish block. Sporinite and cutinite microscopically bright yellow to orange. Vitrinite is bright and shows high reflectance, (Fig. 4).

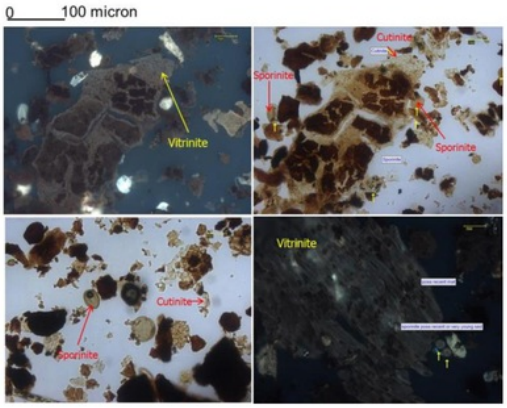

Fig. 4. Vitrinite in Semilir Formation shale

ORGANIC GEOCHEMICAL ANALYSIS:

Generally that samples with TOC content < 0.5% are potentially bad for producing hydrocarbons. Samples with TOC content 0.5 – 1. % have medium value as source rock, whereas for TOC between 1.0 – 2.0% is a good potential samples as hydrocarbon source rock. Samples that are potentially very good as hydrocarbon source rocks (Table 1, 2 , 3, and 4).

Based on the analysis above, 3 shale rock samples BYTN A-2 (TOC = 1.49%); BYTN B-2 (TOC = 3.28%) and MGRI-2 (TOC = 7.26%). Semilir Formation shale has excellent potential as a hydrocarbon source rock.

Table 1. Result of Rock Eval Pyrolysis Analysis Semilir Formation Buyutan Area (analysis by PT. GEOSERVICES)

Sample ID	Composite log	Litology/Washed Residue/	Sample Type	TOC wt%	S_1 mg/g	S_2 mg/g	S_3 mg/g	HI mg/gC	OI mg/gC	OPI	T Max °C
BYTN - A2			OC	1.49	0.11	0.19	2.73	13	183	0.37	397
BYTN - B2			OC	3.28	0.13	0.47	2.90	14	88	0.22	385
MGRI - 2			OC	7.62	0.34	4.23	7.56	56	99	0.07	408

TOC = Total organic carbon
S1 = Volatile hydrocarbon (HC)
S2 = HC generating potential
S3 = Organic carbon dioxide
HI = Hydrogen index
OI = Oxygen index
OPI = Oil Production index
T max = Max. temperature S2
nd = No data

Pyrolisis analysis was performed on samples which has TOC content ≥ 1.0%. It was performed on samples that have been finely ground, weighing approximately 100 mg using the Rock-Eval Pyrolisis tool. The purpose of this analysis is to determine the quantity of existing petroleum or hydrocarbon in samples of free hydrocarbons (S1), expressed in mgHC/g rocks. Analog with organic material which can be extracted also to know the quantity of hydrocarbon (S2) result of kerogen braching in samples during heating between 3000°C and 6000°C expressed in mgHC/g rocks.

Then the Mximum temperature (Tmax, °C) is the temperature at the the peak of S2 or the maximum temperature of the hydrocarbon formation. The hydrocarbon potential (PY) can be obtained from the value of (S1+S2) mgHC/g rocks. When the ratio of S2 * TOC / 100% indicates the sum of the hydrogen index (HI = mmHC/g TOC). In addition to the calculation of HI also plotted the value of Tmax. Generally shows the quality of kerogen (kerogen type) and will release or produce gas or oil and gas or oil only. Total Production Index (TPI) obtained from the calculation of S1 / (S1+S2) indicates thermal maturing. The results of pyrolisis of two samples are interpreted as foolows:

- S1 value (mgHC / g TOC) is not used, because if S1 is high (mgHC/g TOC) value, it corresponds to S2 (mgHC/g TOC) value become low, interpreted to have migration hydrocarbons or migration trapped in the rock.
- The potential yield S1+S2 indicates the potential of hydrocarbon rocks
  - Poor : PY < 2kg/ton
  - Moderate : PY = 2-5 kg/ton
  - Good : PY > 5kg/ton
- The maturity level pf organic matter can be determined based on Tmax value
  - Tmax < 435^0C (Immature)
  - Tmax 435^0C-470^0C (mature)
  - Tmax > 475^0C (overmature)

Based on 3 samples of shale from Semilir Formation (Sample code: BYTN A-2; BYTN B-2 and MGRI -2) can be interpretated as follows:

Table 2. Formation of Semilir Hydrocarbon Potential Quantity

Sample Code	BYTN A-2	BYTN B-2	MGRI - 2
TOC	1.49%	3.28%	7.62%
S2	0.19 mgHC/g rock	0.47 mgHC/g rock	4.23 mgHC/g rock
Potential Yield	0.3 mgHC/g rock	0.6 mgHC/g rock	4.57 mgHC/g rock
TOC vs S2	*poor*	*poor*	*good*

Table 3. Hydrocarbon Semilir Formation Quality

Sample Code	BYTN A-2	BYTN B-2	MGRI - 2
HI	13 mg/gC	14 mg/gC	56 mg/mC
HI vs Tmax	Kerogen type III	Kerogen type III	Kerogen type III
HI vs OI	Kerogen type III	Kerogen type III	Kerogen type III
TOC vs HI	Kerogen type Gas	Kerogen type Gas	Kerogen type Gas

Table 4. Hydrocarbon Maturity of Semilir Formation

Sample Code	BYTN A-2	BYTN B-2	MGRI-2
Tmax	397^{0}C	385^{0}C	408^{0}C
OPI	0.37	0.22	0.07
Maturity	Immature	Immature	Mature

The resulting range of vitrinite reflectance (Ro) is as follows:

< 0,35% : immature
<0,60% : early mature
0,60-1,20% : oil
0,70-1,00% : oil peak
1,00-2,00% : wet gas
1,35-3,20% : dry gas

Ro Mean value from 3 samples (BYTN A-2 = 0.47%, BYTN B-2 = 0.5%, and MGRI–2 = 0.64%) Semilir Formation shale are 0.47% - 0.64% all samples belong immature to mature category.

CONCLUSION

Semilir Formation Shale in Buyutan area which has potential as shale hydrocarbon (gas prone), has a low maturity level (immature to mature).

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