

# **PS A Sequence Stratigraphy-Based Diagenetic Study with the Sha-3 Member Sandstones in the Central-South Parts of the Raoyang Depression as an Example\***

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Search and Discovery Article #51365 (2017)\*\*

Posted March 13, 2017

\*Adapted from poster presentation given at AAPG/SEG International Conference & Exhibition, Cancun, Mexico, September 6-9, 2016

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## **Abstract**

Based on the thin sections combined with well logging and drilling data, this study documents the diagenetic characteristics of the sandstones in the Sha-3 Member of the Shahejie Formation in the central-south parts of the Raoyang Depression. It was conducted within the sequence stratigraphic framework from two aspects: control of sequence boundary on diagenesis, and diagenetic evolution of sandstones in different systems tracts. The results indicate that the Shahejie Formation comprises one second-order sequence and three third-order sequences. Each of them can be subdivided into three system tracts: low stand (LST), transgressive (TST), and high stand (HST) systems tracts. The sequence boundary controlled carbonate cementation and dissolution in the underlying sandstones. However, it did not act as the preferential migration pathway of fluids which facilitated the dissolution in the sandstones overlying the sequence boundary.

Sands in the LST tend to be mixed with clays and were less resistant to compaction so that primary porosity was most likely to be lost due to compaction and precipitation of early carbonates from the over-saturated alkaline solutions. Although sandstones in TST are of small size, they are well sorted. As a result, considerable primary porosity could be preserved at the early diagenetic stage. Furthermore, secondary porosity could be developed since sandstones in TST were in direct contact with source rocks and could be easily accessed by organic acid. Sands in HST consist of well-sorted large grains and were more resistant to compaction. Their relatively shallow burial made it possible for primary porosity to be preserved more easily. In addition, the leaching by the atmospheric waters in the early diagenetic stage and the subsequent dissolution of organic acids led to the significant development of secondary porosity, which improved the reservoir quality of the sands considerably. Thus, sandstones in HST possess the best reservoir quality. This study proposed the diagenetic evolution models for sands in different systems tracts at syngenetic, eogenetic, and telogenetic stages. It characterized the diagenetic features within the sequence stratigraphic framework. The study results made it possible to delineate the high quality reservoirs.

# A Sequence Stratigraphy-based Diagenetic Study of the Sha-3 Member sandstones in the Raoyang Sag in Bohai Bay Basin



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AAPG SEG International Conference & Exhibition 2016

## 1. Introduction

### Current status in study of diagenesis in Raoyang Sag of Bohai Bay Basin:

- Few workers have studied diagenesis of clastic reservoirs in non-marine rift basins from a perspective of sequence stratigraphy.
- This study is the first one attempting to link the spatial and temporal distribution of diagenetic alterations and minerals to sequence stratigraphic framework of the Sha-3 sandstones.

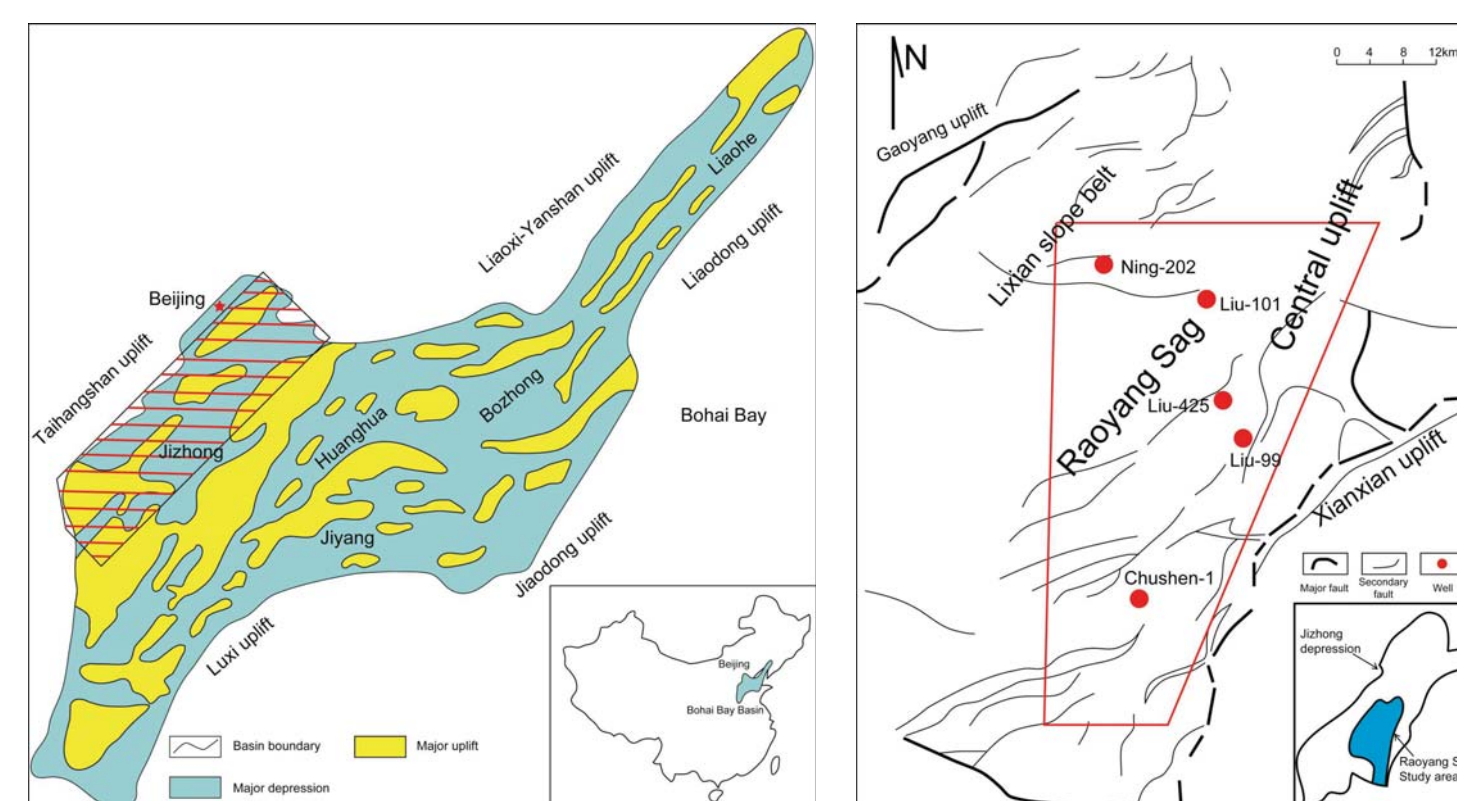


Fig.1. Maps showing location of the study area and studied wells

## 2. Geological Setting

- The Eocene Shahejie Formation is one of the main oil-producing strata in the Raoyang Sag, Bohai Bay Basin. Numerous studies have been conducted for the Shahejie Formation in the the Raoyang Sag, focusing on different aspects including stratigraphy, depositional environments, sequence stratigraphy, diagenesis and tectonic setting.
- Linking the types and distribution of diagenetic processes within a sequence stratigraphy framework allows a better understanding of the factors controlling the spatial and temporal distribution of diagenetic alterations.

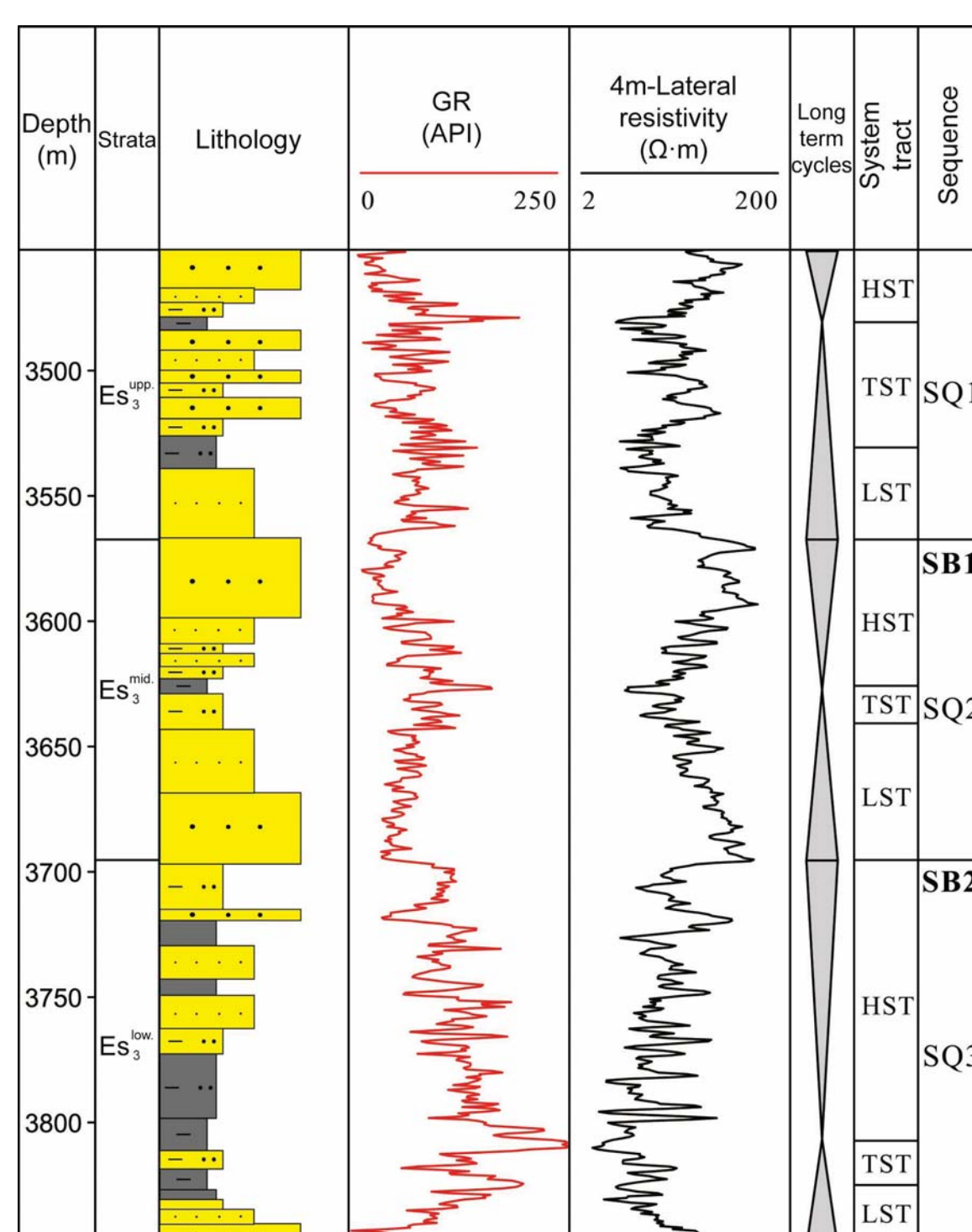


Fig.2. Ternary plot showing the framework-grain composition of Shahejie Formation sandstones in Raoyang Sag

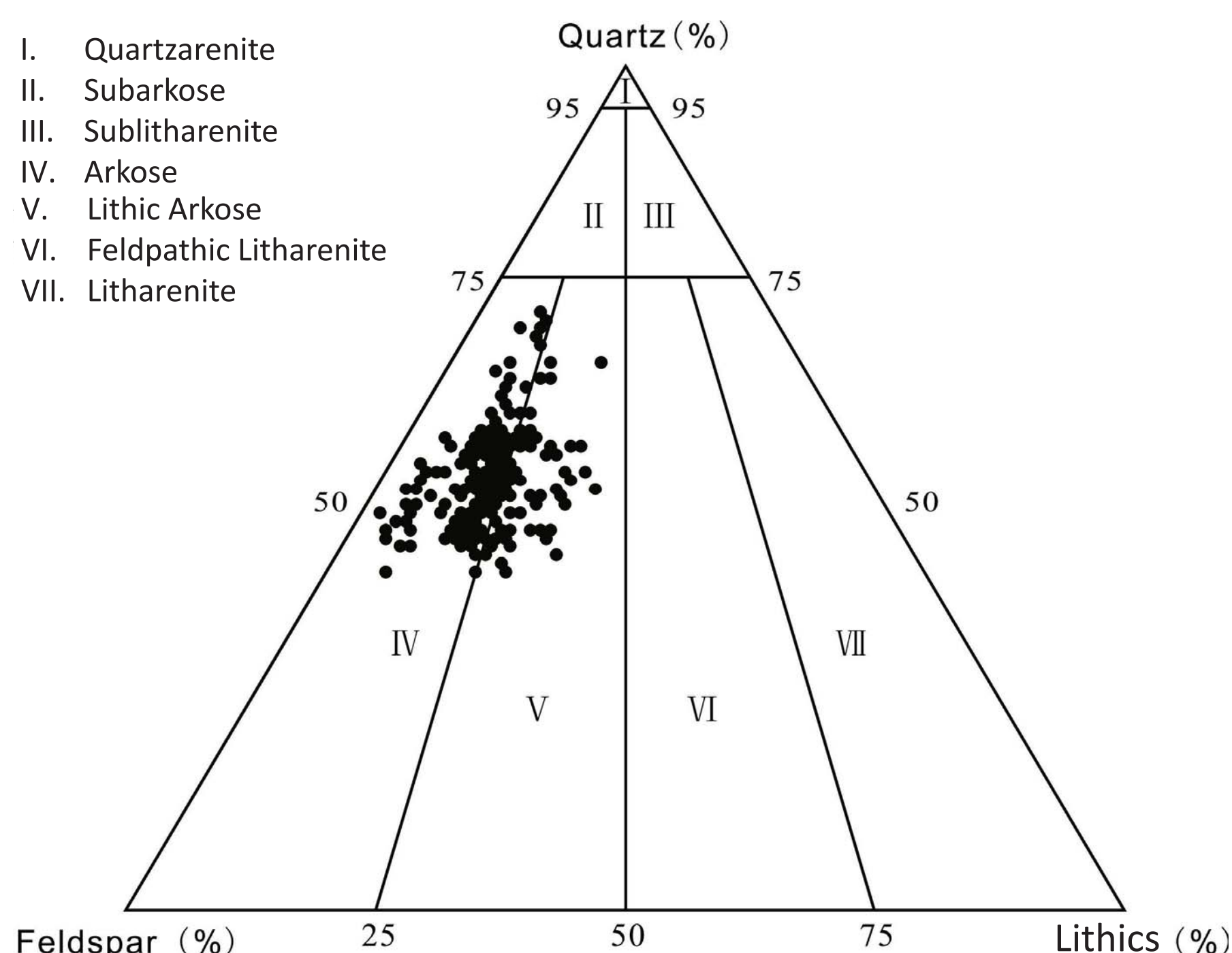
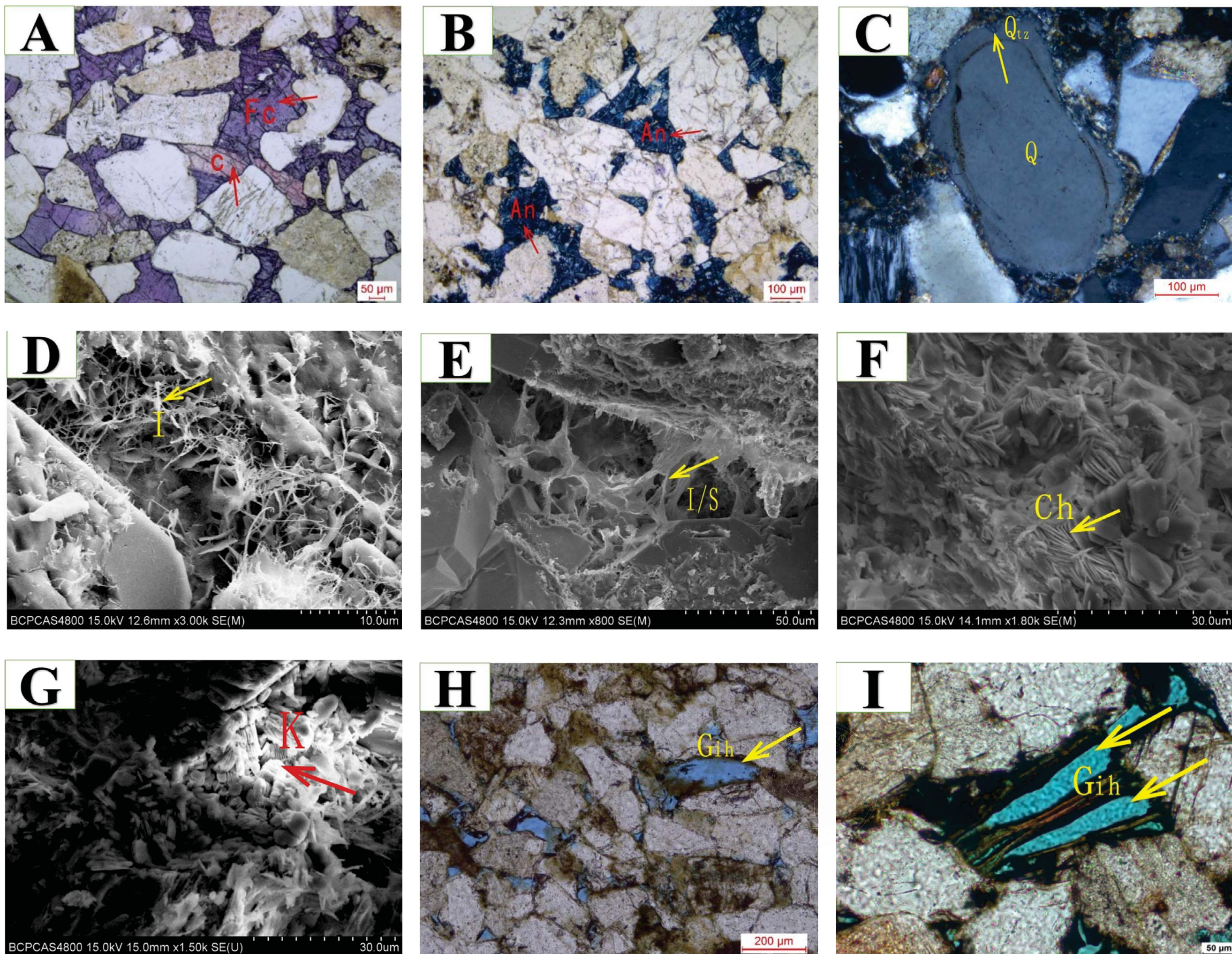


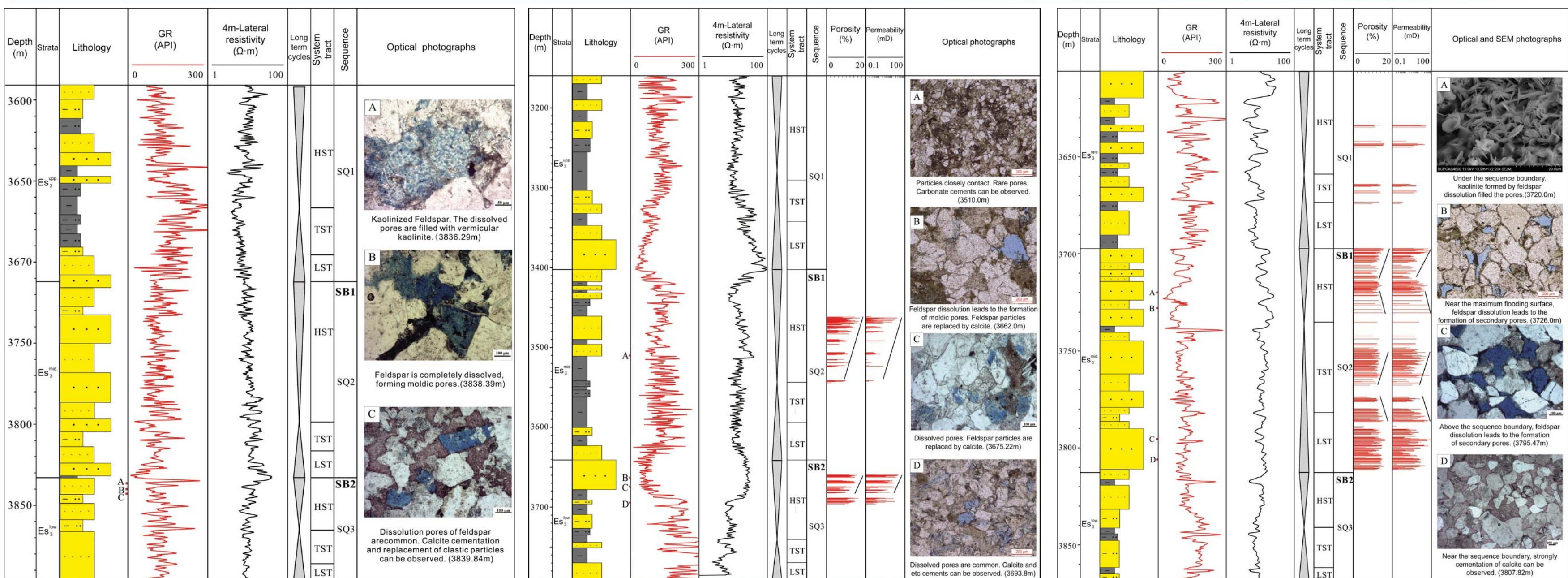
Fig. 3. Ternary plot showing the framework-grain composition of Shahejie Formation sandstones in Raoyang Sag

### 3. Data and Methodology



**Fig. 4. Reservoir pore space and cements in sandstones of Member 3 of Shahejie Formation in Raoyang sag.**  
 (A) Calcite and ferroan calcite cement.  
 (B) Dolomite and ferrocalcite cement. Calcareous lithic sandstone. Line contact.  
 (C) Quartz overgrowth.  
 (D) Pore-bridging fiber-like illite.  
 (E) Pore-bridging illite here consist of sheets of crystals with “cockscomb” margins that give rise to ribbons.  
 (F) Authigenic kaolinite cements grew as booklets or stacks of plates in this sandstone.  
 (G) Booklet-shaped kaolinite.  
 (H) Primary intergranular pores.  
 (I) Intragranular pores formed by mica dissolution.

### 4. Salient Diagenetic Features in Different System Tracts



(A) Well Ning-202

(B) Well Liu-425

(C) Well Liu-101

**Fig. 5 Diagenetic characteristics within a sequence stratigraphic framework**

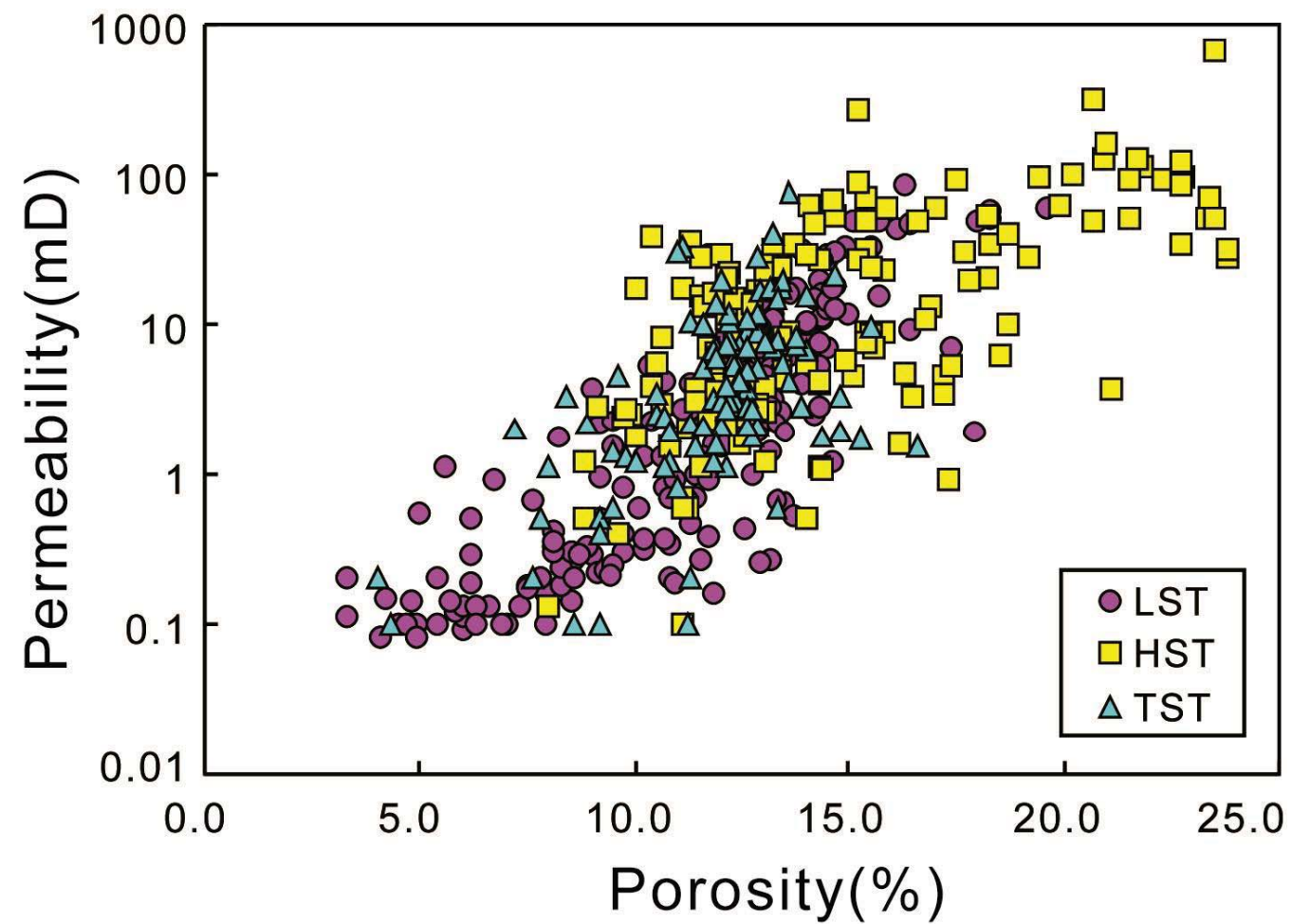


Fig.6. Cross plot of porosity versus permeability of sandstones in different systems tracts

- It was conducted within the sequence stratigraphic framework from two aspects: control of sequence boundary on diagenesis and diagenetic evolution of sandstones in different systems tracts.
- The results indicate that the Shahejie Formation comprises one second-order sequence and three third-order sequences.
- The sequence boundary controlled carbonate cementation and dissolution in the underlying sandstones.

## 5. Proposed Model and Conclusions

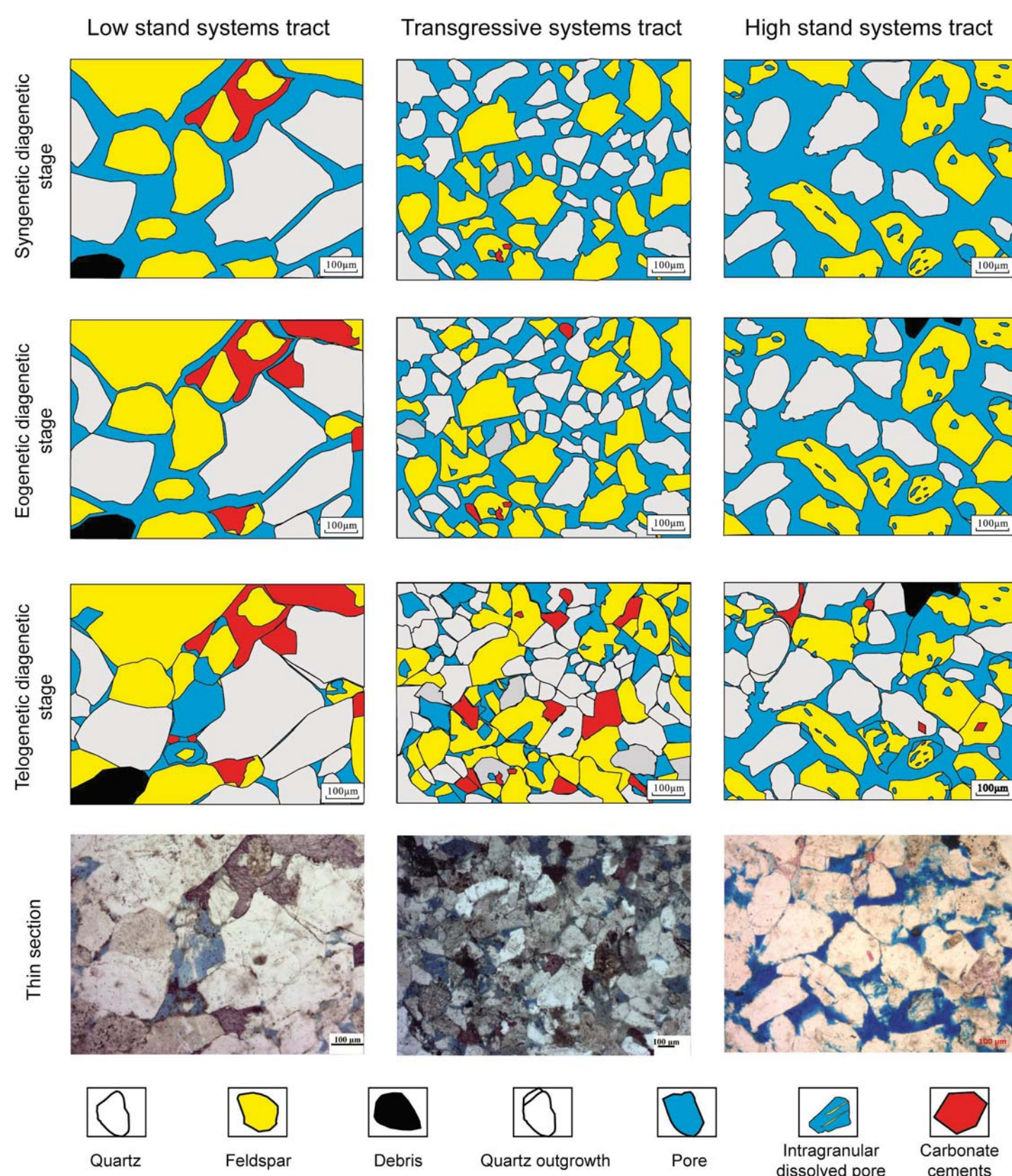


Fig.7. Diagenetic evolution models for sandbodies in 3 different systems tracts within the sequence stratigraphic framework

- Sands in HST consist of well-sorted large grains and were more resistant to compaction. Their relatively shallow burial made it possible for primary porosity to be preserved more easily.
- The leaching by the atmospheric waters in the early diagenetic stage and the subsequent dissolution by organic acids led to the significant development of secondary porosity, which improved the reservoir quality of the sands considerably. Thus, sandstones in HST possess the best reservoir quality.
- This study proposed the diagenetic evolution models for sands in different systems tracts at syngenetic, eogenetic, and telogenetic stages. It characterized the diagenetic features within the sequence stratigraphic framework.

## 6. References

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## 7. Acknowledgments

