Reservoir characterization and identification of new prospect in Srikail gas field using wireline and seismic data

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Received: 11 January 2021 / Accepted: 11 June 2021 / Published online: 19 June 2021
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Abstract
Although reservoir characterization has been carried out by many researchers on the sedimentary package of the Bengal basin hydrocarbon province, integration of petrophysical and seismic sequence-based reservoir evaluation is rarely taken into account. This paper focuses on the identification of gas zones, reserve estimation and identification of new prospects in Srikail gas field within the eastern fold belt of Bengal basin integrating four wireline logs and 2D seismic data. Our study finds seven hydrocarbon-bearing zones (A, B, C, D, E, F and G) within the measured depth between 2429.5 and 3501 m. Petrophysical properties of seven hydrocarbon-bearing zones indicate that they are good quality reservoir sands. The gas horizons were mapped on seismic sections which reveal that the NW–SE anticlinal structure is largely affected by channels in the crest and western flank. The channels are infilled by fine-grained sediments which act as cap rock on northern and western parts of the structure. Thus, the anticlinal structure and fine-grained sediments make a potential trap for hydrocarbon accumulation and laterally and vertically well-distributed sequence remnants are the main reservoir rocks in this area. Volumetric reserve estimation of these sands provided a total gas initially in place as 552 billion cubic feet. Moreover, all the four wells are drilled in the southern block of the structure, and since there is a structural continuity from south to the north, it is highly recommended to drill a well up to 3000 m depth in the northern block to test its hydrocarbon potentiality. Overall, the outcomes of this study contribute new insights for reservoir characterization and identification of new prospects in an efficient way.

Keywords Reservoir characterization · Petrophysical properties · Seismic stratigraphy · New prospect · Srikail gas field

Introduction
According to the British Petroleum statistics, the demand for energy is rising sharply in developing countries. Hence, it is the single most crucial challenge for the global energy system for the next couple of decades (Dudley 2019). Like most of the developing countries, Bangladesh is confronting the problem of energy shortages in the fossil fuel sector. From the remaining recoverable gas reserves (approximately 11.91 Trillion Cubic Feet) and the future energy demand, it seems that the country may be unable to gain a sustainable energy situation (Petrobangla 2017). However, it can achieve sustainable energy conditions if the available resources are exploited in an efficient way.

Geologically, Bengal basin is one of the youngest deltaic sedimentary basins of the world (Imam & Hussain 2002). Geological and seismic studies have shown that it has spectacularly maintained a thick sedimentary apron and salient petroleum geological features favorable for hydrocarbon generation and accumulation (Imam 2005). In fact, favorable conditions are offered by the presence of thick and repetitive intervals of organic-rich shales and reservoir quality sandstones together with different types of traps in the Oligocene to Pliocene sequences (Imam & Hussain 2002). The country has proven natural gas-rich provinces in the eastern part where most of the gas fields are discovered. Among the 27 discovered gas fields, the Srikail gas field is one that lies in the western part of the fold belt of Bengal basin (Petrobangla 2009).
During 1991–1992, 12-fold common depth point (CDP) surveys were carried out in Srikail by Bangladesh Petroleum Exploration and Production Company Limited (BAPEX) and Srikail-1 (SK-01) was drilled in 2004 (Petrobangla 2009). Unfortunately, the primary target was not achieved and finally failed to discover commercial gas. However, BAPEX carried out another seismic survey during 2006–2007 and an exploratory well Srikail-2 (SK-02) was drilled in 2012. Fortunately, it was completed as a producer (Petrobangla 2009). Consequently, two deviated wells named Srikail-3 (SK-03) and Srikail-4 (SK-04) were drilled recently for higher extraction of gas from the Srikail gas field. Current gas discoveries suggest the field will continue to be a focus of more exploration activities. It is now necessary to apply modern exploration and production technologies to harness these hydrocarbon resources.

To minimize drilling risk and maximize well and reservoir productivity, adequate analyses of seismic and petrophysical data are very important (Amelokoko et al. 2019). Many researchers conclude that integration of seismic and well log data plays an important role in determining the structural framework and reserves of a field (Fajana et al. 2019; Owolabi et al. 2019; Oyejemi et al. 2018, 2019; Sanuade et al. 2018). In fact, the combination of structural interpretation, seismic stratigraphy, core data and logging, geological knowledge of depositional facies and modeling are crucial elements in building reservoir geological model and characterization (Norden and Frykman 2013; Edigbue et al. 2015; Jegede et al. 2015; Akm et al. 2016; Al-Fatlawi 2018; Eahsanul Haque et al. 2018; Kalu et al. 2019).

Several studies have been carried out on reservoir rock in Bengal basin hydrocarbon province, mostly focusing on their depositional environment and diagenesis, modeling, petrophysical evaluation and quantitative assessment of reservoir quality either using wireline log data or seismic data (Imam and Shaw 1987; Islam 2009; Sazal et al. 2015; Rahman and Worden 2016; Alam et al. 2019). However, combinations of wireline and seismic data are rarely used due to unavailability of the data. Moreover, for reservoir characterization and identification of new prospects, integration of petrophysical and sequence-based reservoir evaluations are rarely taken into account. Recently, few endeavors have been made by Parvin et al. (2019) considering the sequence stratigraphy for identifying hydrocarbon prospective zones in the Fenchuganj gas field. Hence, there is a dearth of study to identify potential hydrocarbon-bearing zones, subsurface structure and new prospects in the light of petrophysics and sequence stratigraphy. Considering these circumstances, this study aimed to fill this gap by characterizing the reservoir for better understanding of hydrocarbon-bearing zones and sequences, subsurface structures and identification of new prospect integrating petrophysics and seismic stratigraphy. An implementation of the combined analyses will provide crucial insights for designing and exploring hydrocarbons efficiently.

**Geological framework**

The tectonic framework of the Bengal basin has been investigated by many researchers (Evans 1964; Bakhtine 1966; Guha 1978; Liu et al. 1991; Reimann 1993). The basin is encompassed by the Precambrian Meghalaya craton to the north, Indian shield to the west, the Indo-Myanmar orogenic belt to the east and Bay of Bengal to the south (Fig. 1). Based on different tectonic settings, evolution of basin and history of sedimentation, the basin has been categorized into three petroleum regions: (i) the eastern fold belt, (ii) the central foredeep and (iii) the NW stable shelf/platform (Curray et al. 1982; Roy 1984; Roybarman 1984; Salt et al. 1986; Murphy 1988; Khan et al. 1988; and Shamsuddin and Abdullah 1997; Imam and Hussain 2002).

The study area is located in Muradnagar Upazila of Comilla district under Chittagong Division (Fig. 1). It lies in the central part of petroleum Block-9 (Petrobangla 2009). Tectonically Srikail gas field is located on the western part of the Tripura–Chittagong fold belt (Fig. 1). According to Petrobangla (2009), Alluvium, Dupitila sandstone, Tipam sandstone, Bokabil and Bhuban formations are encountered as sedimentary strata at Srikail Gas Field (Table 1). The sediments consist of the alteration of shale, sandstone and siltstone in varying proportions. Sediments are deposited in a fluvo-deltaic to shallow marine environment.

As the Srikail is located at the eastern part of Bengal Basin, the representative stratigraphic column and petroleum system of this province is summarized in Fig. 2.

**Materials and methods**

**Datasets of Srikail**

Four digital wireline log data (Las format) and eight seismic data (SEG-Y) were used in this work. All relevant data were collected from Bangladesh Petroleum Exploration and Production Company (BAPEX). The geophysical well logs contain chiefy caliper, gamma ray, spontaneous potential, neutron, density, sonic and resistivity logs of four wells (Sk-1, Sk-2, Sk-3 and Sk-4). The 2D seismic data covered a region of approximately 225 km² (Fig. 1). The seismic datasets include: check shot data, wellhead data, deviation data, well tops data and vertical seismic profile data of Srikail-1. The data were processed and interpreted using software which helps to estimate all the parameters needed for the estimation of hydrocarbon volume.
As shown in the workflow chart in Fig. 3, the dataset available was first imported into the software for examination. The logs were viewed on appropriate scales and normalized. For calculating true vertical depth (TVD), true vertical depth subsea (TVDSS) and measured depth (MD) borehole deviation data and borehole azimuth were used. Additionally, these were scrutinized for spikes and errors before log-based interpretation was done.

**Petrophysical properties**

Petrophysical properties of the reservoirs were calculated from the evaluation of the wireline logs of the four wells. These parameters include shale volume ($V_{shale}$), porosity ($\phi$), effective porosity ($\phi_e$), formation water resistivity ($R_w$), water saturation ($S_w$), hydrocarbon saturation ($S_h$) and net-to-gross (NTG) ratio.

**Shale volume**

Generally, the reservoirs of the Bengal basin are Tertiary in age and chemically immature in terms of sedimentology (Rahman & Worden, 2016). Thus, it may contain radioactive minerals such as feldspars and contribute to gamma but unrelated to shale volume (Worthington 1985). Hence, the shale volume was calculated using gamma ray logs by applying nonlinear ‘Larionov tertiary rock’ method (Larionov 1969) as shown in Eq. (1):

$$GR_{index} = \frac{GR - GR_{index}}{GR_{shale} - GR_{matrix}}$$  \hspace{1cm} (1)

Larionov tertiary rock method is given by Eq. (2):

$$V_{sh} = (0.0832(3.7 * GR_{index}) - 1)$$  \hspace{1cm} (2)
where GR is the gamma ray (GR) log reading in the zone of interest; GR_{matrix} is the GR log reading in 100% matrix rock; GR_{shale} is the GR log reading in 100% shale; GR_{index} is the gamma ray index; and V_{sh} is the volume of shale. Other petrophysical parameters were estimated using Eqs. 3–8.

**Porosity**

Porosity ($\phi$) was estimated from density log using Eq. (3) (Asquith and Krygowski 2004):

$$\phi = \frac{\rho_{ma} - \rho_{fl}}{\rho_{ma} - \rho_{f}}$$  

(3)

where $\rho_{ma}$ = matrix density; $\rho_{fl}$ = density log represents bulk density of the formation; and $\rho_{f}$ = density of the fluid in the formation.
**Effective Porosity ($\phi_e$)**

The average effective porosity is calculated using data from sonic, density and neutron logs. Different sonic, bulk density and neutron porosity values of shale are suggested to indicate different depositional environments (Hossain et al. 2018). The effective porosity was subsequently calculated by subtracting the porosity calculated in the shale part of the lithology using Eq. 4

\[
\phi_e = (\phi_t - \phi_{sh}) \times V_{sh}
\]

where $\phi_e$ = effective porosity, $\phi_t$ = total porosity, $\phi_{sh}$ = porosity in shale and $V_{sh}$ = volume of shale.

**Formation water resistivity ($R_w$)**

The formation water resistivity ($R_w$) was determined using the Pickett plot and apparent water resistivity ($R_{wa}$) method (Fig. 4). Apparent water resistivity for each of the reservoirs was calculated using Eq. 5.

\[
R_{wa} = R_T \phi_T^m
\]

where $R_T$ is the long normal and LLD resistivity as applicable and $\phi_T$ is the total porosity while $m$ was assumed to be 2.

**Water saturation ($S_w$)**

For water saturation calculation, Archie equation was not directly used as the equation is valid for clean sand. Due to lack of core data, Indonesia equation (derived from Archie equation) was used for saturation calculation using Eq. (6).

\[
w_{\text{indonesia}} = \left[ \frac{1}{R_t} \right]^\frac{1}{m} \left\{ \frac{V_{sh}(1-0.5V_{sh})}{R_{sh}^2} \right\}^{\frac{1}{2}} \left( \frac{\phi_e}{\phi_{wa}} \right)^{\frac{1}{2}}
\]

where $a$ = formation factor coefficient; $m$ = cementation exponent; $n$ = saturation exponent; $R_w$ = water resistivity (ohm*meter); $R_t$ = true formation resistivity (ohm*meter); $R_{sh}$ = resistivity of shale (ohm*meter); and $\phi$ = porosity (dec).

**Hydrocarbon saturation ($S_h$)**

Hydrocarbon saturation was calculated using Eq. (7):

\[
S_h = 1 - S_w
\]
Net-to-gross ratio (NTG)

Net-to-gross (NTG) ratio was estimated using Eq. (8):

\[
NTG = \frac{\Sigma \text{Net Int.}}{\Sigma \text{Gross Int.}}
\]

where Net Int. is the interval of the net pay section of the reservoir and Gross Int. is the interval of the entire reservoir. In this way, formations are evaluated and correlated across the wells to establish lateral continuity.

Seismic-to-well tie

After formation evaluation, the 2D seismic data were processed and interpreted to define the structural frameworks of the Srikail field. The structures were mapped out using the reflection continuity of geological events. This was followed by the identification and mapping of horizons of interest on the seismic which corresponds to reservoirs A, B, C, D, E, F and G (seismic-to-well tie using sonic and density logs).

Generation of time and depth structure maps

The horizon mapping facilitated the generation of a time map (i.e., map depicting lines of equal time). Using the available check shot data and logs, the time maps were converted to top structure maps which were used to calculate the gross rock volume and hydrocarbon volume.

Gas initially in place (GIIP)

Deterministic approach was used to estimate hydrocarbon volume (Eq. 9) using input parameters including area, thickness, porosity, hydrocarbon saturation, gas formation volume factor (\(B_g\)), recovery factor and net pay thickness.

\[
GIIP = A \times h \times \left( \frac{1}{B_g} \right) \times (1 - S_w)
\]

where \(A\) = area in acre (from contour map). \(h\) = average thickness in feet (net sand). 43,560 = conversion factor (from acre to cubic feet). \(\phi\) = average porosity. \(B_g\) = gas formation volume factor (0.0075 rcf/scf\(^*\)). \(^*\)rcf/scf = reservoir cubic feet per standard cubic feet.

Results and discussion

From petrophysical analysis, seven gas sands (A, B, C, D, E, F and G) were found in Srikail-4 which lie between 2350 and 3349 m depth subsea, whereas Srikail-3 encountered one gas sand (D Sand). Three gas sands were identified in Srikail-2 (B, D and E sand) and no gas sand was identified in Srikail-1 (Table 2).

Initially, the hydrocarbon-bearing zones were identified by quick look technique and large negative separation (Fig. 5) (Rider 2000). The comparatively low resistivity value was shown by a microspherically focused log (MSFL) which read the flushed zone resistivity while high resistivity values were shown by induction log deep resistivity tool (ILD) due to the saturation of hydrocarbons. The separation between the curves was shown by log signatures, which are diagnostic of hydrocarbons. In neutron density combinations, gas zones were identified very distinctly, giving a large negative separation as the neutron log reads low porosity due to the presence of gas. Applying the similar principle, the rest of the gas zones for other wells were identified. Gas–water contact (GWC) of Srikail gas field was similarly identified using wireline log signatures. Mainly gamma ray, density, resistivity and porosity logs were used to identify GWC.

The correlation across the four wells of A-G reservoir sands suggests the reservoirs are extensively distributed laterally and vertically (Fig. 6a, b, c).

| Gas zone depth interval of Srikail-4, Srikail-2 and Srikail-3 |
|---------------------------------------------------------------|
| **Well** | **Srikail-04** | **Srikail-02** | **Srikail-03** |
| **TVDSS m** | **TVDSS m** | **TVDSS m** | **TVDSS m** |
| **Gas sand** | **Top** | **Base** | **GWC** | **Top** | **Base** | **GWC** | **Top** | **Base** | **GWC** |
| A | 2350 | 2362 | 2355 | 2591 | 2531 | 2499 |
| B | 2481 | 2517 | 2499 | 2922 | 3047 | GDT |
| C | 2574 | 2597 | 2586 | 2923 | 3196 | GDT |
| D | 2904 | 3007 | GDT | 3126 | 3144 | 3132 |
| E | 3104 | 3128 | 3112 | 3267 | 3292 | 3285 |
| F | 3267 | 3292 | 3285 |  |  |  |
| G | 3309 | 3349 | 3314 |  |  |  |
The results of mean petrophysical analysis (Table 3) show that the average gross thickness ranges from 12.61 to 110.93 m and average net thickness varies from 1.3 to 23.08 m. The gross and net thickness suggest that the lateral and vertical extent of the reservoirs is quite optimistic in terms of potential hydrocarbon accumulation.

Further, the range of shale volume lies between 8 and 38% indicating the relatively clean nature of sandstones. The average effective porosity varies from 12.3 to 23.8% which corresponds to fair to excellent pore interconnectivity. Our findings are in agreement with the porosity of nearby gas fields determined by Islam (2010). In very recent studies, Islam et al. (2021) have determined the average permeability of potential reservoir rock of Surma basin is 132.8 milliDarcy that suggests optimistic nature of hydrocarbon flow from these reservoirs.

The mean effective water saturation ranges from 24.9 to 46.9% suggesting gas sands are well saturated with hydrocarbons. Hydrocarbon saturation ranges between 53.1 and 75.1%, indicating source rocks are well cooked within a hydrocarbon kitchen. According to Imam (2005), rapid sedimentation during the Miocene period has contributed to the formation of the hydrocarbon kitchen in this region.

Further from correlation analysis, it is seen that positive correlation between effective porosity and net-to-gross ratio shows a close relationship for the gas sands below SB-3, in which the higher effective porosity corresponds to higher N/G indicating productive hydrocarbon zones (Fig. 7). Similarly, negative correlation between shale volume and N/G for the gas sands below SB-2 suggests a closely inverse relationship, in which the moderate shale volume refers to moderate N/G ratio.

However, the variation of the reservoir properties discussed depends on various factors including rapid sedimentation influx, tectonics, sea level fluctuations and so on (Roy & Moniruzzaman 2010). These factors suggest the existence of different depositional environments which directly control the textural parameters including grain size, shape, sorting, matrix and structure of the reservoir sandstones. Further, these factors are crucial for controlling diagenesis of reservoir rocks and ultimately influence the variation of reservoir properties (Islam 2010).

Using the concept of seismic stratigraphy, seven sequence boundaries (SB-1 to SB-7) from older to younger were identified on every seismic line (Fig. 8). Sequence boundaries are discontinuous seismic reflectors bounded by pronounced
regional unconformities. The truncation of reflectors by incised valleys is easily identified by their poor reflection due to energy loss and broken reflection (Fig. 9). These results are congruent with previous studies that found the association between sequence deposition and fluctuation of sea level (Najman et al. 2012; Hossain et al. 2018).

Multiple down-cutting channels incise into the sequences below with considerable relief. The repeated cut and fill
Fig. 7 Correlation coefficient among gas sands below SB-2 and SB-3

Fig. 8 Sequence boundary (SB) 1-7
indicates the cyclic transgression–regression cycle during the sequence deposition. In addition, the variation of channel width and depth suggests fluctuating relative sea levels. The higher intensity of channel cutting and greater width suggest the much lower position of sea level during the deposition of older SB-1, SB-2 and SB-3. On the contrary, the less intense channel cutting and lesser width imply the evidence of relatively higher sea level position during the rest of the sequence deposition. This finding is aligned with the previous study conducted by Najman et al. (2012) and Hossain et al. (2018) indicating similar characteristics of seismic mega sequence-2.

The sequence remnants act as reservoir rocks preserved between multiple, down-cutting channels. These sequence remnants are recognized from distinct seismic reflection on the seismic section. These reservoirs belong to the Surma group of rocks deposited in shallow marine environments, and most of the gas fields are producing natural gas from these reservoirs (Alam et al. 2019).

From a sedimentological point of view, the erosional channels may be infilled later by fine-grained sediments (shale, silt, clay or fine sand) which were identified by low-amplitude reflectors on the seismic section. They were deposited in High Stand System Tract and made onlap on the both sides of the canyon (Najman et al. 2012). Eventually, these fine-grained sediments possibly act as a cap rock over the northern and western parts of the structure and influence the whole prospects. It seems to appear that this seal rock has similar characteristics of upper marine shale (basin wide marker event) indicating the last marine transgression over the area.

In addition, most of the reservoirs in the Bengal basin are fault controlled (Imam 2005). Surprisingly, our study did not find any types of fault on the seismic section. One plausible explanation is that the field lies western part of Chittagong–Tripura fold belt and the intensity of fold decreases from east to west; thus, it is not affected by any types of fault. Moreover, the southeastern flank of the anticlinal structure is steeper than the northwestern flank which also supports the decreasing intensity of folded structure from east to west.

Although source rock could not be identified in any well in the eastern part of Bangladesh, their presence is indirectly proved due to the gas discovery in nearby structures.
(Imam 2005). Organic-rich shale and siltstone of middle and lower Miocene (Bhuban formation), Oligocene Jenam formation, Kopili and Chera formation of Eocene age are suggested to be potential source rock for this province by different researchers (Roybarman et al. 1983; Khan et al. 1988; Shamsuddin et al. 1997; Curiale et al. 2002).

For each gas sand two-way travel time, velocity and depth grid surface maps were prepared. The depth maps reveal that Srikail is mainly an elongated NW–SE trending and four-way closed anticlinal structure (Figs. 10, 11). According to Imam (2005), rapid sedimentation rates during the Miocene period contributed to formation of the structural traps and hydrocarbon migration probably took place after the development of the structure. However, the closed anticlinal structure has been largely affected by prominent paleo-channels on its crest and western flank. More interestingly, similar paleo-river channels are found on the nearby Fenchuganj gas field by Parvin et al. (2019). Among seven sequence boundaries, gas sands A, B and C are encountered below SB-3 and are washed away prominently. Little crest of the depositional sequence is preserved which may be considered as minor reservoir sand. On the other hand, gas sands D, E, F and G are delineated below SB-2. They are preserved as prominent erosional sequence remnants compared to previous sequences which suggest major reservoir sands for hydrocarbon accumulation. Erosional features are also observed on the depth map (Fig. 11) and it was found that Srikail-1 well was drilled in the middle of the channel suggesting the plausible explanation of failure to produce commercial gas by BAPEX.

Seismic depth maps allowed delineating the reservoir boundary. Using petrophysical properties derived from wireline log analysis, the recoverable reserve was estimated for each gas sand. The maximum estimated

![Fig. 10 Depth contour map of A sand](image-url)
reserves are found in D sand (162.15 billion cubic feet) (Table 4) due to its lateral and vertical extent as well as penetration in all wells. Therefore, D sand will provide higher and sustainable production from all wells. However, the estimated reserves of B (103 BCF), E (138.46 BCF) and F (68.43 BCF) sands are also significant.

Table 4 Parameters used for reserve calculation

| Parameters                      | A sand | B sand | C sand | D sand | E sand | F sand | G sand |
|---------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Net-to-gross ratio (N/G)        | 0.954  | 0.914  | 0.46   | 0.575  | 0.873  | 0.75   | 0.176  |
| Gas–water contact (GWC)         | 2355 m | 2499 m | 2586 m | 3008 m | 3112 m | 3285 m | 3314 m |
| Porosity (\(\phi\))%            | 23     | 21     | 13.4   | 13     | 15.6   | 12.3   | 18.7   |
| Water saturation, Sw            | 0.637  | 0.36   | 0.57   | 0.47   | 0.366  | 0.47   | 0.306  |
| Gas formation volume factor, Bg | 0.00537| 0.00537| 0.00537| 0.00537| 0.00537| 0.00537| 0.00537|
| Recovery factor                 | 0.7    | 0.7    | 0.7    | 0.7    | 0.7    | 0.7    | 0.7    |
| Reserve (BCF)                   | 14.56  | 103    | 29.4   | 162.15 | 138.46 | 68.43  | 28.41  |
According to BAPEX, now production is running only from D sand. So it will be a good initiative to target the B, E and F sands to produce more gas.

It is also observed that all the four wells are drilled in the southern block of the structure and the same structure continues from south to the north. More importantly, the gas–water contact (GWC) is found to continue across the northern block. Based on the outcome of this study, it is recommended that at least one well should be drilled up to the depth of 3000 m in the northern block to test its hydrocarbon potentiality. The location of the proposed well (X-2628603.29 & Y-598266.56) is shown on Fig. 12.

### Conclusions

The reservoir characterization of Srikail gas field reveals the presence of seven hydrocarbon-bearing zones (A, B, C, D, E, F and G) identified from well log data within the measured depth range 2429.5–3501 m. The reservoir properties show the following ranges: shale volume varies between 8 and 38%, effective porosity 12.3 and 24.9%, water saturation 24.9 and 46.9%, hydrocarbon saturation 53.1 and 75.1% and net-to-gross ratio 10 and 56% and indicate that the zones are well saturated with hydrocarbon. Seismic sequence analysis points out that all the gas zones occur between SB-2 and SB-3. Using petrophysical data, the seven gas horizons were mapped that reveal that the NW–SE anticlinal
structure along with channel filled sediments make favorable conditions for trapping hydrocarbons in this area. In addition, the potential reservoir rocks in this area are mainly the sequence remnants and they are laterally and vertically well distributed. Volumetric reserve estimation shows the estimated total gas of seven gas sands is 552 BCF. However, apart from D sand (162.15 BCF), three gas sands (B–103 BCF, E–138.46 BCF and F–68.43 BCF) possess significant amounts of reserve. Currently, all the four wells are drilled in the southern block of the structure, and as there is a structural continuity from south to the north, it is recommended to drill a well up to 3000 m depth in the northern block to test its hydrocarbon potentiality. The location of the proposed well as suggested is (X-2628603.29 and Y-598266.56). Overall, the outcomes of this study provide crucial insights for designing and exploring hydrocarbons in an efficient way. By carrying out the combined analyses, our study determines important reservoir parameters and potential sequences which are critical for understanding the prospective reservoir zones as well as identification of new prospects.

Limitations and future research directions

Although this study provides some significant insights into petrophysical and sequence-based reservoir evaluation pertaining to reservoir characterization, it is not free from certain limitations. Such limitations, however, can open up new avenues for future researchers. For instance, we did not use core and permeability data in this study, which may be considered in the future studies. This study used 2D seismic data, whereas future study can consider 3D high-resolution seismic data for better exploration of the subsurface structure and hydrocarbon-bearing zones. However, the study results can be used, compared and correlated to the future studies for the better understanding of reservoir properties to identify new prospects throughout the Bengal basin.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1007/s13202-021-01217-y.

Acknowledgements

The research work was funded by the Ministry of Science and Technology, Government of Bangladesh. We gratefully acknowledge the contributions of everyone who helped us, specifically, the anonymous reviewers for their critical evaluation and constructive comments to enhance the quality of this research article. Authors highly acknowledge Bangladesh Petroleum Exploration and Production Company Limited (BAPEX) for providing data and Schlumberger Bangladesh for providing software. We appreciate the facilities provided by the Department of Geology, University of Dhaka.

Funding

This study was supported by the Ministry of Science and Technology, Government of Bangladesh through National Science and Technology Fellowship.

Data availability

The datasets used in this study were collected from Bangladesh Petroleum Exploration and Production Company Limited (BAPEX).

Declarations

Conflict of interest

The authors declare that they have no competing interests.

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