# Architecture Characterization of Shoreface Reservoir: A Case Study from the Donghe Sandstone Reservoir in the Hudson Oilfield

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1. Introduction

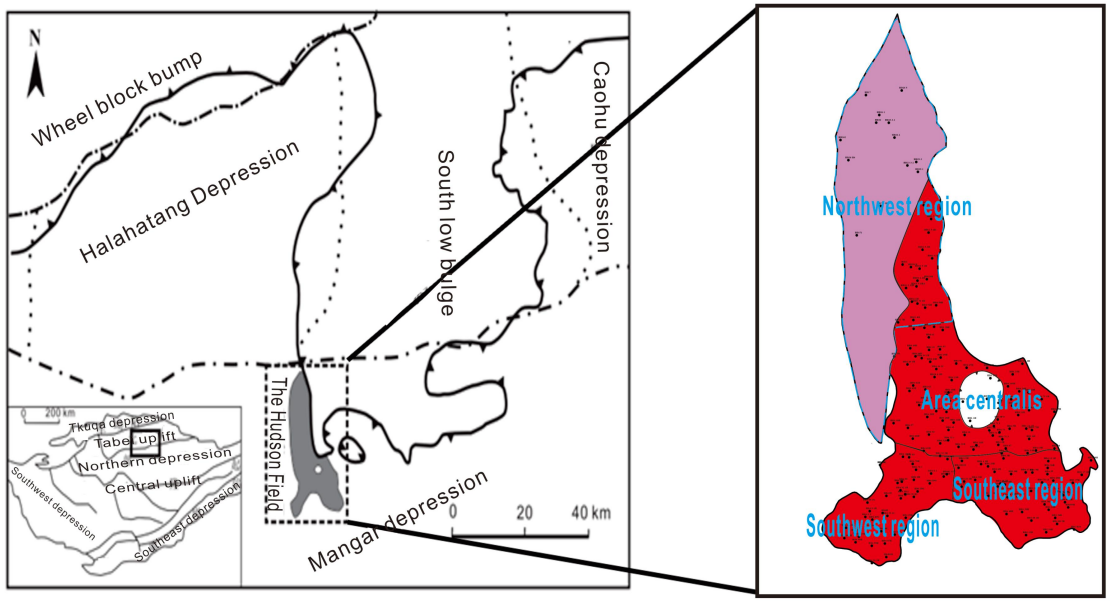
2.Method

3. Results and Discussion

4. Conclusions

# 1. Introduction

## 1.1 Geological setting




Map of regional geology(Wang,2021)

| Formation | | | | Horizon Code | Formation thickness (m) | LITHOGRAPH SUMMARY |
|---|---|---|---|---|---|---|
| Department | System | Group | Segment | | | |
| Quaternary | — | — | — | Q | 50 | Gray-yellow coarse and medium sandstone with sandy soil |
| Neogene | — | — | — | N | 2220~2397 | Yellowish gray siltstone, argillaceous siltstone and grayish brown mudstone silty mudstone |
| Paleogene | — | — | — | E | 113~144 | Brown mudstone, brown silty mudstone, greenish-grey gravelly siltstone, light grey gravelly coarse sandstone |
| White sitting system | — | — | — | K | 703~738 | Brown fine sandstone, siltstone with brown mudstone |
| Companion Luo system | — | — | — | J | 371~420 | Light brown siltstone, fine sandstone, light gray breccia, brown mudstone |
| Triassic | — | — | — | T | 500~547 | Gray, brown mudstone and gray, light gray argillaceous siltstone, siltstone, fine sandstone, gravel fine sandstone |
| Permian | — | — | — | P | 304~355 | Gray-black, purple brown, purple red tuff, basalt, andesite, purple red, purple brown mudstone |
| Carboniferous | Upper system | Small sea Subgroup | Limestone section | $C_{1-2}k^1$ | 20~68 | Off-white argillite with purplish brown mudstone |
| | Lower system | Carla Shayl | Sand-mudstone section | $C_{1-2}k^2$ | 340~366 | Brown, maroon, gray mudstone silty mudstone and thin siltstone, micrite with paste mudstone |
| | | | Upper mudstone section | $C_{1-2}k^3$ | 88~110 | Brown, gray greenish gray mudstone, silty mudstone, thin light gray argillaceous siltstone |
| | | | Standard limestone group | $C_{1-2}k^4$ | 22~31 | Micrite, grayish brown mudstone, grayish white gypsum rock |
| | | | Middle mudstone section | $C_{1-2}k^5$ | 55~88 | Gray, brown mudstone with thin layers of brown gray, light gray siltstone, argillaceous siltstone |
| | | Bachu group | Cuttings limestone section | $C_1b^1$ | Missing | |
| | | | Lower mudstone section | $C_1b^2$ | | |
| | | | Breccia section | $C_1b^3$ | 2~12 | Green gray, light gray, gray argillaceous siltstone, fine sandstone, gravel fine sandstone, medium sandstone |
| | | | East River Sandstone | $C_1b^4$ | 0~57.5 | Brown oil-bearing quartz sandstone, light gray quartz sandstone |
| Silurus | | | | S | Not worn | Light gray siltstone, brown muddy siltstone |

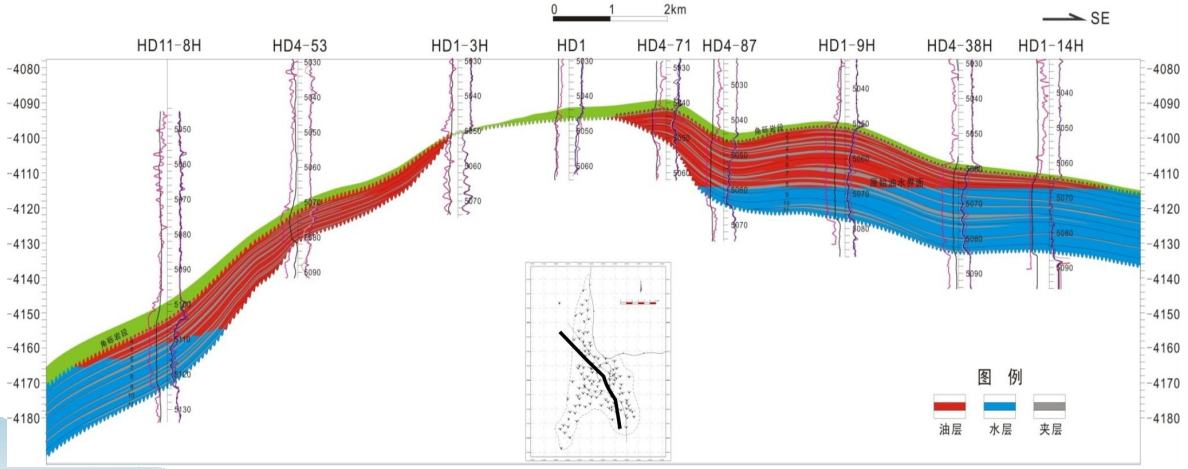
The Hudson oilfield is located in Shaya County, Aksu Region, Xinjiang Autonomous Region. It is located in the Hudson tectonic belt of the low bulge in the south of Tabei Uplift, Tarim Basin. It is connected with Manjia Depression in the south, and its structural form is a broad and gentle anticlinal structure with low amplitude sloping to the northwest.

The upper and bottom strata of Donghe sandstone member in Hudson Oilfield are unconformable contact, which is a set of Marine sedimentary strata deposited in the late Carboniferous system.

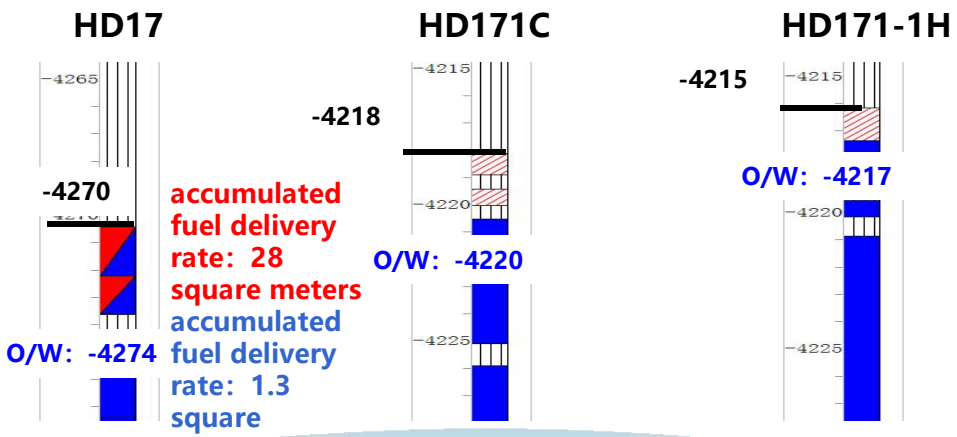
# 1. Introduction

## 1.2 Research status

- The Donghe sandstone member of Hudson Oilfield belongs to the high energy shoreline facies with no barrier sand. At present, the reservoir development performance shows that the Marine sandstone reservoir is still heterogeneous, indicating that the internal structure of the Marine coastal sand reservoir is also complex, so it is necessary to conduct quantitative characterization of the reservoir structure, to provide theoretical and technical support for the interpretation of oil-water distribution and further exploration of potential.
- In the field of reservoir architecture research, fruitful results have been achieved in the fields of fluvial-facies and delta-equivalent continental facies and sea-land interaction, but in the field of Marine coastal sedimentary reservoir architecture research, qualitative prediction and conceptualization model are still the main research, and the research degree is low.



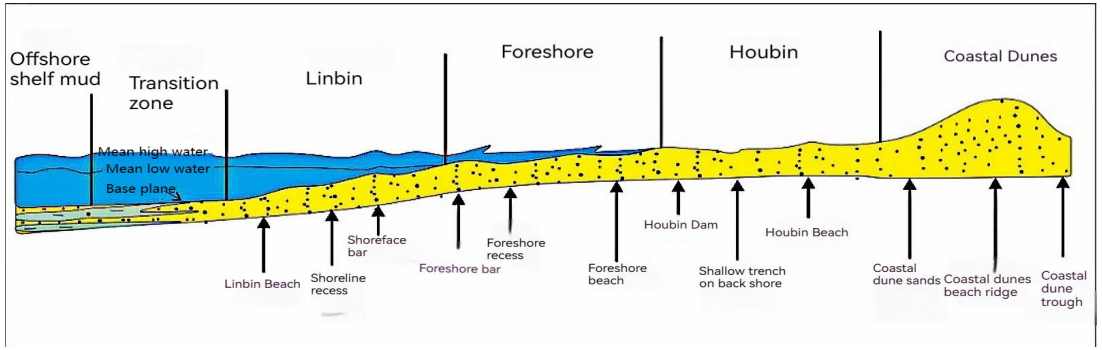

The low part of the structure produces oil and the high part produces water



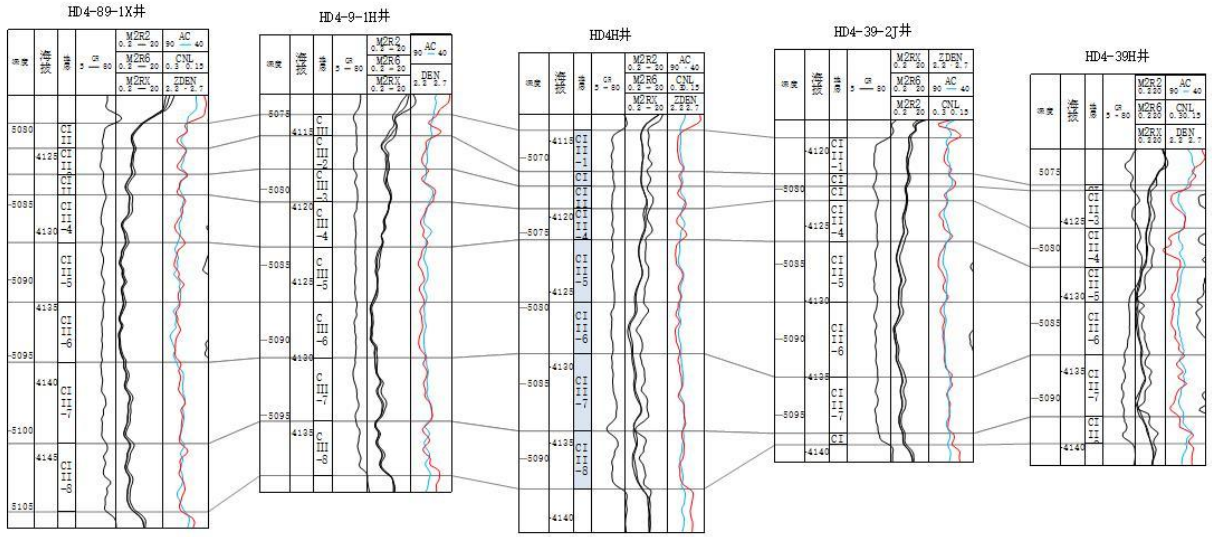
# 1. Introduction

## 1.3 Sedimentary genetic model

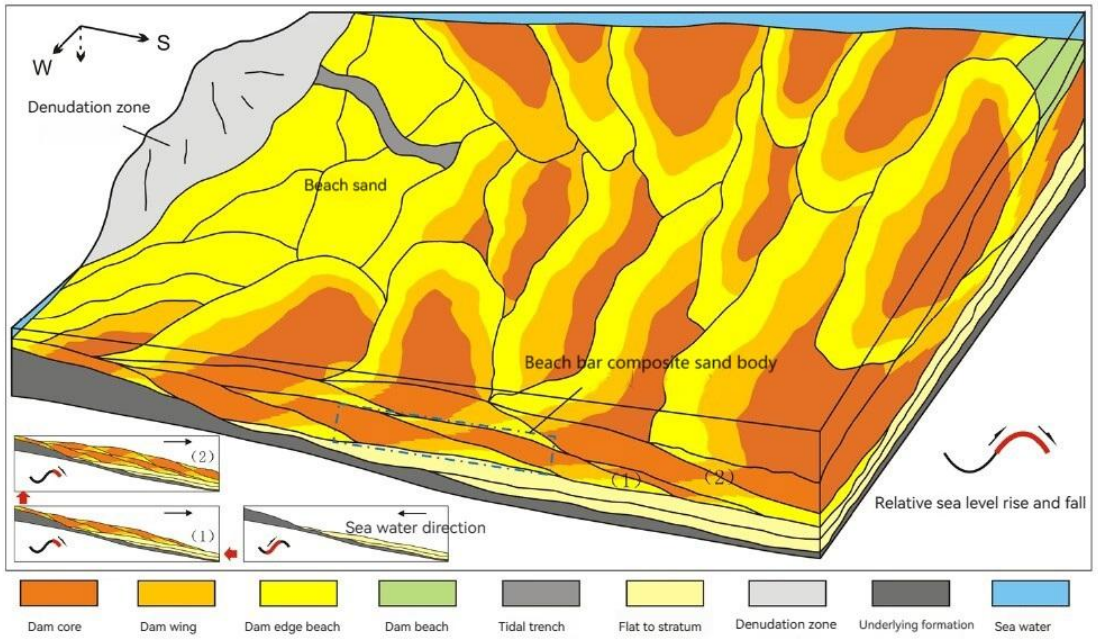
- The high-precision sequence correlation frame of the whole area was established
- A wave controlled shoreline sedimentary model was established
- Reservoir architecture classification




Wave controlled shoreline sand sediment profile




Stratigraphic correlation framework of HD4-89-1X-HD4H-HD4-39H sandstone reservoir in the East Hudson River




Coastal facies sedimentary model

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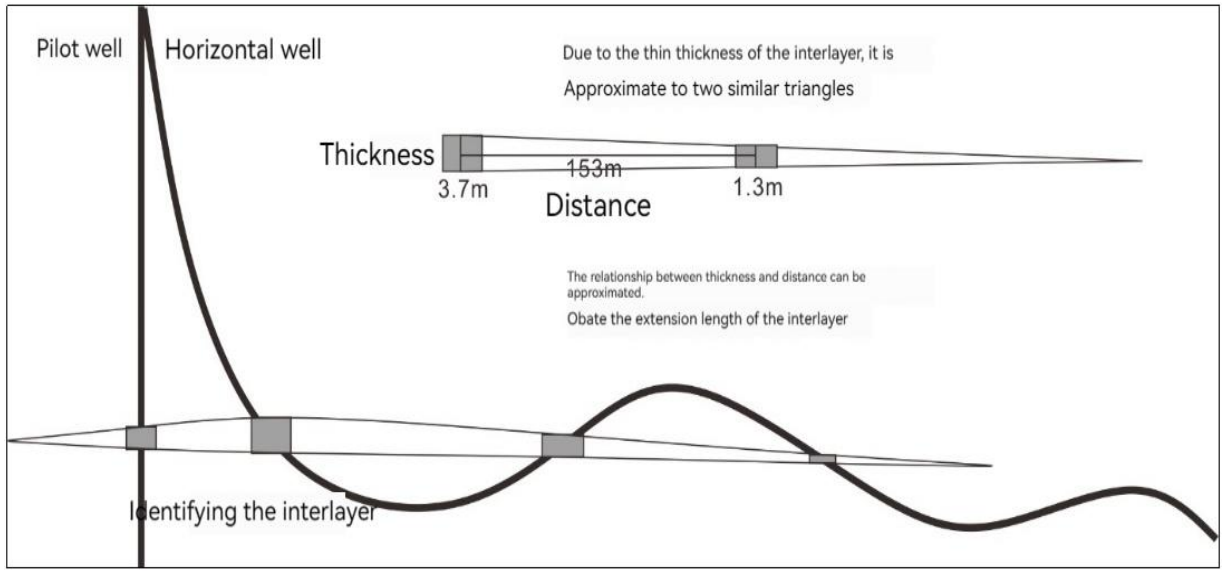
# 2. Method

## Core data calibration log data combined with dip data

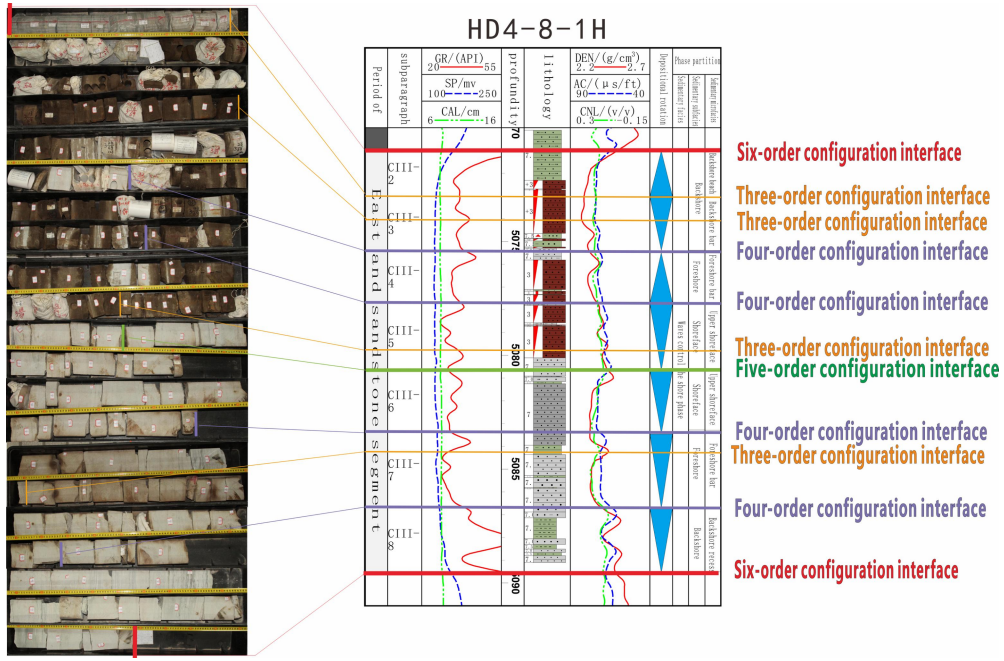
**Quantitative characterization of architectureal interface**

**Straight well + horizontal well**
**conventional logging + inclination logging**




Using straight wells combined with horizontal wells to achieve quantitative prediction between architecture interfaces

The architecture interface is identified by core data combined with logging data




Reservoir architecture classification

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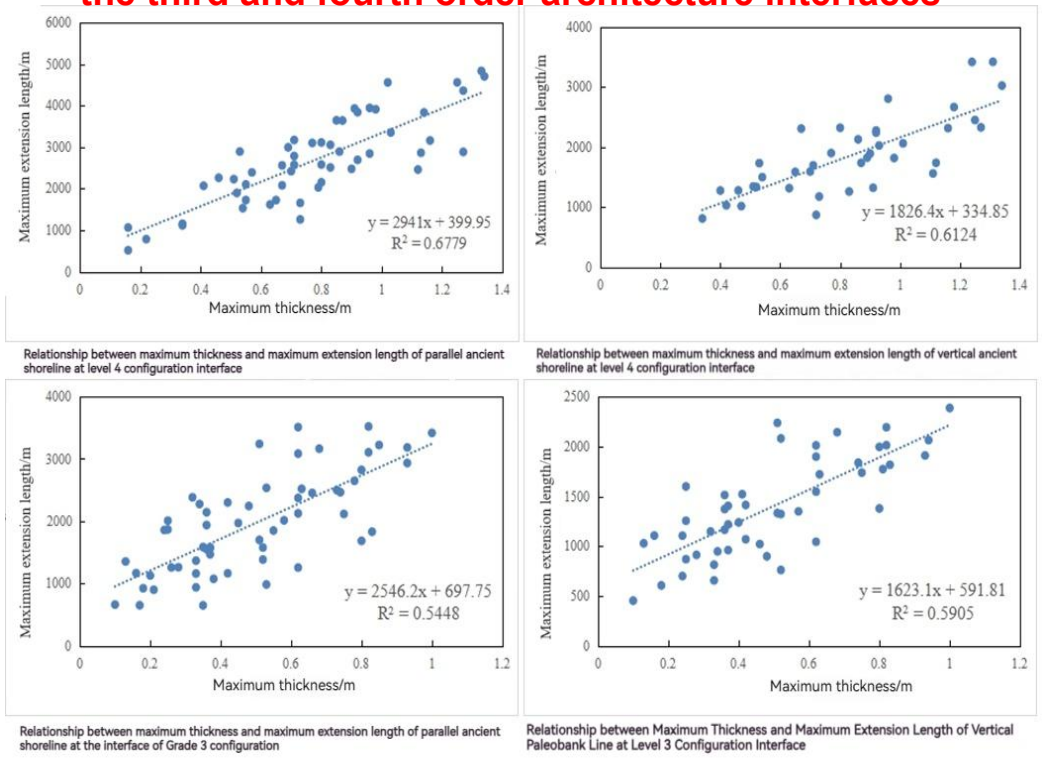
# 3.Results and Discussion

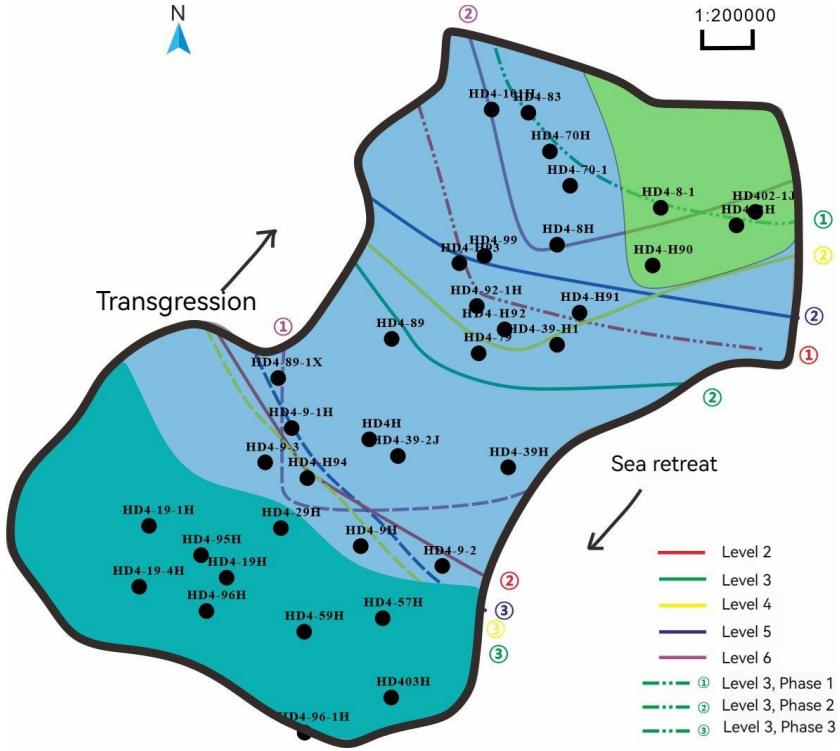
## 3.1 Quantitative characterization of structural interfaces of tertiary and quaternary reservoirs

**Quantitative relationship between vertical and parallel shoreline directions of strata developed at the third and fourth order architecture interfaces**




Quantitative relationship between maximum length and maximum thickness of strata parallel to and perpendicular to the shoreline at reservoir architecture interface

**The planar distribution of the three-order architecture interface is obtained by using the azimuth data**

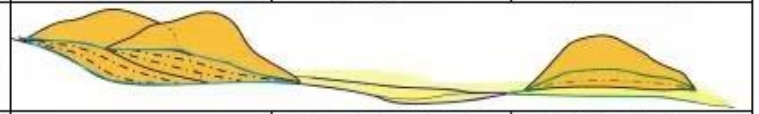
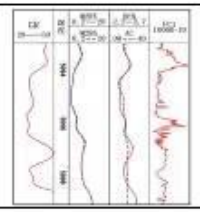
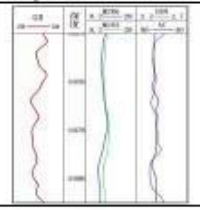
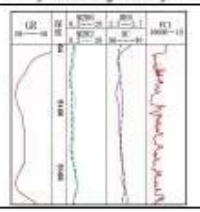



HD4 block in the small layer advance and retreat interface distribution

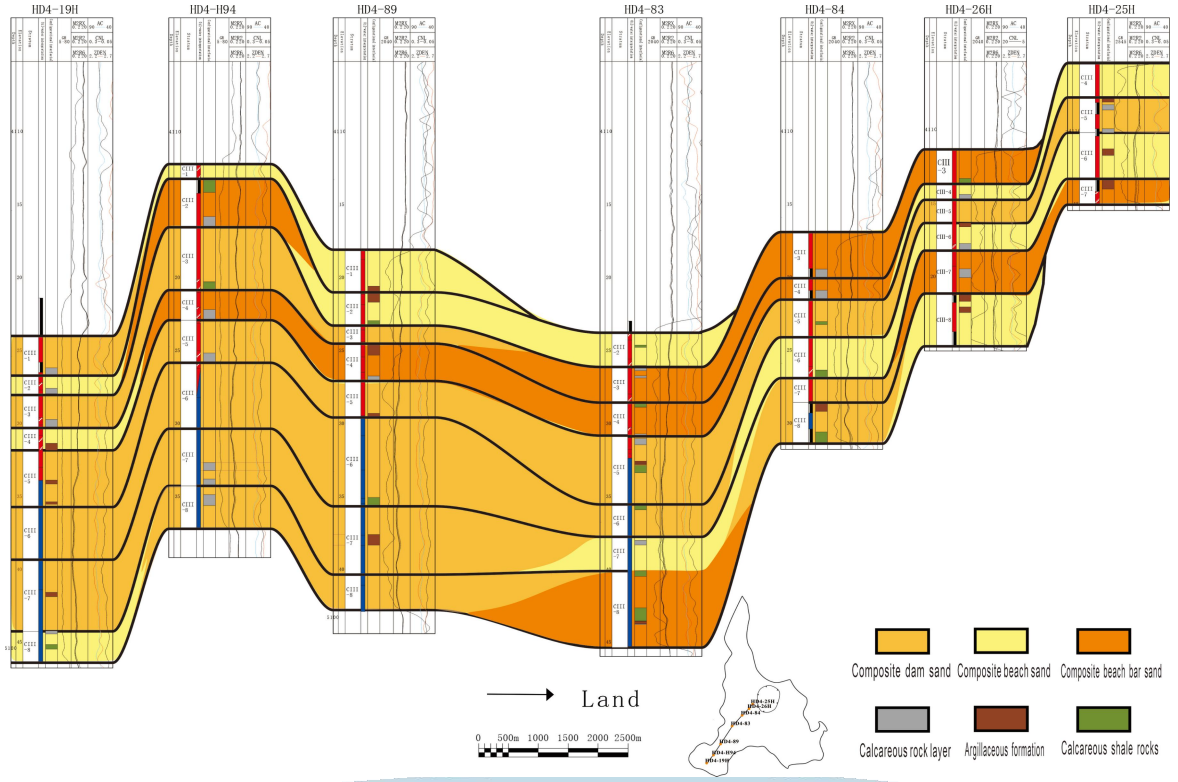
# 3.Results and Discussion

## 3.2 Identification, division and distribution of four-level architecture units

The four-stage architecture units are divided into composite bar sand, composite beach sand and composite beach bar sand. Composite bar sand is widely distributed in the nearshore position and the middle and lower section of Donghe sandstone. The composite beach sand mainly develops in the far bank position and is less distributed in the upper part of Donghe sandstone.

| Sedimentary facies | Shore facies | | |
|---|---|---|---|
| Configuration Unit | Composite dam sand | Composite beach sand | Composite beach dam sand |
| Pattern diagram |  | | |
| Developmental characteristics | The logging response of the sediment formed by the continuous accumulation of bar sand at the same location is that the GR curve presents a large section of box-shaped and finger-like inclusions with higher resistivity and lower density | The beach sand occupies the dominant position in the sedimentary body at the same position, and the logging response is a bell-shaped or small-amplitude finger GR curve superimposed on each other, and the density value is generally large and the resistivity value is generally small | At the same location, the sedimentary body formed by alternating deposit of beach sand and bar sand is corresponding to the GR curve of box type and bell type superimposed on each other, with finger return of low amplitude in the middle, the density value fluctuates greatly, and the resistivity value is generally small |
| Logging facies |  |  |  |
| Core Photo |  |  |  |

Reservoir architecture unit identification and division table



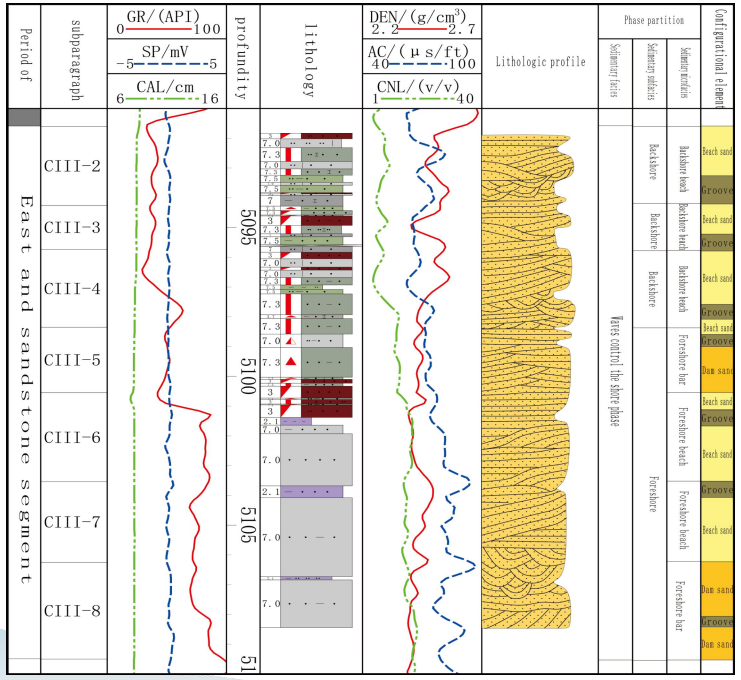

Section layout of quaternary reservoir architecture unit

# 3.Results and Discussion

## 3.3 Identification, division and distribution of tertiary architecture units

The tertiary architecture units are divided into beach sand, bar sand and beach sand deposits. The bar sand is the third-order architecture unit of the main sediment, and the beach sand is scattered among the bar sand.

The three-level architecture unit architecture styles were established, which were parallel, slot and oblique. In the process of single bar sand or beach sand deposition, thin argillous deposits are formed due to the weakening of local hydrodynamic forces, and the layers are mostly parallel to each other, forming parallel architecture patterns. When the water climbs or passes over the underlying layer, such as the dam roof, the bottom of the layer is crossed by wedges, forming an oblique architecture pattern. When the water flows over the dam sand, it is buffered and weakened, and the mud is deposited in the groove or scouring groove between the DAMS, and the trough architecture pattern is developed.

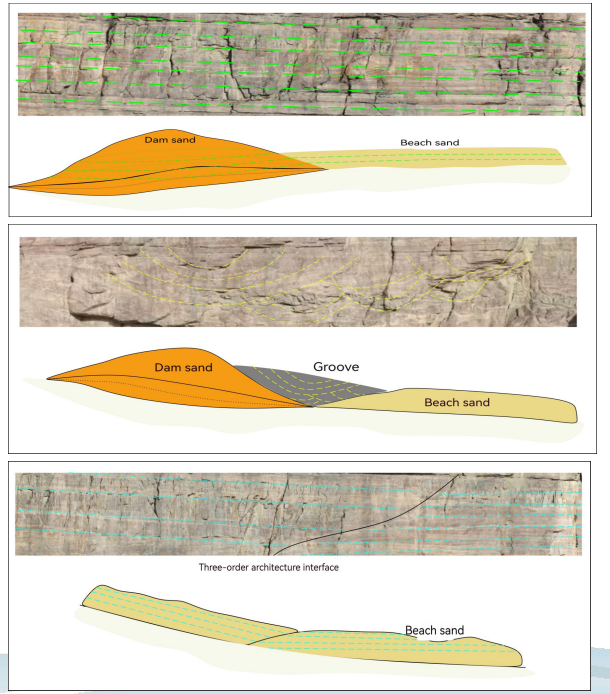



HD111H three-level architecture unit division

parallel-like

trough

oblique

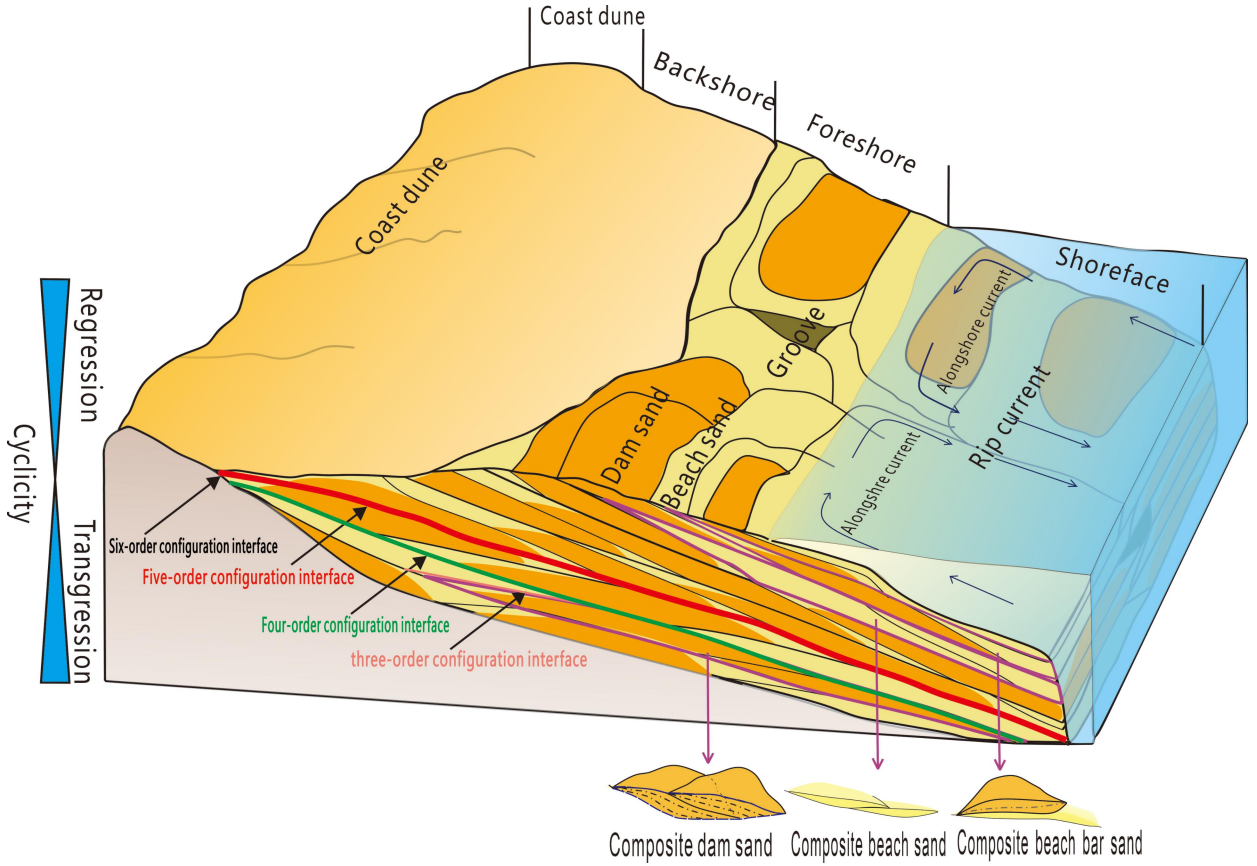



Tertiary architecture unit architecture style

# 3.Results and Discussion

## 3.4 Wave controlled shoreline facies reservoir architecture model

The Donghe sandstone in the Hudson oilfield was in the high system domain during the sedimentary period, and the overall performance was the regression mode of sea level rise. There are sufficient resources, and the three-order architecture units such as bar sand, beach sand and groove are developed, and the three architectures of parallel, trough and oblique are developed in the interior. The three-order architecture units are superimposed to form composite bar sand, composite beach sand and composite beach bar sand, thus forming the Donghe sandstone reservoir in the study area.




Wave controlled shoreline facies reservoir architecture model

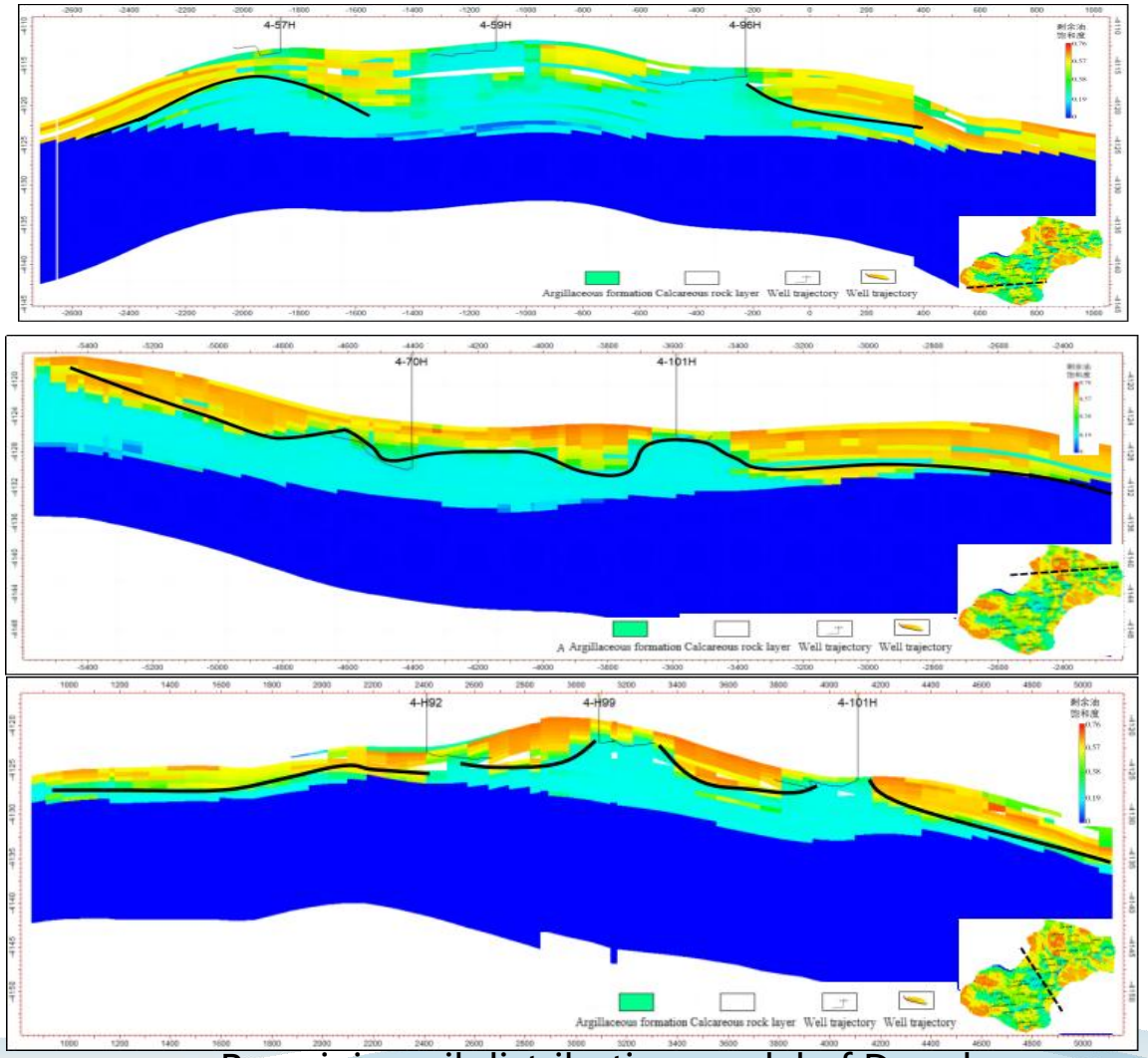
# 3.Results and Discussion

## 3.5 Control of residual oil distribution by reservoir architecture

① The rock formation at the boundary architecture interface is not developed - residual oil at the edge

② The development of shale strata at the internal architecture interface - "roof" remaining oil

③Calcareous rock layer development at the internal architecture interface - "eave" residual oil




Remaining oil distribution model of Donghe reservoir in HD4 well area

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# 4. Conclusions

1.After determining that the third-order and fourth-order architecture mainly controls the oil-water distribution interface in the tight well pattern area, the third-order and fourth-order architecture interface of the reservoir is quantitatively identified based on the sedimentary genetic model and combined with the data of vertical Wells and horizontal Wells, and **the quantitative relationship between the maximum thickness and the maximum extension length of the third-order and fourth-order architecture interface in parallel and vertical paleoshoreline direction** is established. The distribution characteristics of the third-order and fourth-order architecture interfaces and the evolution characteristics of the progradation and regression of the third-order architecture interfaces along the vertical paleoshoreline are defined.

2.On the basis of recognition of architecture interface, the research on classification, recognition and distribution of tertiary and quaternary architectureal units is focused. The distribution characteristics of different order architectures are described in detail, and **the development models of the third order architecture units are established**.

3.There are three types of reservoir architecture control on the present remaining oil: the rock formation is not developed at the boundary architecture interface -- **the remaining oil at the edge**, the shale formation is developed at the internal architecture interface -- **the remaining oil at the "roof"**, and the calcareous rock layer is developed at the internal architecture interface -- **the remaining oil at the "roof"**.

# Thank you!

Please feel free to ask any questions!