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Seismo-stratigraphic analysis of the Begumganj Structure in the Hatia Trough, Bengal Basin: implications for tectonostratigraphic evolution and trapping mechanisms

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Abstract

The Begumganj Structure of the Hatia Trough in the Bengal Basin is well-known for being a gas field. The trapping mechanism and tectonostratigraphic evolution of the trough are poorly understood due to lack of exposed rock units. In this drawback, this research aimed at seismo-stratigraphic analysis to understand the hydrocarbon potentiality, structural style, structure-stratigraphic interactions, and possible timing of the Begumganj Structure. Results show that the Begumganj Structure is elongated - oval shaped, asymmetrical gentle anticline with NNW-SSE-trending anticlinal axis. Most of the reflectors are strongly affected by channels, especially at the western flank. Wireline log interpretation of the well BG#1 shows a 16 m thick gas-bearing zone at depth of 2995 m (within the Miocene Bhuban Formation). Results from borehole data and interpretation of the seismic transects indicate the presence of mud or shale-filled erosional channel in the western flank of the Begumganj Anticline which results in a combinational trapping mechanism (i.e., structure-stratigraphic combinational trap). Results also show evidence of stratigraphic (pinch-out) trap at greater depths. Based on the reflection quality, lapping geometry, and reflection configuration from seismic transects and lithological information from the boreholes, three seismo-stratigraphic units have been identified. The oldest (Oligocene?) seismo-stratigraphic unit 3 shows south- or southeast-ward prograding clinoforms. The highly channelized seismo-stratigraphic unit 2 (equivalent to Miocene Surma Group) shows gradual south- or southeast-ward thickening in the lower part and relatively uniform thickness in the upper part. The topmost unit 1 (equivalent to Pliocene Tipam and Pleistocene Dupi Tila Groups) shows relatively high-frequency reflectors that are gradually onlapping to the anticlinal crest. This youngest (Pliocene to Recent) seismo-stratigraphic unit is also representing the syn-kinematic package, indicating a coeval time for the structural activation in response to the youngest episode of the Indo-Burmese subduction processes to the far east.

Keywords: Begumganj Structure, Hatia Trough, Seismo-stratigraphic analysis, Kinematic packages, Trapping mechanism

Introduction

The Bengal Basin accommodates an extremely thick Cenozoic sedimentary succession derived from the uplifted Himalayan and Indo-Burman Orogenic Belts in response to the subduction of the Indian Plate beneath the Eurasian and Burmese

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plates (ALAM *et al.* 2003). The Hatia Trough (Fig. 1) is a proven petroleum province that occupies much of the southern Bengal Basin (SHAMSUDDIN *et al.* 2001; IMAM 2005). The Begumganj Structure (Fig. 1), tectonically located at the junction between the Hatia Trough and Barisal-Chandpur Gravity High, is also well-known for being a gas field (ABDULLAH *et al.* 2013; RAHMAN *et al.* 2015) with an estimated 0.062 tcf proven reserve (HAQQANI & AHMED 1981).

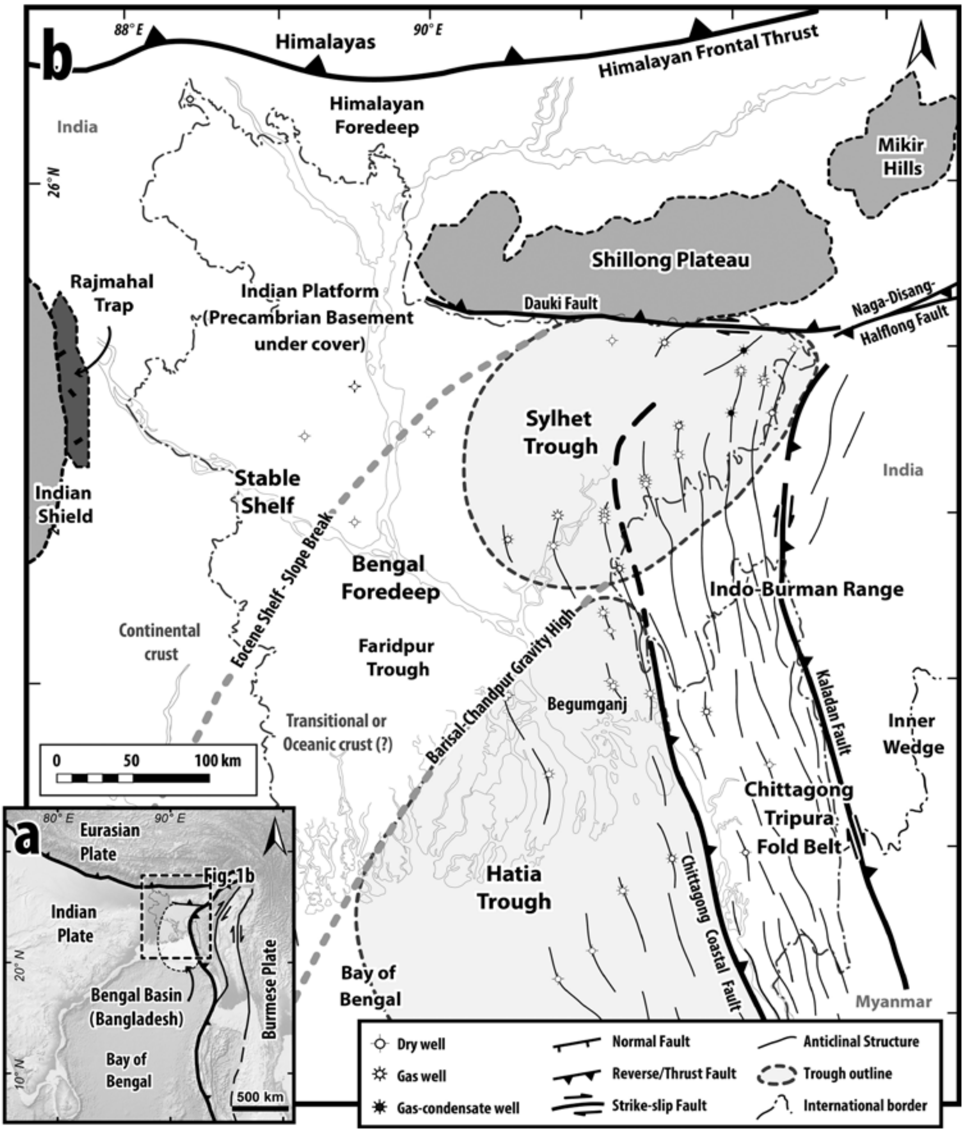

Fig. 1. The tectonic map of the Bengal Basin showing the major structural elements and the location of the Begumganj Structure in the Hatia Trough (modified after ALAM *et al.* 2003; ABDULLAH *et al.* 2013).

The NNW-SSE trending, low amplitude Begumganj Anticline is approximately 25 km long and 10 km wide (Abdullah *et al.* 2013). The structure has no surface expression and is covered by more than 100 m thick alluvium (Bakr 1977). The structure is bounded by the Feni Structure to the east, Bhola (Shahbazpur) Structure to the west and Kutubdia and Sangu structures to the south, and Lalmai and Bakhrabad structures to the north (Fig. 1b).

Structure, stratigraphy, tectonic evolution of the Begumganj Structure in the Hatia Trough is poorly understood and is correlated with the stratigraphic scheme of the Assam region or northeastern Sylhet Trough (Fig. 1) which is not in close proximity and therefore is scientifically problematic. In this drawback, this research aimed at seismo-stratigraphic analysis to unravel the structure, stratigraphy, and tectonic evolution of the Hatia Trough. To achieve the research aim, this work incorporates high-resolution seismic transects and borehole information.

Geological Setting

The Bengal Basin is bounded by the Precambrian Indian Craton to the west, the Shillong Massif to the north, and the Indo-Burman ranges to the east (Fig. 1b) (Khan 1991; Reimann 1993; Alam *et al.* 2003). The Hatia Trough occupies the southern onshore and offshore parts of the Bengal Basin (Fig. 1b). The boundaries of the trough are not well defined. To the north and northwest, the trough is bounded by the Barisal-Chandpur Gravity High (Fig. 1) which possibly corresponds to the boundary between attenuated continental and oceanic crusts (Khan 1991; Reimann 1993). To the east, the so-called "Chittagong Coastal Fault" (Fig. 1b) along the Chittagong coast marks the eastern boundary of the Hatia Trough. To the south, the trough opens into the Bengal Fan in the Bay of Bengal.

Tectonic development of the Hatia Trough of the Bengal Basin was controlled by the Cenozoic onset of the Himalayan Orogeny (Reimann 1993; Curiale *et al.* 2002; Alam *et al.* 2003; Hossain *et al.* 2019). During this event, the Indo-Burman Range was developed due to oblique subduction of the Indian Plate beneath the Burmese Plate (Mitchell 1993; Alam *et al.* 2003; Maurin & Rangin, 2009; Westerweel *et al.* 2019). To the west, Indo-Burman Range Belt is composed of a major fold-thrust system (Mandal *et al.* 2002) within the west-propagating accretionary wedge (Indo-Burmese Wedge) that also includes the Chittagong Tripura Fold Belt (Alam *et al.* 2003; Maurin & Rangin 2009).

The stratigraphy of the Hatia Trough is little known and has only been studied from discrete boreholes because there are no outcropping rock units in the trough. The borehole stratigraphy of the Hatia Trough (Fig. 2) is mainly based on correlation with rock units that are exposed in the north-eastern Bengal Basin (i.e., the Sylhet Trough) and in the Chittagong Tripura Fold Belt to the east (Khan 1991; Reimann 1993; Alam *et al.* 2003; Sikder & Alam 2003; Mandal *et al.* 2006).

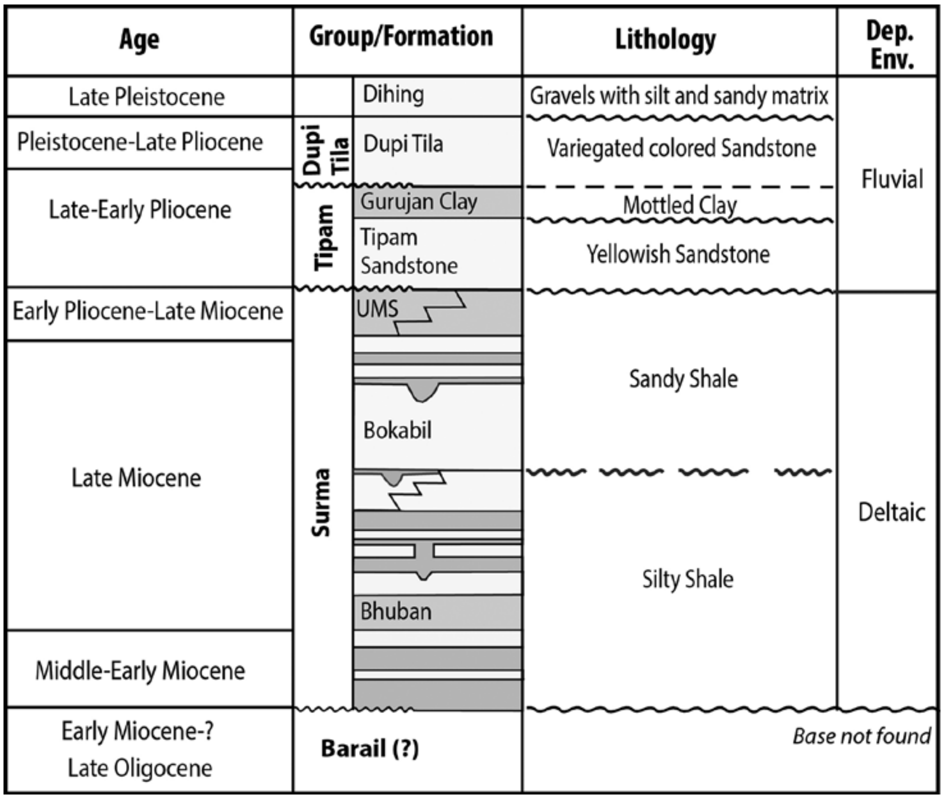

Fig. 2. Simplified stratigraphy of the Hatia Trough (after CURIALE *et al.* 2002; ABDULLAH *et al.* 2013) [Abbreviation: UMS – Upper Marine Shale]

The traditional lithostratigraphy of the Hatia Trough (Fig. 2) shows that the Miocene Surma Group (including the Bhuban and Bokabil formations) is the possible oldest rock unit. The deltaic Bhuban and Bokabil formations of the Surma Group consist of dark grey shale, siltstone, fine to coarse-grained sandstone, and occasional intraformational conglomerate (KHAN 1991; REIMANN 1993; SIKDER & ALAM 2003). The fluvio-deltaic Tipam Group overlies the Surma Group and can be divided into the Tipam Sandstone and Girujan Clay formations. The Pliocene Tipam Sandstone in the lower part of the group typically consists of yellowish-brown to reddish-brown, coarse-grained, cross-bedded to ripple-laminated sandstone with minor siltstone and mudstone (JOHNSON & ALAM 1991). The overlying Girujan Clay Formation is composed of brown, blue, and gray mottled clay (KHAN 1991; REIMANN, 1993). The Plio-Pleistocene Dupi Tila Formation unconformably overlies the Tipam Group (HILLER & ELAHI 1984). The fining-upward sequences with alternating channel-fill and floodplain deposits are characteristic of the Dupi Tila Formation (JOHNSON & ALAM 1991).

Data and method

This research incorporates twelve high-resolution seismic transects and two boreholes (Fig. 3c) (reinterpreted after Abdullah 2008), although only four seismic transects are presented in this paper. Wireline logs (SP and resistivity logs) from the Begumganj Gas Field's wells BG#1 and BG#2 are analyzed to determine the gas-bearing zone, which is then mapped using seismic transects. Borehole information is also used for the identification and tying off the key stratigraphic horizons. In addition, key seismo-stratigraphic units are identified and mapped based on the reflection quality, lapping geometry, and reflection configuration. Such parameters are also used to identify kinematic (i.e., tectonostratigraphic) packages. Finally, integration of wireline logs with borehole lithology and results from seismic interpretation are used to establish the stratigraphic framework.

Results

Wireline Log Interpretation

Interpretation of well BG#1 shows the four stratigraphic units, which are Dupi Tila, Tipam, Upper Surma (Bokabil Formation), and Lower Surma (Bhuban Formation) groups (Fig. 3a). At approximately 700 m, 1520 m, and 2600 m, the tops of the Tipam, Upper, and Lower Surma groups are encountered respectively (Fig. 3a). Conventional SP, resistivity, and gamma-ray logging were carried out in both wells. However, only SP and resistivity logs are available for this study.

Resistivity and SP logs of BG#1 (Fig. 3a, b) have been used in this study. The lithological interpretation based on SP log indicates that the section mainly consists of loosely consolidated sandstone with interbedded shale, claystone, and sandy shale. The main shale unit is recognized over the interval 1870 to 1930 m, 2160 to 2600m, and 2905 to 2995 m. The resistivity log (along with other log types) also indicates the presence of shale because of lower values. The shale zone of 2905 to 2995 m may be the caprock of the gas horizon. There are a few other remarkable shale or claystone units. From the well completion report, seven gas horizons were marked, but only one horizon shows confirmed gas flow. This 16 m thick gas-bearing zone is located at 2995 to 3012 m depths. Within this depth, the resistivity logs show very high values (~100 Ωm), and SP deflection suggests a porous, permeable formation which may indicate the presence of hydrocarbons at this depth (Fig. 3b). Another possible gas-bearing zone can be marked at 3585 m depth. Within the depth ranges of 2600 to 2700 m and 2750 to 2785 m (Fig. 3), variations in the SP and resistivity logs suggest a possible alternation of sandy shale sequences.

In the Begumganj well 02 (or BG#2), SP and resistivity log responses from 2130-3577 m depth (Fig. 3b) indicate the presence of thin shale and sandstone layers. In general, the sandstones are showing higher negative deflection in SP values. Based on the SP log, relatively thick shale layers are identified at 925-1100 m and 1990-2115 m depths. This second well did not encounter any gas-bearing sandstone, possibly due to erosion by the channel which is later filled with clayey material (Fig. 3b).

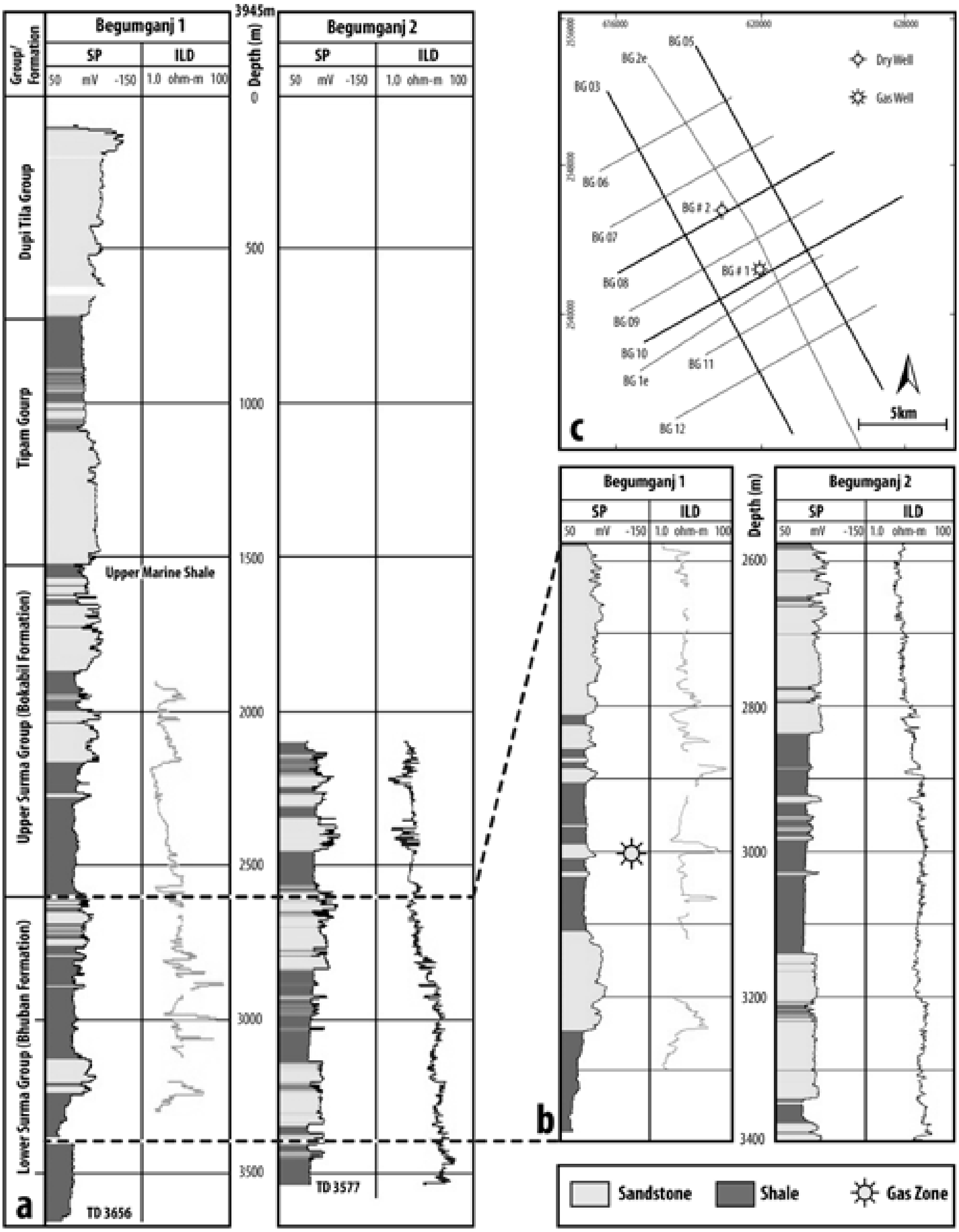

Fig. 3. (a) Interpretation of wireline logs (SP and resistivity logs) of the well BG#1 and BG#2 of the Begumganj gas field. (b) Zoomed section of the wireline logs is showing the gas-bearing zone. (c) Base map showing the location of the seismic lines and boreholes.

Seismic Interpretation

Seismic transects (Fig. 3c) have been interpreted to identify seismo-stratigraphic units and to map several important seismic horizons. Here, only four ideal seismic transects (i.e., BG 03, BG 05, BG 08, and BG 10) are presented (Figs. 4 & 5) and discussed.

The apparently E-W trending seismic transects BG 08 and BG 10 (Fig. 4) are the important dip lines crossing the central parts of the Begumganj anticline. On the other hand, the seismic transects BG 03 and BG 05 (Fig. 5) are the strike lines trending N-S and are crossing the western and eastern parts of the Begumganj Anticline respectively. The boreholes BG#01 and BG#02 intersect at the central parts of the transects BG 10 and BG 08 respectively (Fig. 3c). In general, both the transects are showing fair to good reflection quality. Although, the reflection quality gradually decreases downward, based on reflection quality, lapping geometry, and reflection configuration (Figs. 4 & 5), the section can be divided into three seismic packages.

The lowermost seismic unit (i.e., the seismo-stratigraphic unit 3) is characterized by relatively high amplitude, low frequency and poorly continuous parallel to subparallel reflectors (Figs. 4 & 5). Along the strike lines (i.e., BG 03 and BG 05), this seismic package shows clear evidence of south or southeastward prograding clinoforms (Fig. 5a, b). Unfortunately, none of the boreholes (Fig. 3a) are deep enough to penetrate this seismic unit, and therefore, the lithology and equivalent lithostratigraphy is yet to be established. However, we infer that the seismo-stratigraphic unit is possibly older than the Lower Surma Group or equivalent to the Oligocene (?) sedimentary successions.

The seismo-stratigraphic unit 3 is overlain by the middle seismo-stratigraphic unit 2, which shows relatively low frequency, high amplitude, parallel to subparallel, fairly continuous reflectors that are frequently truncated by large erosional channels (Fig. 4a, b). The lower part of this middle seismo-stratigraphic unit 2 shows a gradual increase in thickness towards the south or southeast. The well information from BG#01 and BG#02 suggests that this seismic unit 2 is equivalent to the Miocene Surma Group. In general, both units 2 and 3 show relatively uniform thickness across the dip sections (Fig. 4a, b). Therefore, these two seismo-stratigraphic units (i.e., units 2 and 3) can be interpreted as the pre-kinematic package (i.e., deposited before the structural activation).

The gas-bearing horizons are located within this seismo-stratigraphic unit 2 (Fig. 4b). Based on the borehole information from well BG#01, a 16 m thick gas-bearing horizon (i.e., the gas zone 1) at the depth of 2995 m can be tied with the prominent reflector at 2300 milliseconds two-way time. Log data from the well BG#02 also suggests that the gas-bearing reflector is truncated by an erosional channel (Fig. 4a). This is also consistent with the previous interpretation (ABDULLAH *et al.* 2013).

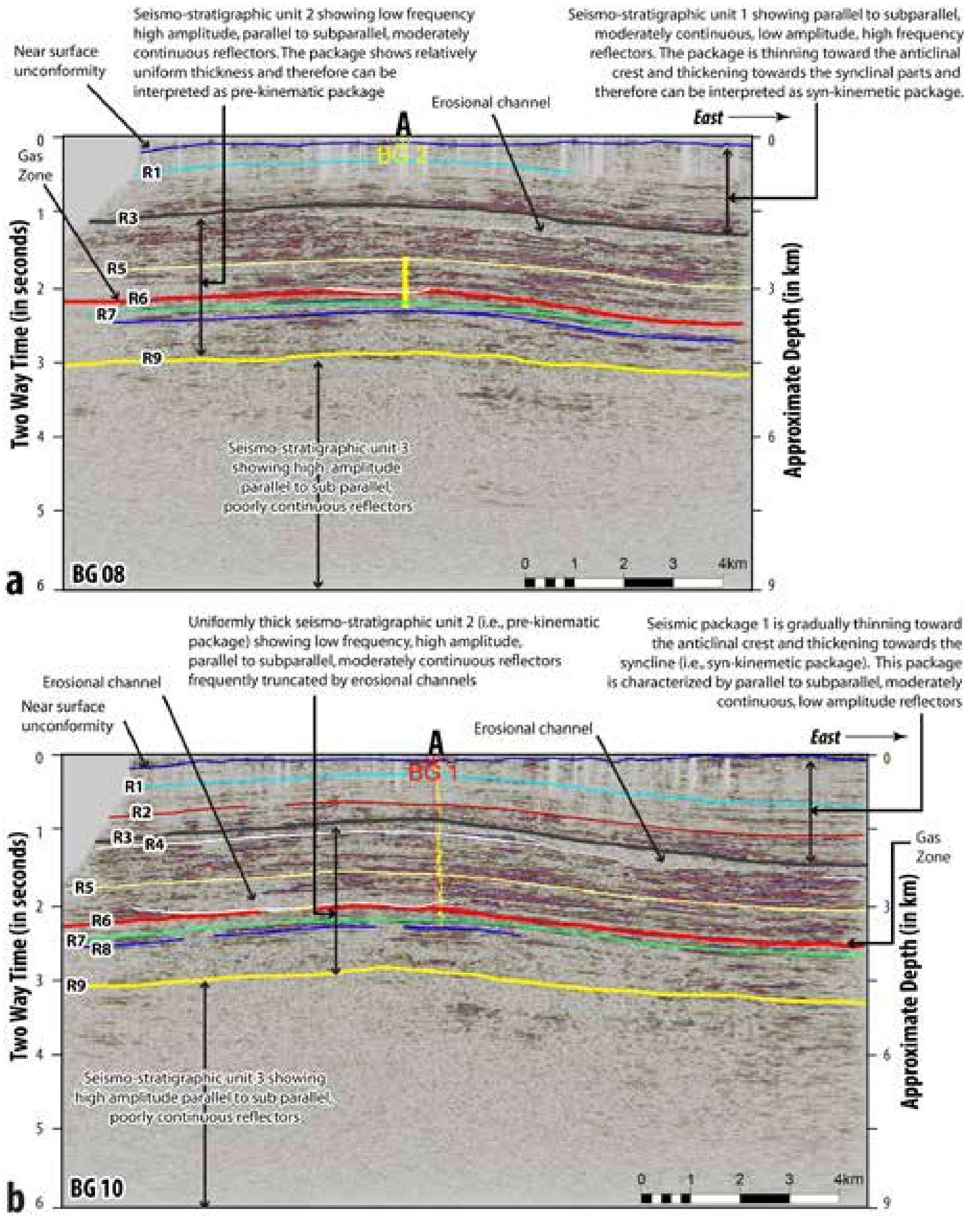

Fig. 4. Interpreted E-W trending dip seismic transects (a) BG 08 and (b) BG 10 across the Begumganj Anticline showing the distribution of the seismo-stratigraphic packages and location of the gas zone.

Another possible gas-bearing horizon can be correlated with the reflector at 2300 milliseconds of two-way time (ABDULLAH *et al.* 2013).

To the top, the seismo-stratigraphic unit 1 is characterized by moderately continuous,

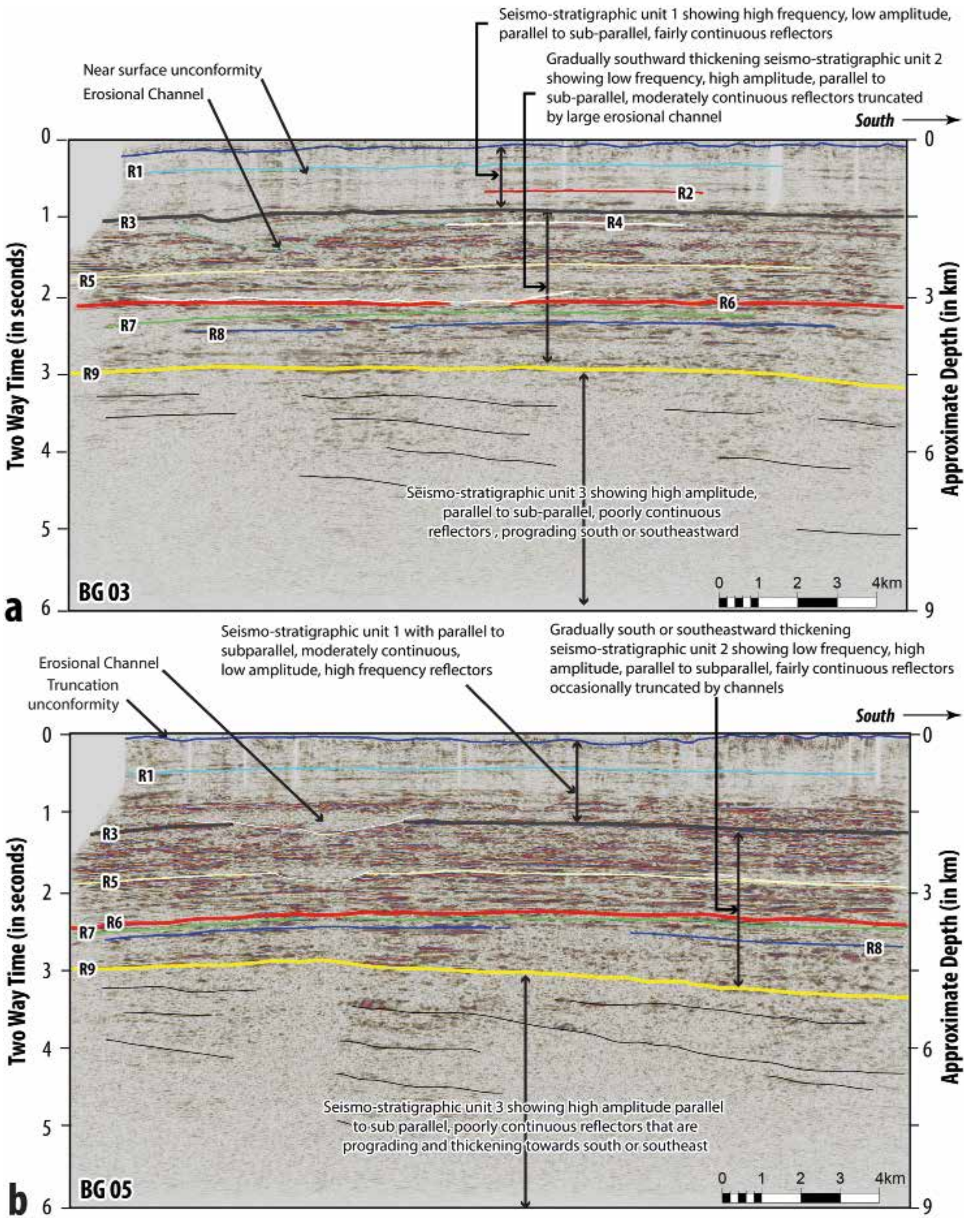

Fig. 5. Interpreted N-S trending strike seismic transects (a) BG 03 and (b) BG 05 across the Begumganj Anticline showing the distribution of the seismo-stratigraphic packages.

parallel to sub-parallel, relatively low amplitude, high-frequency reflectors (Fig. 6). Based on the borehole data of well BG#01 and BG#02, this topmost unit corresponds to the undifferentiated Pliocene Tipam Group and Plio-Pleistocene Dupi Tila Group or their equivalents. In the lower part of this unit, some of the reflectors are poorly onlapping above the underlying seismo-stratigraphic unit 2 (Fig. 4). In general, this reflection package is thickening towards the synclinal parts and thinning towards the anticlinal crest (Fig. 4). This implies that this youngest seismo-stratigraphic unit 1 (Figs. 4 and 5) was deposited during the time of the structural activation (i.e., the syn-kinematic package).

Structural interpretation across the dip seismic transects BG 08 and BG 10 (Fig. 4) have shown the presence of an anticlinal structure at the subsurface, with both the limbs are dipping very gently in opposite directions. The anticline is nearly symmetrical with an upright axial plane (Fig. 4). This seismic transect shows no solid evidence of faulting (Fig. 4), but the overall board fold geometry of the Begumganj Anticline (ABDULLAH *et al.* 2013) indicates that a deep-seated reverse fault is not unlikely. Structural interpretation across the strike lines BG 03 and BG 05 (Fig. 5a, b) does not present much structural information. However, the reflectors in the seismo-stratigraphic units 2 and 3 show clear evidence for plunging in both north and south directions (Fig. 5a, b).

Discussion

Structural style of the Begumganj Anticline

The Begumganj Structure is located in the northern tip of the Hatia Trough. The time structure maps of the interpreted horizons show that the Begumganj Structure is an elongated - oval shaped, NNW-SSE-trending, double plunging anticline (Fig. 6). Thus, the structure demonstrated a simple four-way closure. No-fault has been mapped within these time structure maps. However, the time structure map of the gas-bearing zone (R6 map; Fig. 6d) is disrupted by a major erosional channel to the west. Minor erosion also presents near the well BG#2, which may be the cause for the absence of the gas-bearing zone in this borehole.

All the time structure maps (Fig. 6a-e) have shown a similar shape down to the depth of approximately 2200 milliseconds two-way time (R7 horizon). Interpretation of these maps (Fig. 6a-e) shows that the contour spacing is narrower to the east, implying that the eastern flank is relatively steeper. Near the plunging zone to the north and south, contours show relatively greater spacing and thus suggest a relatively gentle slope. However, the shape of the contours changes significantly in the R9 map at approximately 2825 milliseconds two-way time (Fig. 6f). To the north, the contours are bifurcated and show two fringes with relatively wider contour spacing and thus implying a relatively gentle slope (Fig. 6f). Time contour map (Fig. 6f) shows that the contour spacing is narrower to the southeastern part, possibly due to the south-eastward progradation of the lower seismo-stratigraphic unit (seismo-stratigraphic unit 3; Fig. 5).

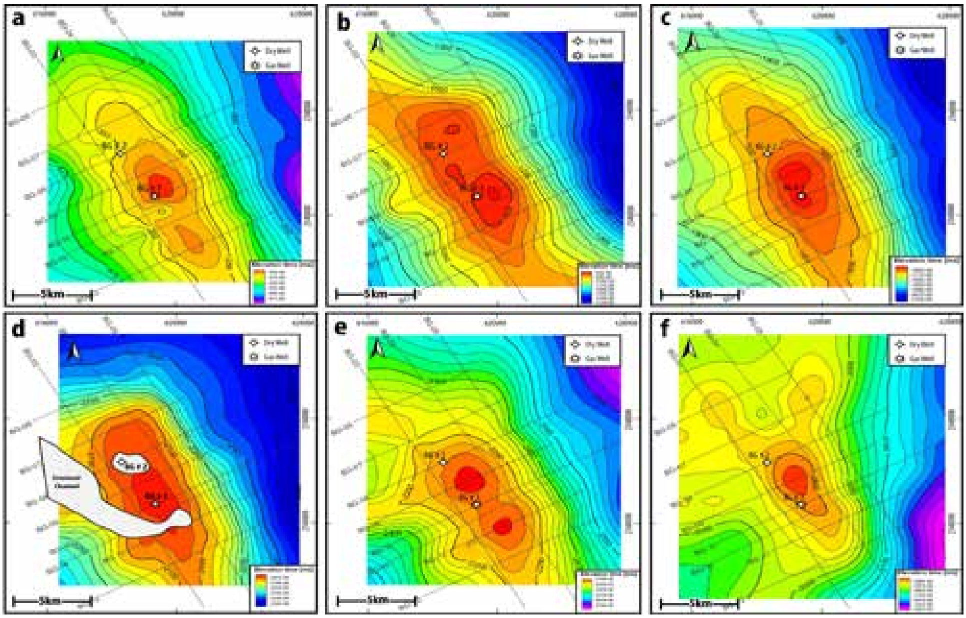

Fig. 6. Time contour maps (contour interval 25 ms) of the Begumganj Anticline of the reflectors (a) R1 at ~ 300 milliseconds TWT; (b) R3 at ~ 875 milliseconds TWT; (c) R5 at ~ 1500 milliseconds TWT; (d) R6 at ~2050 milliseconds TWT; (e) R7 at ~ 2200 milliseconds TWT, and (f) R9 at ~ 2825 milliseconds TWT.

Seismo-stratigraphy of the Hatia Trough

Based on the seismic reflection characteristics (e.g., reflection configuration, continuity, frequency, amplitude) and borehole information (BG#1 and BG#2), three seismo-stratigraphic units (unit 1, 2, and 3) have been identified (Figs. 4 & 5). The oldest is the seismo-stratigraphic unit 3 which, is characterized by south or southeast-ward prograding clinoforms. Unfortunately, no borehole has penetrated this unit 3. However, based on the seismic character and stratigraphic position, we infer that this unit is possibly equivalent to the Oligocene (?) sedimentary successions.

The middle seismo-stratigraphic unit 2 shows a minor south or southeast-ward thickening in the lower part and maintains relatively uniform thickness in the upper to middle parts. This unit 2 is truncated by several erosional channels. Borehole data suggests that this seismo-stratigraphic unit corresponds to the Miocene Surma Group or equivalent sediments. This interpretation is also consistent with the previous works (GANI & ALAM 2003; NAJMAN *et al.* 2012; ABDULLAH *et al.* 2013).

The youngest seismo-stratigraphic unit 1 is dominated by high frequency, parallel to sub-parallel reflectors, are gently onlapping to the anticlinal crests. Lithostratigraphy from the boreholes BG#1 and BG#2 suggests that this youngest seismo-stratigraphic unit 1 corresponds to the sandstone dominating Pliocene Tipam and Plio-Pleistocene Dupi Tila groups or equivalent.

Tectonostratigraphic evolution of the Begumganj Anticline in the regional context

The seismic packages 2 and 3 can be interpreted as the pre-kinematic tectonostratigraphic package that is equivalent to the Miocene Surma Group and/or older (Oligocene?) sedimentary successions. These pre-kinematic sediments were possibly deposited at the time (up to the Miocene) when there was no major structural activation. However, the overlying Pliocene and younger syn-kinematic tectonostratigraphic package (the equivalent of Tipam and Dupi Tila group sediments) indicates the major episode of structural activation occurred at that time. This is also consistent with the regional tectonics of the Hatia Trough or of the Bengal Basin since no major episode of compressional tectonics has been reported prior to Pliocene (Maurin & Rangin 2009; Hossain *et al.* 2019). In the Hatia Trough, the major episode of structural activation initiated in response to the subduction of the Indian Plate beneath the Burmese Plate since Pliocene (Alam *et al.* 2003; Hossain *et al.* 2019).

Presence of hydrocarbon and trapping mechanism

The Hatia Trough is a proven petroleum province (Shamsuddin *et al.* 2001; Curiale *et al.* 2002; Abdullah *et al.* 2013). In the Begumganj Anticline, the only proven gas-producing sand zone is located within the Miocene Bhuban Formation. There is no direct indication of gas water contact from the well BG#1, but pressure data suggests that the gas water contact is at 3027 m depth (Abdullah *et al.* 2013). Reserve was estimated to be 0.062 tcf in the proven category and 0.063 tcf in the probable category (Haqqani & Nazim 1981).

The Begumganj gas field is dominantly an anticlinal trap with NNW-SSE axial trend (Figs. 4-6). This elongated anticlinal structure shows a simple four-way dip closure and gas sand level is disrupted by an erosional channel to the west and near the well BG#2 (Fig. 6d). Lithological information from the borehole BG#2 indicates that this erosional channel is filled with mudstone. The mud-filled channel can act as burier, and therefore, the trap can be defined as a structure-stratigraphic combinational trap (Abdullah *et al.* 2013). In the Begumganj area of the Hatia Trough, stratigraphic pinch-outs at greater depths (below 2700 milliseconds two-way time) may also act as an excellent trap for hydrocarbon accumulation and therefore needs to be evaluated for future exploration.

Conclusions

Interpretation of the seismic transects, time structure maps, and wireline logs of the study area provide the following conclusions:

(1) The Begumganj Structure, a proven gas field in the north-eastern Hatia Trough, is characterized by an elongated-oval-shaped NNW-SSE-trending gentle anticline with no major faults. Based on borehole information and seismic interpretation, a 16 m thick gas-bearing zone at a depth of 2995 m within the Miocene Bhuban Formation has been identified. The time map of the gas-bearing zone shows a major channel erodes this gas zone in the western part and partly near the well BG#2. This mud or shale-filled erosional channel in the western flank of the anticlinal structure resulted in a combinational trapping mechanism (structure-stratigraphic combinational trap) which is also consistent with previous works. Deeper stratigraphic (pinch-out) traps are also possible.

(2) Three seismo-stratigraphic units have been identified. Among these, the oldest unit or unit 3 includes the Oligocene (?) clinoforms and are prograding south or southeast-ward. The overlying seismo-stratigraphic unit 2 is highly channelized and shows gradual south- or southeast-ward thickening in the lower part and relatively uniform thickness in the upper part. To the top, the youngest (Pliocene to Recent) seismo-stratigraphic unit 1 is characterized by relatively high-frequency reflectors that are gradually onlapping to the anticlinal crests.

(3) Timing of the structural activation is speculative. However, the presence of Pliocene and younger syn-kinematic (Tipam and Dupi Tila groups or equivalent) packages indicate a coeval time for the structural activation. This Pliocene and onward structural activation can be linked to the westward propagation of the fold-thrust system in response to the Indo-Burman subduction system.

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বেঙ্গল বেসিনের হাতিয়া খাদ এর অন্তর্গত বেগমগঞ্জ গঠনের সাইসমোস্ট্রাটিগ্রাফিক বিশ্লেষণঃ টেকটোনোস্ট্রাটিগ্রাফিক বিবর্তন ও ট্রাপিং পদ্ধতিতে এর গুরুত্ব

সানজিদা ইকবাল ইভা, রাশেদ আবদুল্লাহ ও আহাদুল ইসলাম

সারসংক্ষেপ

বেঙ্গল বেসিনের হাতিয়া খাদের অন্তর্গত বেগমগঞ্জ গঠনটি একটি অতিপরিচিত গ্যাসক্ষেত্র। উম্মুক্ত শিলাস্তরের অভাবে খাদটির টেকটোনোস্ট্রাটিগ্রাফিক বিবর্তন ও ট্রাপিং পদ্ধতি কিছুটা অজানা। বর্তমান প্রেক্ষিতে এই গবেষণা কর্মটিতে সাইসমোস্ট্রাটিগ্রাফিক বিশ্লেষণের মাধ্যমে বেগমগঞ্জ গঠনের তেল-গ্যাস প্রাপ্তির সম্ভাব্যতা, কাঠামোগত ধরন, গঠন এবং স্ট্রাটিগ্রাফির পারস্পরিক সম্পর্ক এবং সম্ভাব্য সময়কাল অনুসন্ধান করা হয়েছে। গবেষণার ফলাফল নির্দেশ করে যে, বেগমগঞ্জ গঠনটি একটি ডিম্বাকৃতি, অপ্রতিসম, উর্ধ্বভাঁজ যার অক্ষটি উত্তর-উত্তর পশ্চিম হতে দক্ষিণ-দক্ষিণ পূর্ব দিকে। এই গঠনটির অধিকাংশ রিফ্লেকটর চ্যানেল দ্বারা প্রভাবিত। বেগমঞ্জের ১নং কূপ হতে প্রাপ্ত লগ উপাত্ত বিশ্লেষণ করে বলা যায় যে, ২৯৯৫ মিটার নিচে ১৬ মিটার পূরুত্বের একটি গ্যাস স্তর আছে। যা সম্ভবত মায়োসিন সময়কার ভূবন শিলাস্তরের অন্তর্গত। কূপ এবং সাইসমিক উপাত্ত হতে প্রাপ্ত ফলাফল বেগমগঞ্জের পশ্চিম অংশে চ্যানেল দ্বারা আবদ্ধ একটি গাঠনিক-স্তরতাত্ত্বিক কম্বিনেশনাল ট্রাপের উপস্থিতি ইঙ্গিত করে। প্রাপ্ত ফলাফলের ভিত্তিতে বেগমগঞ্জের গভীরে একটি স্তরতাত্ত্বিক (পিঞ্চ আউট) ট্রাপের উপস্থিতি লক্ষ্য করা যায়। সাইসমিক রিফ্লেকশনের মান, জ্যামিতিক গঠন এবং কূপ হতে প্রাপ্ত শিলাসমূহের তথ্যাদি বিশ্লেষণ করে তিনটি সাইসমোস্ট্রাটিগ্রাফিক ইউনিট চিহ্নিত করা হয়েছে। এর মধ্যে প্রাচীনতম (ওলিগোসিন) সাইসমোস্ট্রাটিগ্রাফিক ইউনিট নং ৩ দক্ষিণ বা দক্ষিন-পূর্বে অগ্রসরমান ক্লাইনোফর্ম নির্দেশ করে। মায়োসিন বা সমসাময়িক সাইসমোস্ট্রাটিগ্রাফিক ইউনিট নং ২ ব্যাপকভাবে চ্যানেল দ্বারা প্রভাবিত যার নিম্নাংশ দক্ষিণ বা দক্ষিণ-পূর্বে ক্রমবর্ধমান পূরুত্ব নির্দেশ করে। পক্ষান্তরে এই ইউনিট এর উপরাংশ মোটামুটি সমপূরুত্ব নির্দেশ করে। ইউনিট ১ (প্লাইস্টোসিন টিপাম এবং প্লাইস্টোসিন ডুপি টিলা বা তার সমসাময়িক) এর অন্তর্গত রিফ্লেকটরগুলো উর্ধ্বভাঁজের চূড়ার দিকে অনল্যাপিং। এই কনিষ্ঠতম ইউনিটটি (প্লাইয়োসিন হতে বর্তমান) সিন-কাইনেমেটিক শিলাস্তর নির্দেশ করে, যা পূর্ব দিকের ইন্দো-বার্মিজ সাবডাকশন প্রক্রিয়ার কনিষ্ঠতম সময় কালকে নির্দেশ করে।