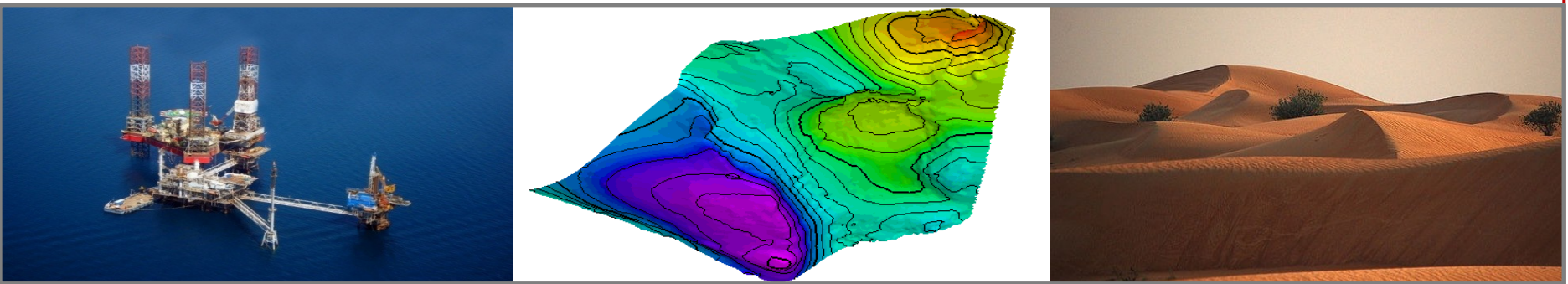




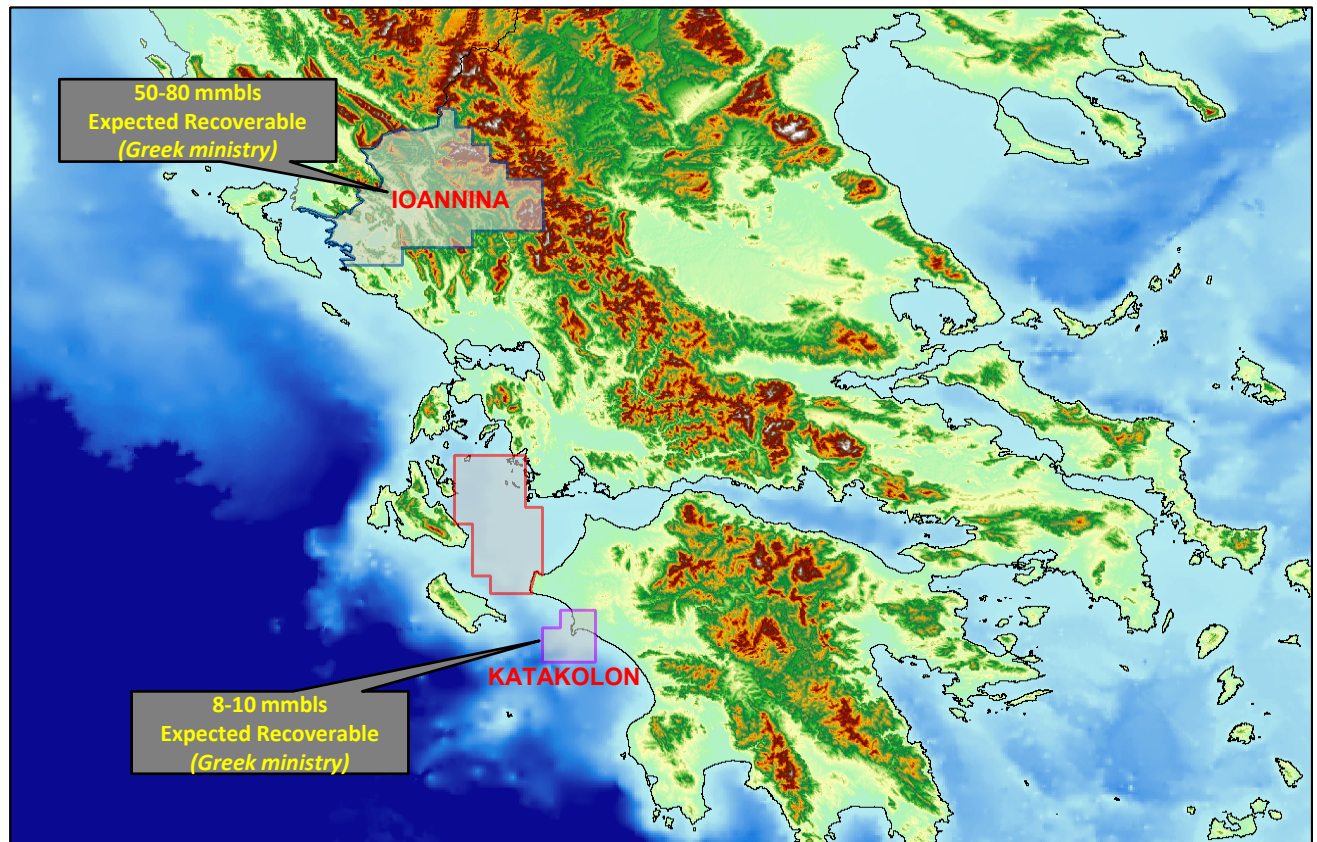
On the Prospectivity of Western Greece

Mr. Hank David, New Business Development Manager



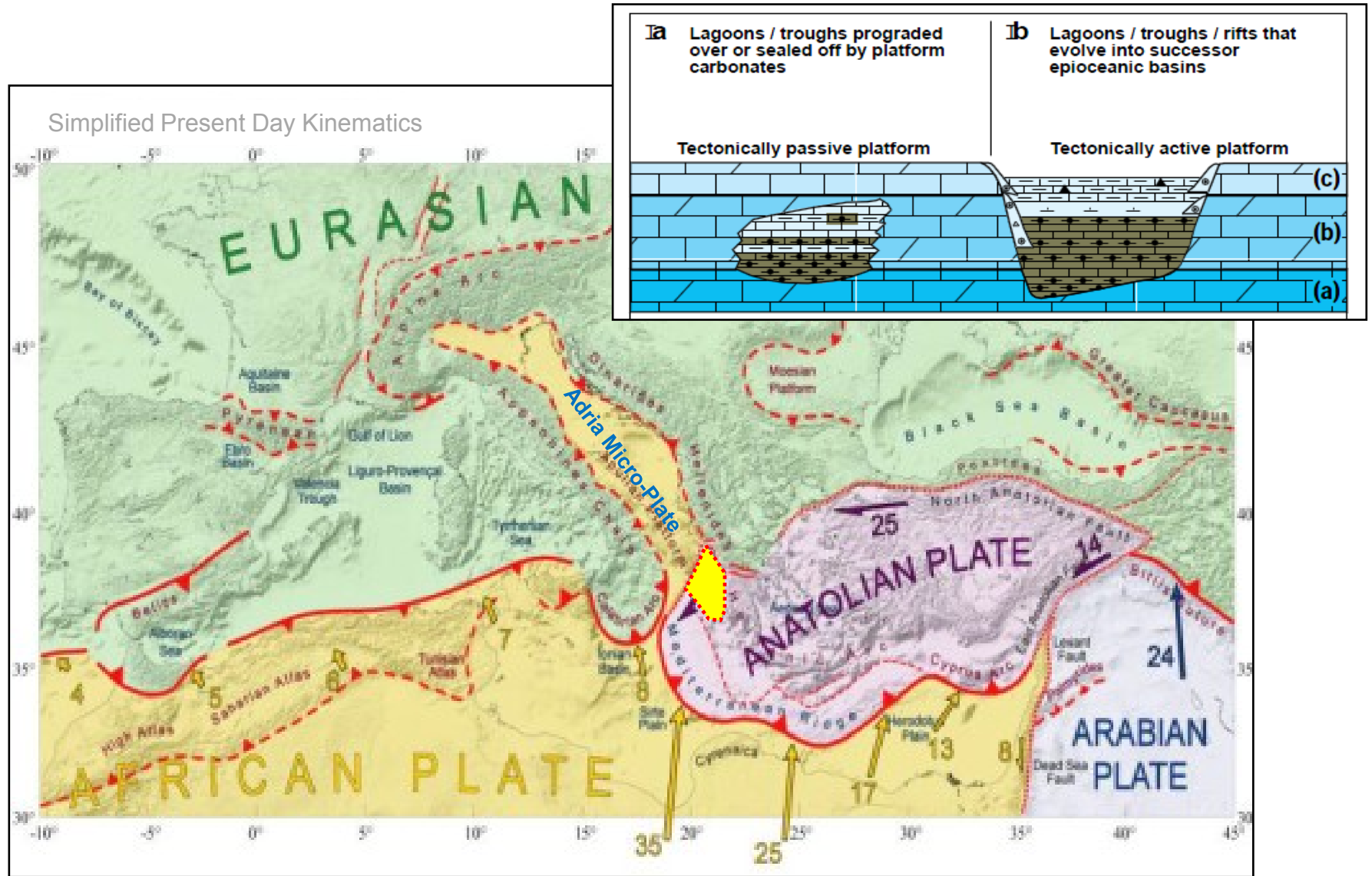
IENE, 2nd SE Europe regional Upstream Workshop
Athens, October 31st- November 1st, 2013

- The Southern Adriatic Petroleum System
- Italy and Albania Field Analogs and the Potential for Greece
- Energean **Ioannina** and **Katakolon** Concessions (pending)
- Summary



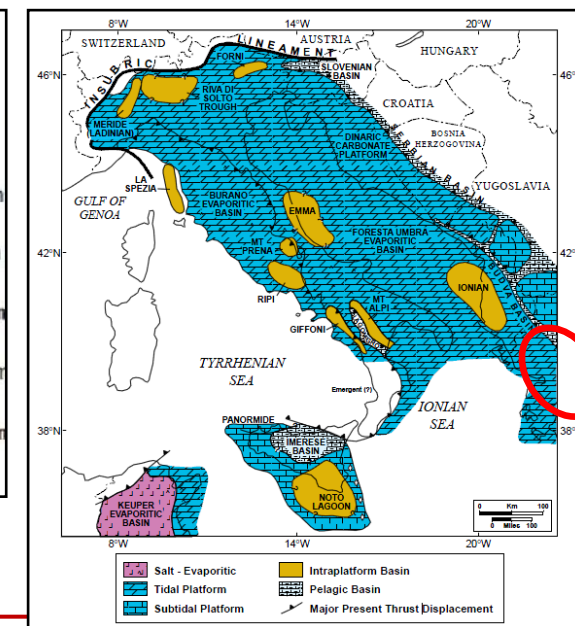
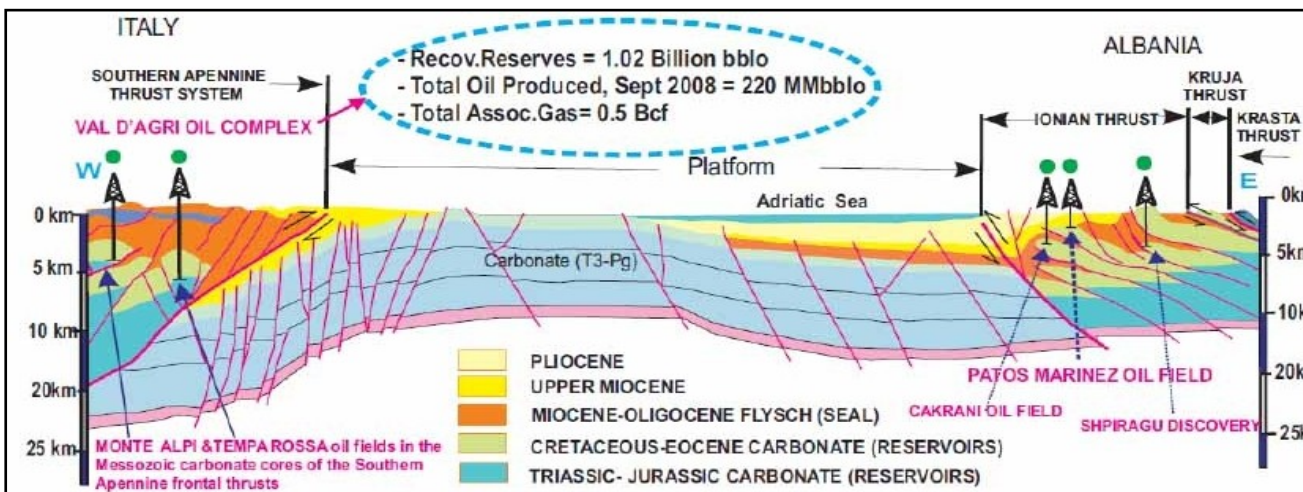
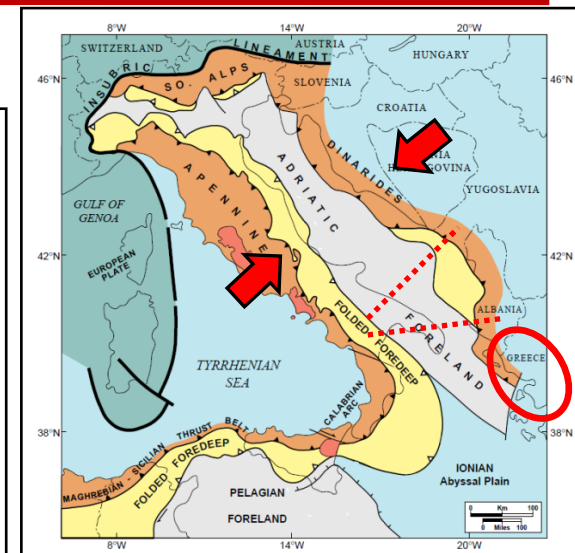
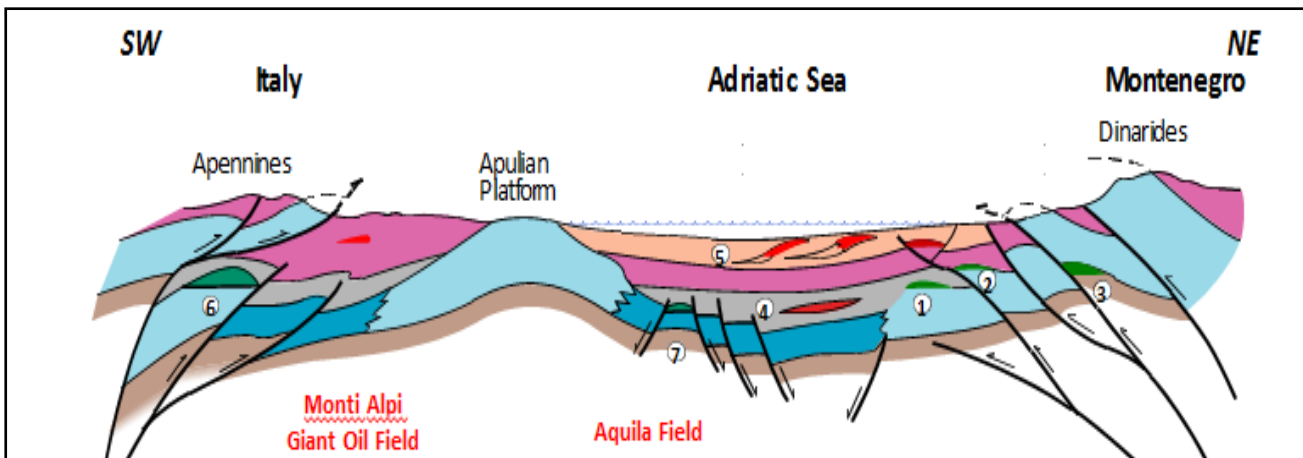
S. Adriatic / Ionian Tectonic History

The petroleum system(s) of the S. Adriatic, including NW Greece, are genetically related to continuous carbonate deposition on the Adria Plate as it drifted away from Africa and eventually impinged into Eurasia (Early Jurassic to Oligocene time)



Hydrocarbon Play Distribution

The successful exploration in S. Italy and Albania are essentially from the same play due to the shared geological history of the Adria Plate. The deformation of the plate edges in Italy (S. Apennines) and Albania (Albanides / Hellinides) are a “mirror image” of each other.



S. Adriatic Petroleum System

S. Italy, Albania and NW Greece

Multiple source rocks

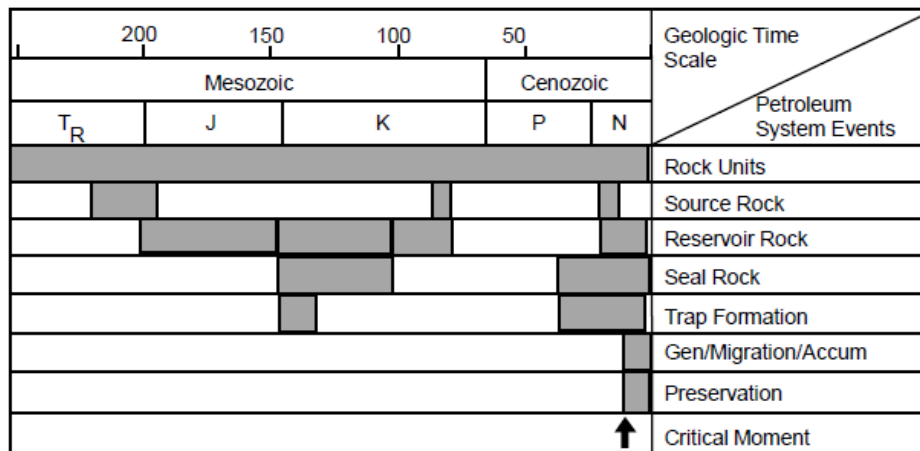
- Late Triassic Burano Fm. proven carbonate source rock.
 - Type II kerogen
 - HI 600 (Onshore Italy)
 - TOC possibly up to 10-12%
- Early Liassic source
- Possible Cretaceous source
- Late Tertiary biogenic gas

Multiple reservoirs

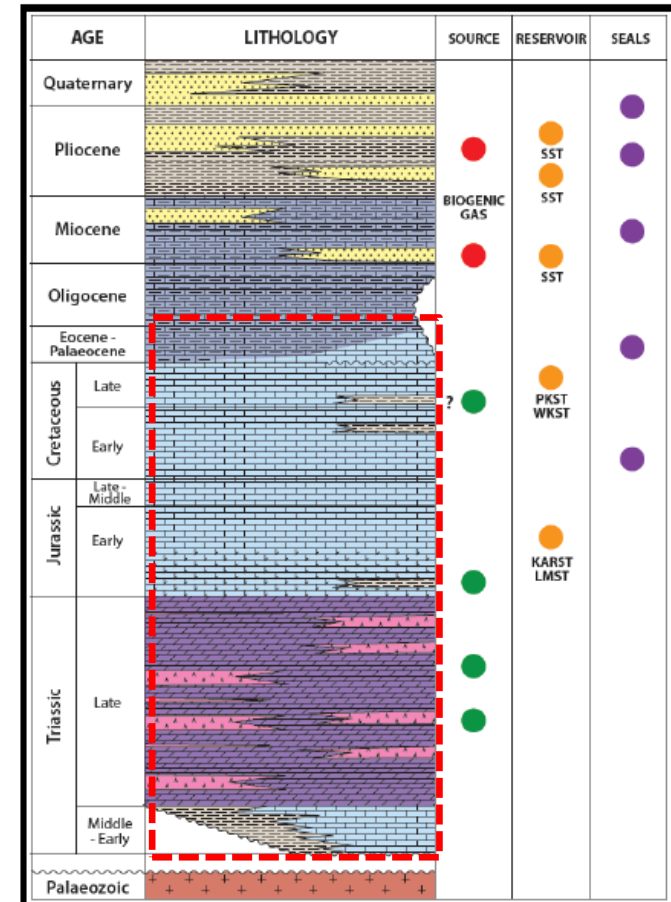
- Liassic Dolomites?
- Early Cretaceous – fractured Maiolica Ist
- Late Cretaceous 'Monte Acuto and Monte S. Angelo Fm.'
- – resedimented platform carbonates
- Oligocene 'Porto Badisco/Castro' Ist
- Mio-Pliocene sands and calcarenites

Multiple seals

- Cretaceous pelagic carbonates
- Oligocene 'Scaglia Cinerea' pelagic marl
- Mio-Pliocene marls and shales



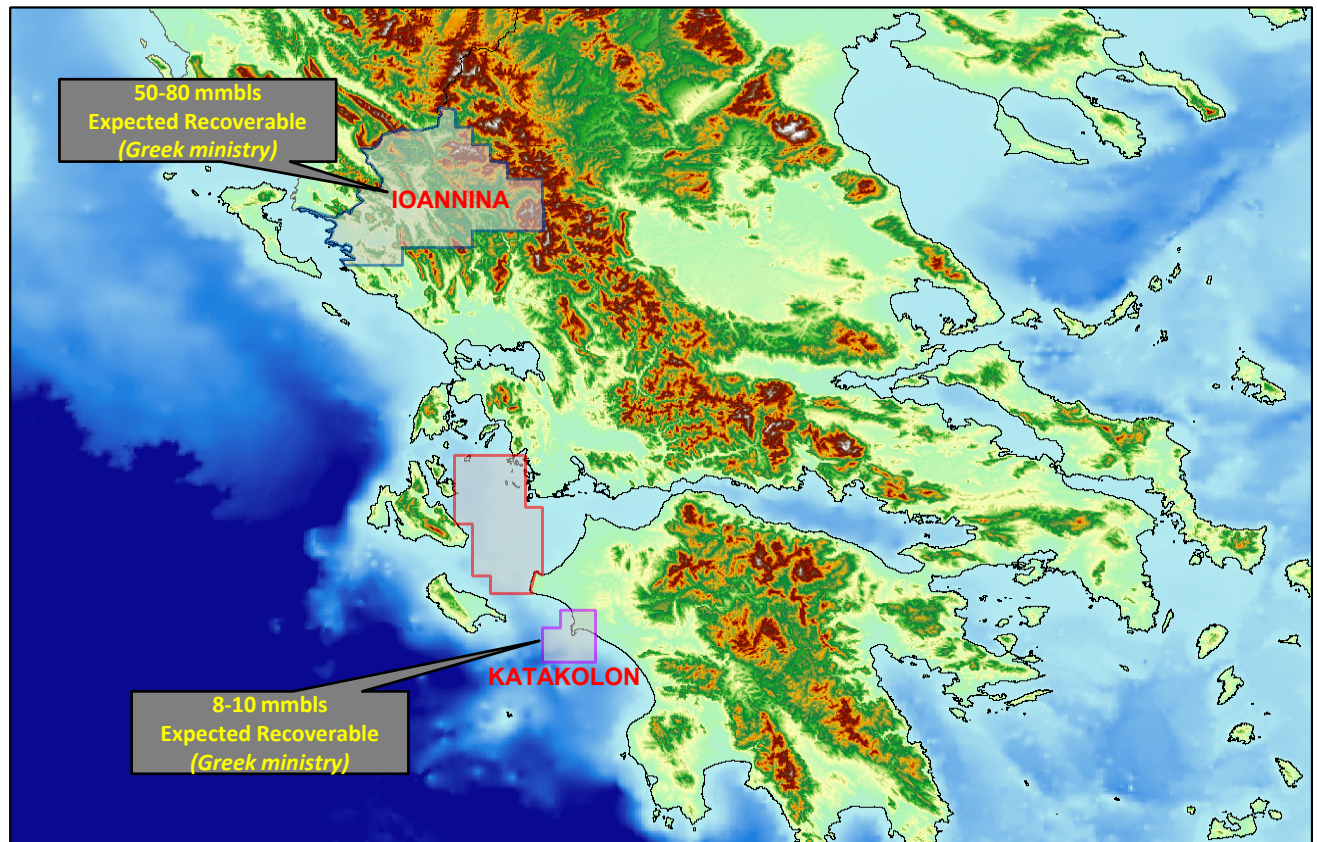
* Petroleum system and lithostratigraphic charts refer to the Southern Adriatic Basin



Optimal HC generation/migration

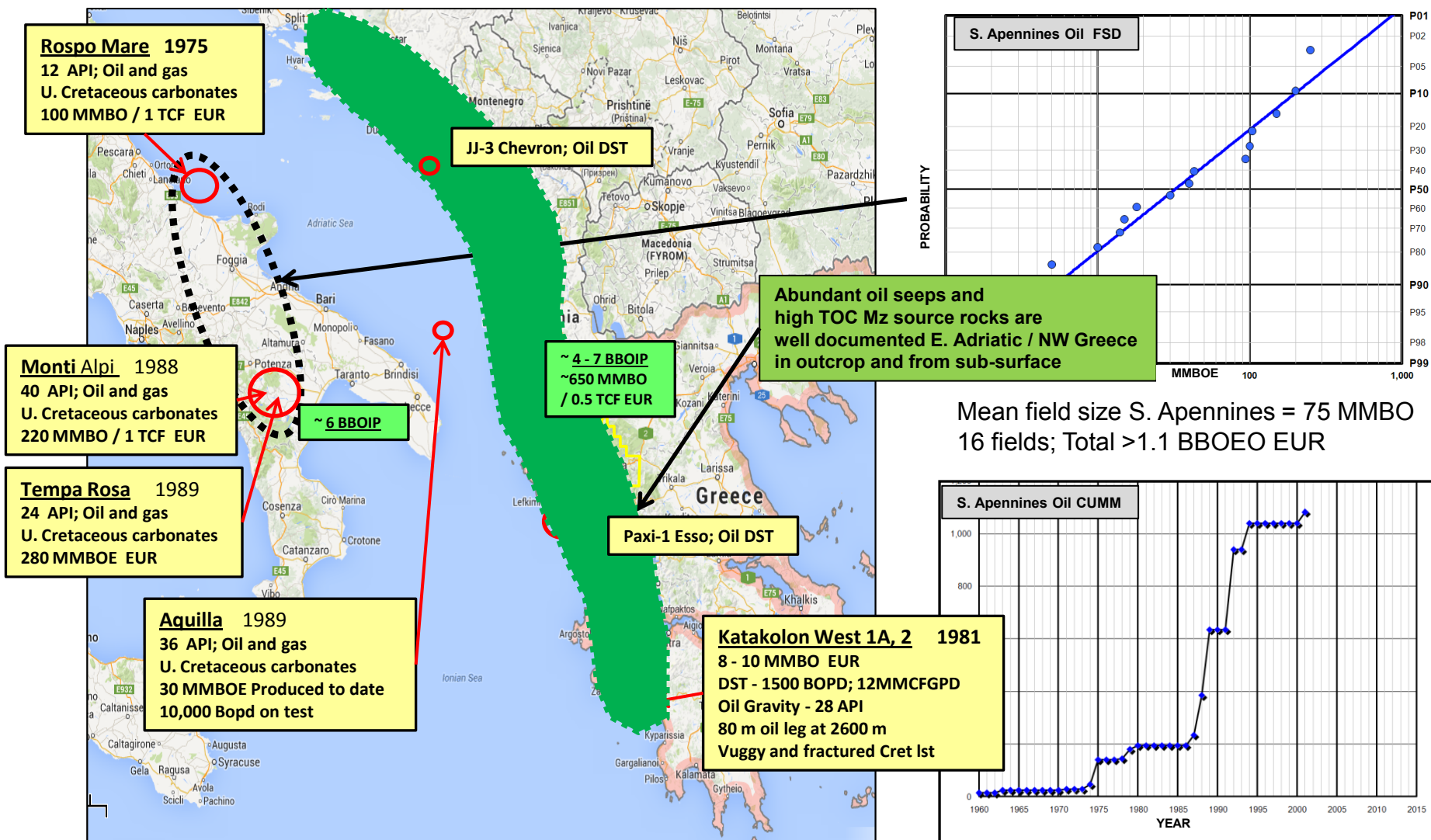
Triassic Burano Fm., K/J source
Generation and migration from Middle-Late
Miocene to post-Pliocene

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Hydrocarbon Occurrence / Analogs

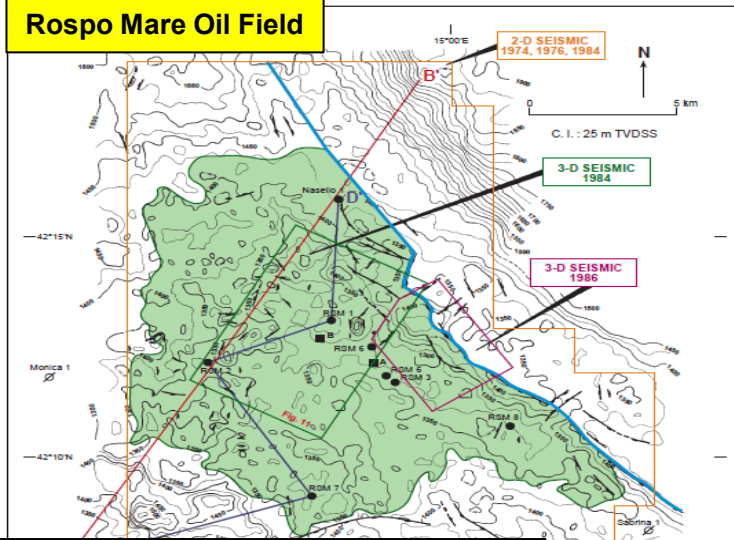
The largest onshore oil and gas fields in Europe are associated with the Adria Plate. Exploration results and surface studies convincingly show the play extends to the south into NW Greece, where it is underexplored



Analog / Italy

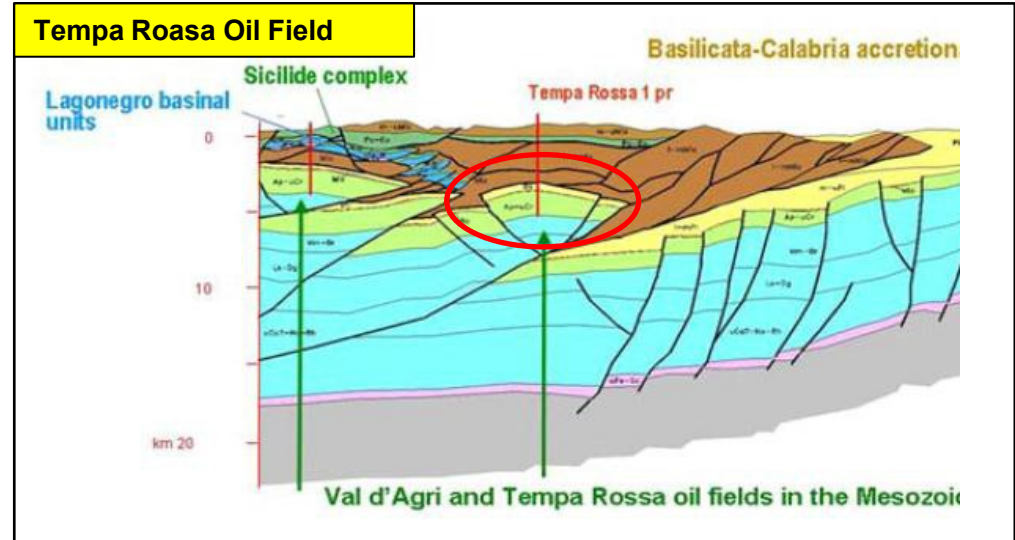
Eocene / Cretaceous karstified platform carbonates. Traps are created by E. Miocene compression / folding, Sourced by very rich Triassic / Lower Jurassic source rocks, and sealed by syn - to post depositional Tertiary flyshe deposits.

Rospo Mare Oil Field



- STOOIP: 540 - 1100 MMBO; ~150 Km2 Area
- Depth: 1350m
- Matrix porosity: 2%. Secondary porosity karstification and fractures
- API: 11 (Tr oil, immature)
- structural / stratigraphic trap

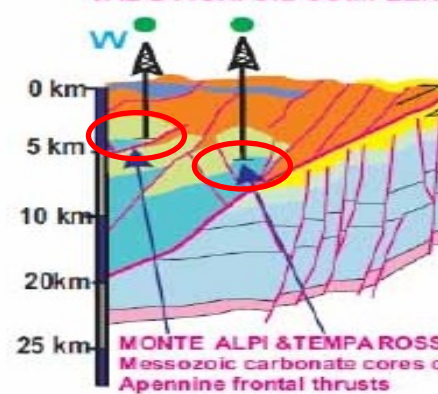
Tempa Roasa Oil Field



ITALY

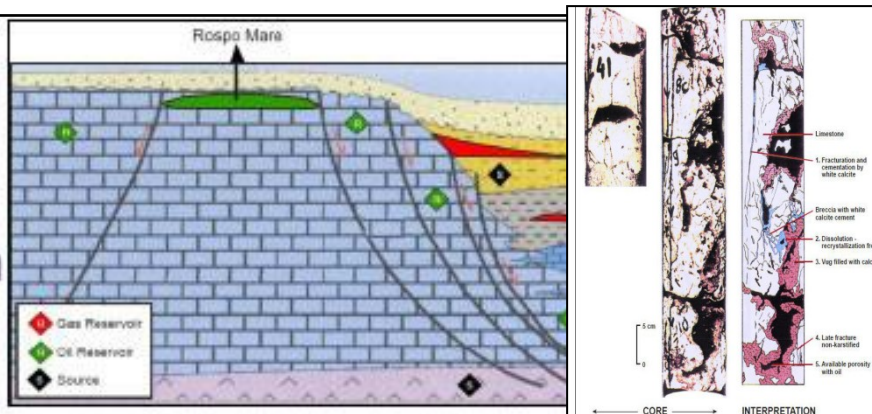
SOUTHERN APENNINE THRUST SYSTEM

VAL D'AGRI OIL COMPLEX



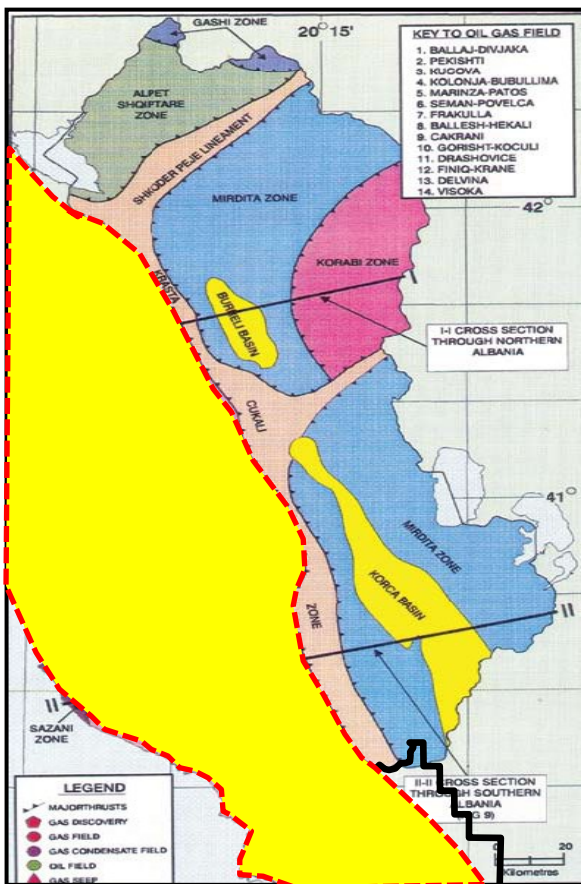
Monti Alpi / Tempa Rosa

24 - 40 API; Oil and gas
U. Cretaceous carbonates
~ 500 MMBO EUR

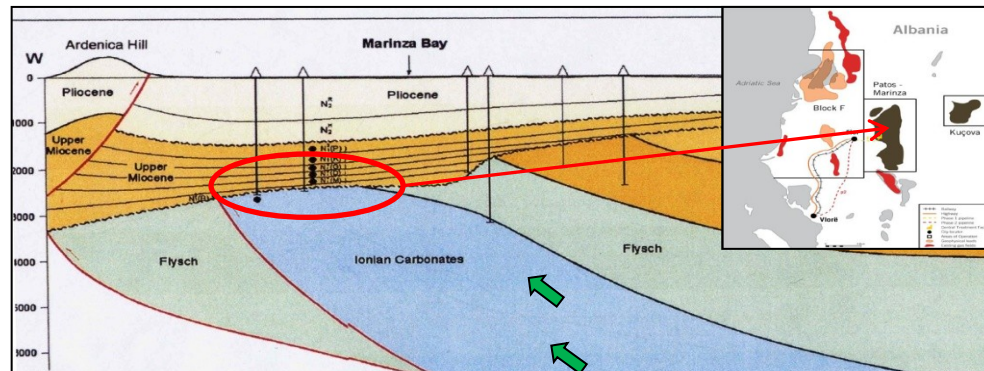


Analog / Albania

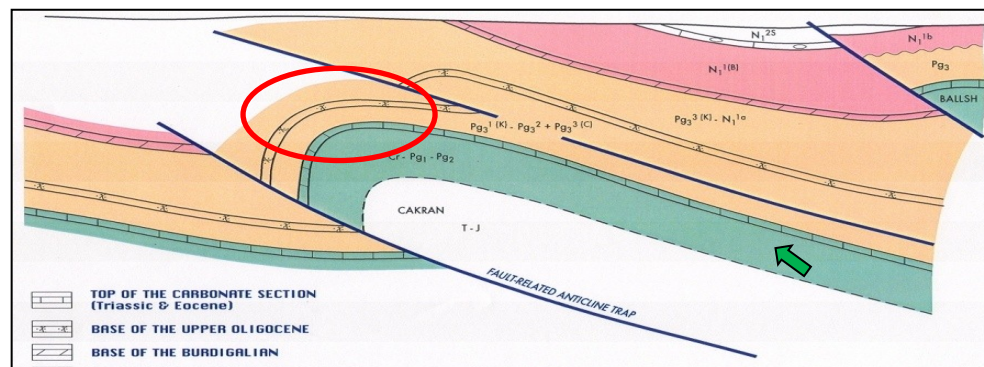
Eocene / Cretaceous karstified platform carbonates and Miocene flysh reservoirs. Traps are created by E. Miocene compression / folding, sourced by very rich Triassic / Lower Jurassic source rocks, and sealed by syn- to post depositional Tertiary flysh deposits. The “Ionian Zone”



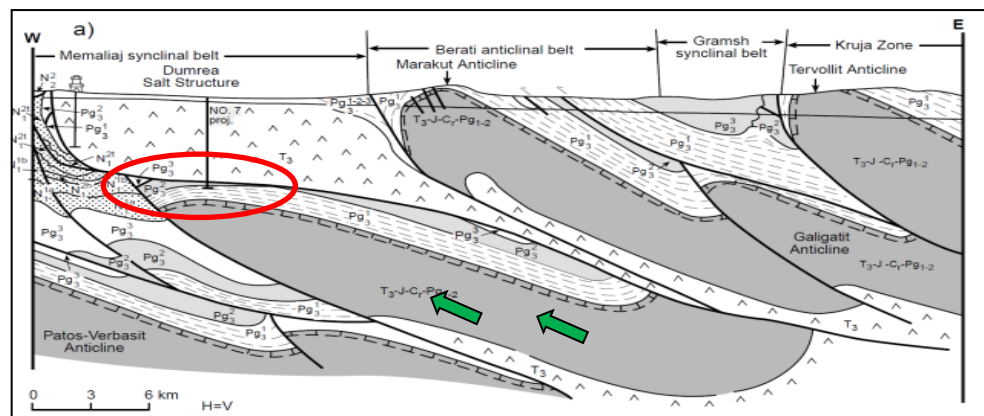
W-E Geological Cross Section; Patos-Mariza Field, onshore Albania- **5 billion bbl** in place



Schematic Geological Cross Section; Cakran oil field



Schematic Geological Cross Section; Dumrea oil field



Field Area	Formation	Depth (m)	HC Column (m)	Reservoir	Recoverable Reserves BOE	API
Delvina	Carbonates	2800-3500	500-2000	Gas & Cond.	184Bcf (GIIP)	62°
Dumrea	Flysch	5700	600	Oil	110-140 MM	

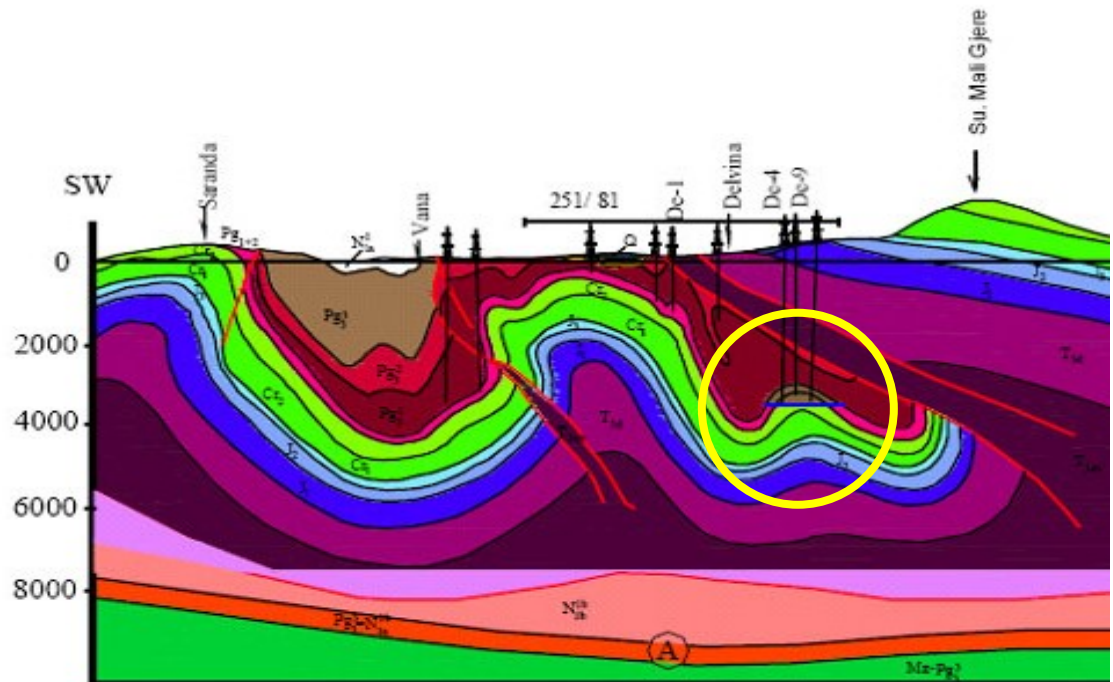
Delvina Gas / Condensate Field; Albania

Closest analog to Ioannina Block

STRUCTURAL FRAMEWORK MAP (ALBANIA)

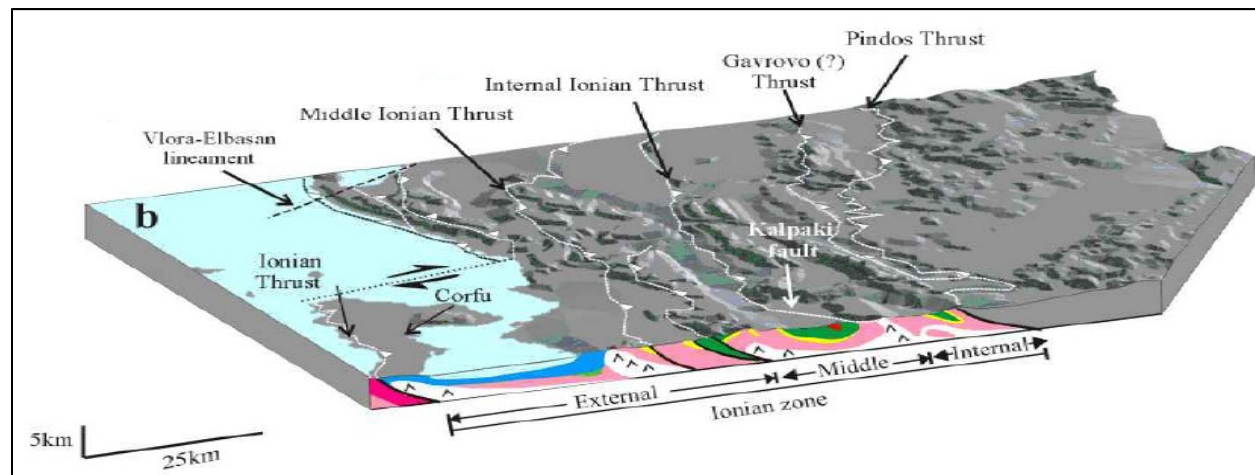
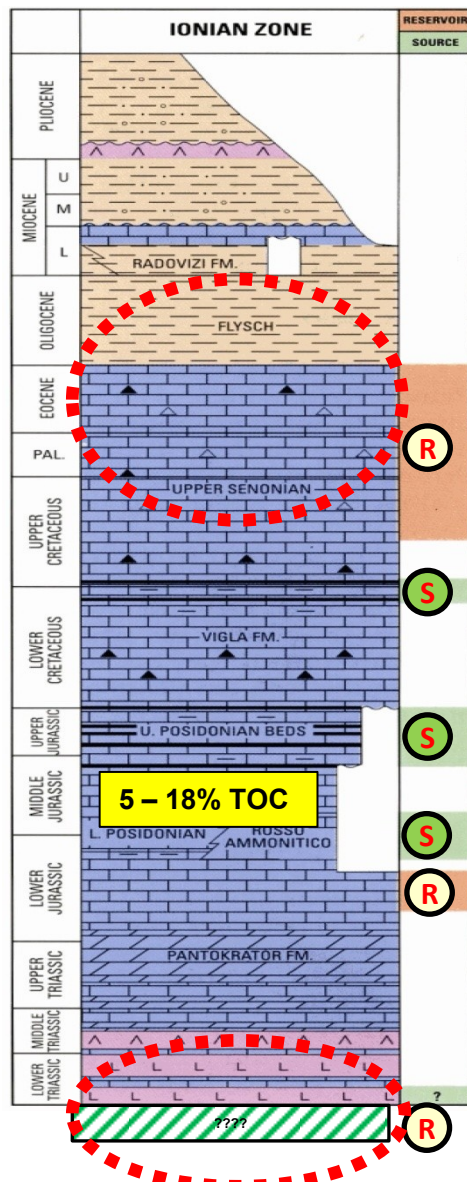


- Largest gas field is SE Europe
- 4 existing wells; 2 currently producing
- Fracing completed production rate 2.5 MMcfd
- Tight gas reservoir development with Hz drilling/fracing
- 615 BCF PIIP (OGIP) + ~100 bbl/MMCF
- 4 structures: 1 proven/producing



Summary of Petroleum System - NW Greece; Ionian Zone

Western Greece and Albania have had a broadly similar geological history. The hydrocarbon potentials of both areas can therefore be expected to be comparable.



RESERVOIR

- Eocene and upper Cretaceous limestone
- Fractured and/or karstified Mesozoic limestone sealed by Pliocene clays
- Upper Miocene sands and sandstones (Excellent porosity)
- Possible Pre-Triassic evaporites section ??

Limestone:

- Matrix porosity & permeability expected low
- Reservoir quality dependent on fracturing

TRAP

- Structural traps
 - Fault blocks
 - Anticlines
 - Traps related with diapirism

SEAL

Ionian zone:

- Deep marine shales of Oligocene flysch
- Miocene/ Pliocene clays which overlie unconformably the eroded Mesozoic carbonate.

Paxi zone:

- Miocene marine shales

SOURCE

- Early Cretaceous marls (Vigla fm.)
- Middle-Upper Jurassic (Posidonian beds)
- Upper Triassic shales

Enterprise Oil target 2001 Demetra-1 well. Not reached

Exploration Play Targets NW Greece; Ionian Zone

The structural style and hydrocarbon play components of the Ionian Zone in Albania continue into NW Greece and will be the model for Exploration of the play here

Thrust Anticlines

Target: Shallow Mz
Carbonates (Eoc / Cret)

Productive in Albania

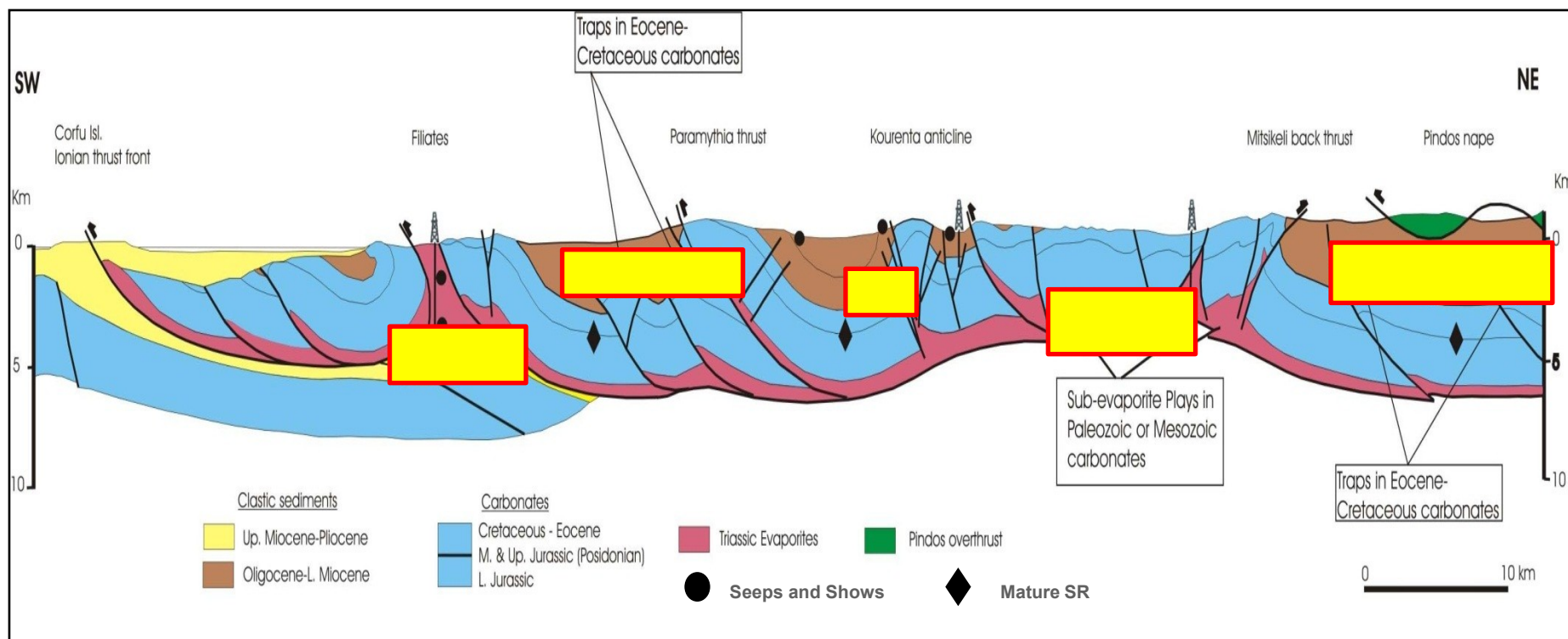
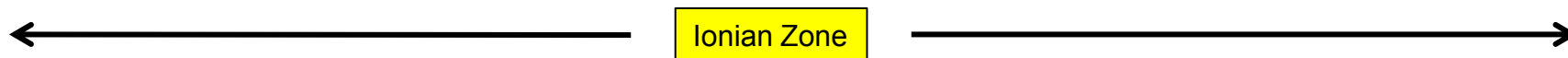
Thrust Footwall Drag

Target: Mz Carbonates & Flysch
Example: Delvinaki Well

Deep Diapir associated

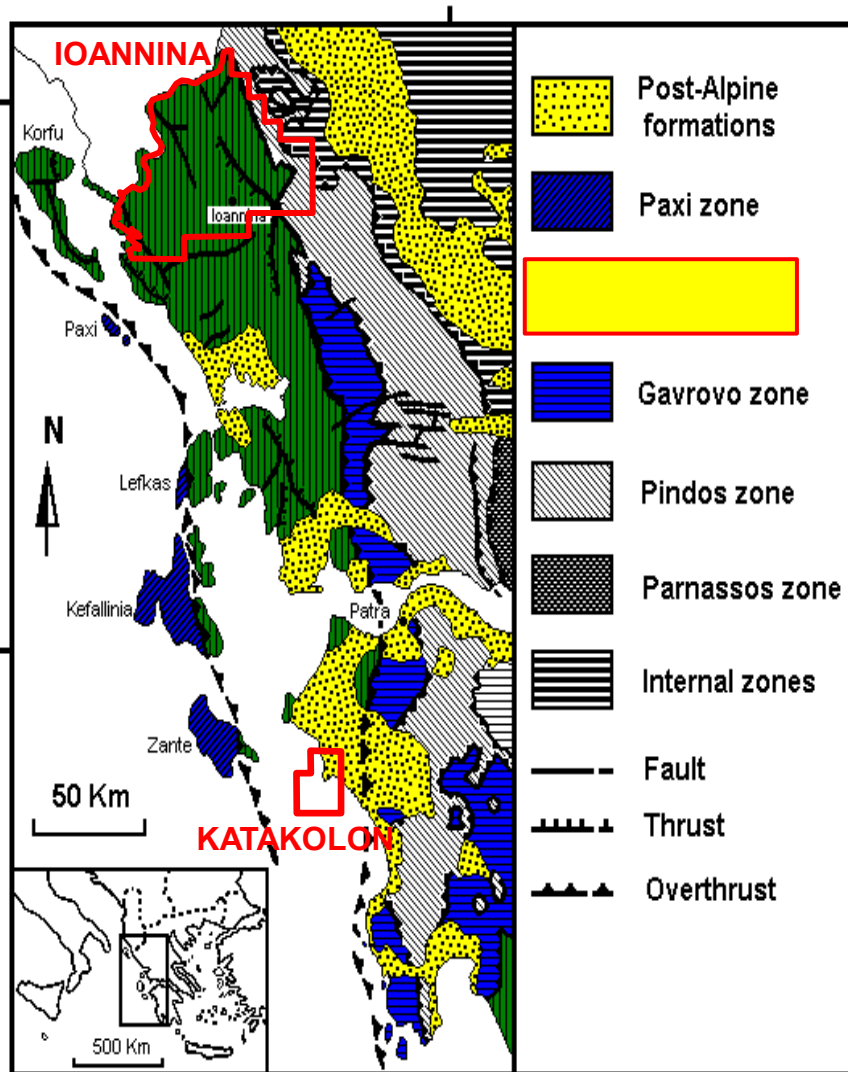
Target: Repeat Mz Carbonates or Pre-Triassic

Example: Dumrea Diapir, Albania



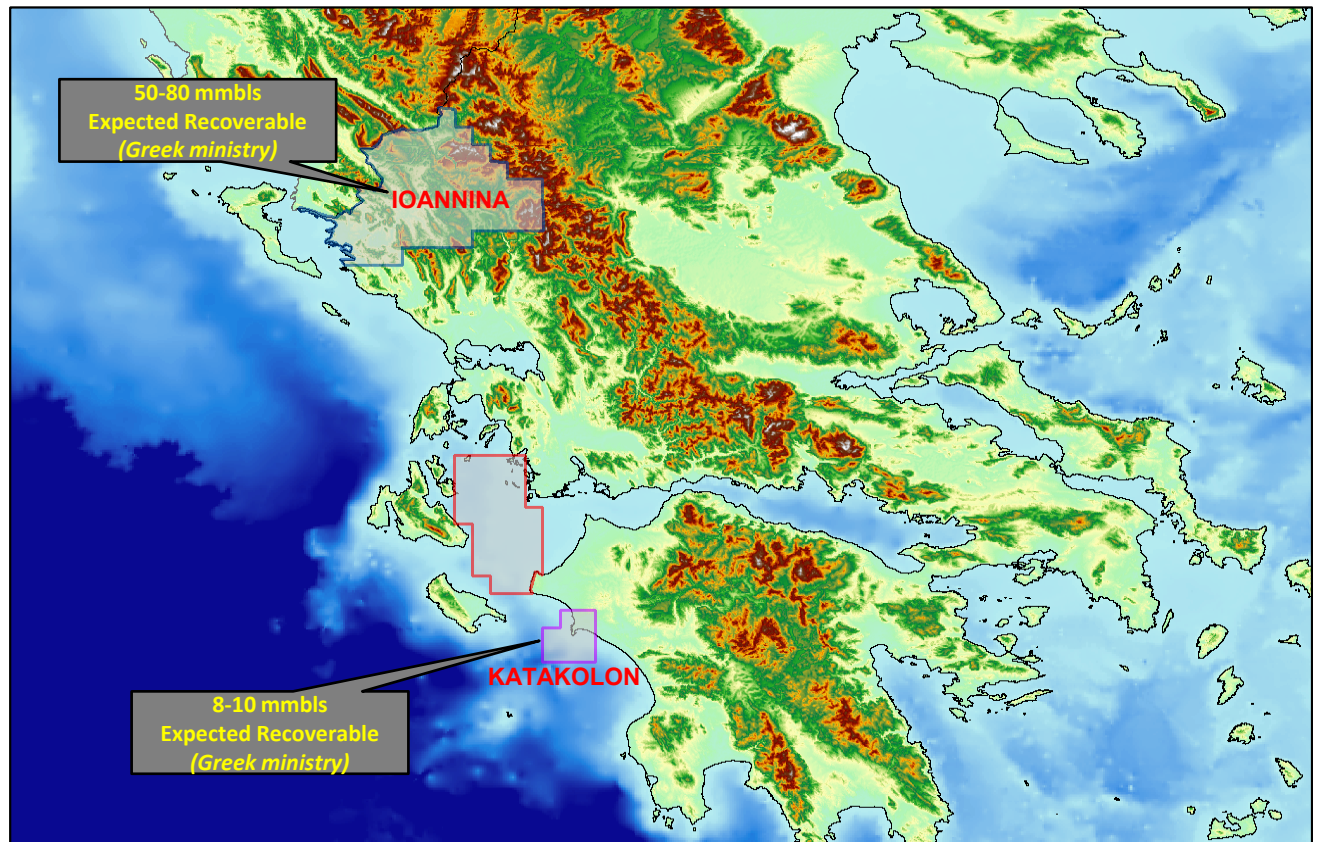
Exploration History; NW Greece

Given similarities between NW Greece and S. Italy / Albania, comparatively little exploration has taken place



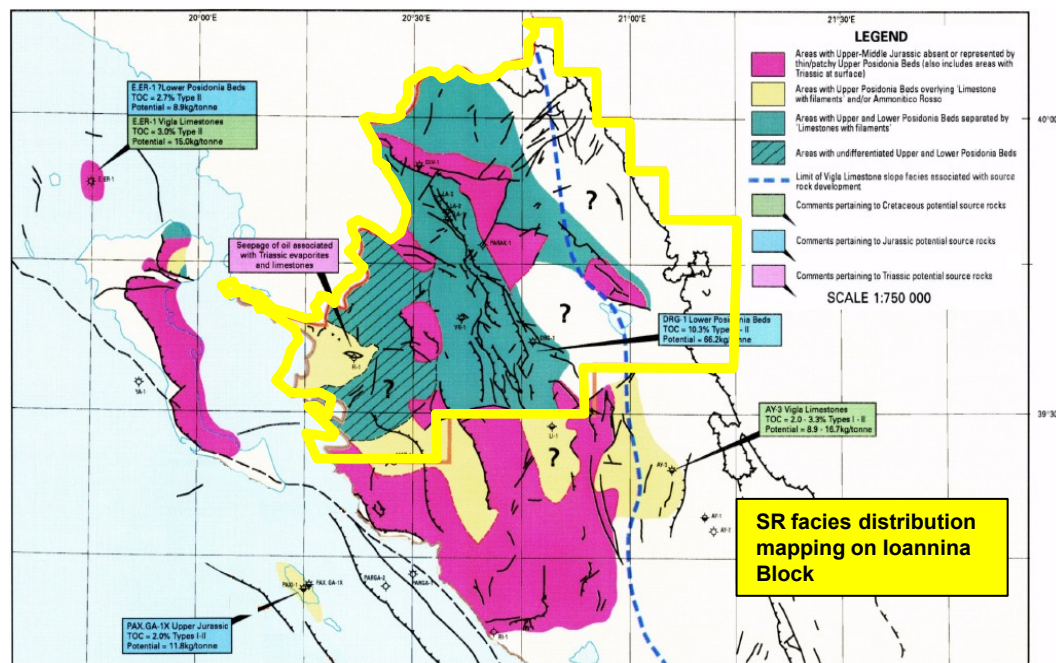
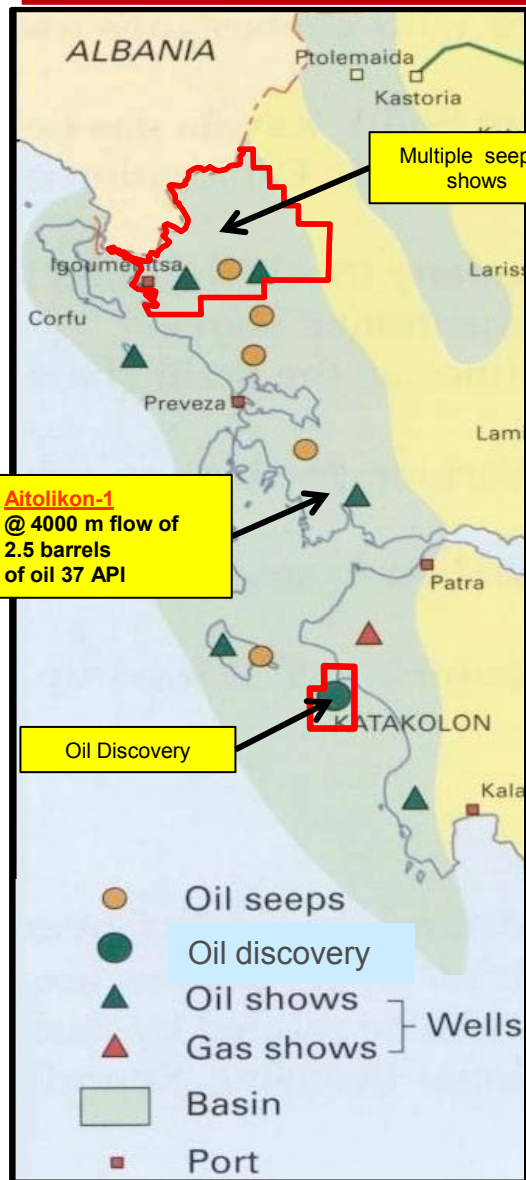
- 1940's: Exploration started in the 2nd World War by the Italian army. Several shallow wells drilled up to 300m without success.
- 1960's: Greek State & I.F.P.
Regional mapping & 2 exploration wells
Targets were the top carbonates & the pre-evaporate (Triassic) sequence.
- 1979-80's: DEP-EKY
1000km of seismic lines acquired & 8 wells drilled
Oil & gas shows.
- 1997-2002: 1st International Licensing Round.
Enterprise et al awarded NW Greece
Gravity, Magnetotellurics, Passive Seismic & 430km of 2D seismic acquired.
2001-2002 - **Demetra-1** well was drilled targeting pre-evaporite structure at 4000m but was abandoned at 3966m within the evaporitic sequence due to high pressures

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Ioannina and Katakolon Blocks

Oil seeps, well-shows & the Katakolon discovery provide evidence for favorable H/C exploration in the Ionian geotectonic zone.



Source Rocks

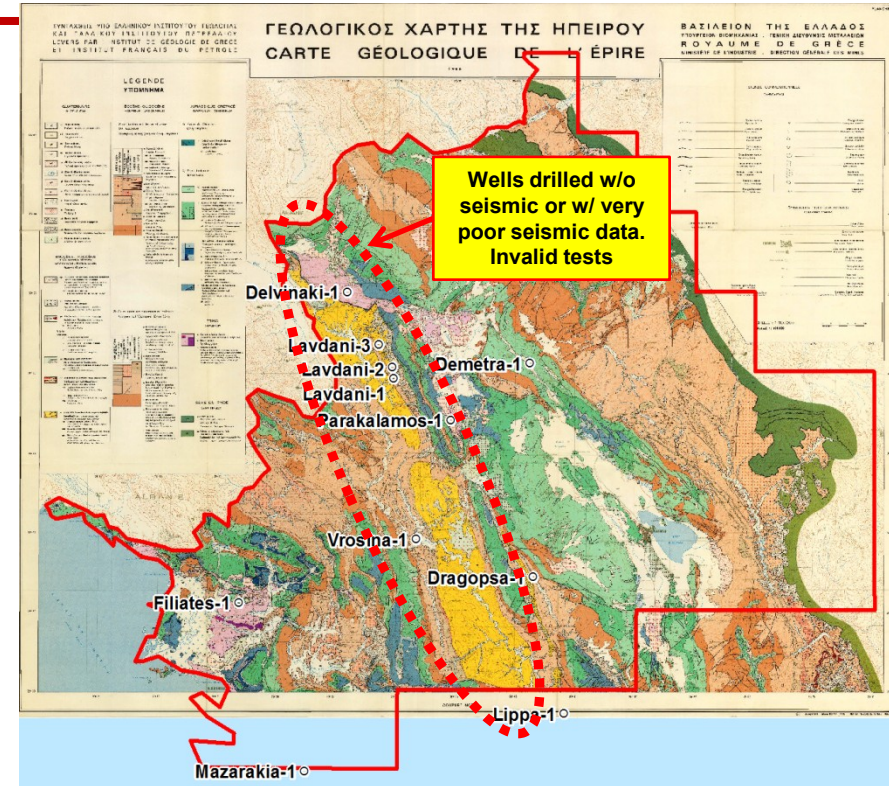
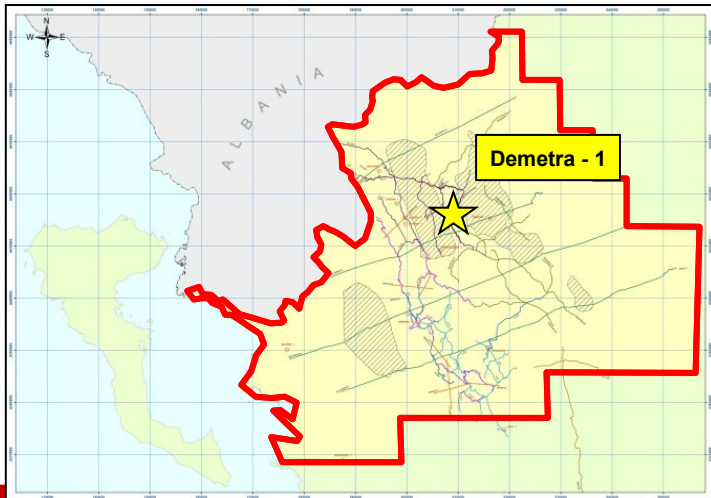
The most important source rock of the Ionian zone is the Posidonia Shales of Jurassic age.

Other source rocks include the Vigla Limestones (Cretaceous age), the Triassic Evaporites (in shales intercalations) and the Lower Miocene shales



Ioannina Block

- Underexplored Area (4,187 km²)
 - Only 11 wells, < 1500 Km 2D seismic
 - Only one well in last 25 years (2001)
- Extension of working analogues; Albania & Italy
- Good evidence for working source rock – HC shows & seeps
- Multiple Play Concepts
- Main reservoir target: CARBONATES with **upside potential** in Flysch
- Poor seismic data quality & coverage
 - Technological opportunity
- Prospects & Leads Identified. Potential of large reserves prospects of >50mmbbls oil or >1tcf gas
- Civil infrastructure nearby (roads, ports, airport)

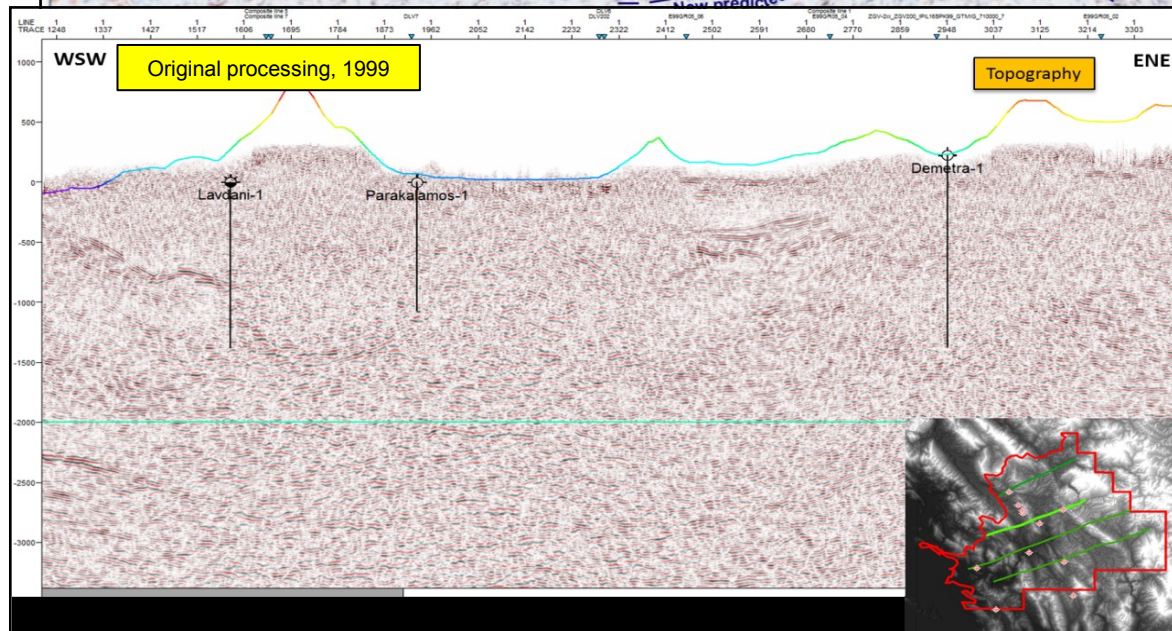
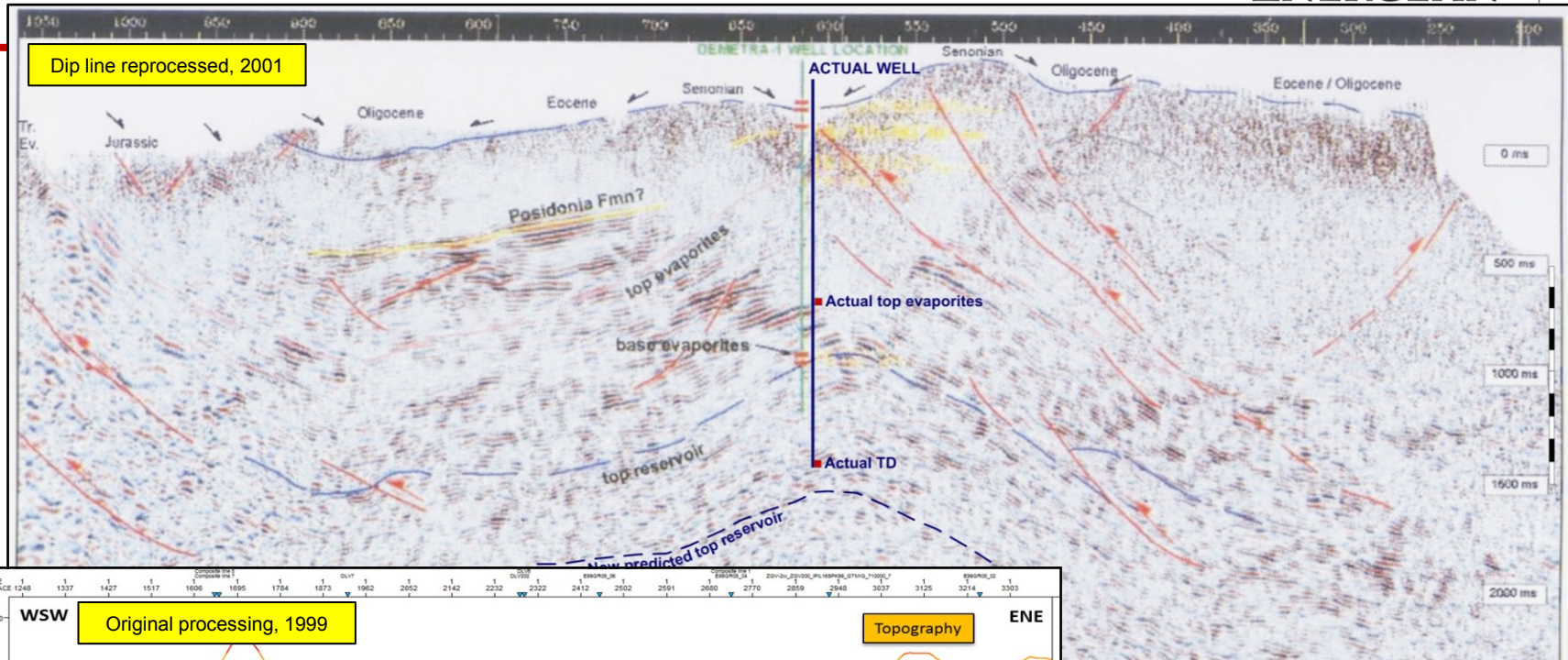


Challenges

- Onshore mountainous terrain, hence high operating costs
- Complex structural setting - geological regime (thrust fold belt)
- Key risks are the sealing capacity of the shallow structures and the trapping efficiency of the deeper structures
- H₂S potential

Demetra-1 well: Pre-drill prognosis vs actual well

1999 2D seismic data by Enterprise



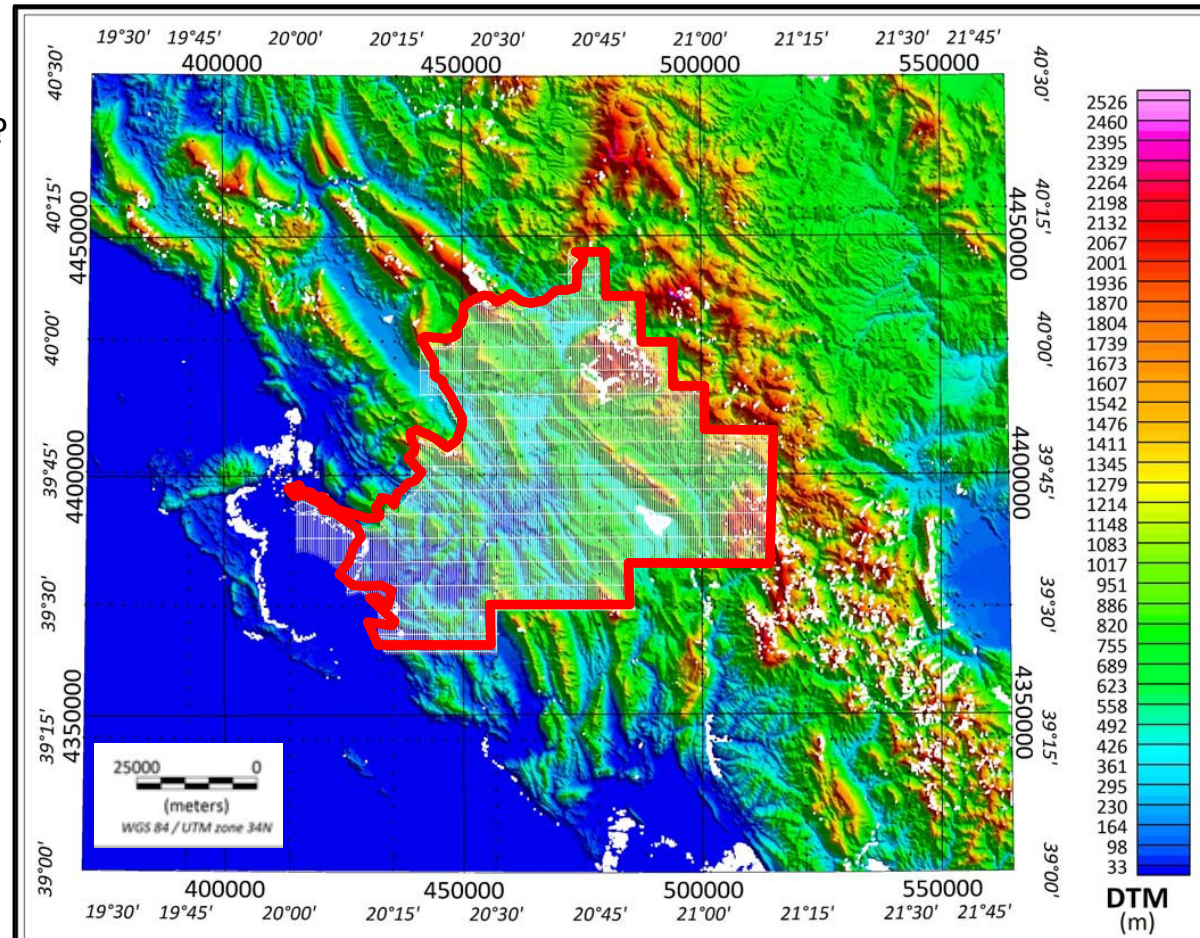
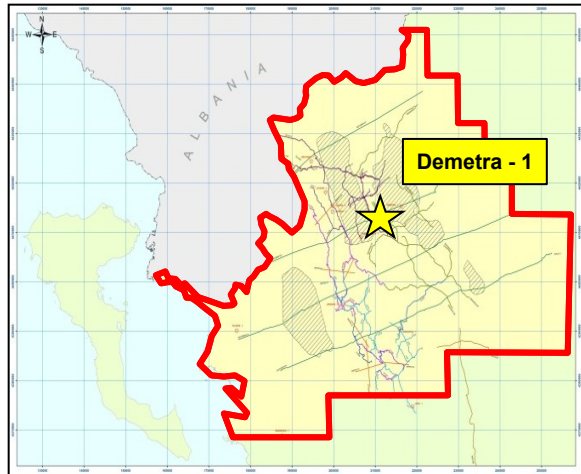
Original 1999 data was reprocessed by Enterprise 2001 with velocity field from Passive Seismic program

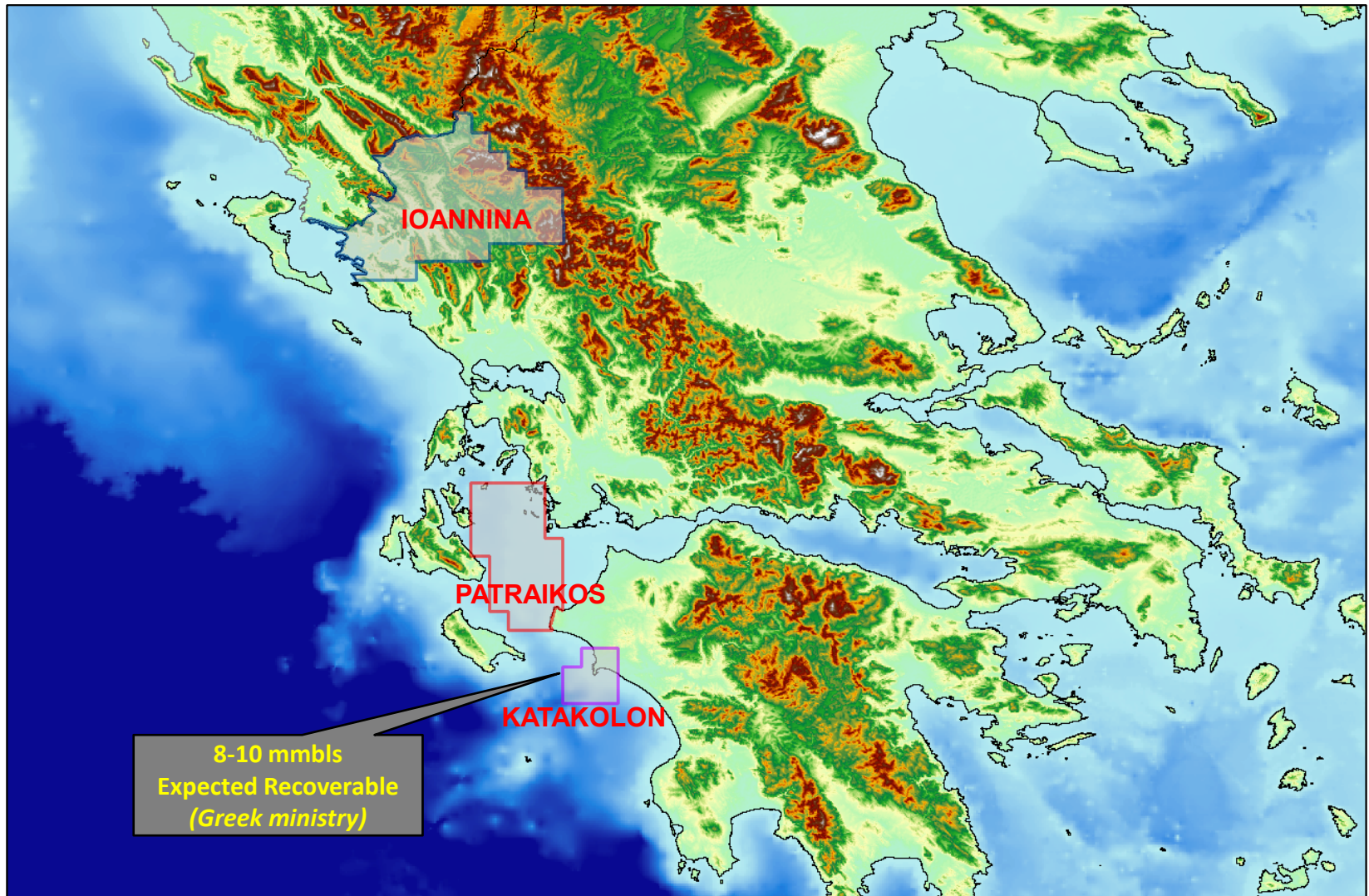
Ioannina Block

GOAL: Drill the first well in NW Greece to test a well imaged trap in the MZ section in the Ionian Zone

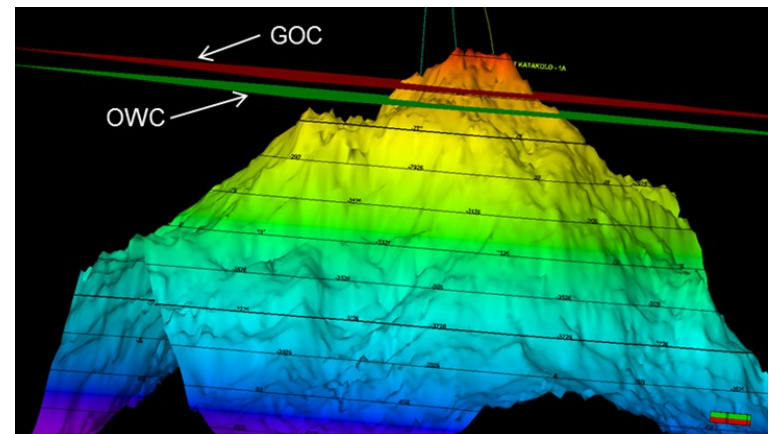
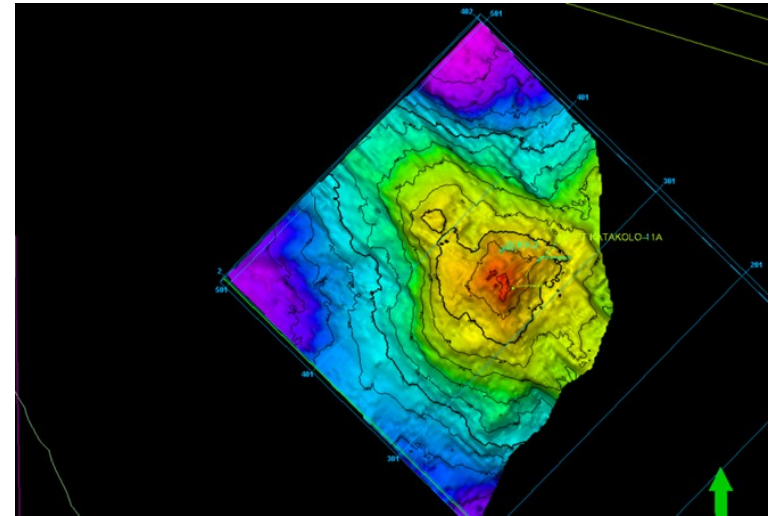
Anticipated First Period Work Program

- Seismic Reprocessing: ~ 1500 km ?
- FTG Survey
- G & G Studies (Satellite image mapping)



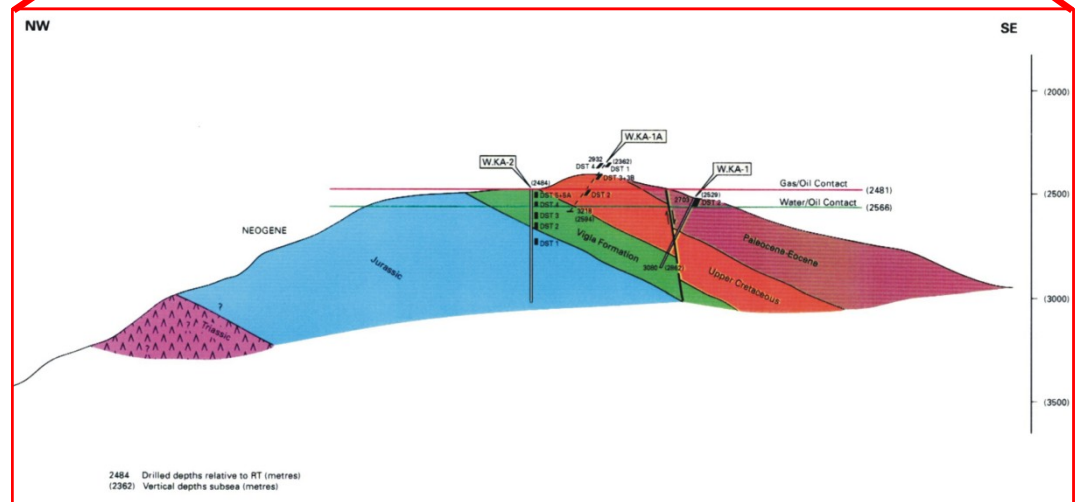
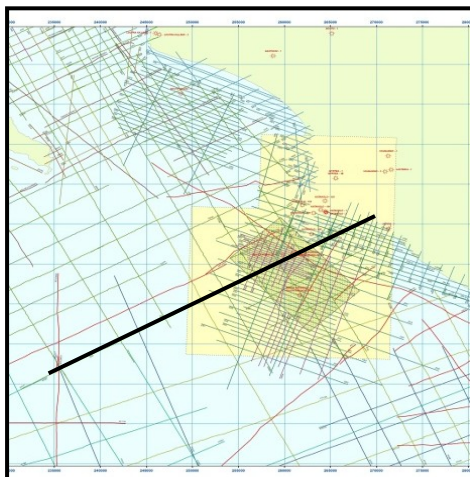
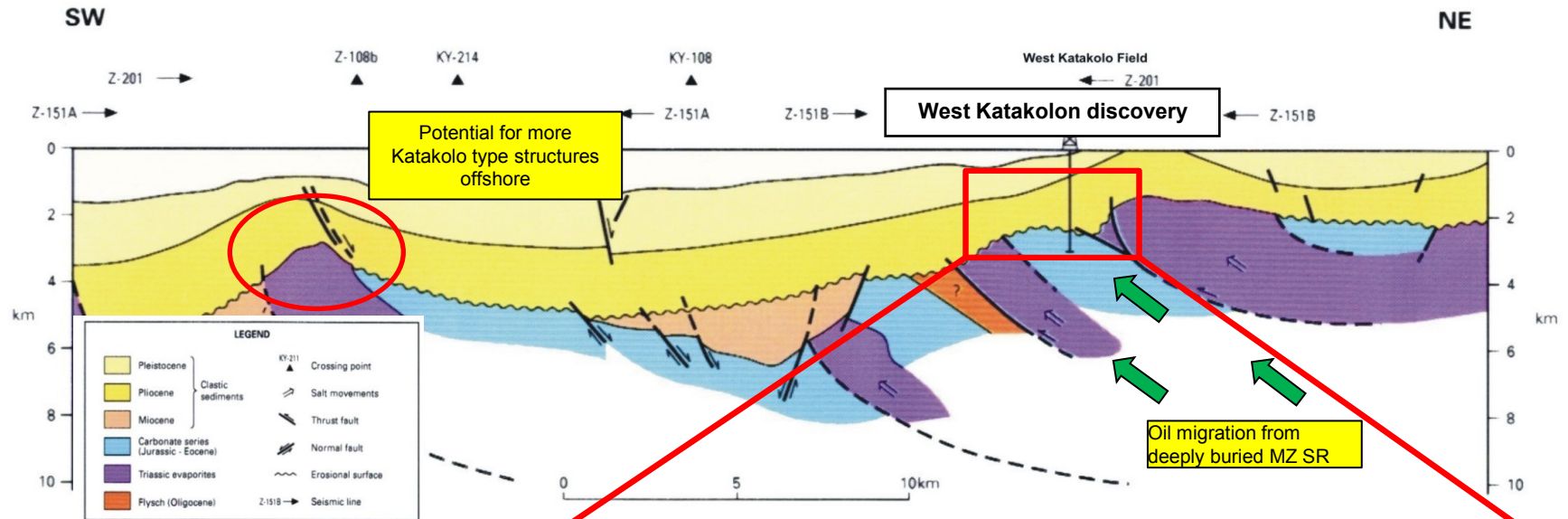


- Explored Area (545 km²) – Oil Discovery 1981
- Proven Play System – DST: 1200 – 1400 BOPD
- Water Depth range 200-300m over discovery – accessible from onshore (3.5 km)
- Single Reservoir: Oil 26-28°API. Solution gas contains 9% CO₂, 6-8% H₂S
- Complex structural setting
- Reservoir type: CARBONATES ($\phi \approx 5\%$)
- Poor seismic data quality
 - <1500 Km 2D (1978 – 1984)
 - 100 Km² 3D (1984)
 - Reprocessing opportunity
- Key uncertainty is the reservoir quality regarding matrix and vugs porosity
- Civil infrastructure nearby (roads, ports, airport)



Katakolon Block

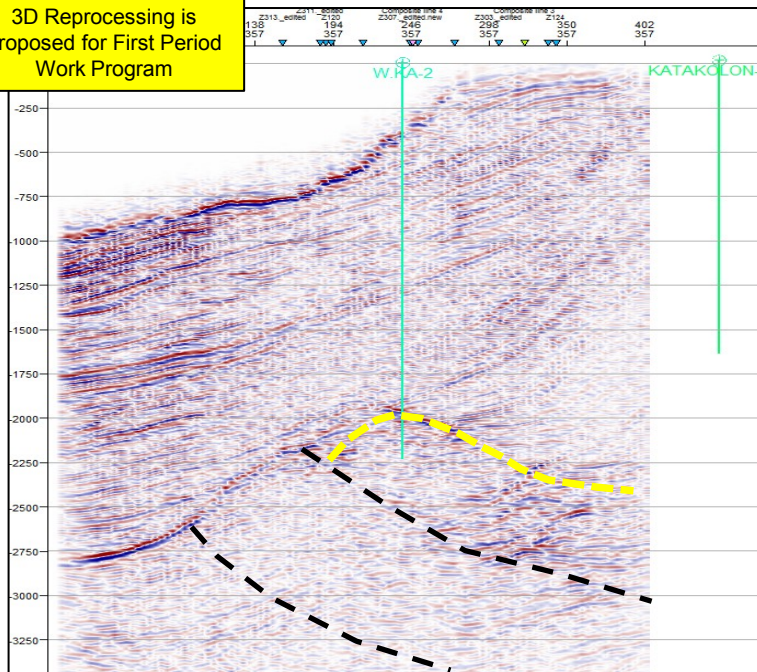
Structural geoseismic section



Katakolon Block

Summary

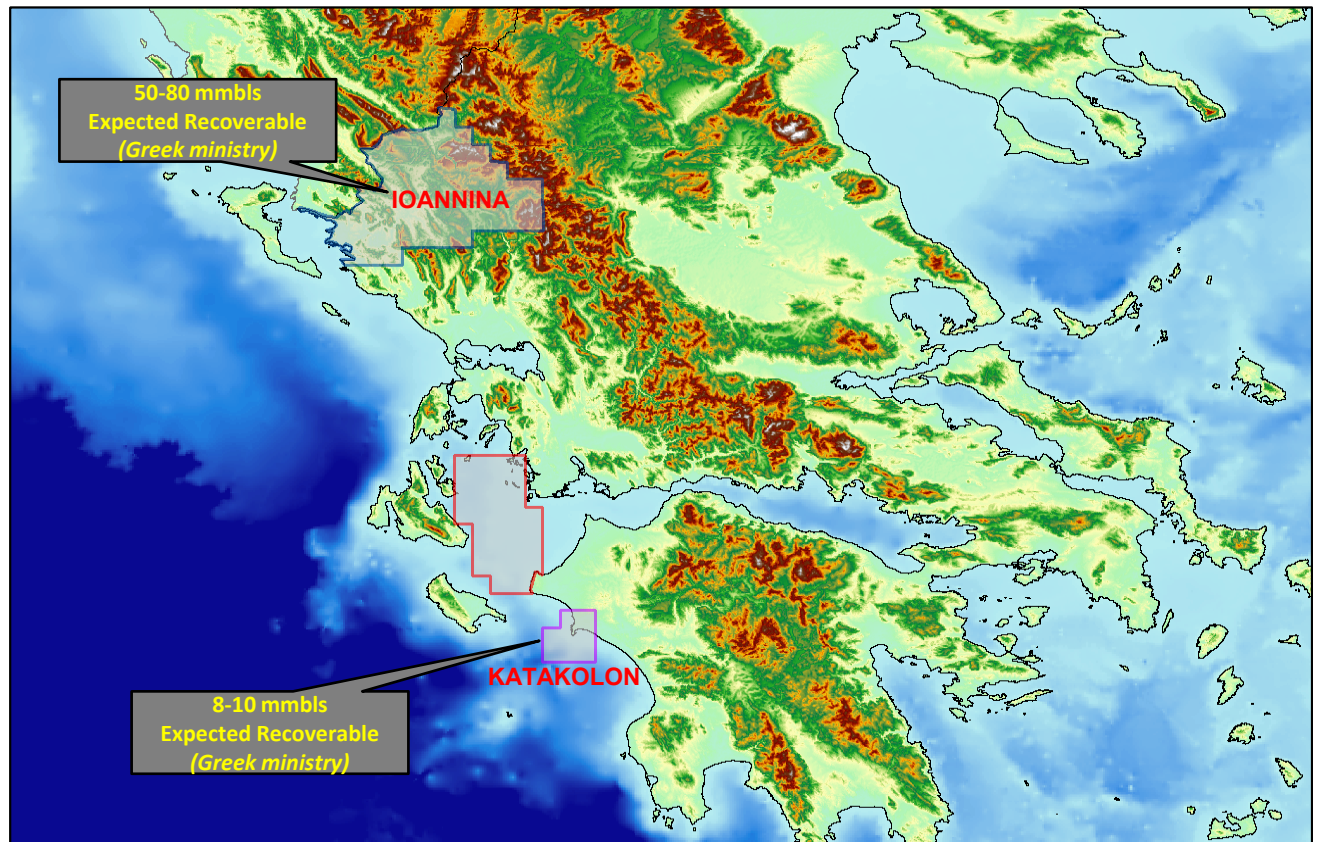
3D Reprocessing is
proposed for First Period
Work Program



- Proven oil field
- DST's: 26-28° API, out of 2 zones 18m thick @ depth of around 2,500m, 1,000-1,400 bbls/day.
- Geochemical studies show the occurrence of more than one oil types indicating possible two different sources.
- Modern technology may allow the exploitation from the shore by means of long reach wells with limited impact on the marine environment and the tourist activity particularly in the harbor of Katakolon.



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Conclusions; NW Greece

- Underexplored area with proven analogues nearby
- All elements of petroleum system are present:
 - multiple source rocks
 - sandstone and carbonate reservoirs
 - structural traps (thrust and fold belt, diapirism)
 - multiple shale intervals providing good seal
- proven oil (W. Katakolon discovery; Aitolikon – 1 oil flow from Triassic, multiple seeps and shows)



Western Greece is a highly prospective area for future exploration

