Collaborative Geological-Engineering Integration for Unconventional Reservoir Development

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Digitally Intelligent Evaluation Method for Shale Gas

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Outline

1. Introduction

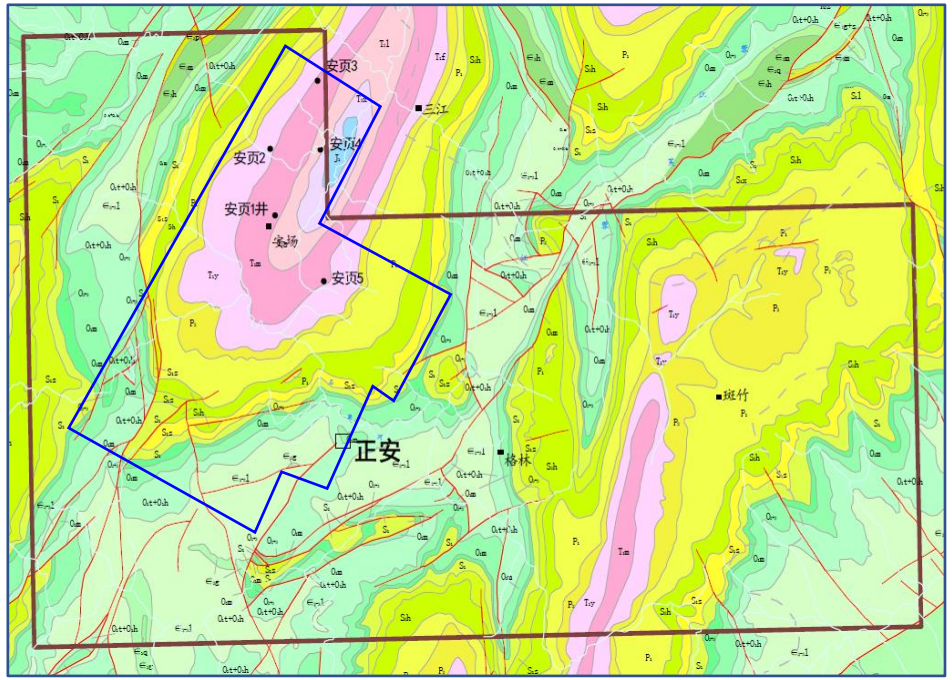
2. Methods & Results

3. Discussion

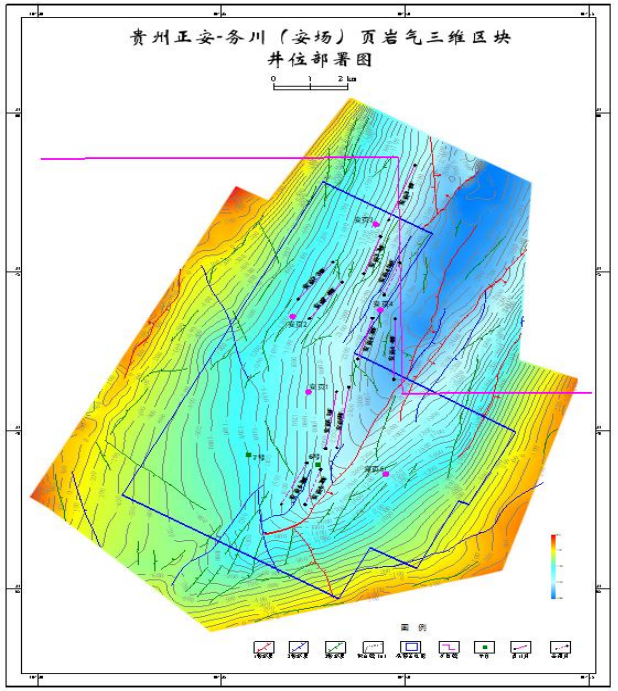
4. Summary

Overview of the study area

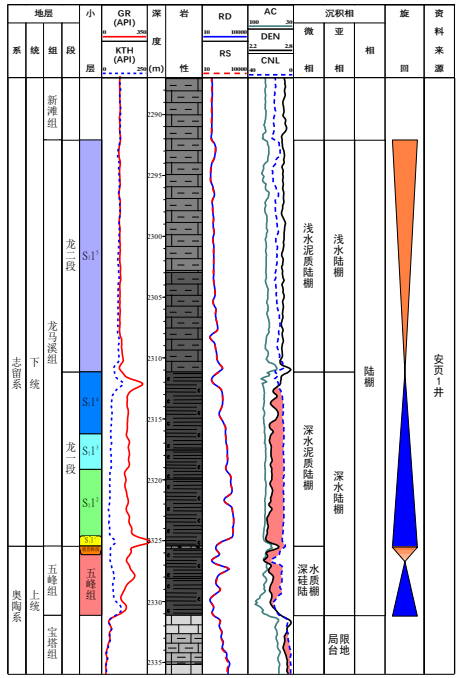
- Anchang Block is located on the western part of the Wuling Depression
- primary reservoir is the Wufeng-Longmaxi shale



Geological map of Anchang shale gas exploration area



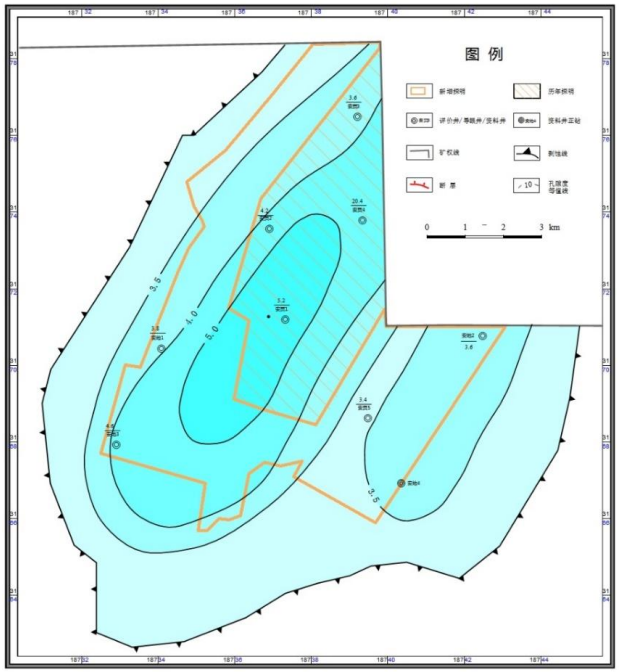
Structural map



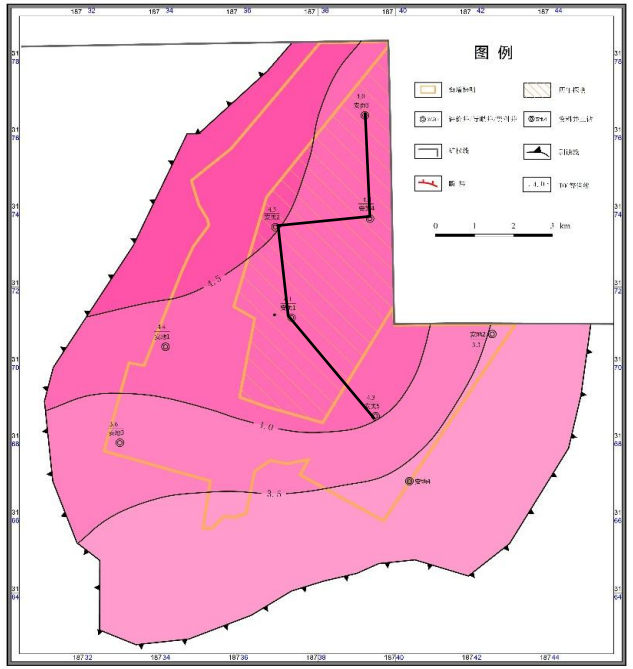
Synthetical stratigraphic

Geological characteristics

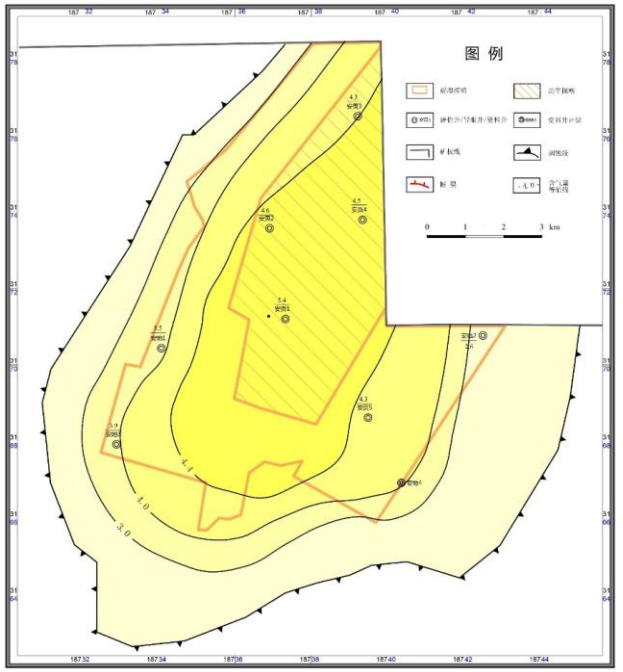
- Formation thickness is17.6-23.3m, porosity is 2.8-3.8%, TOC is 3.7-4.2%, gas content is 3.1-5.3m^3/t



Porosity distribution map



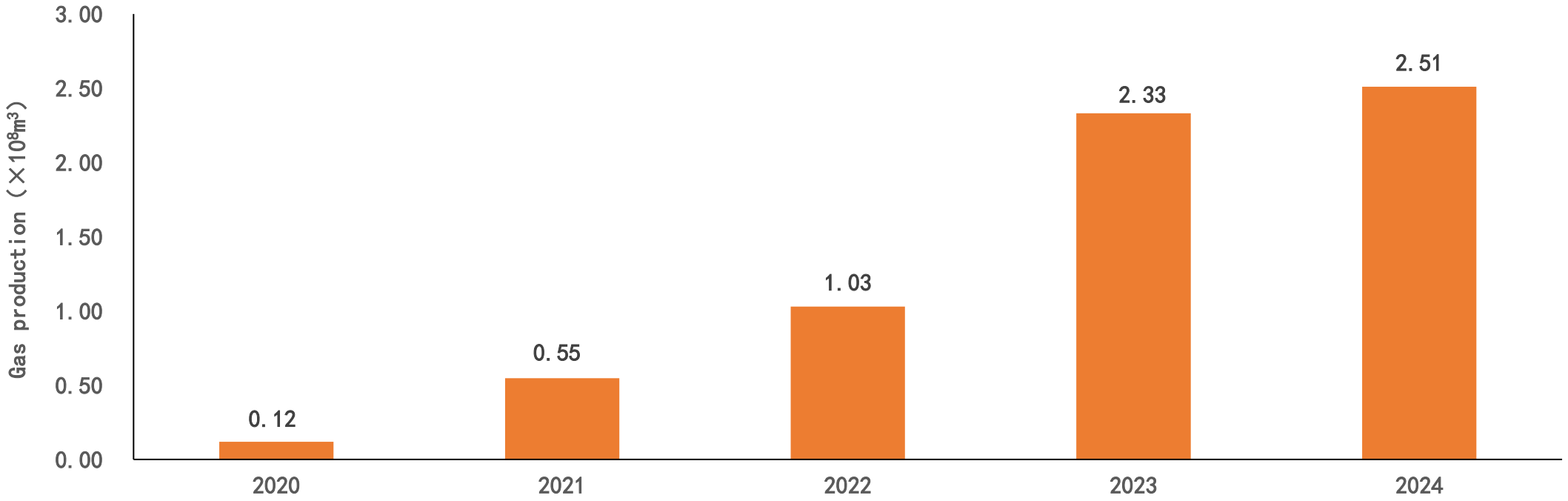
TOC distribution map



Gas content distribution map

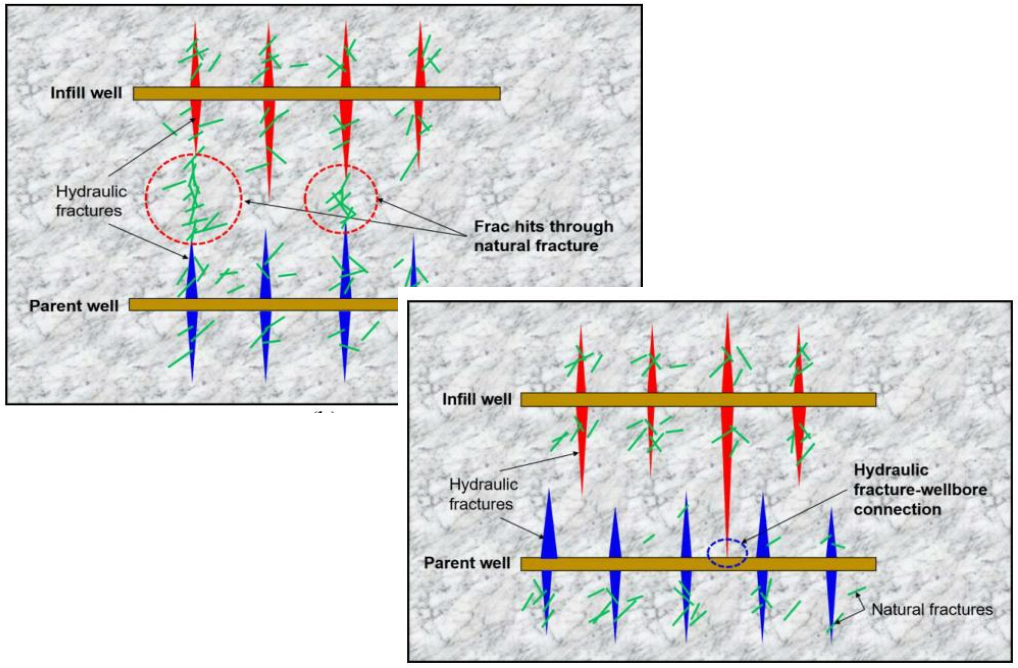
Gas production status

- Since 2018, 67 production wells, daily gas production per well is $1.2\times10^4m^3$, annual gas production is $2.5\times10^8m^3$

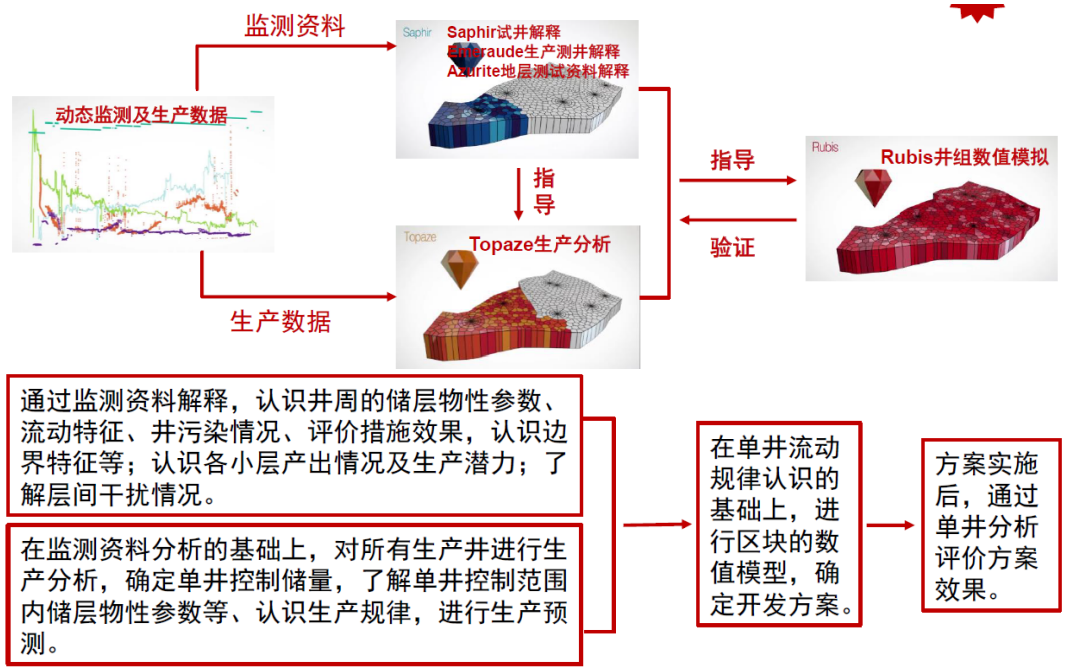


Development chanllenges

- Unclear geology, high well interference, and rapid production decline
- Lack of a methodology for evaluating development performance



Well interference mechanism



Traditional performance analysis process

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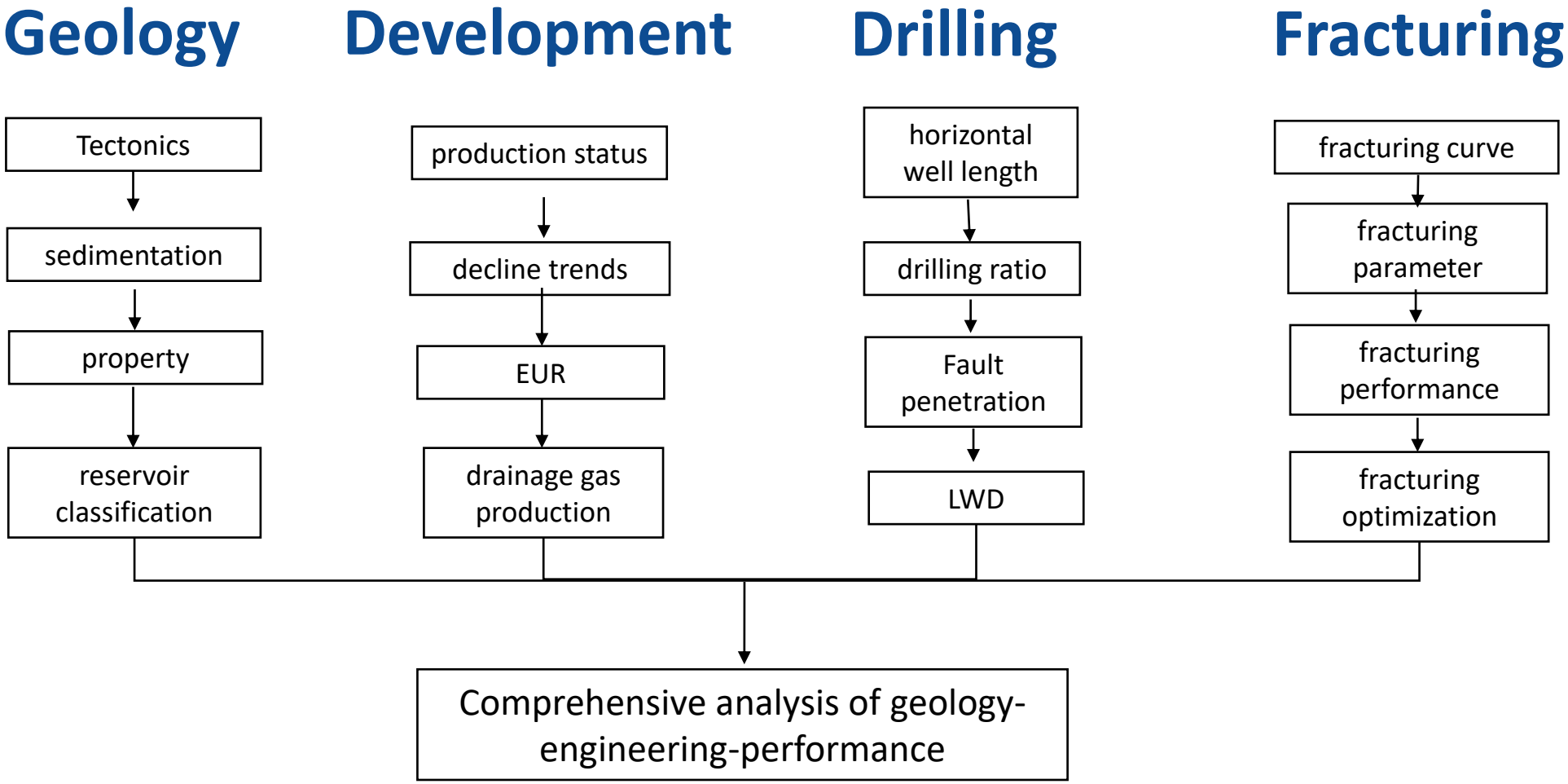
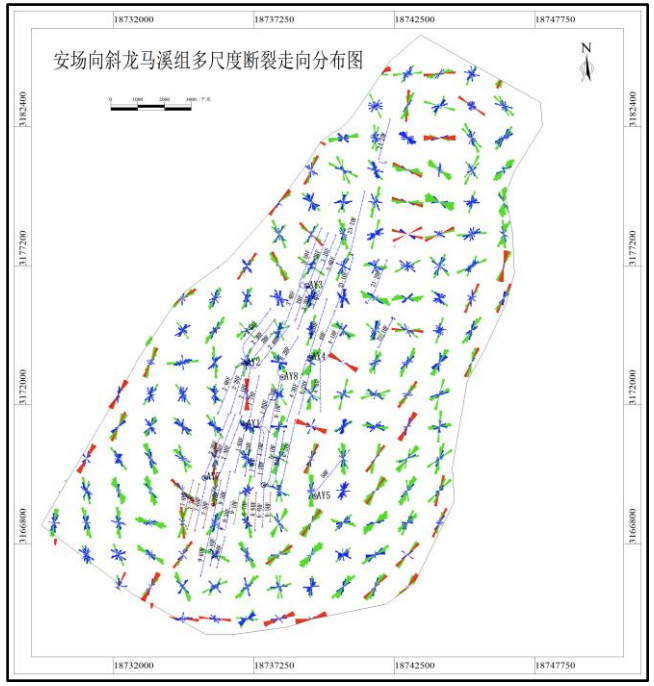
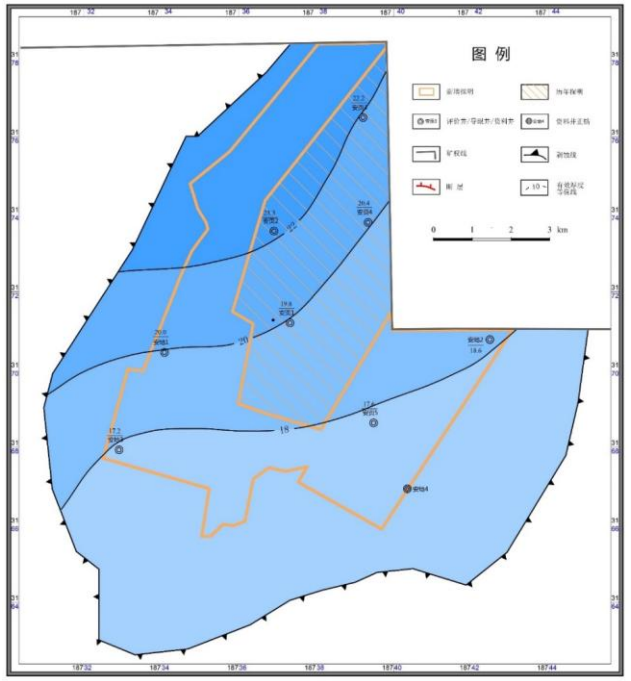

Geology
Development
Drilling
Fracturing
Tectonics
sedimentation
property
reservoir classification
production status
decline trends
EUR
drainage gas production
horizontal well length
drilling ratio
Fault penetration
LWD
fracturing curve
fracturing parameter
fracturing performance
fracturing optimization
Comprehensive analysis of geology-engineering-performance

Geological characteristics analysis

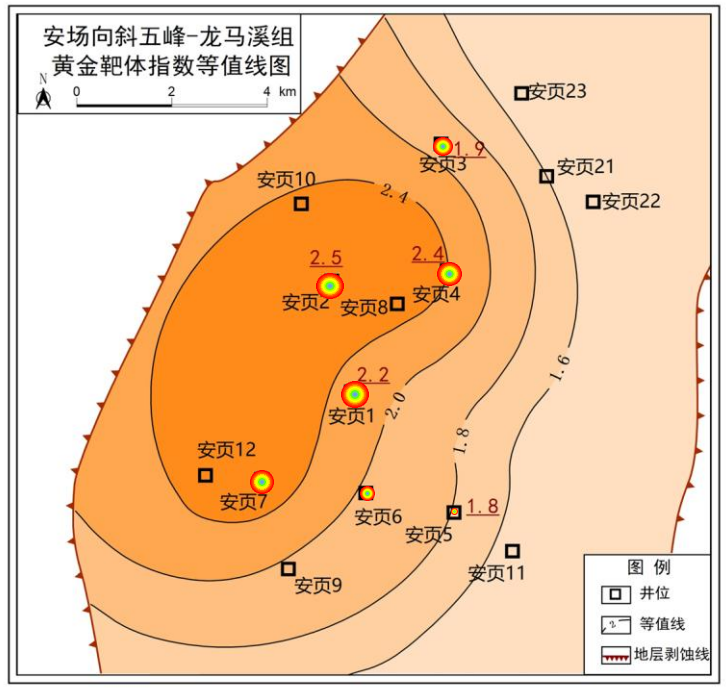
- Tectonics, sedimentation, and reservoir properties, were carried out to conduct an integrated evaluation and classification of reservoir



Faults distribution



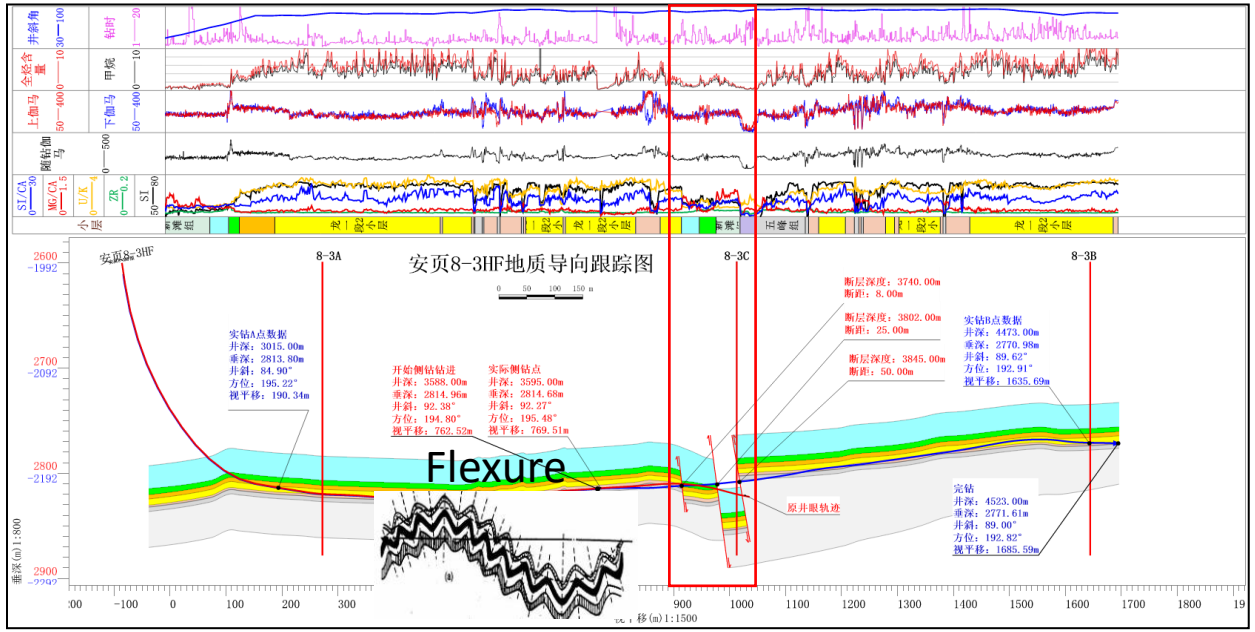
Formation thickness



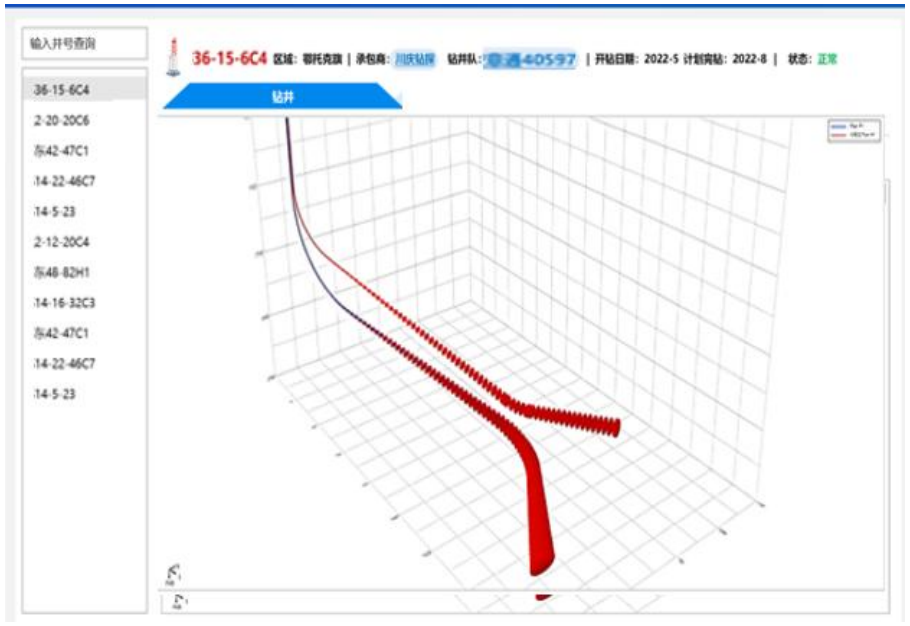
Reservoir evaluation distribution

Drilling performance analysis

- Fault penetration, logging while drilling (LWD), and drilling rate analysis provide support for the study of single-well gas production capacity



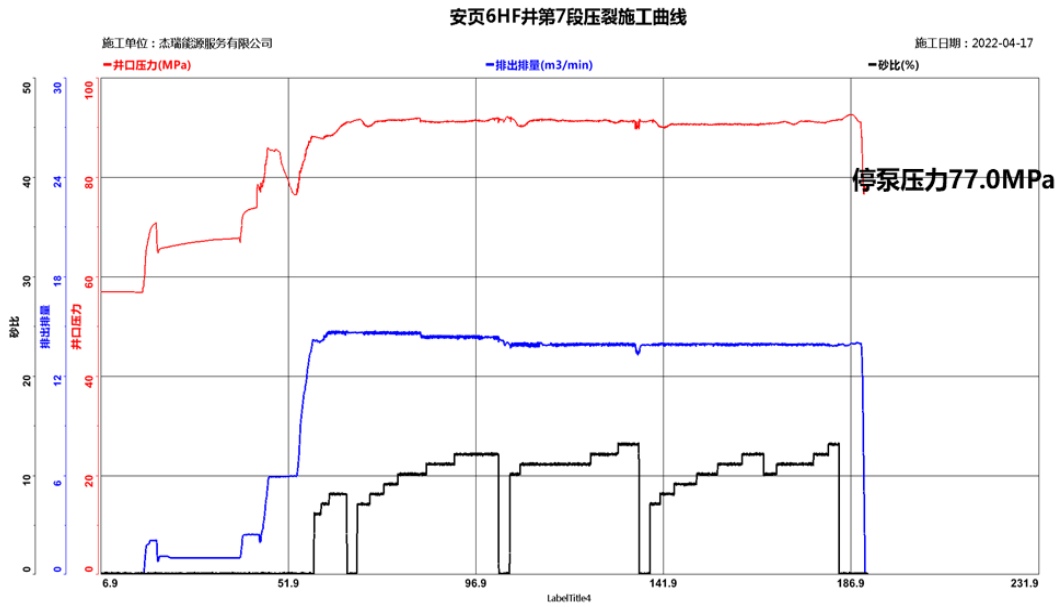
Drilling analysis of well 8-3HF



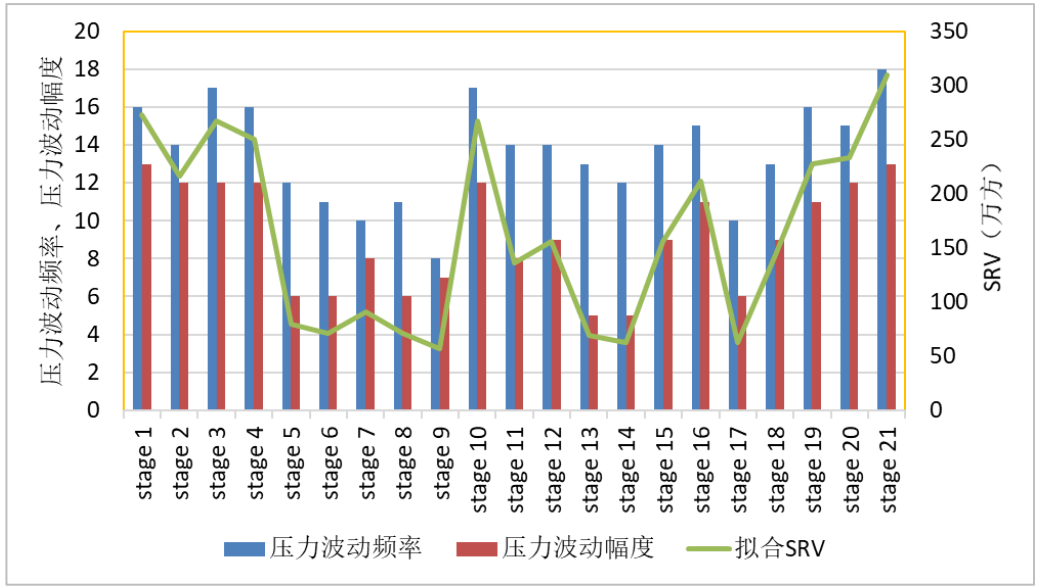
Drilling optimization

Fracturing performance analysis

- Analyze the high-frequency fracturing data to evaluate the fracturing performance



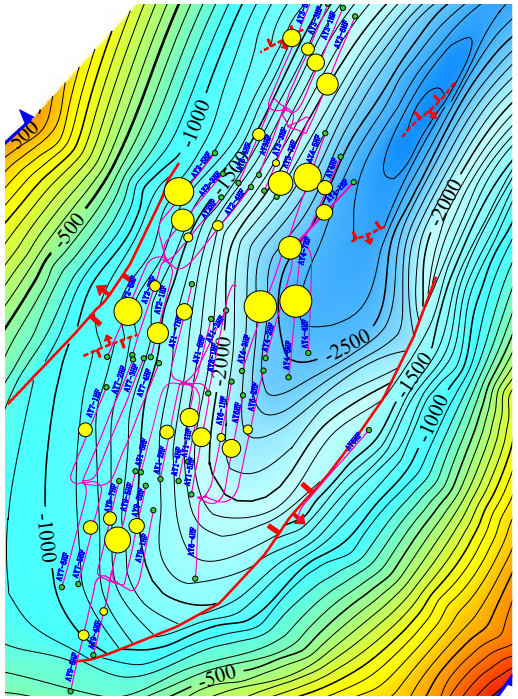
Fracturing curve of well 6HF



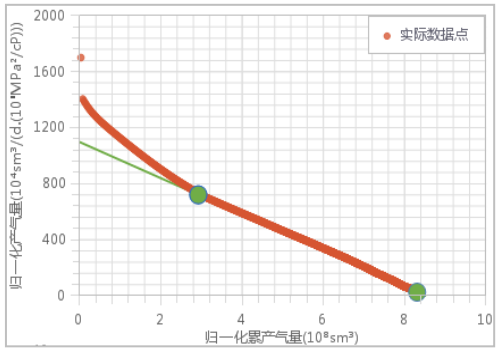
Fracturing performance analysis of well 6HF

Development performance analysis

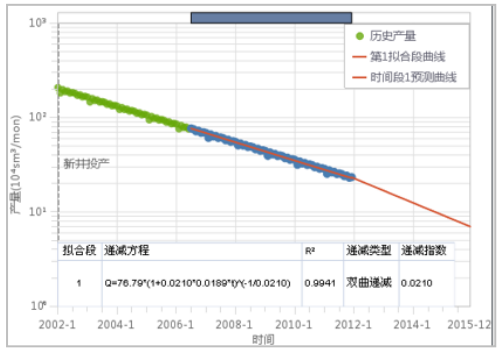
- Production status, decline trends, EUR, and drainage gas production were conducted to determine the main controls on production capacity



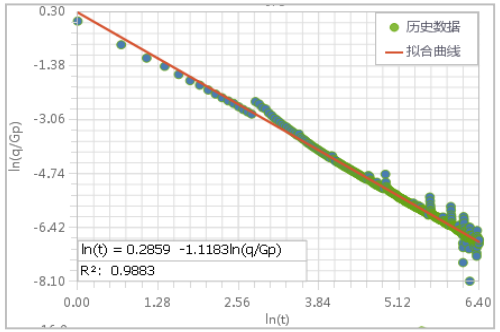
Daily gas production distribution



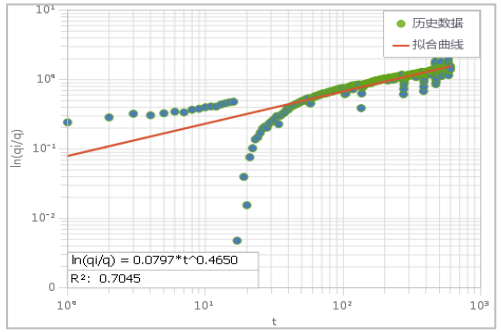
Flowing material balance



Arps decline



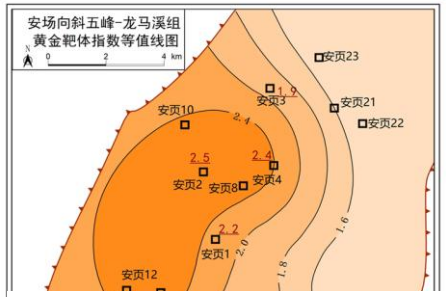
Duong analysis

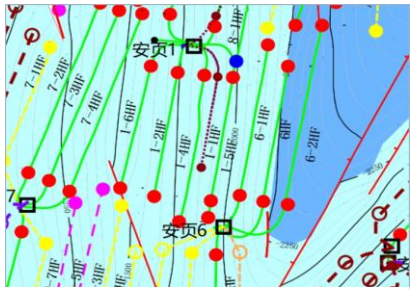


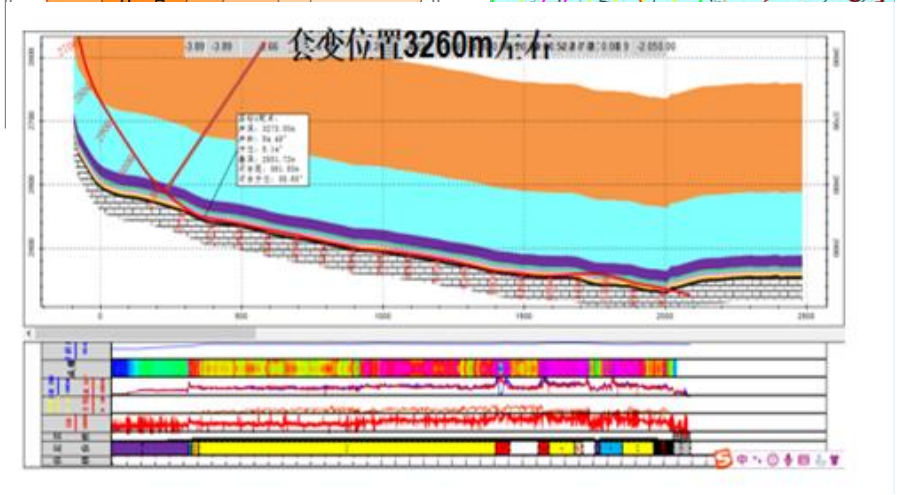
YM-SEPD analysis

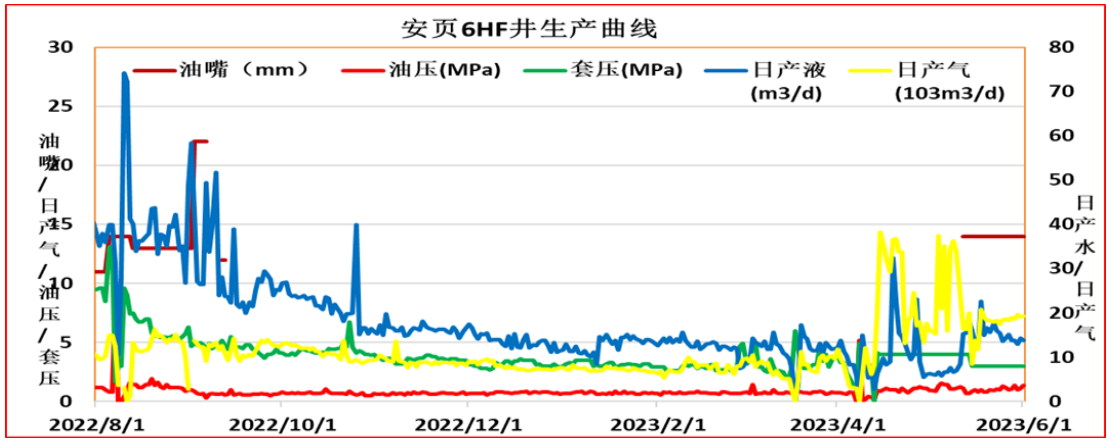
Comprehensive analysis of geology-engineering-performance

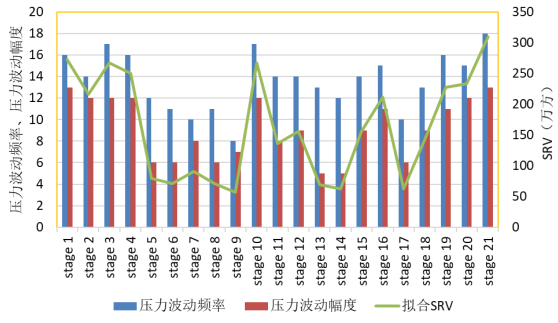
- Comprehensive evaluation integrating geological, engineering and performance data was performed to analyze suitability of the development approach, identify abnormal factors affecting production, and evaluate the effectiveness of implemented engineering measures

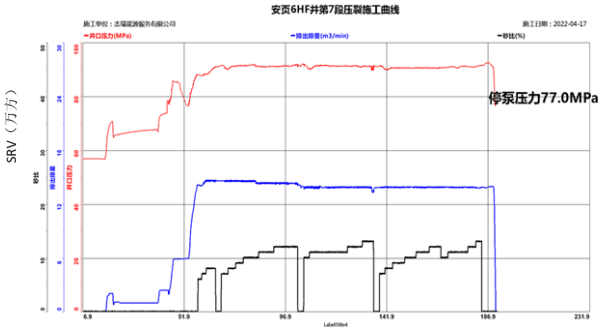












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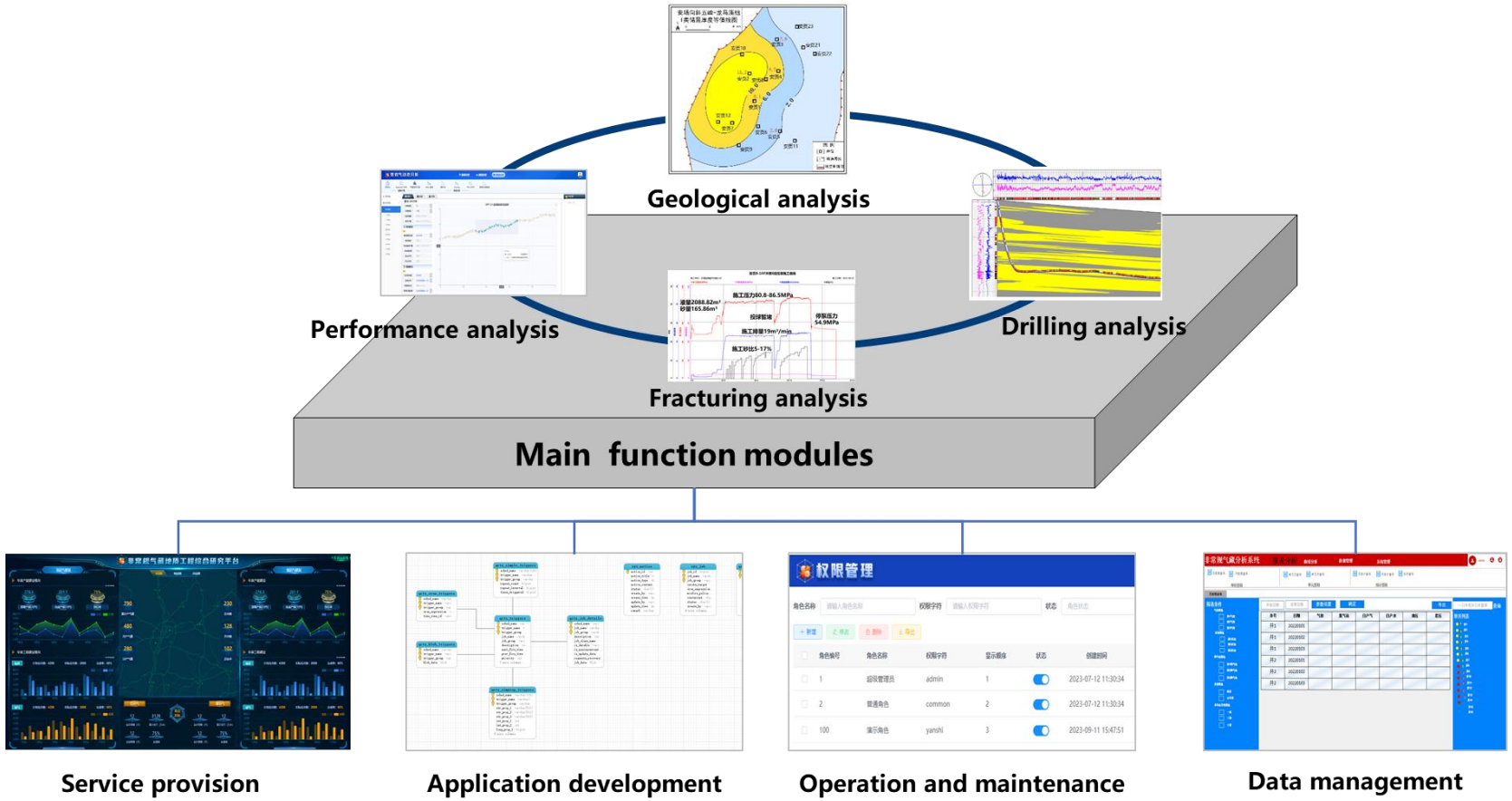
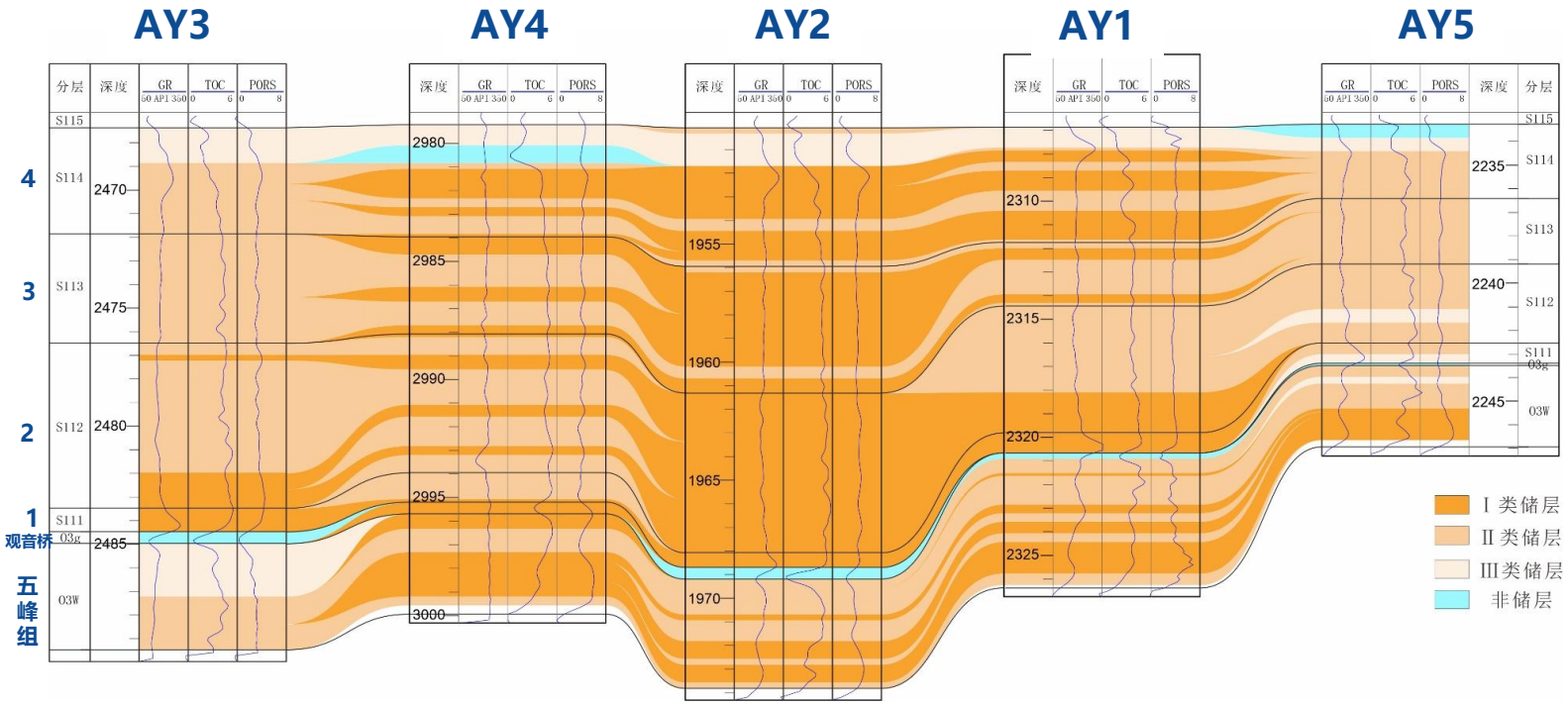
Integrated geological-engineering evaluation system for normal-pressure shale gas

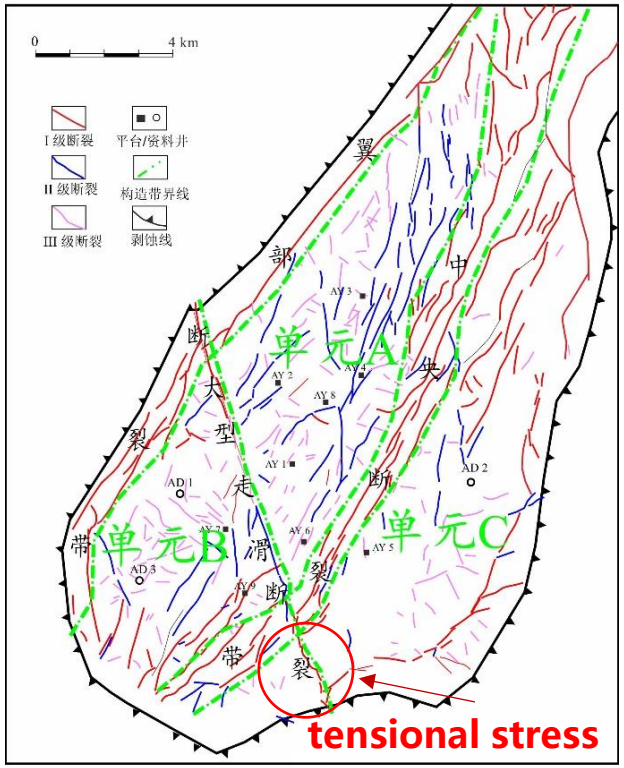


Geology is the internal key determining gas well production

- Poor reservoir quality and a tensional stress are the primary reasons for the relatively low gas productivity in the eastern area



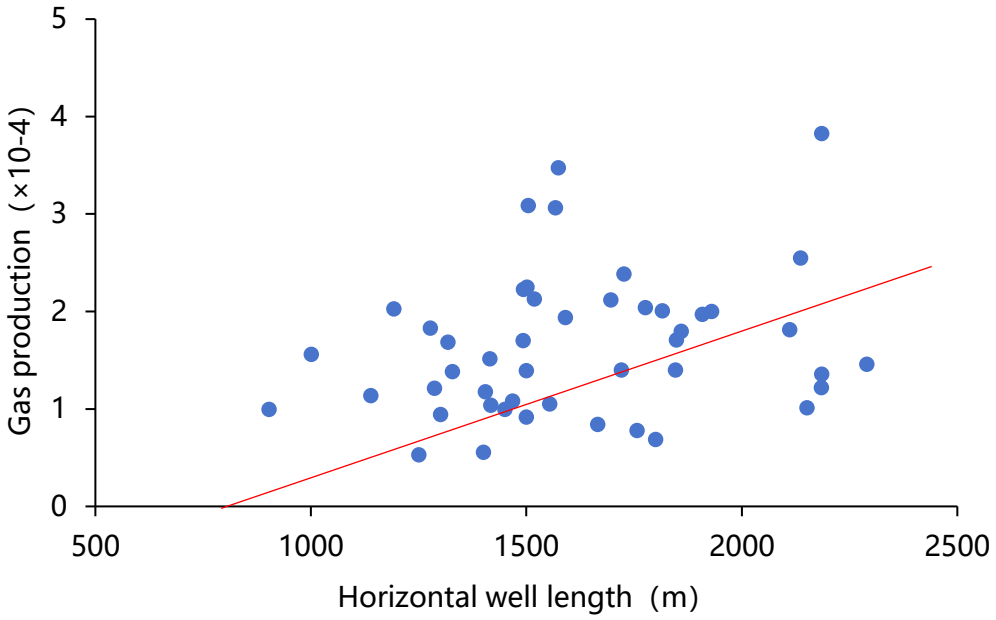
Well section profile



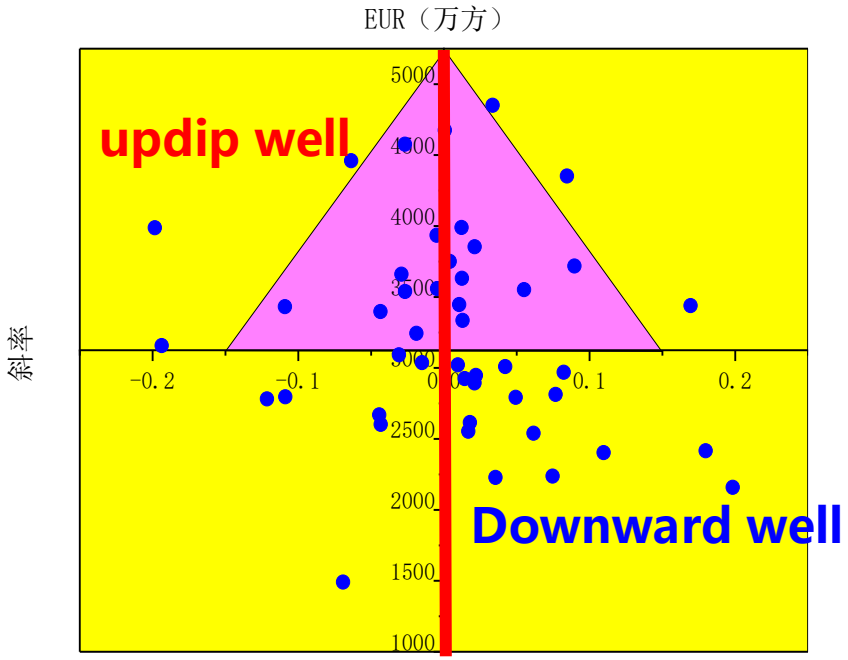
Faults distribution

Engineering is the external key determining gas well production

- Horizontal well length, fracturing parameters, and drainage gas production governs gas well production performance



Horizontal well length effect gas production



Well type effect EUR

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- Guizhou's shale gas reservoirs are characterized by shallow burial, significant variation in strata dip, well-developed fault systems, high total organic content, and good gas-bearing properties.
- Integrated geological-engineering evaluation system for normal-pressure shale gas has been developed by upgrading the existing evaluation processes and establishing mechanisms for data and result sharing.
- Geology is the internal key determining gas well production, the economic development of geologically challenged areas is a function of engineering innovation and cost-control measures.
- Engineering is the external key determining gas well production, by optimizing key engineering parameters facilitates could enhance gas well production.

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Thank you

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