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"Sweetness" seismic attribute as indication for hydrocarbons in the Bandar Jaya Sub-Basin

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ABSTRACT

Bandar Jaya sub- basin is a part from South Sumatra Basin . The South Sumatra Basin is one of the basin sediment that has been proven as basin producer hydrocarbons . In the Bandar Jaya sub- basin , done several times drilling , however results drilling no get economical hydrocarbon _ so that the sub-basin this impressed no interesting for conducted exploration . Study this aim for see potency hydrocarbons in the Bandar Jaya Sub- basin using attribute seismic *sweetness* based on 2 passes 2 dimensional seismic and 3 well data . In relation with existence hydrocarbon , attribute *sweetness* will show score tall because presence hydrocarbon usually will increase score amplitude seismic and have score small frequency . _ Use attribute *sweetness in* Bandar Jaya Sub- Basin shows relative value _ small in the area around 3 wells *existing* which has *dry well* status with a number of findings trace / *trace* hydrocarbons . Result of attribute *sweetness* also shows existence indication potency hydrocarbons in the Bandar Jaya Sub - Basin which is represented with relative value _ high at the peak structure anticline and on pattern structure in the form of *pinchout* .

1. Introduction

Hydrocarbons still Keep going needed until moment this although diversification energy Keep going improved . Indonesia still have potency backup abundant hydrocarbons _ if seen from amount basin existing sediment . _ Based on release from Survey Center Geology through the Geological Agency (2009), Indonesia has 128 basins classified sediment _ into 3 types based on age basin , that is basin tertiary , basin pre-tertiary , and basin pretertiary-tertiary . one _ basin sediment that has been proven as basin producer hydrocarbon is The South Sumatra Basin which consists of from several sub- basins .

One of the sub - basins found in the South Sumatra Basin is the Bandar Jaya Sub - basin . Potency hydrocarbons in the sub-basin this showed from a number of findings seepage oil . In the Bandar Jaya sub- basin , done several times drilling , however results drilling no get economical hydrocarbon _ so that the sub-basin this impressed no interesting for conducted exploration . Besides drilling , in this area has also been conducted a 2 - dimensional seismic survey .

Study this aim for see potency hydrocarbons in the Bandar Jaya Sub- basin using attribute seismic *sweetness* based on 2 dimensional seismic data and well data . Attribute seismic *sweetness* chosen because could represents an area that has indication potency hydrocarbons .

1.1. Bandar Jaya Sub Basin

Bandar Jaya Sub - Basin administrative located in Lampung Province with part big It is an area of Central Lampung Regency . by Geology , Bandar Jaya Sub- basin is a part from the South Palembang Sub- Basin so that have relative stratigraphy _ same between the two sub- basins (Wiyanto _ et al ., 2009). Sub - basin of South Palembang itself is part from South Sumatra Basin . Stratigraphic column from The South Sumatra Basin can seen in

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Figure 1 while map location from the Bandar Jaya Sub - Basin area (Bishop, 2001) can seen in Figure 2.

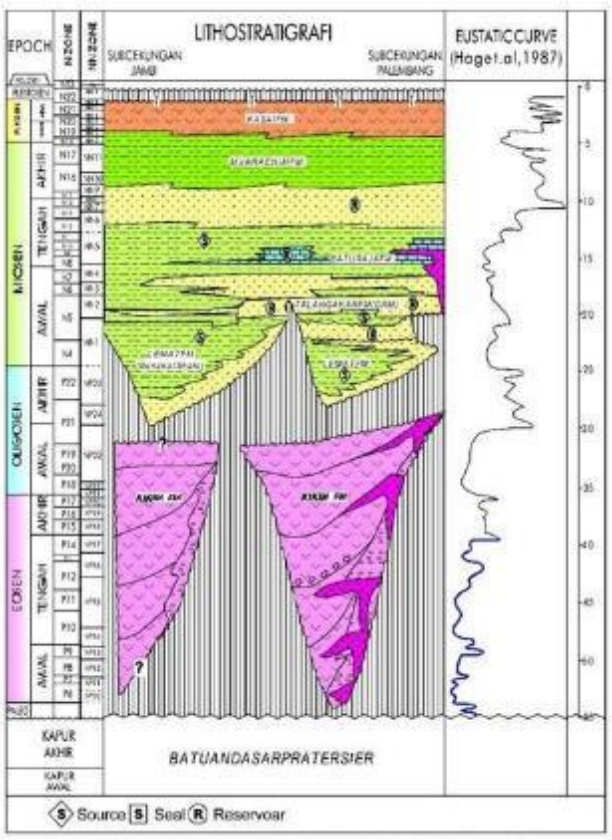

Figure 1. Regional stratigraphic column of the South Sumatra Basin

Order regional stratigraphy in the Bandar Jaya Sub- Basin of the oldest age that is rock base (*basement) in the* form of rock metamorphic schist chlorite aged pre-Tertiary . above _ rock base by consecutive deposited Old Lahat Formation Oligocene Awla -End, Formation gutter Oligo - Miocene roots , and unit rock carbonate from Formation Baturaja . in harmony above Formation King stone deposited unit sediment sea shallow from Formation Old Gumai _ Early-Middle Miocene . In phase regression deposited unit rock from The aged Water Benakat Formation Middle Miocene , next aligned above _ Water Benakat Formation there is sediment deltaic from The aged Muara Enim Formation Late Miocene . Unit the youngest rock is The aged Kasai Formation Plio-Pleistocene .

According to Wiyanto et al ., (2009), the *Petroleum System in the* Bandar Jaya Sub- Basin has rock parent origin _ from flakes Lahat and Gutter Formation root . Reservoir rock is a sandstone from Lahat Formation , sandstone Formation gutter Roots , limestone Formation Baturaja , and sandstone from Formation gumi . The cap rocks that developed in the Bandar Jaya sub- basin are: flakes or claystone found in each formation . Trap hydrocarbon could in the form of trap associated structure _ with faults and traps stratigraphy in the form of blasphemy . Migration hydrocarbon from rock parent to reservoir rock interpreted through track fault estimated pull _ occurred in the Middle-Late Miocene .

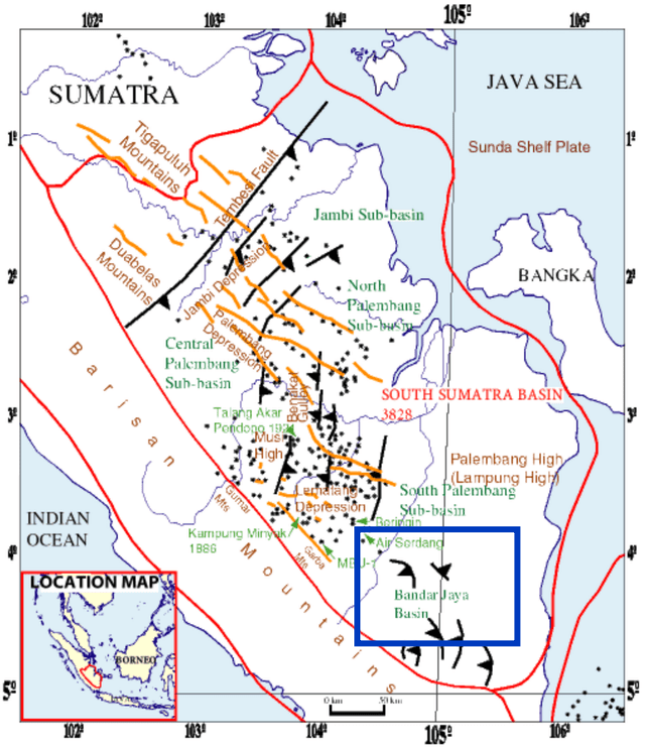

Figure 2. Map of the location of the Bandar Jaya Sub-Basin area (blue box)

2. Methodology

2.1 Data availability

Study this using 3 data wells (Table 1) with the status of all three is *dry well* . Besides that use 3 passes seismic , namely Track-1 and Track-1A in the West-East direction that passes through wells S-1 and S-2; and Track-2 in the South-North direction that passes through well S-3 (Table 3). Track-1 and Track-1A have design overlapping survey . _ Acquisition Seismic Trajectory-1A in 2016 is expected capable describe condition lower surface with more good . Base map from track seismic and well can seen in Figure 3.

Table 1. Availability of Well Data

Well Name	Status
S-1	*dry well*
S-2	*dry well*
S-3	*dry well*

Table 2 . Seismic Data Availability

Track Name	Year Acquisition
Track-1	1979
Track-1A	2016
Track-2	1979

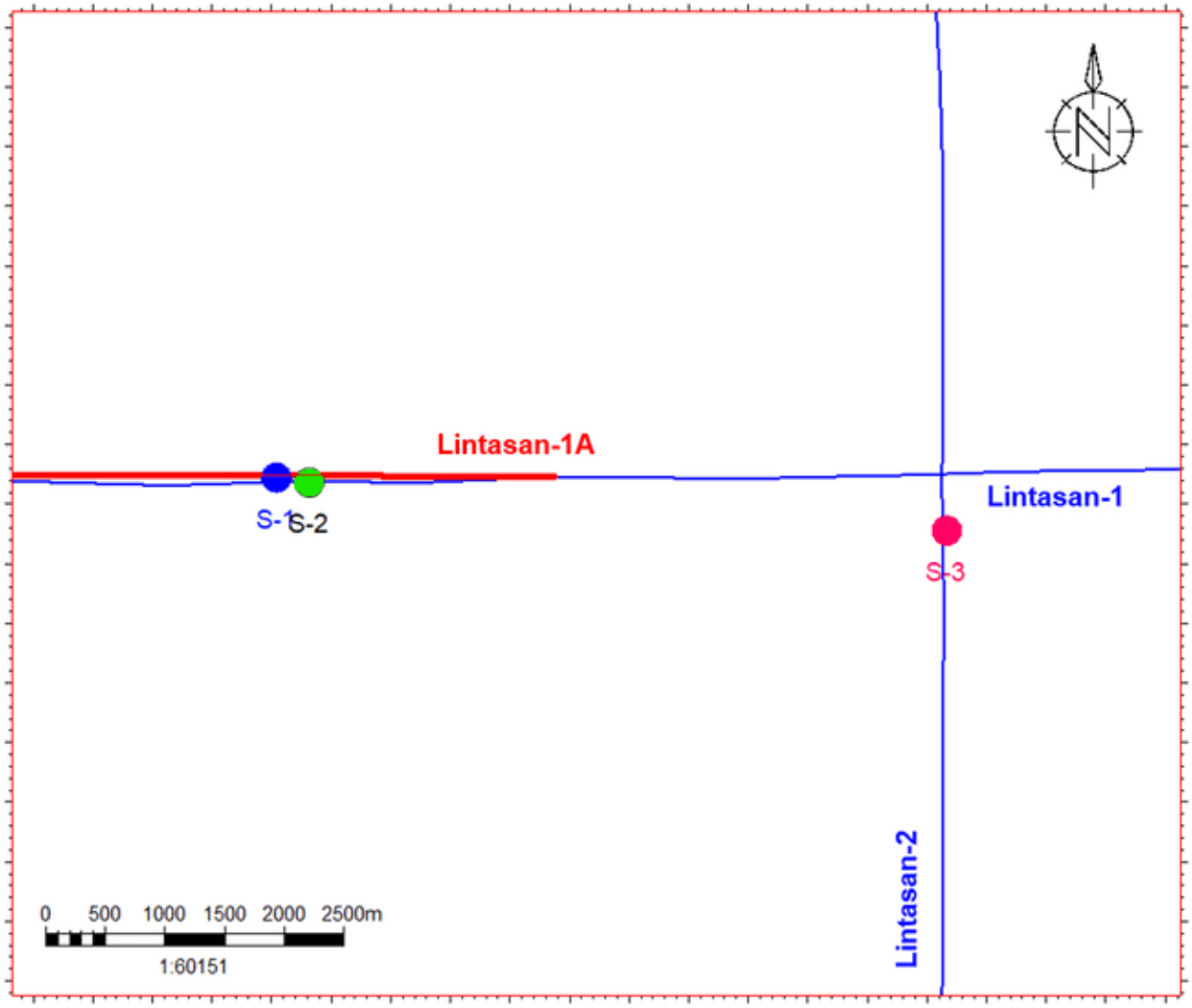

Figure 3. Base map of the position of the seismic trajectory of Trajectory-1A (red line), Track-1 (blue line), Track-2 (blue line), well S-1 (blue circle), well S-2 (green circle) , and well S-3 (red circle)

2.2 Seismic attributes swetness

Seismic attribute *sweetness* is implementation from combination Among attribute seismic amplitude momentary (*instantaneous amplitude*) with the attribute frequency (*instantaneous frequency).* Attribute *sweetness* could help in indicates change energy in related seismic data with change lithology . Method *sweetness* is method that utilizes analysis frequency and not depends on the offset length of track seismic (Zulivandama et al ., 2018). by math , calculation attribute *sweetness* use equation 1, which is distribution Among score amplitude moment shared with root square from frequency .

$$sweetness(t) = \frac{a(t)}{\sqrt{fa(t)}} \quad (1)$$

In relation to the presence of hydrocarbons, this attribute will show a high value because the presence of hydrocarbons will usually increase the value of the seismic amplitude and have a small frequency value. (Koson et al., 2014).

To display seismic data and well data, a *well to seismic tie should be performed* . However, due to data limitations, the process of binding well data into the time domain only uses Checkshot data from S-3 wells.

3 . Results and Discussion

3.1 Results of data processing

The result of data processing is in the form of a cross section of the seismic *sweetness attribute* . Figure 4 is the result of the *sweetness* attribute on the seismic data of Track-1 and Track-2 that pass through wells S-1 and S-2. The results of the *sweetness* attribute for Track-2 that pass through the S-3 well can be seen in Figure 5. The images also show an interpretation of the horizon which refers to the continuity of the seismic reflector to describe the condition of the subsurface structure. The green horizon is assumed to be equivalent to the Gumai Formation, *cyan* to the Baturaja Formation, and yellow to be equivalent to the Talang Akar Formation.

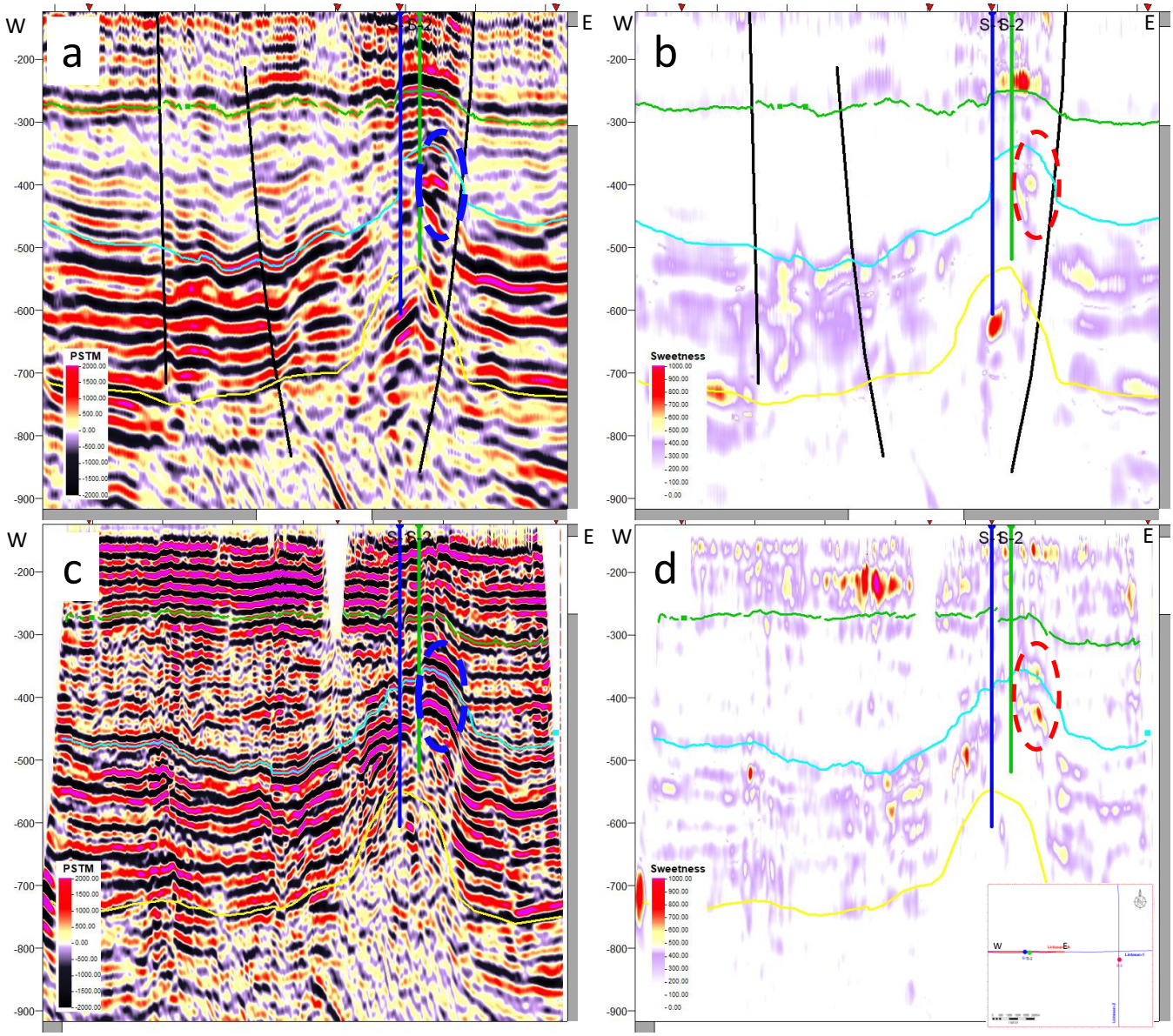

Figure 4. (a) PSTM seismic section on Track-1, (b) *sweetness attribute section* on Track-1, (c) PSTM seismic section on Track-1A, and (d) *sweetness attribute section* on Track-1A. The position of the S-1 well is indicated by a blue vertical line while the S-2 well is indicated by a green vertical line

3.2 Hydrocarbon potential indication

From the seismic data of Passage-1 and Pass-1A PSTM it can be seen that the position of wells S-1 and S-2 is in an anticline structure influenced by faults. There are differences in anticline formations between Track-1 which was acquired in 1979 and Track-1A which was acquired in 2016. Wells S-1 and S-2 which are both *dry wells were* drilled referring to the seismic of Passage-1. In Seismic Trajectory-1 the position of the S-2 well is right at the top of the anticline structure, but the latest data acquisition results show that the top of the anticline structure is to the east of the S-2 well.

sweetness attribute in Track-1 and Track-1A also do not show any anomalies in the S-1 and S-2 wells at intervals below the Gumai Formation (green) to Talang Akar Formation (yellow). Based on the drilling report, it was stated that there were traces *of* hydrocarbons. In the results of the *sweetness* of the two paths, there are interesting areas where anomalies appear in the form of *The relatively high sweetness* amplitude which may be correlated with the presence of hydrocarbons to the east of the well location S-2 (red ellipse with dashed line) based on Trajectory-1A is the peak of the anticline structure. *The results of the sweetness* attribute in Track-1 and Track-1A can help answer the reasons why wells S-1 and S-2 are *dry well* .

sweetness attribute on Track-3 can be seen in Figure 5(b). The *sweetness* attribute at the location passed by the S-3 well indicates an increase in the amplitude value at a depth of about 500 milliseconds. The anomaly is indicated by a red ellipse. Anomalies in this area are supported by *composite log data* (Figure 5(c)). The *composite log* shows that there is a *crossover* between the density data and the neutron data in the area which is equivalent to the anomaly from the *sweetness attribute* . Anomalies in the form of an increase in the amplitude of the *sweetness attribute* and *crossover* in *the composite log* are expected to be an indication of potential hydrocarbons in the

research area. The higher the *sweetness* attribute value, the higher the potential for hydrocarbon indications is expected.

From the PSTM seismic pattern on Track-2 on the equivalent horizon of the Talang Akar Formation (yellow) there is a *pinchout pattern* to the south of the S-3 well. At that location, the results of the *sweetness attribute* also showed a significant increase in amplitude (green ellipse with a dotted line). The potential for the presence of hydrocarbons in the area will be very interesting if there is a fault structure or shale layer that can be a cover layer.

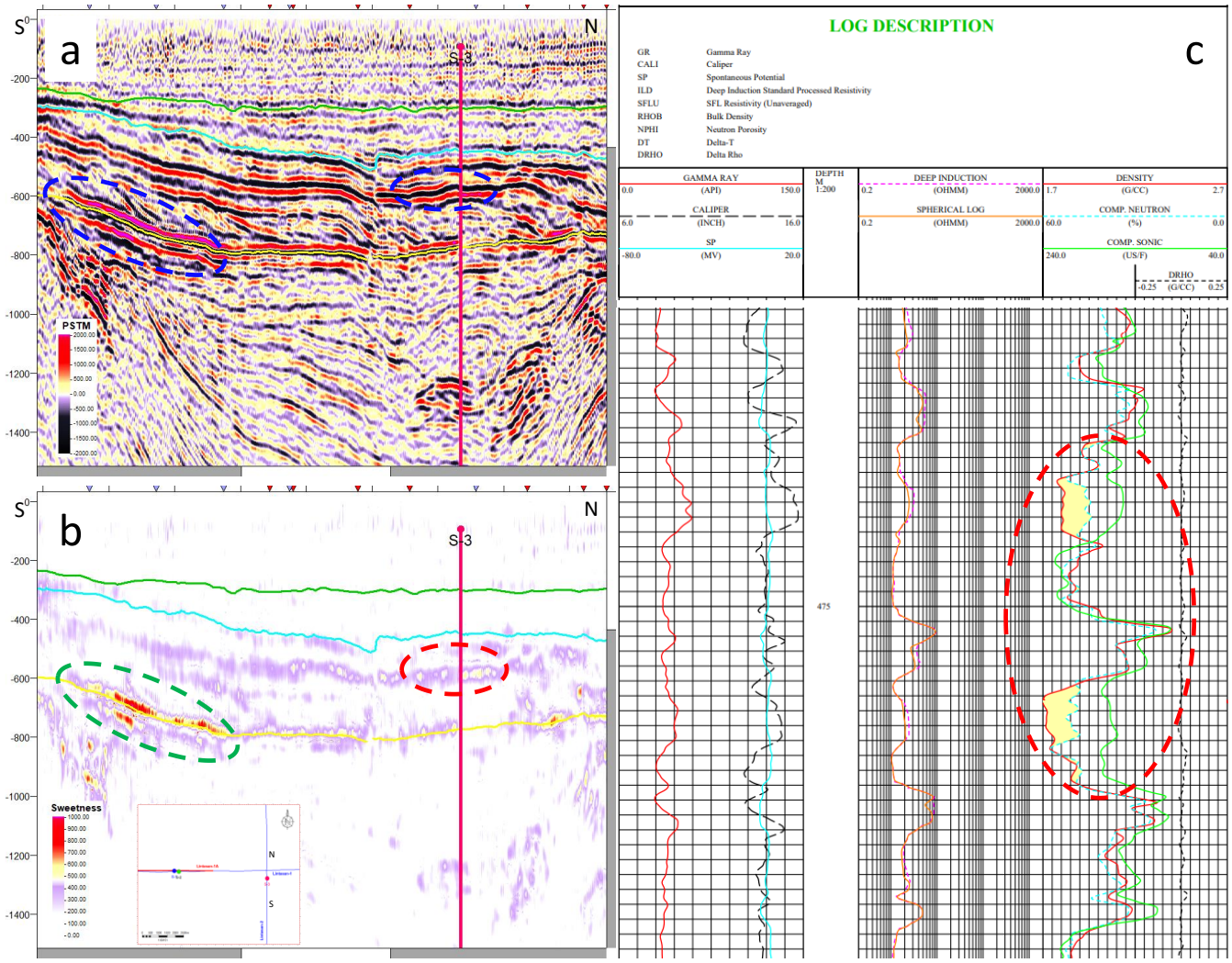

Figure 5. (a) Seismic cross-section of PSTM on Track-2, (b) cross-section of the *sweetness attribute* on Track-2, (c) *crossover anomaly* between density and neutron data in well S-2

4. Conclusion

sweetness attribute in the Bandar Jaya Sub-Basin shows a relatively small value in the S-1, S-2, and S-3 well areas. This is in accordance with the drilling results which stated that these wells are *dry wells* with the presence of several traces *of* hydrocarbons. The results of the *sweetness* attribute also indicate the potential for hydrocarbons in the Bandar Jaya Sub-Basin. In Track-1 and Track-1A, indications of the presence of hydrocarbons based on the *sweetness attribute data are* found at the anticline peak east of the S-2 well with a depth of about 400 milliseconds. Another potential is in Track-2 to the south of the S-3 well with a depth of about 600 milliseconds.

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