Determination of fracture trends and facies characterisation of Rohtas Limestone, Son Valley, Vindhyan Basin

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Summary

Vindhyan Basin is the largest sedimentary basin in terms of sedimentary thickness situated in the north central part of India. Gas discovery in Nohta-B from Rohtas Limestone has opened up a new spectrum for the prospectivity of Son Valley sector of Vindhyan Basin. So far, out of fourteen Exploratory Wells drilled within the Damoh-Jebara-Katni PEL Block in the Son Valley Vindhyan Basin, eleven wells have proved the presence of gas from the and more specifically, eight wells have produced gas from the Rohtas Limestone with a maximum production rate of $3897m^3/d$ in Nohta-C. The gas accumulations are mainly associated with the maximum concentration of fractures in view of absence of any significant porosity as the reservoir is very tight in nature. Therefore, the fracture/fault analysis are of utmost important for the identification of likely locales for hydrocarbon accumulation along fracture driven secondary porosity and the fracture patterns will be governed by major tectonic trends and paleo-stress directions. The objective of the present study is to understand the reservoir characteristics and fracture trend to assess the hydrocarbon potential of this area. The present work is an integrated and comprehensive evaluation of Rohtas Limestone, by subdividing it into different units/zones by multidisciplinary approach (i.e. sedimentology, geochemistry and logging). Rohtas Limestone is dominantly limestone in upper and lower part and generally tight in nature, whereas the middle part is mainly shaly with thin limestone bands. The primary porosity is almost negligible. The only effective porosity present is the fracture porosity. An attempt has been made to further subdivide this formation based on electrolog data and fracture identification using FMI logs.

Keywords: Rohtas Limestone, fractures, FMI log

Introduction

The discovery of gas in Nohta-B within the Rohtas Limestone has opened up a new spectrum to the prospectivity of Son Valley sector of Proterozoic Vindhyan Basin. The present work is focused towards the comprehensive evaluation of Rohtas Limestone by subdividing it into different macro and micro units/zones by multidisciplinary approach. Lack of visible fossils and diagenetic overprints make facies analysis in Proterozoic carbonate successions difficult and thus are rarely reported in literature (Sherman et al., 2001).

In the present study, authors have attempted to bring out the different facies subdivisions, their characters and depositional architecture that prevailed during the deposition of Rohtas Limestone of the Vindhyan Supergroup.

Geological Background

Among the Purana basins (1600-600 Ma) in the Indian craton, one of the best known is the Vindhyan Basin or Vindhyan Supergroup (Krishnan, 1968; Kale, 1991, and Chaudhuri et al., 1999). The Meso- to Neo-Proterozoic intracratonic arcuate shaped Vindhyan Basin is the largest sedimentary basin in terms of sedimentary thickness situated in the north central part of India, covering an area of about 1, 00,000 sq. km. The true extent of the basin is difficult to understand as large part of the sediments are concealed under the sediments of Gangetic alluvium in the north and also the southern margin of the basin is concealed partly under the Deccan Traps and partly under the recent alluvium cover. The Great Boundary Fault (GBF) and the Narmada-Son Lineament delineates the north-western and south-eastern margins of the basin respectively (Fig. 1a). The basin contains un-metamorphosed and only mildly deformed sediments with remarkable preservation of sedimentary structures both in siliciclastics and carbonates. Sedimentation in the Vindhyan Basin took place in an intracratonic and epicontinental setting dominantly of shallow marine in nature (Chanda and Bhattacharyya, 1982).

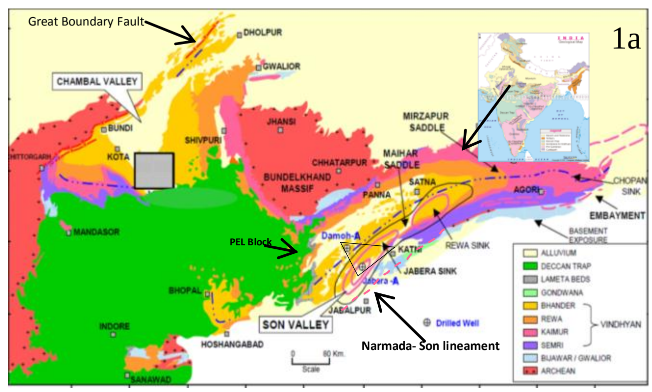
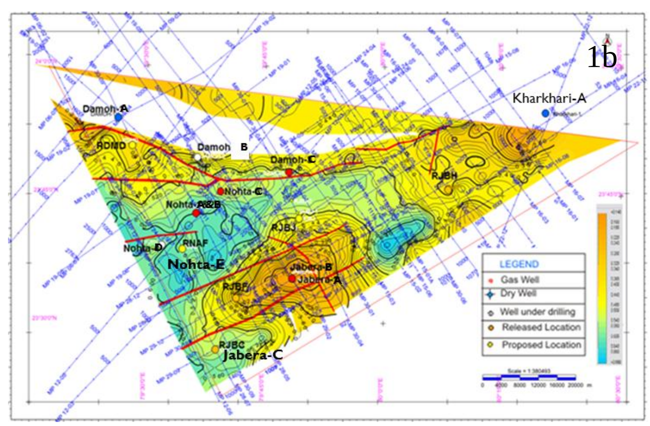


Fig. 1: a) Geological map of Vindhyan Basin (Source: DGH, 2013), b) Damoh-Jabera-Katni PEL Block showing location of drilled wells.



The Vindhyan Supergroup in central India is two tiered, up to 4500m thick and chiefly composed of shallow marine siliciclastics and carbonates (Fig. 1a). The Rohtas Limestone belongs to the upper part of the Lower Vindhyans or the Semri Group (Table-1) and is terminated above by an unconformity from the overlying Kaimur Formation which is mainly siliciclastic in composition (Bose et al., 2001), barring few exception. The two sequences designated as the lower and upper Vindhyans are further subdivided into alternate highstand systems tract (HST) and transgressive systems tract (TST). The Vindhyan Basin is generally considered as a shallow marine epeiric sea opening southwestward (Chanda and Bhattacharyya, 1982; Bose et al., 2001; Chakraborty, 2006). The work has been carried out in Son Valley of Vindhyan Basin, Central India on the basis of data obtained from the ten wells drilled, three each from Damoh, Nohta and Jabera and one from Kharkhari structures (Fig. 1b). Laboratory data on the basis of lithological, petrographic, mineralogical, clay mineral (XRD) and SEM studies of cores and cuttings was integrated for the purpose. The electrofacies of different units are subdivided and fracture identification has been carried out using XRMI data.

Table 2: Generalized stratigraphic chart of Chambal Valley with a Son Valley comparison

SUPER GROUP	GROUP	SUBGROUP	WEST VINDHYAN BASIN (CHAMBAL VALLEY): CHITTOR-BUNDI AREA (After Prasad, 1976) STRATIGRAPHY	GWALIOR-KARAULI AREA (After Prasad, 1984)	STRATIGRAPHY	EAST VINDHYAN BASIN (SON VALLEY): DAMOH-REWA AREA (After Srivastava et.al. 1983)		STRATIGRAPHY	M.	MIRZAPUR-ROBERTGANJ AREA (After Sastri & Moitra 1984)	STRATIGRAPHY
					DECCAN TRAP			LAMETA FM.			SUB-RECENT LATERITE
VINDHYAN SUPERGROUP	UPPER VINDHYAN GROUP	BHANDER	DHOLPURA SHALE	BHANDER SUBGROUP		BHANDER SUBGROUP	HAVELI FM.	MAIHER SST.	87		
			BALWAN LIMESTONE								
			MAIHER SST.		UPPER BHANDER SST.						
			SIRBU SHALE		SIRBU SHALE			SIRBU SHALE	80		
			BUNDI HILL SST.		LOWER BHANDER SST.						
			SAMARIA SHALE		SAMARIA SHALE		BETWA FM.	NAGOD LST	112		
			LAKHERI LST.								
			GANURGARH SHALE					GANURGARH SHALE	45		
		REWA	GOVINDGARH SST.	REWA SUBGROUP	UPPER REWA SST.	REWA SUBGROUP	ADHESAR FM.	GOVINDGARH SST.	55		
			JHIRI SHALE		JHIRI SHALE			JHIRI SHALE	34		
			INDARGARH SST.		LOWER REWA SST.		ADWA FM.	ASAN SST.	64		
			PANNA SHALE		PANNA SHALE			PANNA SHALE	34		
		KAIMUR	AKODA MAHADEV SST.	KAIMUR SUBGROUP	AKODA MAHADEV SST.	KAIMUR SUBGROUP	CHURK FM.	DHANDRAUL QTZ.	185	KAIMUR GROUP	DHANDRAUL SANDSTONE
			CHITTAUR FORT SST.					SOMAN SCARP SST.	140		MANGESAR FORMATION
							RAMPUR FM.	BIJAIGARH SHALE	34		BIJAIGARH SHALE
								DOMARKHOKA QTZ.	95		GHAGHAR SANDSTONE
											SUSNAI BRECCIA
											SASARAM SANDSTONE
	LOWER VINDHYAN GROUP		SUKET SHALE	TIROHAN GROUP	TIROHAN BRECCIA	SEMRI GROUP	ROHTAS FM.	BHAGAWAR SHALE	420	ROHTAS SUBGR	BHAGAWAR SHALE
			NIMBAHERA LST.					ROHTAS LIMESTONE			ROHTASGARH LST.
			BARI SHALE								
			JIRAN SST. WITH CONGL.		CONGLOMERATE		KHEINJUA FM.	BASUHARI (GLAUCONITIC) SST.	320	KHEINJUA SUBGR	RAMPUR GLAUCONITE
			BINOTA SHALE		TIROHAN LST.						
			KALMIA (GLAUC.) SST		GLAUCONITIC BEDS			MOHANA (FAWN) LST.	207		SALKHAN LST.
			PALRI SHALE WITH PORCL.					CHARKARIA (OLIVE) SHALE	561		KOLDAHA SHALE
			SAWA SST. WITH CONGL.		SST. WITH CONGLOMERATE		CHOPAN FM.	JARDEPAHAR PORCELLANITE	555	PORC. SUBGR	DEONAR PORCELLANITE
			BHAGWANPURA LST.					KAJARAHAT LIMESTONE	335	MIRZAPUR SUBGROUP	KAJARAHAT LIMESTONE
											ARANGI FORMATION
			KHARDEOLA SST.					BASAL CONGLOMERATE			DEOLAND FORMATION
			KHARMALIA ANDESITE								
ARAVALI GROUP				GWALIOR GROUP		BIJAWAR GROUP				BIJAWAR / MAHAKOSHAL GROUP	
BUNDELKHAND GNEISS				BUNDELKHAND GNEISS / GRANITE		BUNDELKHAND GNEISS				BUNDELKHAND GNEISS	

Table-1: Generalized stratigraphy of Vindhyan Basin (Son and Chambal Valleys)

Facies Characterization

Rohtas Limestone represents a typical rhythmite consisting of repetitive shale-limestone/dolomite alternations. In the present study, an attempt has been made to bring out the different facies subdivision, their characters and depositional architecture that prevailed during the deposition of Rohtas Limestone of the Vindhyan Supergroup. The Rohtas Limestone was deposited over the Basuhari Formation. It represents a basin-wide gentle south-westerly sloping large inner shelf set-up suitable for deposition of a thick carbonate sequence in a quiet water environment. It has been sub divided into three broad mappable units, the lower, middle and the upper units, based on the broad lithological characteristic (Fig. 4). The upper and lower units are dominantly limestone with thin shale interbeds whereas the middle unit is argillaceous in nature with intervening thin limestone beds.

Zonation of Rohtas Limestone based on litho & electrofacies

The three broad units are well developed and correlated within the Rohtas Limestone in all the studied wells of Nohta, Jabera and Damoh structures. However, based on log signatures, 10 electrofacies (Fig. 3) or sub-units have been identified in all the wells. Only in well Kharkhari-A, 9 electrofacies, 3 each in upper, middle and lower unit are developed.

Lower Rohtas Unit:

The lower unit mainly consists of greyish white, buff to reddish brown, selectively sparitised and partially dolomitized limestone with thin lamination of argillaceous matter and thin calcareous shale interbeds. The shale sequence is dark grey, thinly laminated and pyritiferous at times. The character of limestone varies from homogenous, friable, non-indurated lime mud to slightly indurated, argillaceous and organic matter rich limestone. Microfacies investigation of the limestone reveals that the limestone is micritic in nature showing varied degrees of sparitization and also preferentially dolomitized. The degree of dolomitization in lower unit is more than that of upper unit indicating effects of burial as significant. The argillaceous part is rich in organic matter and consists of scattered quartz grains in a groundmass of micrite and/or microsparite.

Lower Unit is divided into three sub-units, viz. Lower Unit-I, II and III, which are correlatable in all studied wells. The uppermost sub-unit (i.e. Lower Unit-I) on top part of the lower unit is not developed in Damoh-A.

This unit, comprises almost a uniform thickness (av. 110-130m) over the entire Damoh-Jabera-Katni Block, was penetrated in all the drilled wells except Nohta-B and Jabera-C. In well Damoh-A, drilled over an inverted structure also referred to as Damoh high, only a thin sequence of 63m of Lower Rohtas unit has been developed. The reservoir is very tight and porosity development is negligible, except some minor intercrystalline porosity developed during dolomitization as a result of compaction or volume shrinkage (Fig. 2a). The fracture development is also negligible, however, where overburden stress is less some fractures are seen under the microscope (Fig. 2b).

Middle Rohtas Unit

The Middle Rohtas Unit, having a moderate thickness of 200-300m, represents a predominantly argillaceous unit with infrequent interlaminations of calcareous shale/siltstone and thin to thick beds of limestone sandwiched within the thick shale. Shale is dark grey, poorly fissile, silicified, micaceous and feebly calcareous. This unit is not found to be developed over Damoh high in well Damoh-A. Well Nohta-B did not penetrate this unit, while well Jabera-C has penetrated only the upper 50m of this middle unit. The microfacies of the limestone beds of this unit are dominantly mudstone with associated carbonaceous and argillaceous matter. Mudstone is recrystallized and sparitised and partially dolomitized. Micro-fractures are also observed at places (Fig. 2c).

SEM study shows that mudstone facies is very tight in nature and porosity is almost negligible. XRD analysis of the shale samples indicates presence of kaolinite, illite and chlorite with traces of montmorillonite. The lithological assemblages deposited during the Middle Rohtas unit suggests deposition under a pulse of minor transgression resulting in a predominantly subtidal set up in the large part of the area.

The Middle Unit has been further sub-divided into two sub-units, based on electrologs and designated as Middle Unit-I and II However, in well Kharkhari-A, it has been sub-divided into three subunits. Middle Unit is dominantly argillaceous and is not developed in Damoh-A.

Upper Rohtas Unit

This unit has been penetrated in all the drilled wells, except Damoh-A, where it was not developed or pinches out against the existing Damoh high. The upper unit is thicker in the southern part in the area around Jabera low, while it is less in thickness in the northern platform area. The Upper Rohtas Unit comprises of a thick carbonate (200-500m) sequence punctuated by thin beds of shale. Limestone is dirty white, light grey, hard and compact, massive, recrystallized, at places pyritic, interlaminated with shale having occasional development of calcite crystals. At places limestone is yellowish with disseminated very fine grained quartz (Nohta-C, interval: 1175-1475m). Shale is dark grey, incipiently fissile, micaceous, silicified and feebly calcareous. Microfacies analysis of the limestone shows that it is also, like the Lower Rohtas Unit, dominantly mudstone which is sparitised and selectively dolomitized and shows varied effects of aggrading neomorphism. Presence of stylolaminations provides evidences of compaction (Fig. 2f).

SEM study shows presence of secondary porosity in form of fractures and tensional cracks at places. XRD analysis of limestone indicates dominance of calcite (35-80%) over dolomite (9%, occasionally as high as 25%) with quartz (10-30%). Shale is characterized by presence of kaolinite, illite, chlorite and at places montmorillonite. Development of secondary porosity is negligible with some isolated intercrystalline and vuggy porosity and presence of some secondary porosity in form of fractures and tensional cracks (Figs. 2d&e).

The Upper Unit has been further sub-divided into five sub-units, designated as Upper Unit-I to V (Fig. 3). Upper Unit-I is present in Nohta-A and B but is eroded in Nohta-C. All five units are present in all three studied wells of Jabera field. In Damoh structure, Damoh-C has all five units while Upper Unit-I and II are eroded in Damoh-B. In Damoh-A, the upper unit is not developed. The Upper Unit of Rohtas Limestone in Kharkhari-A has been divided into 3 sub-units. The upper unit was deposited in a limestone shoal in an overall regressive phase. The major part of the study area during this time was under intertidal to sub tidal condition. The overall thickening-up trends of the carbonate beds indicate a progradation or basin ward shift of paleoshoreline. The top part of Rohtas Limestone is demarcated by an unconformity that developed in the basin margin as a result of this progradation (Bose et al., 2001).

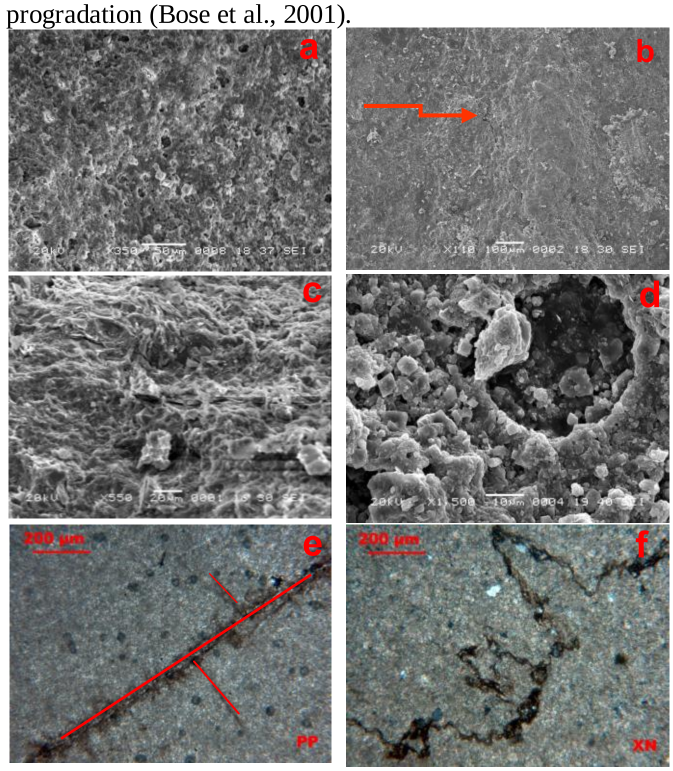


Fig. 2: a) General view showing intercrystalline porosity and dolomite rhombs within lower unit (Nohta-A, depth: 2150-2155m); b) Image showing micro fractures within lower unit (Damoh-A, depth: 575-580m :); c) presence of micro-cracks and detrital clay within middle unit (Nohta-C, depth: 1625-1630m); d) Presence of vuggy porosity with pore filled dolomite crystals in micritic mudstone within upper unit (Damoh-B, depth: 1005-1010m); e) Silicified tight mudstone within upper unit showing solution activities along stress direction (diagonally shown in the image, creation of natural tensile fractures perpendicular to stress direction) (Nohta-B, depth 1550-1555m); f) Mudstone exhibiting stylolaminations as evidence of compaction in micritic/ microsparitic matrix and silica cement within upper unit (Nohta-B, Depth: 1725-1730m).

Correlation of the facies units

Correlation profiles along dip and strike directions across the structures have been attempted to cover the area under study. The thickness of upper, middle and lower units of Rohtas Limestone in drilled wells of Damoh, Nohta, Jabera and Kharkhari structures are given in Table-2. Correlation across Damoh, Nohta, Jabera structures reveal that all the three litho-units are well correlatable and the thickness of lower and middle unit has been more or less constant whereas the top unit increases southwestward that supports the general consensus that the Son Valley Vindhyan Basin opens southwestward (Fig. 4). Electrolog correlation across the structure (N-S profile) has also shows similar southwestward thickening of the Rohtas Limestone (Fig. 3).

Fracture Analysis

Fracture identification has been carried out using XRMI data processed by M/s HLS Asia Ltd. The fractured intervals and fracture orientations have been identified in the studied wells and detailed description has been given in Table-2. Moreover, fracture analysis is also carried out from the conventional cores taken from the Damoh-B, Nohta-B and D and calibrated with XRMI log.

Fracture analysis from all the three units of Rohtas Limestone reveals that there are two fracture orientations. The dominant fractures have strike in NE-SW direction, the second set of fractures are oriented in NW-SE direction (Fig. 5). These two sets of fractures indicate two dominant stress directions perpendicular to the direction of fractures.

Damoh-B

Numbers of partially open fractures have been identified based on the XRMI log taken in this section, particularly in the interval 940-945m, 965-973m and 1019-1022m. The conventional core (CC-1, int.: 1017-1023m) shows the presence of partially open as well as few healed fractures which corroborates the observations made on the basis of XRMI log (Figs.6, 7b). An intensely fractured zone is also observed in XRMI logs in the interval 1232-1240m with thin laminations in between (Fig. 7a). The core also shows alternation of limestone and shale. Fractures filled with secondary calcite, thin calcite veins, discordant calcite veins, micro faults, stylolaminations, thin parallel laminations and small scale ripple surfaces.

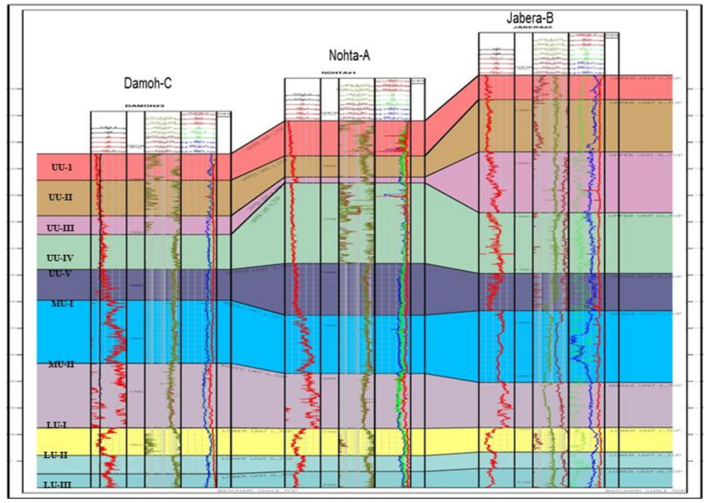


Fig. 3: N-S electrofacies correlation (flattened at Basuhari Formation top) across Damoh, Nohta and Jabera structures showing increasing thickness towards southern part

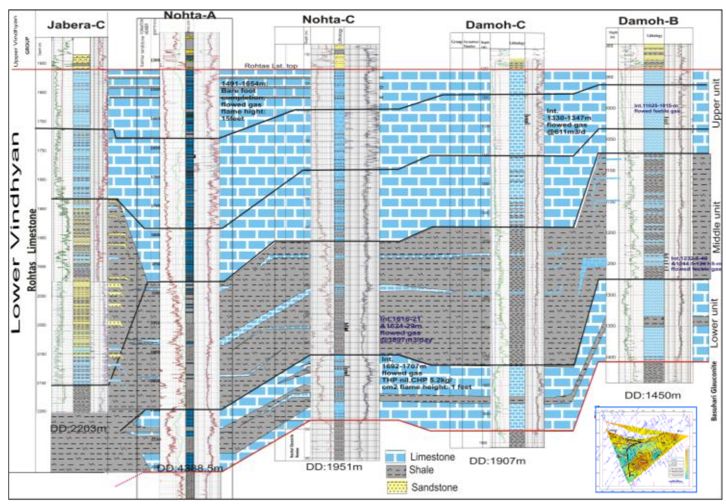
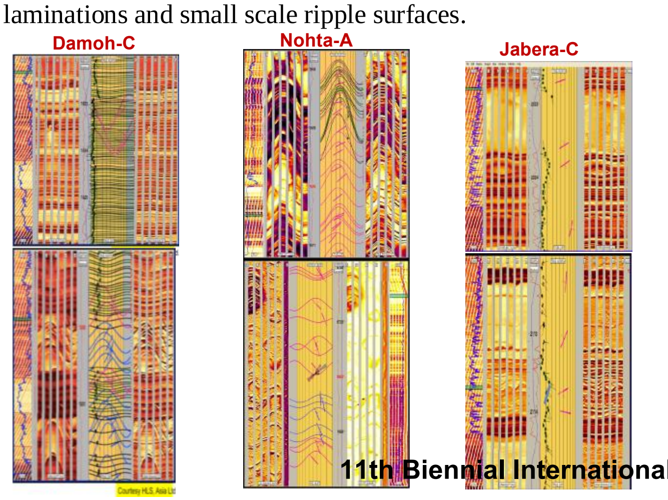


Fig. 4: Facies correlation of Damoh, Nohta and Jabera wells across the structures showing increasing thickness towards basinal part. The Rohtas Limestone top is taken as datum.

The petrographic study of selected core samples at 1017.8m shows mudstone with spar filled micro fractures (Fig. 8a). More or less at the same level, dolomitic ferruginous mudstone with spar filled criss-cross micro fractures is recorded (Fig. 8b). Spar filled fractures are also present 1019.5m and 1020.



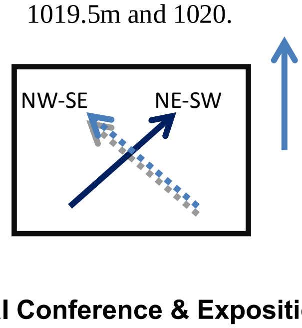


Fig. 5: XRMI image showing fracture orientations in wells Damoh-C, Nohta-A and Jabera-C. Two sets of fracture orientations are marked with arrows.

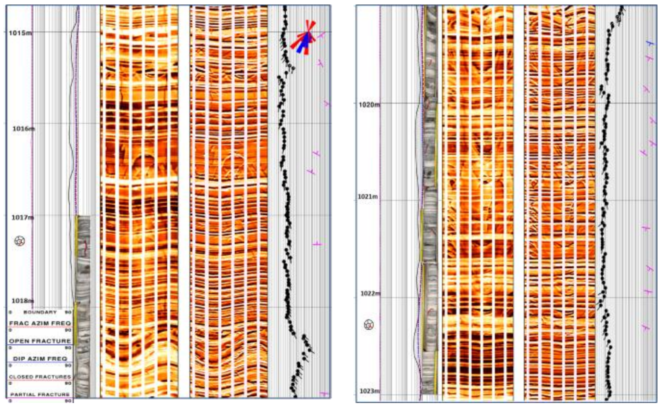


Fig. 6: XRMI log of the cored interval (1017-1023m) in Damoh-B and core photographs exhibiting fractures in Rohtas Limestone.

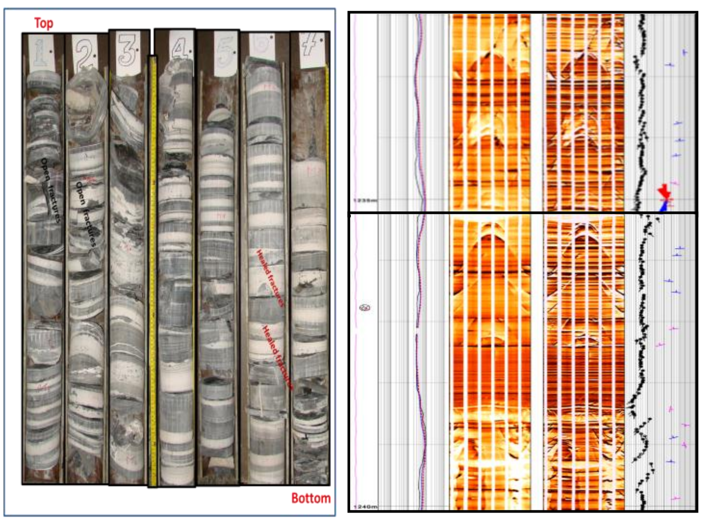


Fig. 7a: Whole core photograph of well Damoh-B, CC-1, 1017-1023m showing open fractures (marked). 7b: XRMI log in interval (1232-1240m) of well Damoh-B exhibiting partially open fractures in Rohtas limestone.

Nohta-B

The Conventional Core (CC-1, int.: 1576-1567m) in Nohta-B represents thinly and thickly parallel-interlaminated shale and limestone. In ortho-planic view, within limestone, dark residual solution channel infillment along with slikenslides and crushed/fractured surfaces are observed.

Petrographic study of limestone indicates mudstone microfacies comprising micrite/micro-sparite, dolomite and silt grade quartz. Recrystallized calcite has been observed along fracture planes. At places mudstone is laminated with thin clay laminae and is composed of micro-sparite, micrite and clay groundmass along with dolomite exhibiting stylolites as evidence of compaction. The mudstones are highly fractured filled with sparite (Fig. 8c).

Nohta-D

The conventional core (CC#2, int.: 1592.5-1595.5m shows several cross-cutting fracture filled calcite veins and micro-stylolites (Fig. 8d). These cross-cutting veins are filled with open space sparry calcite cements (Fig. 8d).

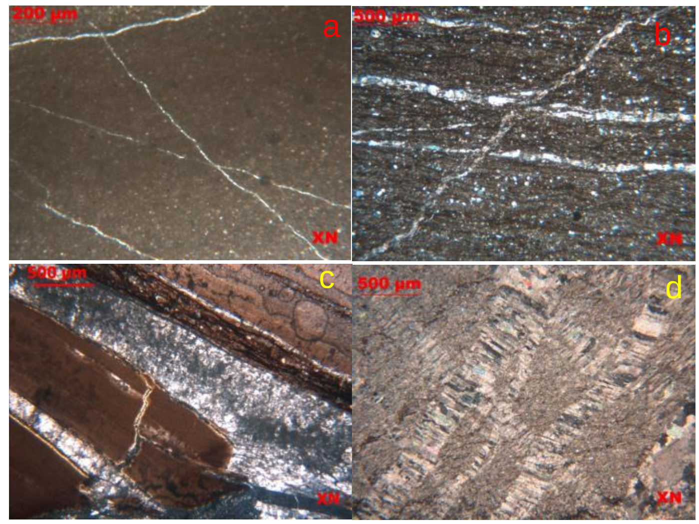


Fig. 8: Petrographic images of core samples from different wells showing micro-fractures: a) spar filled criss-cross micro fractures (Damoh-A, depth: 1018m, CC-1), b) Dolomitic mudstone with set of spar filled fractures (Damoh-A, depth: 1019.20m, CC-1), c) Highly Fractured filled with sparite in laminated mudstone and carbonaceous silty shale (Nohta-B, depth: 1574.41m, CC-1), d) Several cross-cutting fracture filled calcite veins within recrystallized mudstone (Nohta-D, CC-2, Depth 1597.15m).

The NE-SW and NW-SE orientation of fracture suggests orthogonal extension. The dominantly marine Vindhyan sediments accumulated in an E-W elongated depository segmented into smaller NW-SE oriented sub-basins formed under influence of N-S rifting and a dextral shear (Bose et al., 2001). The cessation of rifting is marked by basin floor sagging under orthogonal extension, manifested by mutually perpendicular fracture orientations, although paleo-shoreline alignment changed little. The NE-SW extension resulted the NW-SE oriented farctures and was possibly caused by readjustment of underlying rift blocks and the frequency of this extension decreased progressively, as envisaged by sub-ordinate fracture orientation along this trend. In contrast, the dominant NW-SE extension that resulted the dominant fracture trends along NE-SW direction was possibly propagated from plate margin, maintained a uniform tempo. This indicates a change from rift to sag stage and with gradual decline of the former stress, the basin tended circular or even elongated in a NE-SW direction from an initial elongation along NW-SE direction (Bose et al., 2001). The fractures analysis indicates that rift-to-sag transition phase of the Vindhyan Basin probably completed by the end of Rohtas time.

Conclusions

- Rohtas Limestone has been subdivided into three broad mappable lithounits that can well be correlatable over the entire PEL area. The lower and upper carbonate rich units were developed in response to a punctuated progradation of relative sea-level whereas the argillaceous middle unit was formed in a transgressive phase.
- The three broad lithounits have been further subdivided into ten electrofacies on the basis of log signatures, viz. five within the upper, two within the middle and three within the lower unit.
- The reservoir in general is tight with minor micritic porosity and occasional presence of secondary porosity due to dolomitization and in form of partially open tensional cracks/ fractures. Development of low and high amplitude stylo-lamination bears testimony of compaction of micritic matrix.
- Fracture analysis revealed two fracture-sets, viz. the dominant NE-SW trend and the subordinate being NW-SE trend. This indicates the presence of orthogonal stress directions (extension). The dominant NE-SW fracture trends indicate progressive dominance of NW-SE extension over the initial NE-SW extension and suggest rift to sag transition of Vindhyan Basin took place during deposition of Rohtas Limestone.
- Fracture analysis reveals presence of partially open fractures, mainly within the upper and middle unit of Rohtas Limestone, where overburden stress is less.
- Fractures are present in lower unit also where the upper part of Rohtas Limestone has not developed or eroded away (e.g. Damoh-A).

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The views expressed in the paper are of authors only and not necessary of the organization to which they belong.

Litho-unit (m)	Sub-unit interval (m)	Fractured Interval (m)	Fracture description
Upper Unit: 938-1073	UU-III: 938-972.5	940-945	Partial fractures, 80°, 315° strike
		964-967	Partial fractures, 45°, 225° strike
		967-971	Open fractures, 225°, 315°, 80° strike
	UU-IV: 972.5-1031.5	971-973	Open and partial fractures, 315° and 225° strike
		996-998	Partial fractures, 60° strike
		1013-1017	Partial fractures, 135°, 315°, 45° strike
		1019-1023	Partial fractures, 135°, 315° strike, An open fracture, 135° strike
	UU-V: 1031.5-1073	1044-1045	Partial fractures, 225°,45° strike
		1048-1050	Partial fractures, 225°,45° strike
		1054-1060	Partial fractures, 315°, 135°, 45° strike
		1071-1073	Partial fractures, 315°, 135°, 225° strike
Middle Unit: 1073-1275	MU-I: 1073-1164	1075-1085	Partial fractures, 135°, 315°, 45°, 225° strike, Two open fractures, 100° strike
		1088-1095	Partial fractures, 135°, 315° strike an open fracture, 135° strike
		1097-1100	Partial fractures, 135° strike
		1101-1113	Partial fractures, 135°, 315°, 225° strike Open fracture, 315° strike
		1151-1160	Open and partial fractures, 45° strike
	MU-II: 1164-1275	1168-1171	Partial fractures, 135°, 315° strike an open fracture, 315° strike
		1172.3-1174.5	Partial fractures, 135° & 315° strike
		1193-1196	Partial fractures, 45°, 225° strike
		1203-1205	Two open fractures, 135° & 300° strike
		1213-1216	Partial fractures, 45° strike
		1218-1221	Partial fractures, 45° and 225° strike an open fracture having 45° strike .
		1221-1224	Partial fractures, 45° strike
		1225-1227	Partial fractures, 45°, 225° strike
		1229-1240	Open fractures, 250°, 300°, 45° strike partial fractures, 135°,250°,315° strike
		1244-1250	Partial fractures, 135° & 315° strike two closed fractures, 300° strike
		1250-1262	Open fractures, approx 250° strike Partial fractures, 250°, 315°, 45° strike
		1266-1270	Open fractures, approx 45° partial fractures, 45° & 225° strike
		1272-1275	Partial fractures, approx 45° strike
Lower Unit: 1275-1408	LU-I: 1275-1333	1275-1278	Open fractures, approx 75° strike partial fractures, approx 300° strike
	LU-II: 1333-1373.5	1363-1370	Partial fractures, approx 315° and 225° strike
	LU-III: 1373.5-1408	1397-1400	Partial fractures, approx 45°, 225°, 315° strike
		1401-1404	Open and partial fractures, approx 120° strike

Table-2: Electrofacies and fracture analysis of well Damoh-B

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