A Comparison of Stratigraphic Architecture, Lithofacies, and Reservoir Quality in Adjacent Large and Small Isolated Carbonate Platforms: Tengiz and Korolev Fields, North Caspian Basin, Kazakhstan*

By
J.F. Collins[1], K.L. Putney[2], P.M. Harris[2], A. Zhumagulova[3], and D.J. Fischer[3]

Search and Discovery Article #20054 (2008)
Posted May 25, 2008

*Adapted from oral presentation at AAPG Annual Convention, Calgary, Alberta, June 19-22, 2005

[1]ExxonMobil Development Company, Houston, Texas
[2]ChevronTexaco Energy Technology Company, San Ramon, California (MitchHarris@chevron.com)
[3]Tengizchevroil, Atyrau, Kazakhstan.

Abstract

Tengiz and Korolev are isolated platform complexes separated by less than 15 kilometers. They have similar thickness and stratigraphic age range, but Tengiz is large (100 km^2) compared to Korolev (7 km^2). Both platforms have similar sequence architecture and cycle thickness, suggesting that differential subsidence is only a minor factor governing platform evolution. Tengiz and Korolev thus provide an opportunity to examine the effect of areal extent on platform accretion, lithofacies, and reservoir properties.

Eight sequences are recognized from seismic and well data within the Tengiz and Korolev platforms: Devonian, Tournaisian, Visean D, Visean C, Visean B, Visean A, Serpukhovian, and Bashkirian. The Tournasian - Visean C sequences form the transgressive leg of a second-order supersequence that resulted in near-drowning of both platforms. The Visean B - Serpukhovian sequences comprise the regressive leg of the supersequence. At both platforms, this regressive phase is characterized by up to 2 kilometers of basinward progradation, primarily during the Serpukhovian. The Serpukhovian progradation is asymmetrical and irregular at both platforms, and the amount of progradation appears to have been controlled by the stacking geometries of the underlying aggradational Visean sequences.

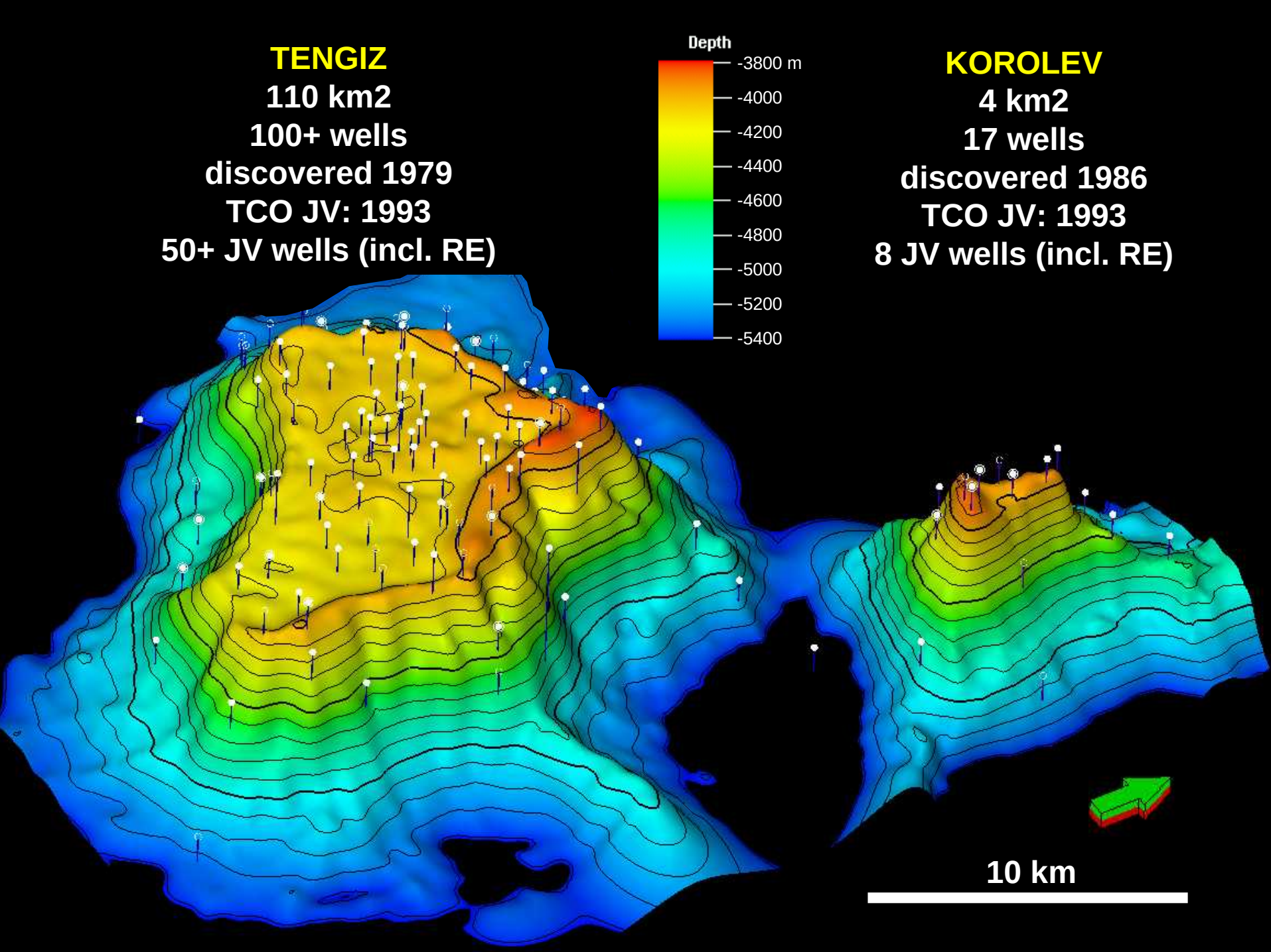
The Visean A sequence demonstrates that the spatial distances over which platform facies variations occur appears to be independent of platform size. Visean A - Bashkirian reservoirs are dominated by interparticle porosity and matrix microporosity over much of the Tengiz platform. Vugs and solution-enlarged fractures become important only in the outer platform. At Korolev, these secondary pore types are more abundant throughout the platform in the same reservoir intervals, perhaps because of the comparatively greater number of fluid pore volumes that affected Korolev during later diagenesis.

"Earth at Night", National Geographic, Nov. 2004

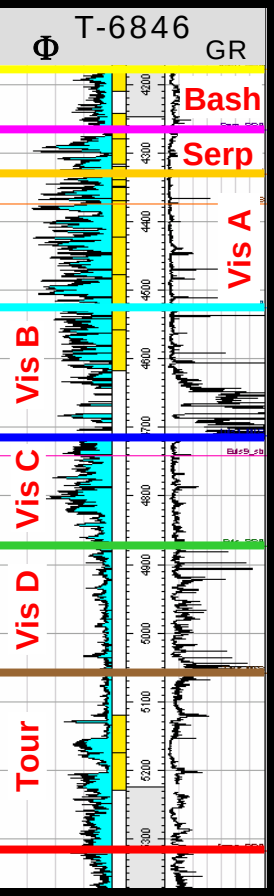
A Comparison of Stratigraphic Architecture, Lithofacies, and Reservoir Quality in Adjacent Large and Small Isolated Carbonate Platforms: Tengiz and Korolev Fields, North Caspian Basin, Kazakhstan

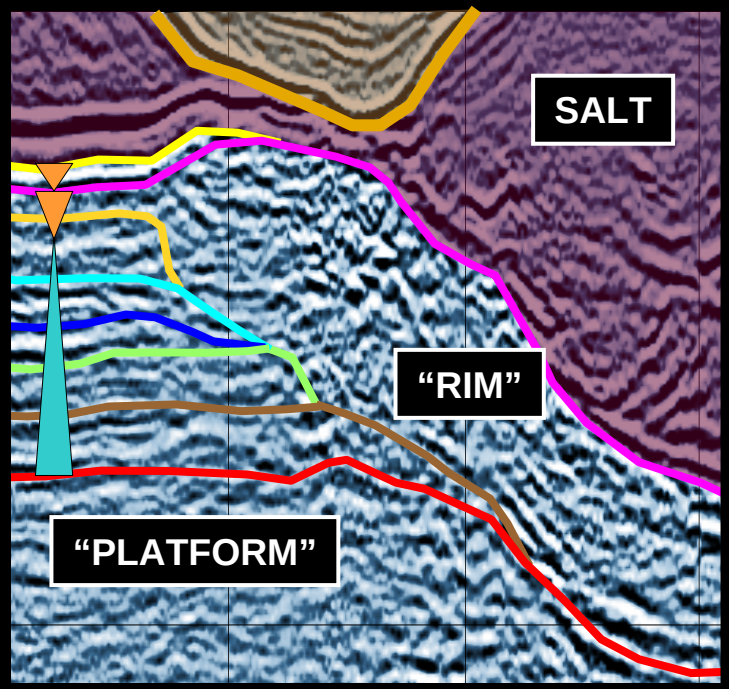
J. F. Collins[1], K. L. Putney[1],
P. M. Harris[2],
A. Zhumagulova[3], D.J. Fischer[3]

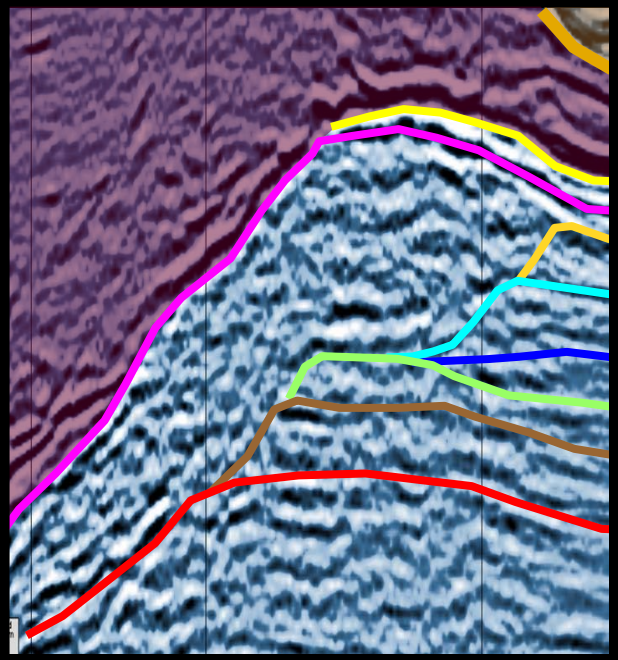
1 ExxonMobil 2 Chevron 3 TCO

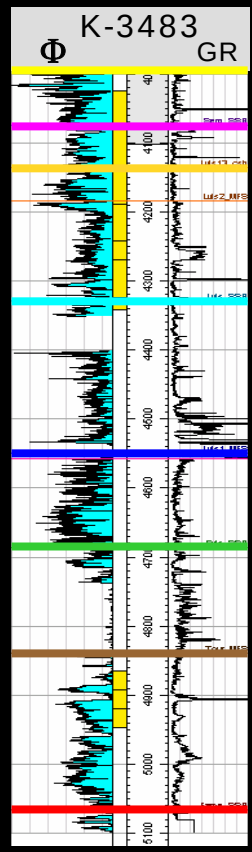

TENGIZ
110 km2
100+ wells
discovered 1979
TCO JV: 1993
50+ JV wells (incl. RE)
Depth
-3800 m
-4000
-4200
-4400
-4600
-4800
-5000
-5200
-5400
KOROLEV
4 km2
17 wells
discovered 1986
TCO JV: 1993
8 JV wells (incl. RE)
10 km

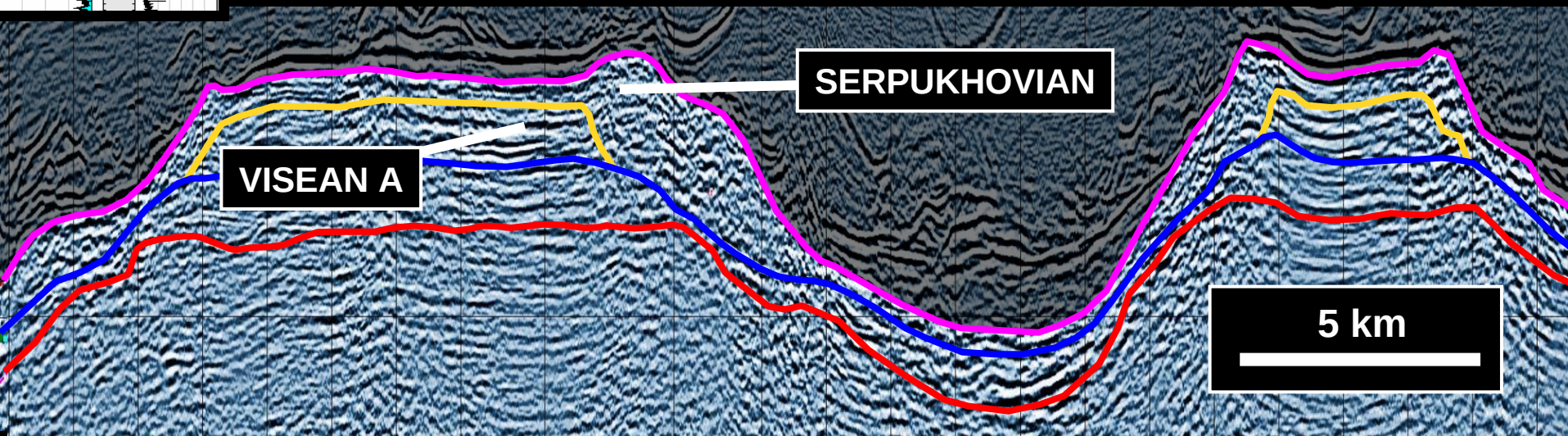
TENGIZ & KOROLEV PLATFORM ARCHITECTURE





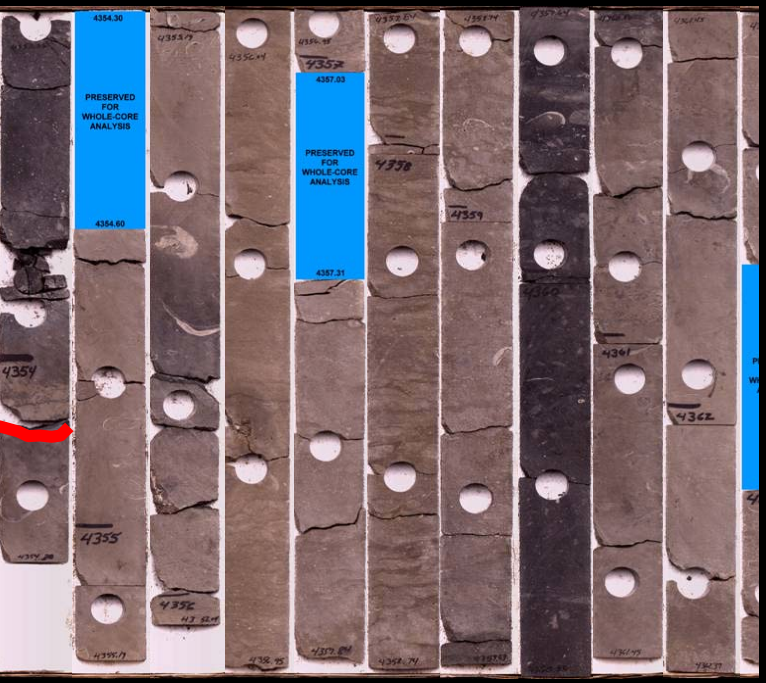


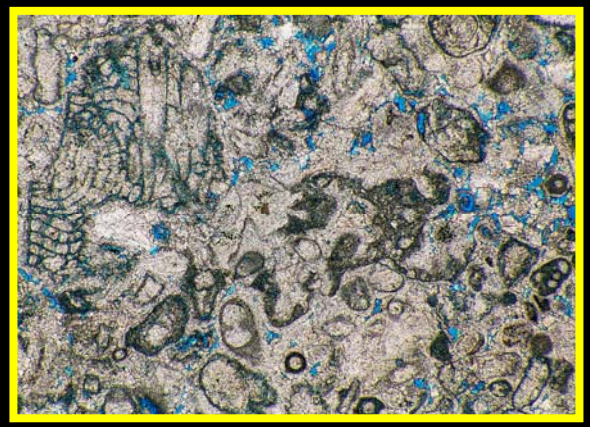


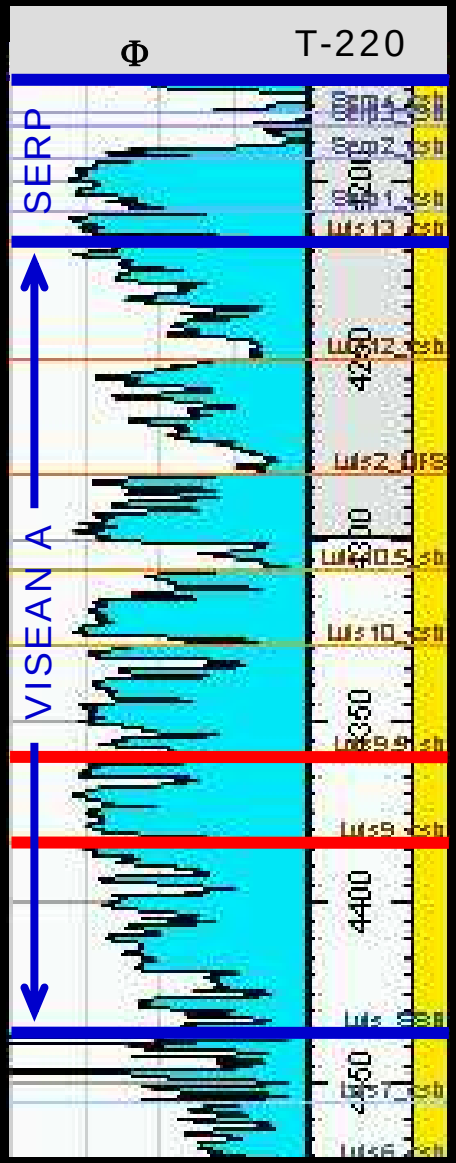


VISEAN A - SERPUKHOVIAN PLATFORM CYCLES

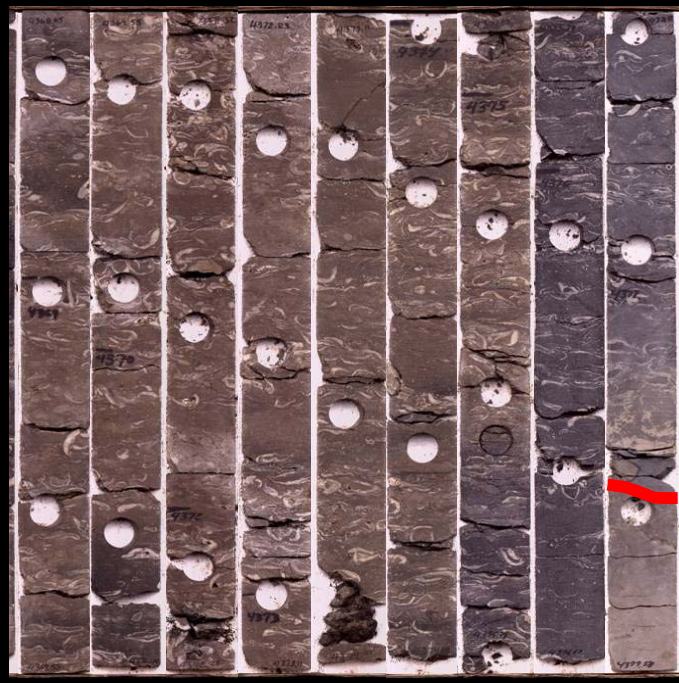
SKELETAL GRAINSTONE

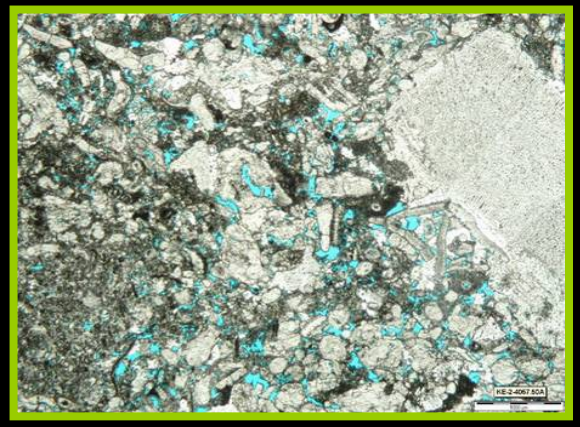




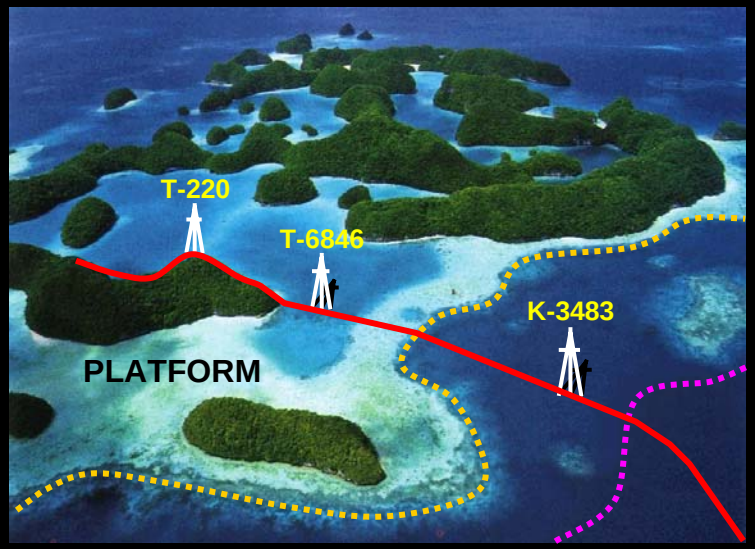


SKELETAL PACKSTONE-GRAINSTONE + BRACHIOPODS

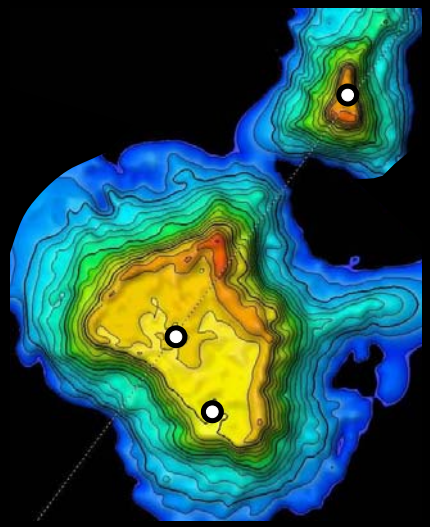




VISEAN A & SERPUKHOVIAN DEPOSITIONAL MODEL



National Geographic photo by David Doubilet

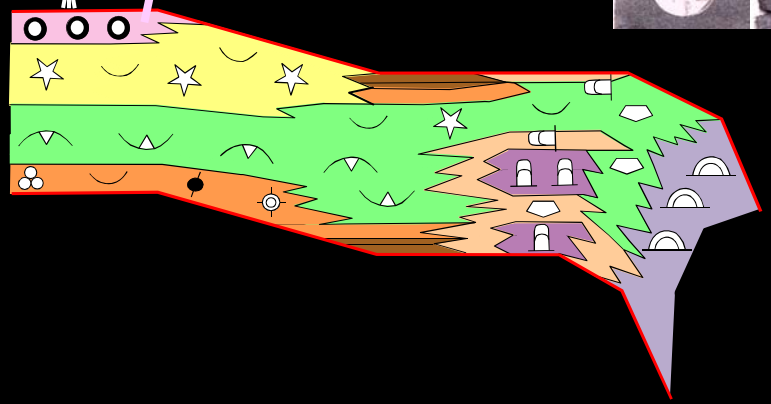


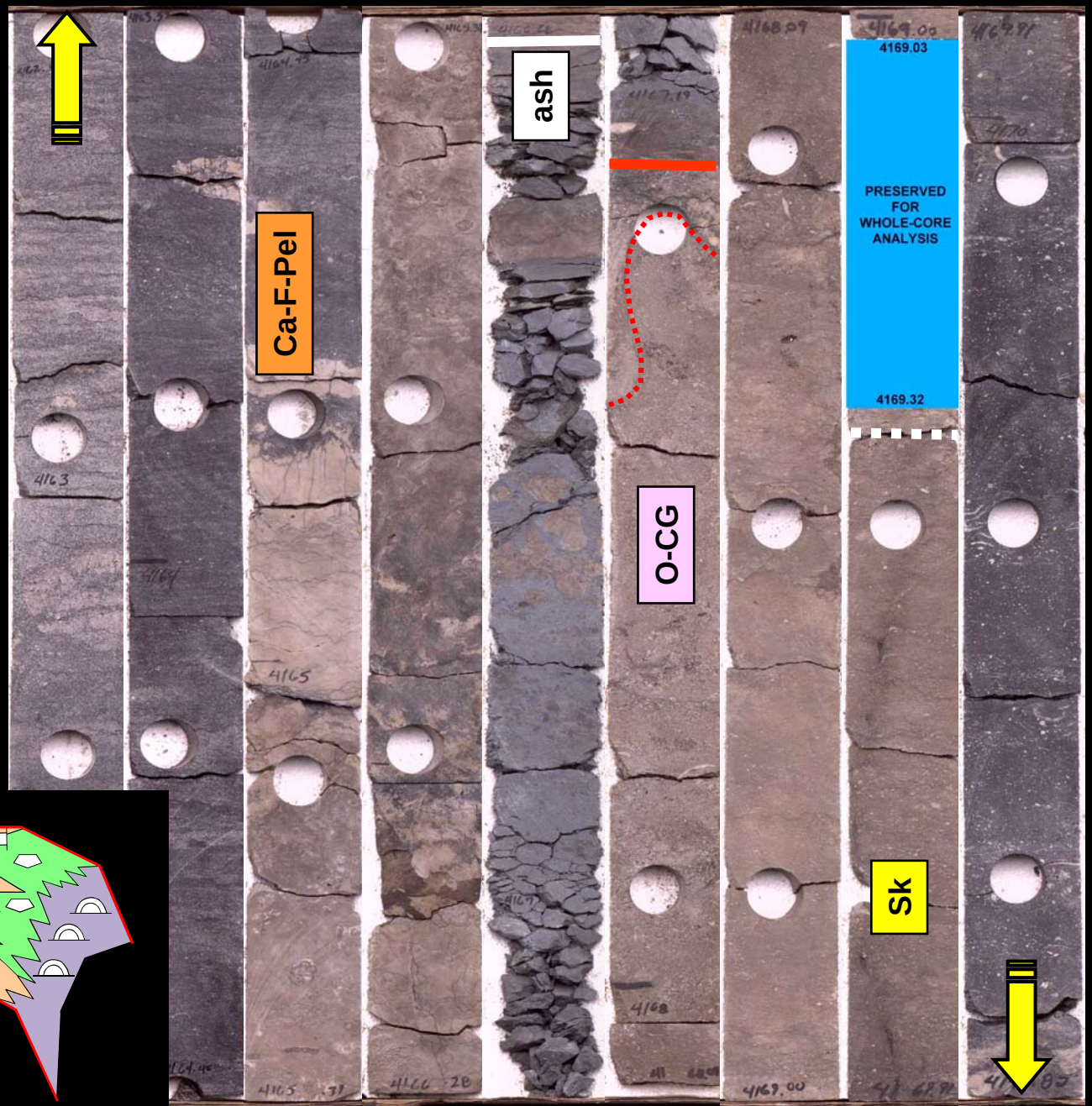
- CG-OOLITIC SANDS
- GRAINSTONE
- FINE GRAINSTONE
- MUDSTONE + ASH
- ALGAL SANDS
- PACKSTONE to GRAINSTONE
- ALGAL-SKEL. BOUNDSTONE
- MICROBIAL BOUNDSTONE

TENGIZ SEQUENCE BOUNDARY: SHALLOW PLATFORM PALEO-RELIEF

SHALLOW PLATFORM

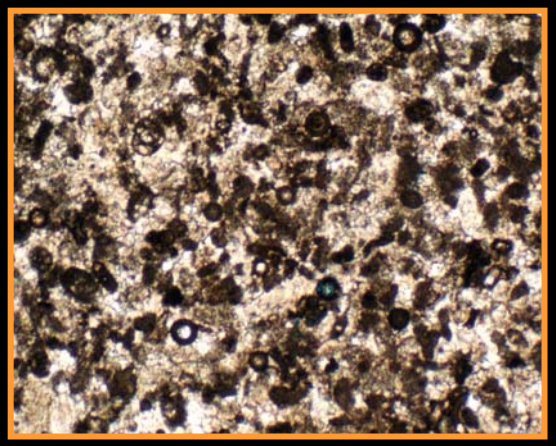
OOID-COATED GRAIN



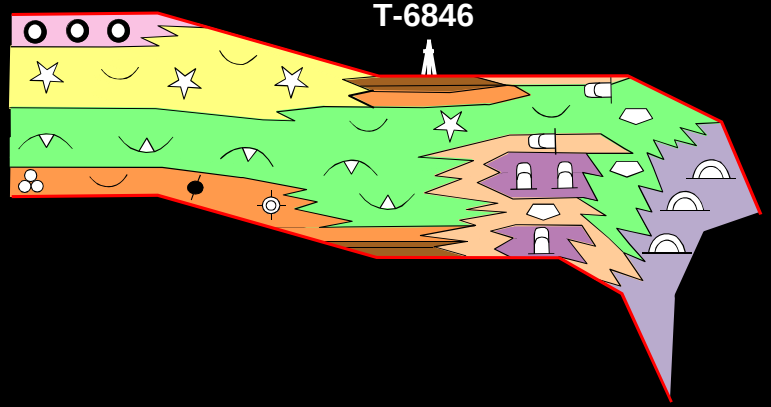


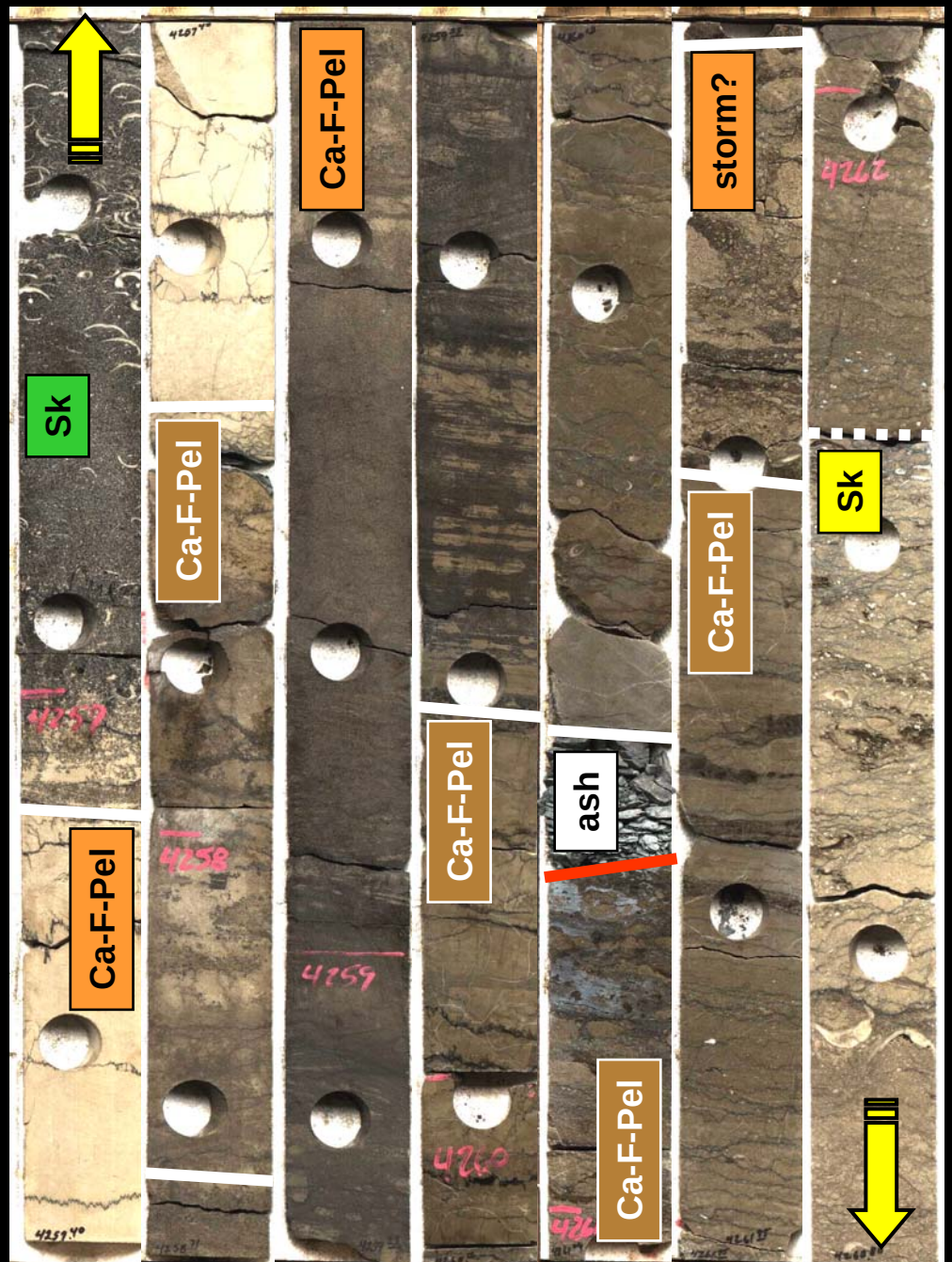
TENGIZ SEQUENCE BOUNDARY: DEEPER PLATFORM PALEO-RELIEF

DEEPER PLATFORM



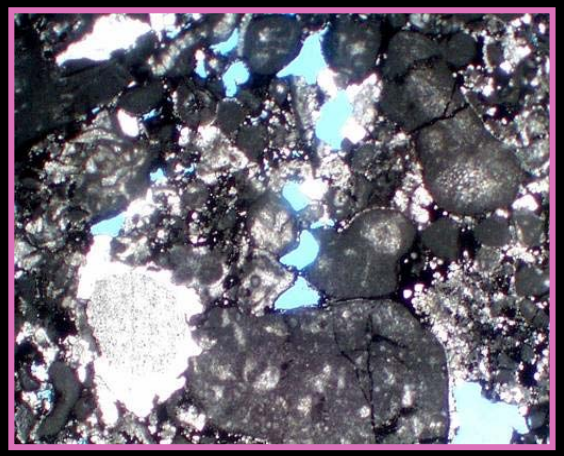
CALCISPHERE-FORAM-PELOID



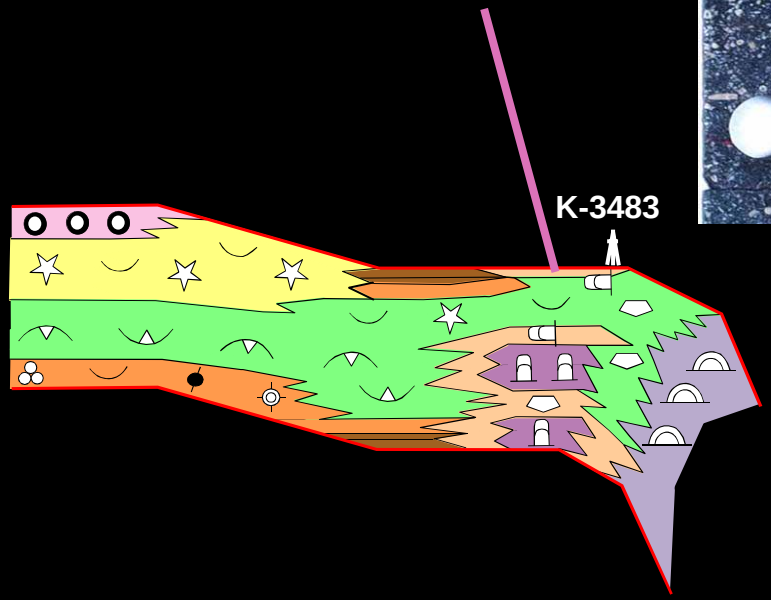


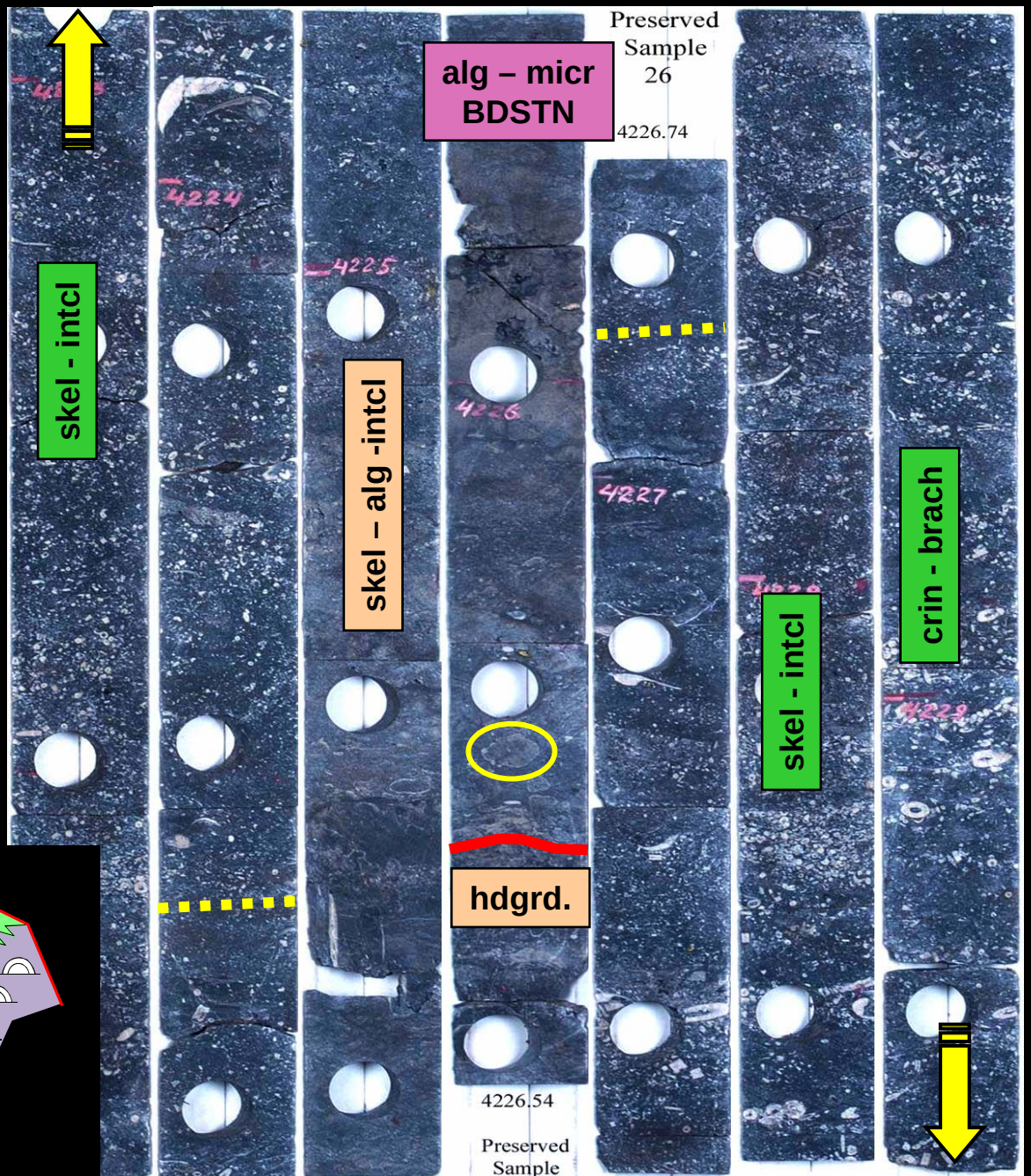
KOROLEV SEQUENCE BOUNDARY: OUTER PLATFORM PALEO-RELIEF

OUTER PLATFORM

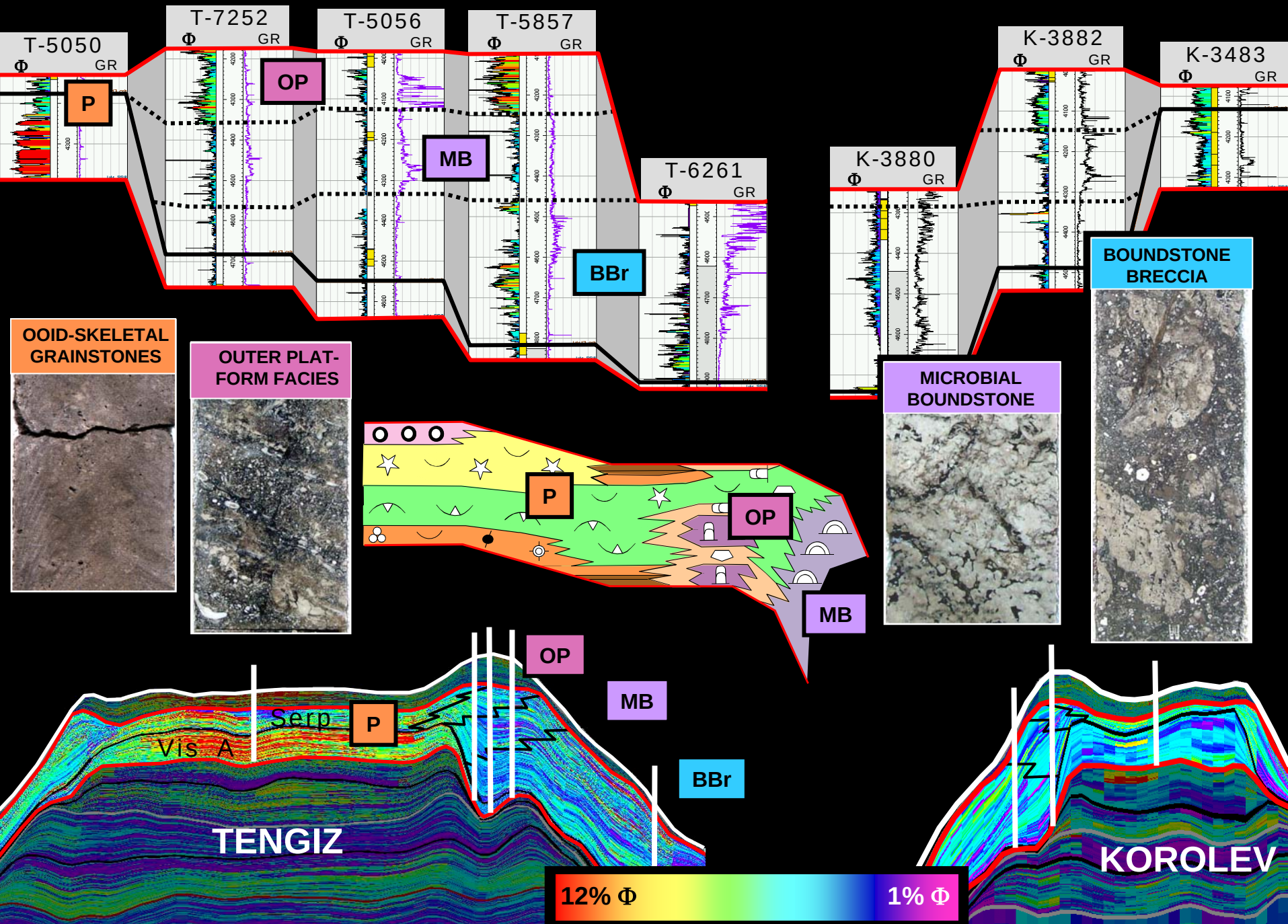


SKELETAL-ALGAL-INTRACLAST

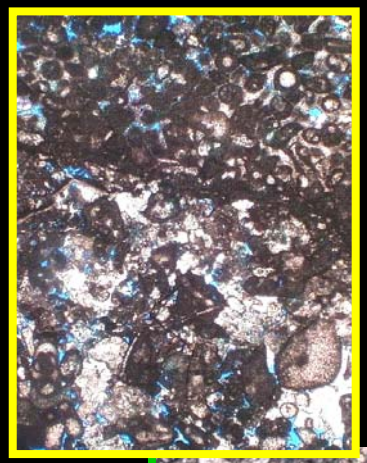


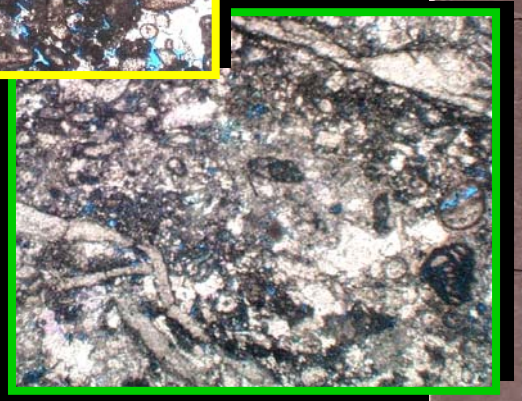


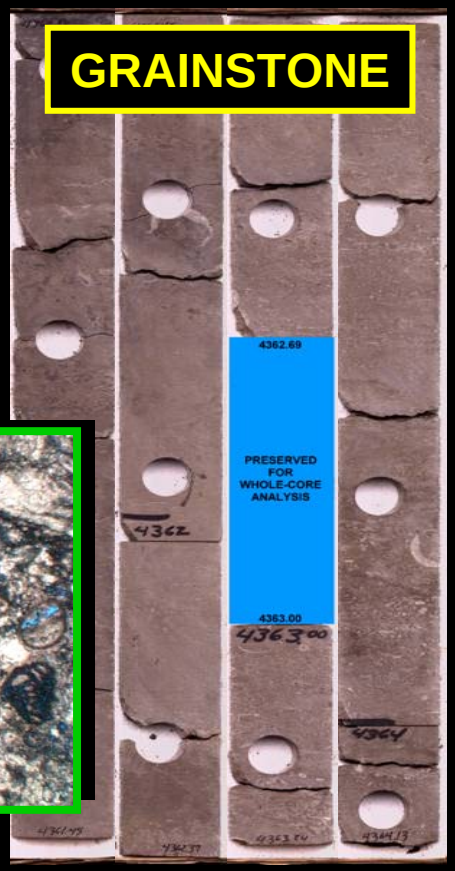
SERPUKHOVIAN FACIES



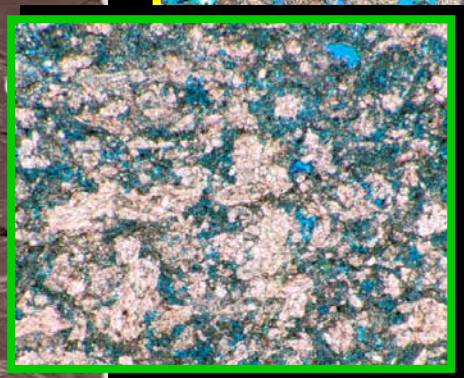
TENGIZ PLATFORM RESERVOIR: NO FRACTURES, BITUMEN, LOST CIRCULATION

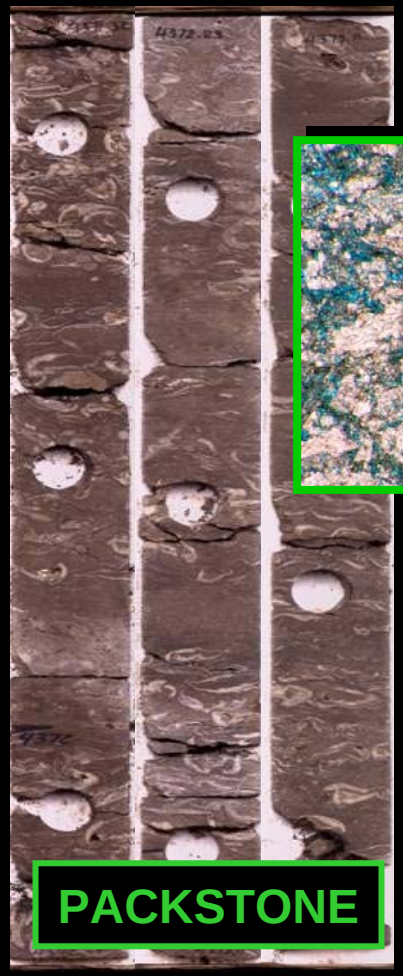






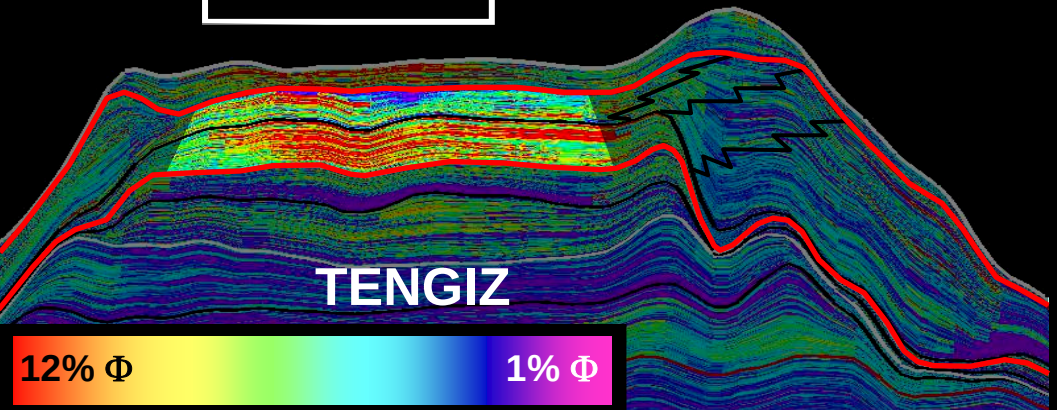
POROSITY VARIATIONS ASSOCIATED WITH INCREASED DISSOLUTION





LOWER Φ

HIGHER Φ



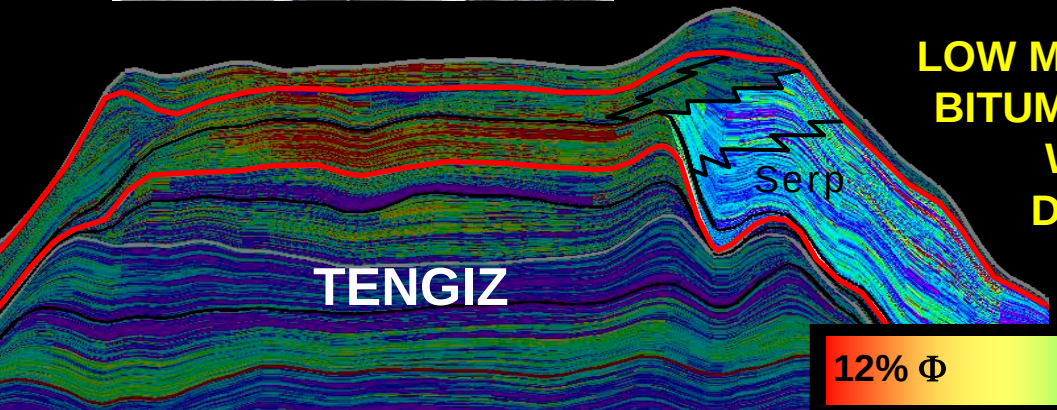
SERPUKHOVIAN RIM RESERVOIR: CORROSION, FRACTURES, BITUMEN, LOST CIRCULATION

TENGIZ BOUNDSTONE

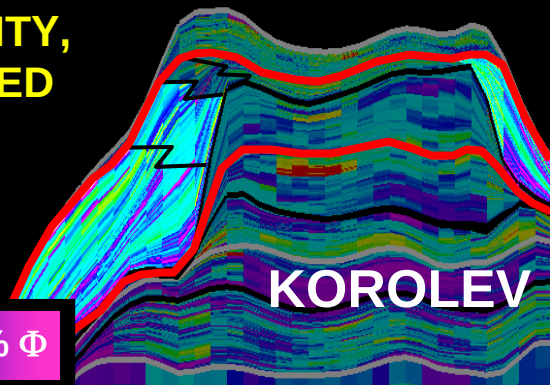
TENGIZ BRECCIA

TENGIZ BRECCIA

KOROLEV BOUNDSTONE

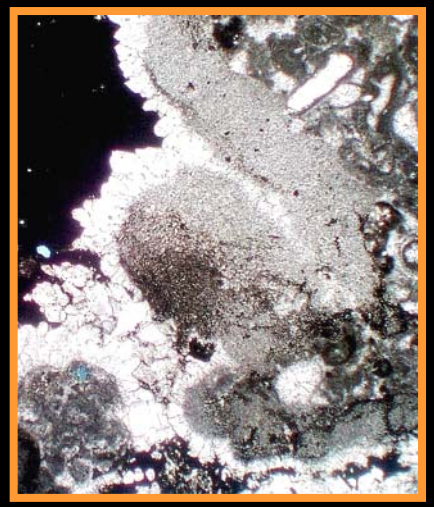


LOW MATRIX POROSITY, BITUMEN ASSOCIATED WITH LATER DISSOLUTION

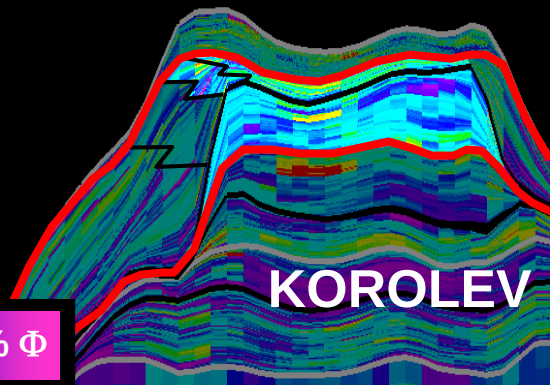


12% Φ — 1% Φ

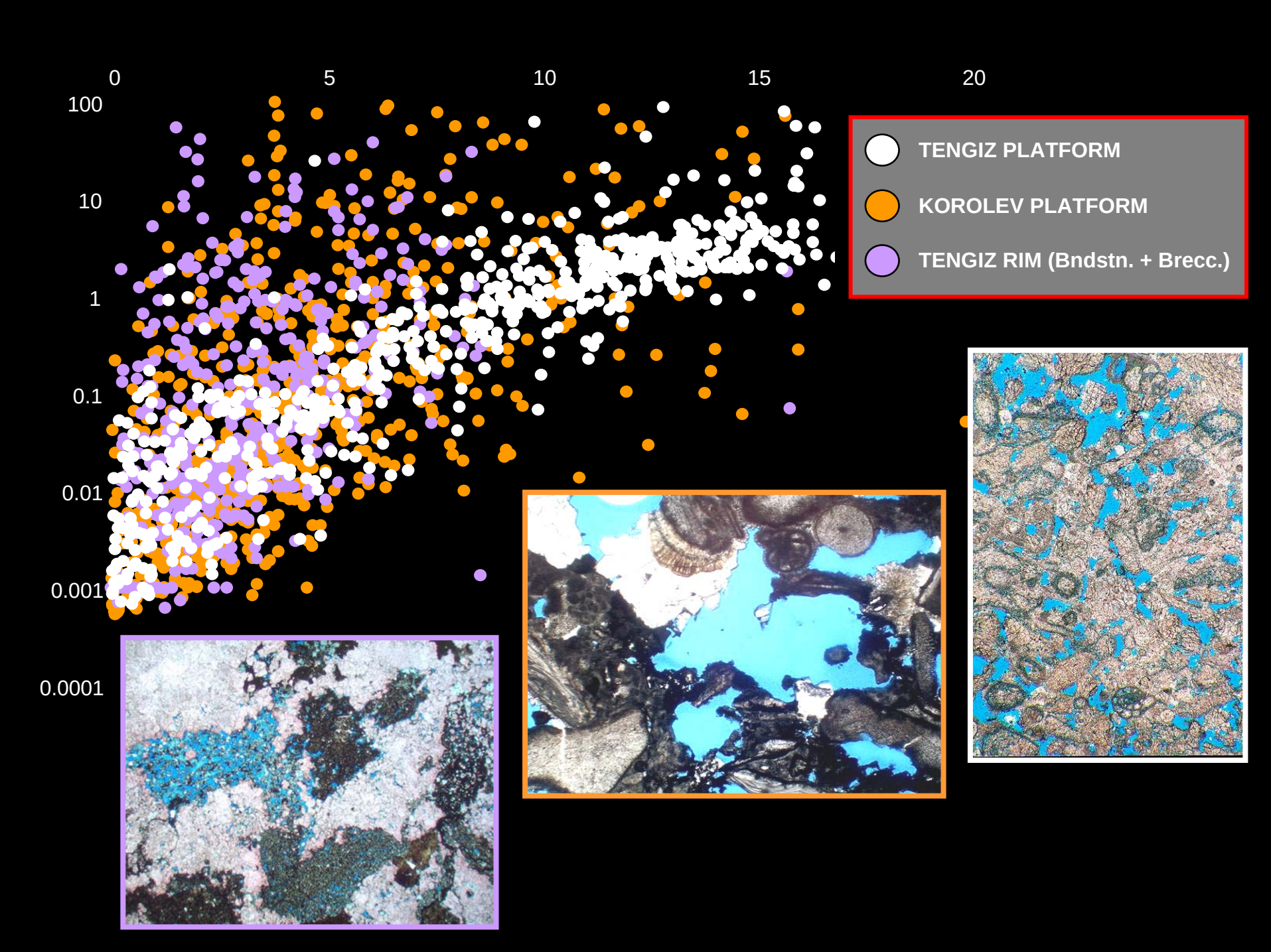
KOROLEV PLATFORM RESERVOIR: CORROSION, FRACTURES, BITUMEN, LOST CIRCULATION



PERVASIVE BITUMEN IN GRAINY PLATFORM FACIES



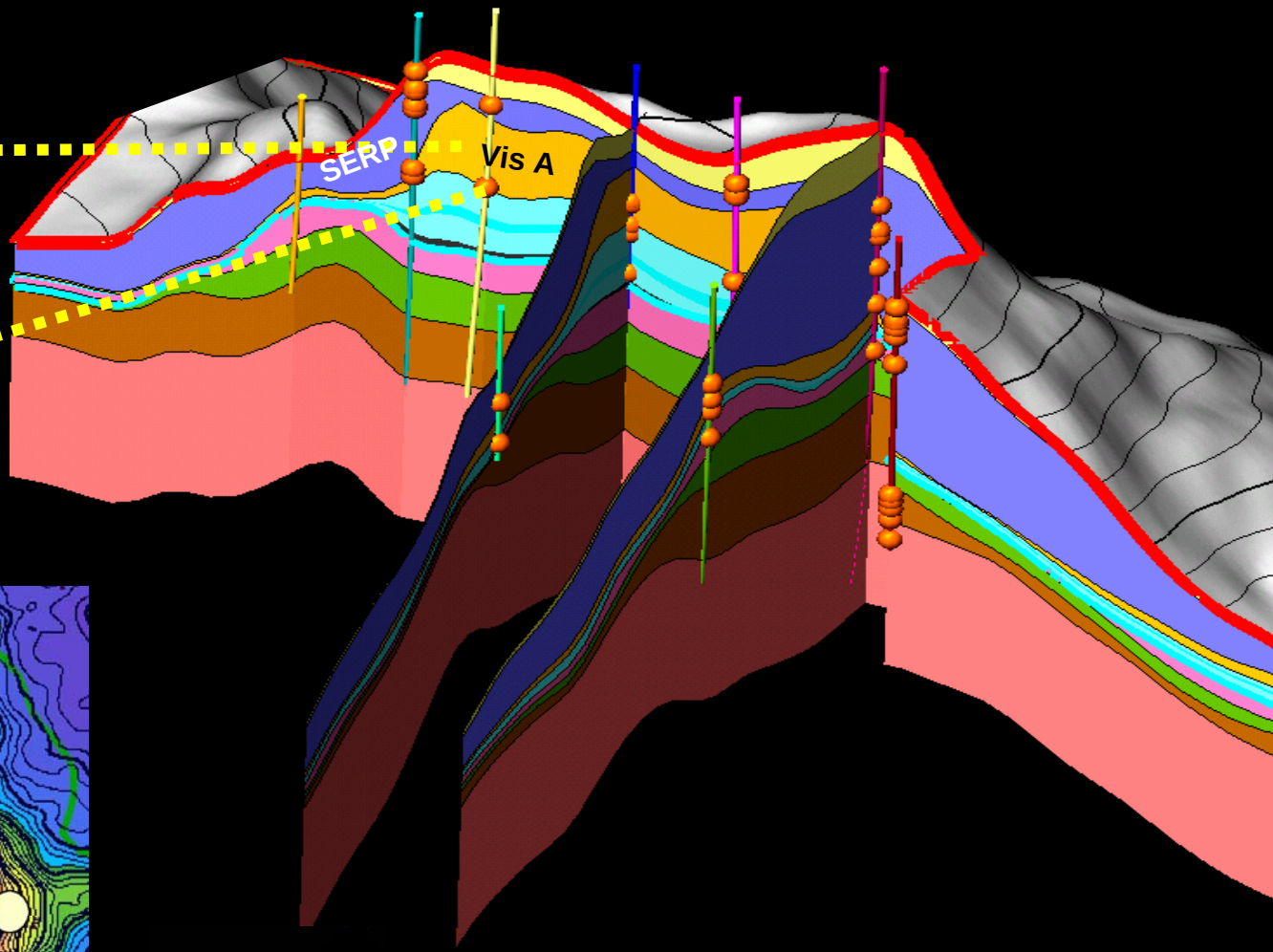
12% Φ — 1% Φ

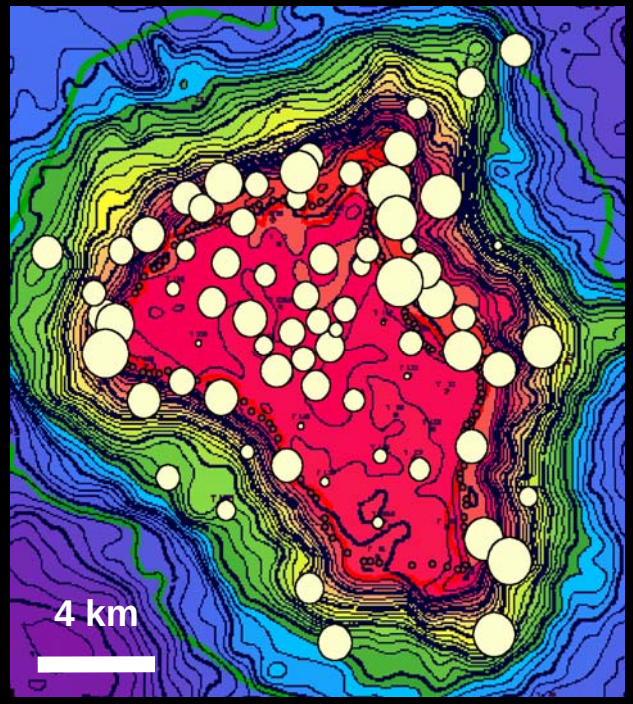

0
5
10
15
20
100
10
1
0.1
0.01
0.001
0.0001
TENGIZ PLATFORM
KOROLEV PLATFORM
TENGIZ RIM (Bndstn. + Brecc.)

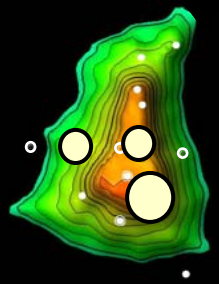
KOROLEV: IMPROVED RESERVOIR CONTINUITY

OUTER PLATFORM FACIES

PLATFORM LCZ's







Higher Initial Rates
Greater Recovery Efficiency
Better Sweep Efficiency

CONCLUSIONS

TRANSITIONAL RESERVOIR AT PLATFORM MARGIN:
-reduced perm contrast
-LCZ's

OUTER PLATFORM FACIES:
-fewer barriers (ash)

PERVASIVE TRANS-ITIONAL RESERVOIR

COMPLEX PLATFORM FACIES:
-high Kh component
-"matrix"-dominated

SIMILAR "RIM" RESERVOIR
-high Kv component
-low matrix Φ

SIMILAR STRATIGRAPHIC ARCHITECTURE