Dr. Dinos Nikolaou - George Panagopoulos, 3rd IENE Workshop,
Athens 30-31 October 2018

ENERGEAN
OIL & GAS

# West Katakolo Field Development: A unique analogue for Western Greece

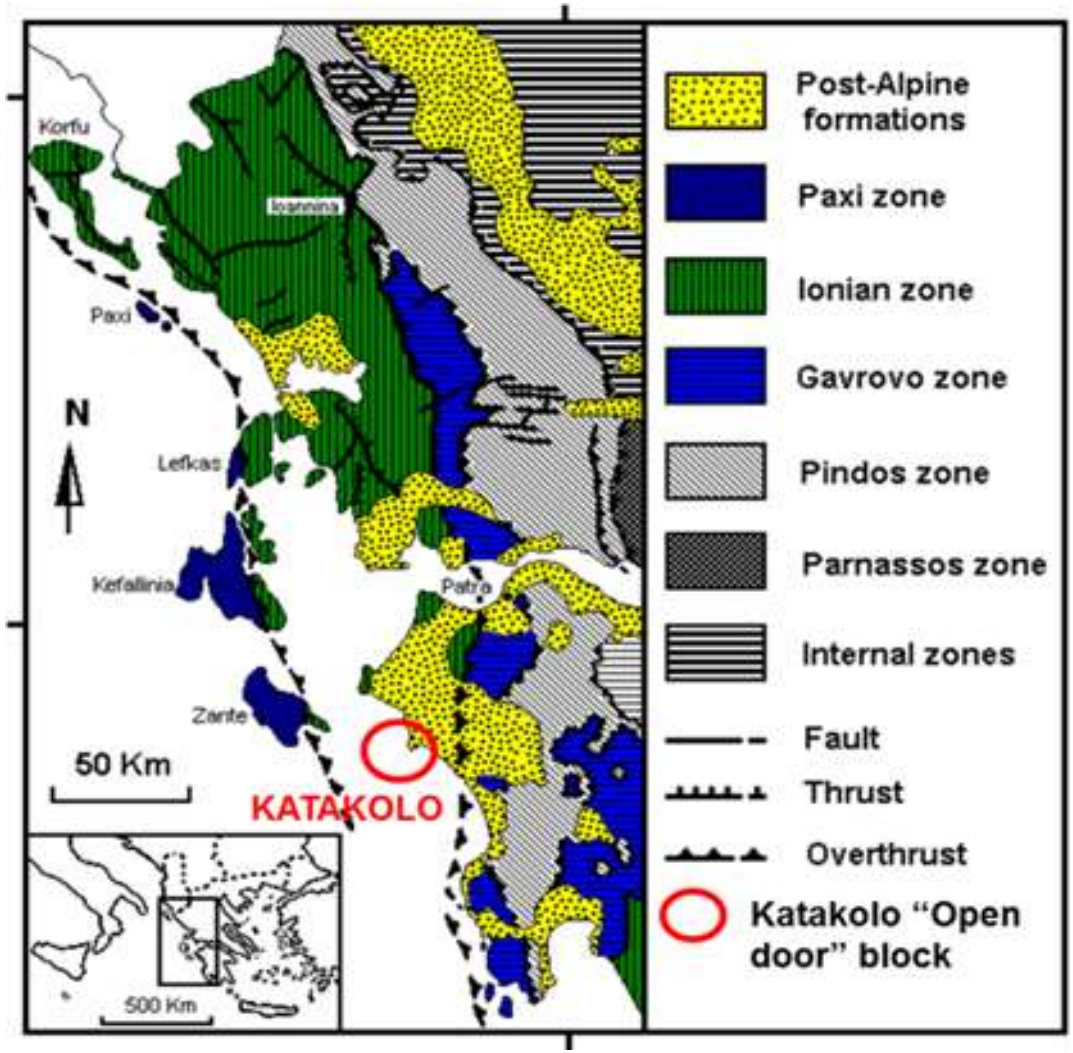
# Katakolo Discovery

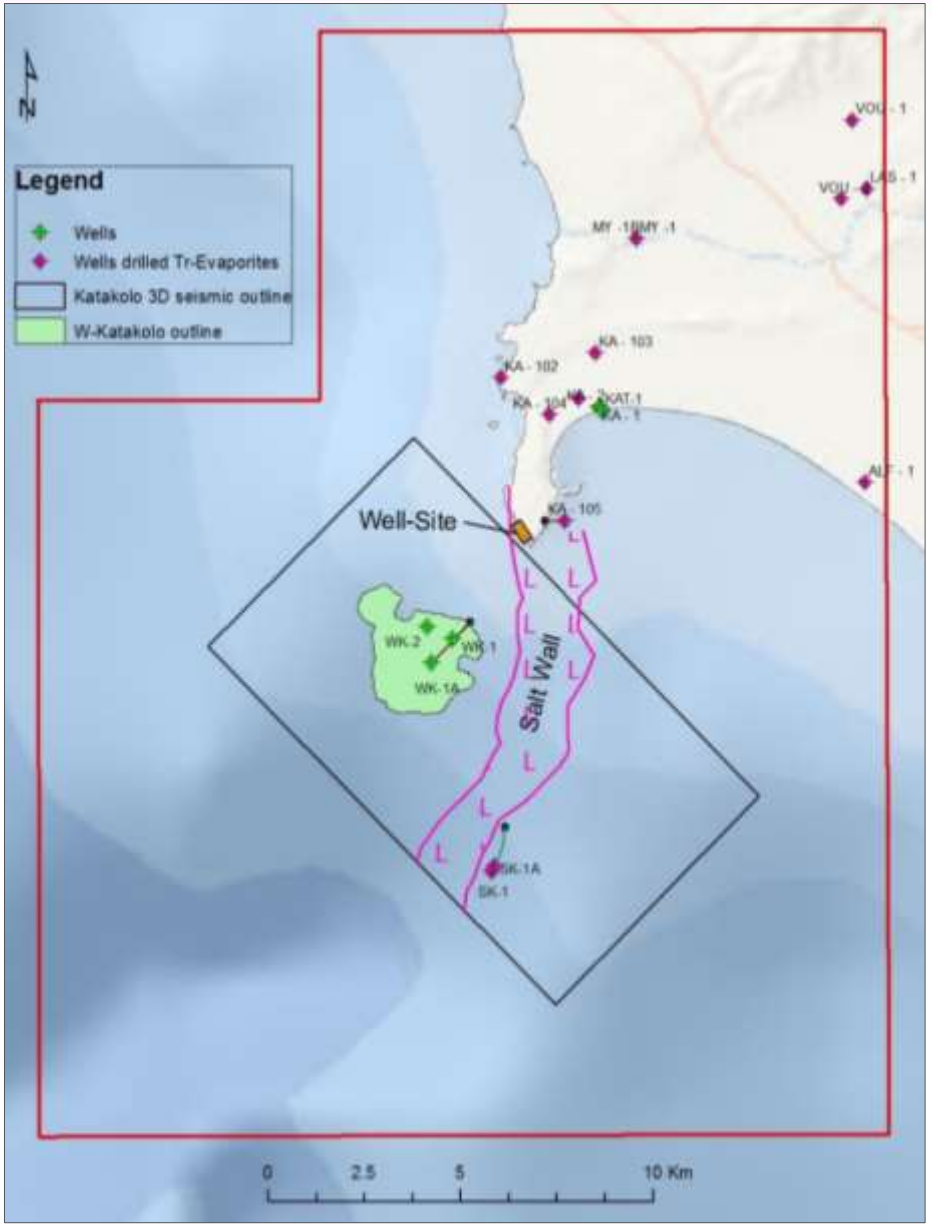
**WK-2 Oil zone**


**WK-1A Gas zone**


- West-Katakolo Field was discovered by the State Oil Company (DEP-EKY) in the early ‘80s by three offshore wells (WK-1, WK-1A, WK-2)
- Both Oil and Gas zones were tested, with flow rates 1000-1500 MMbbl/d and 14-23 MMSCF/d respectively
- The development of the field was uneconomic on the basis of the low oil-prices during the ‘80s

# West-Katakolo location



# H/C indications

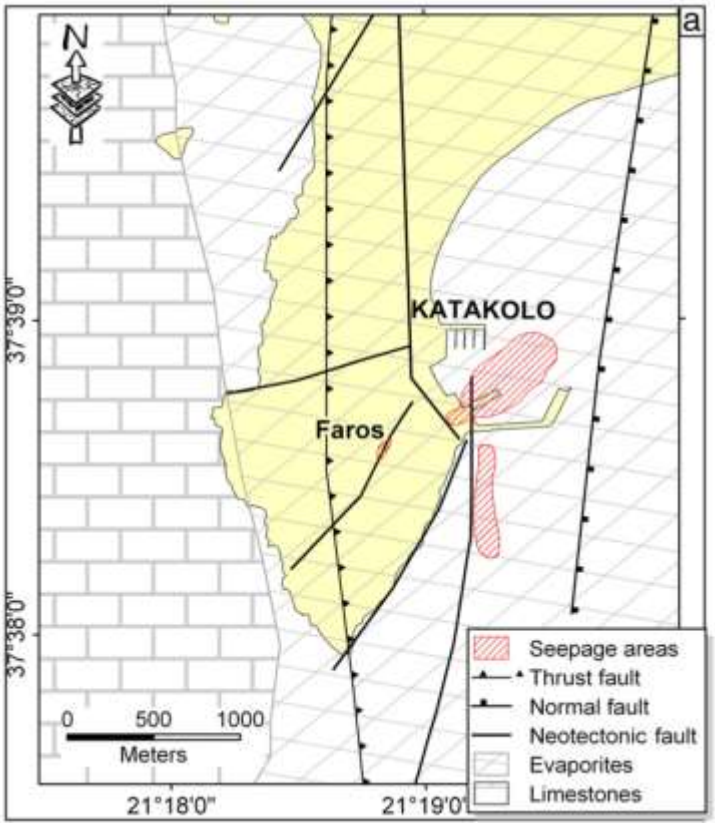
«Ηφαίστειο» Κατακόλου, 1976

«Ηφαίστειο» Κατακόλου, 2004

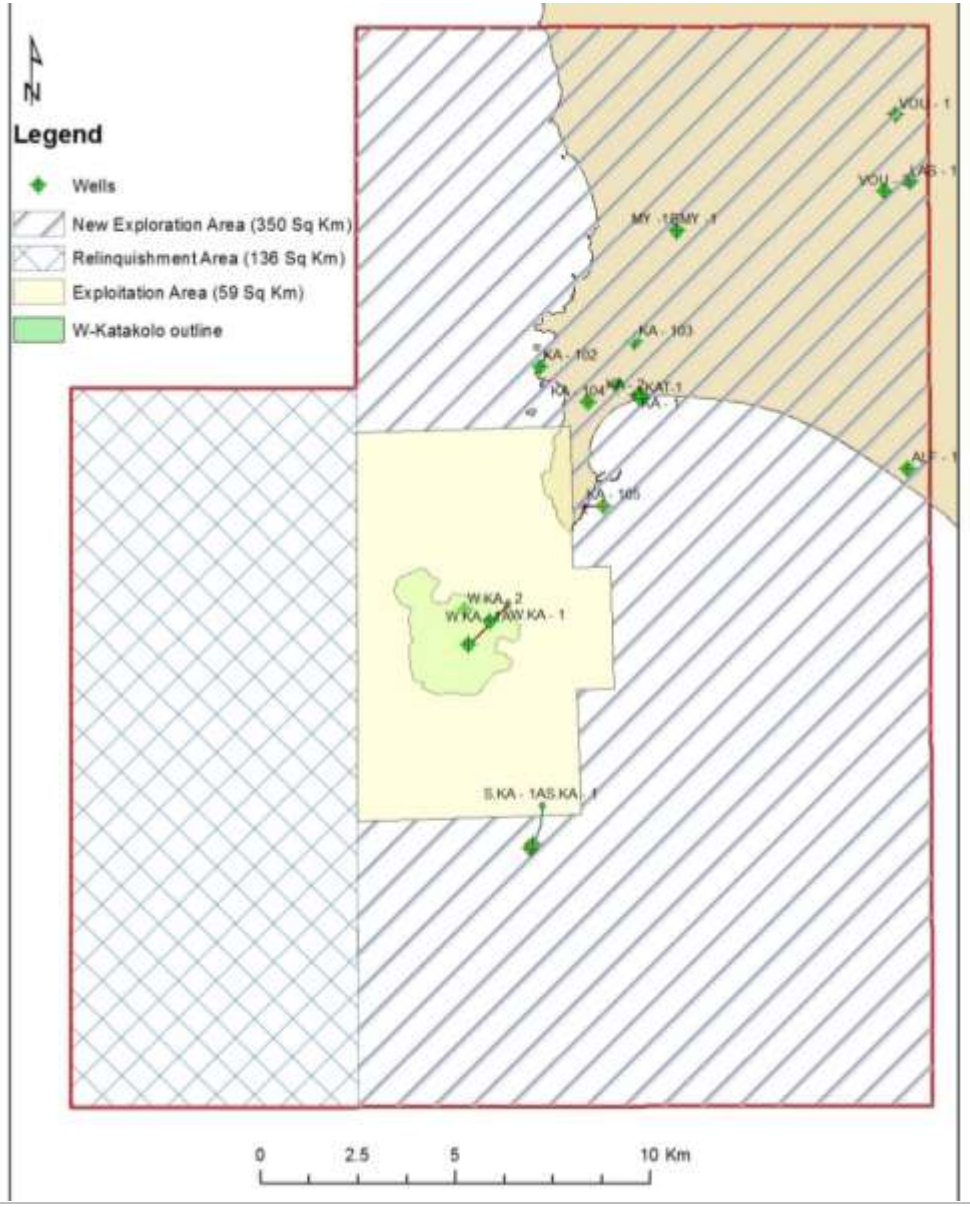
Λουτρά Κυλλήνης

Ζάκυνθος, πηγή Ηροδότου (480 π.Χ.)

G. Etiope et al. / Chemical Geology 339 (2013) 115–126



# Current situation




## Block split

- Exploitation Area: 59sqKm. Effective date 26/8/2016. Duration 25yrs. 5+5yrs optional extension
- Relinquishment area 136sqKm (25% of the initial area)
- Exploration Area 350sqKm. Effective date 3/10/2016 for 5 yrs.

## Field Development Plan

- Drill 4 ERD wells, 3 producers & 1 sour-gas injector
- Crude Oil-storage and Sour-Gas Injection (SGI) facilities
- Offshore off-loading to Sigma processing plant in Kavala.

## Exploration license

- G&G studies in the 2nd Exploration phase
- 1 onshore well in the 3rd Exploration phase

# Project Milestones

# Latest NSAI report Oct 2017: A significant increase in resources

| Category | Gross (100%) Oil Reserves (MMBBL) | Future Net Revenue After Income Tax[1] (MM$) | |
|---|---|---|---|
| | | Total | Present Worth at 10% |
| Proved Undeveloped | 6.3 | 126.8 | 59.0 |
| Proved (1P) | 6.3 | 126.8 | 59.0 |
| Probable | 4.2 | 146.1 | 55.1 |
| Proved + Probable (2P) | 10.5 | 272.9 | 114.1 |
| Possible | 5.8 | 214.0 | 52.5 |
| Proved + Probable + Possible (3P) | 16.3 | 486.9 | 166.6 |

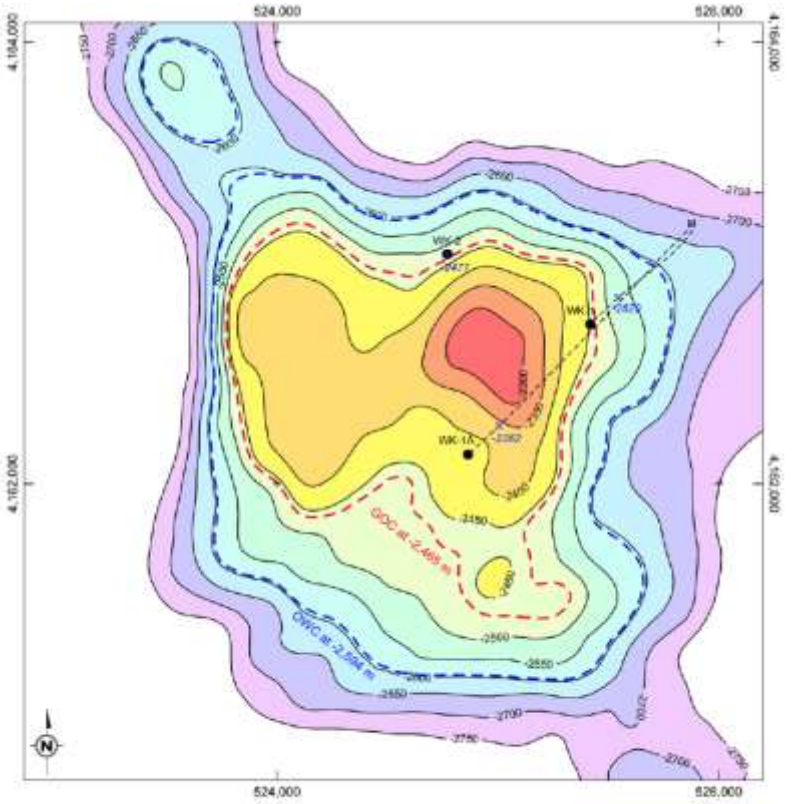
(1) Taxes include both corporate and municipality taxes.

| Porosity System | Original Oil-in-Place (MMBBL) | | | Gross (100%) Technically Recoverable Oil Volumes[1] (MMBBL) | | | Recovery Factor[2] (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1P | 2P | 3P | 1P | 2P | 3P | 1P | 2P | 3P |
| Matrix | 13.4 | 25.0 | 41.6 | 1.1 | 2.5 | 4.9 | 8 | 10 | 12 |
| Fractures | 5.2 | 8.9 | 14.3 | 4.6 | 8.0 | 13.1 | 88 | 90 | 91 |
| Arithmetic Sum[3] | 18.6 | 33.9 | 56.0 | 5.6 | 10.5 | 18.0 | 30 | 31 | 32 |
| Probabilistic Sum | 21.2 | 34.3 | 52.6 | 6.4 | 10.7 | 16.8 | 30 | 31 | 32 |

(1) Technically recoverable volumes associated with reserves are prior to application of economics. The portion of the volumes that are economic are classified as reserves.

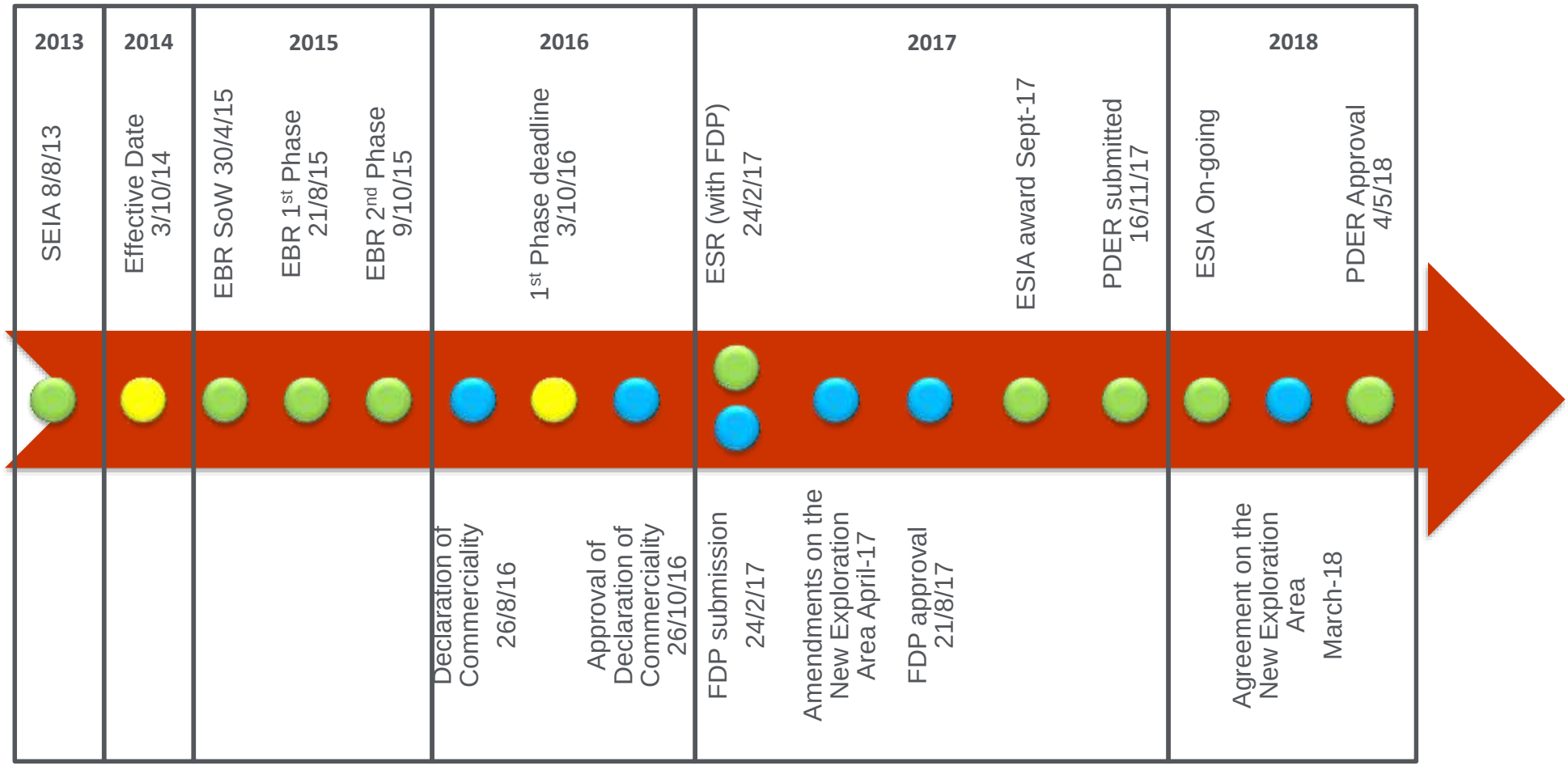
(2) Recovery Factor is calculated by dividing unrounded Gross (100 Percent) Technically Recoverable Oil Volumes by unrounded Original Oil-in-Place. See Volumetric Input Parameters for recovery factor input distributions.

(3) Arithmetic sums do not include the portfolio effect that might result from statistical aggregation and may not add because of rounding.




West Katakolo Field

# Project Progress



# West Katakolo Forward Planning

- **ESIA – Permits**: Phase A: Pilot well (Injector) and Horizontal well (Producer) (to be submitted in 2018)
  Phase B: Facilities (follows just after)

- **FID (A) or farm down in 2019**

- **FDP Stage 1**: Application of the Approved FDP
  1. *FDP Phase A*: Pilot well →completed as Gas Injector (Q4/2019)

- **FID (B) May 2020**

  1. *FDP Phase B*:
     - 1st Horizontal Producer (1500 bbl/d) (May 2020)
     - Install necessary facilities
     - Initial production 1500bbl/d (2021/2022)

  2. *FDP Phase C*
     - 2nd Horizontal Producer (increase production +1500 bbl/d = 3000 bbl/d)
     - 3rd Horizontal Producer (stabilization at 3000 bbl/d)

- **FDP Stage 2:** Application of a New FDP. After the depletion of Oil, for Gas Production.
  1. Phase A:
     - Convert Gas injector to Gas producer
     - Convert existing facilities and install new facilities for Gas production
       - Scenario A: For electricity production
       - Scenario B: For Gas sales

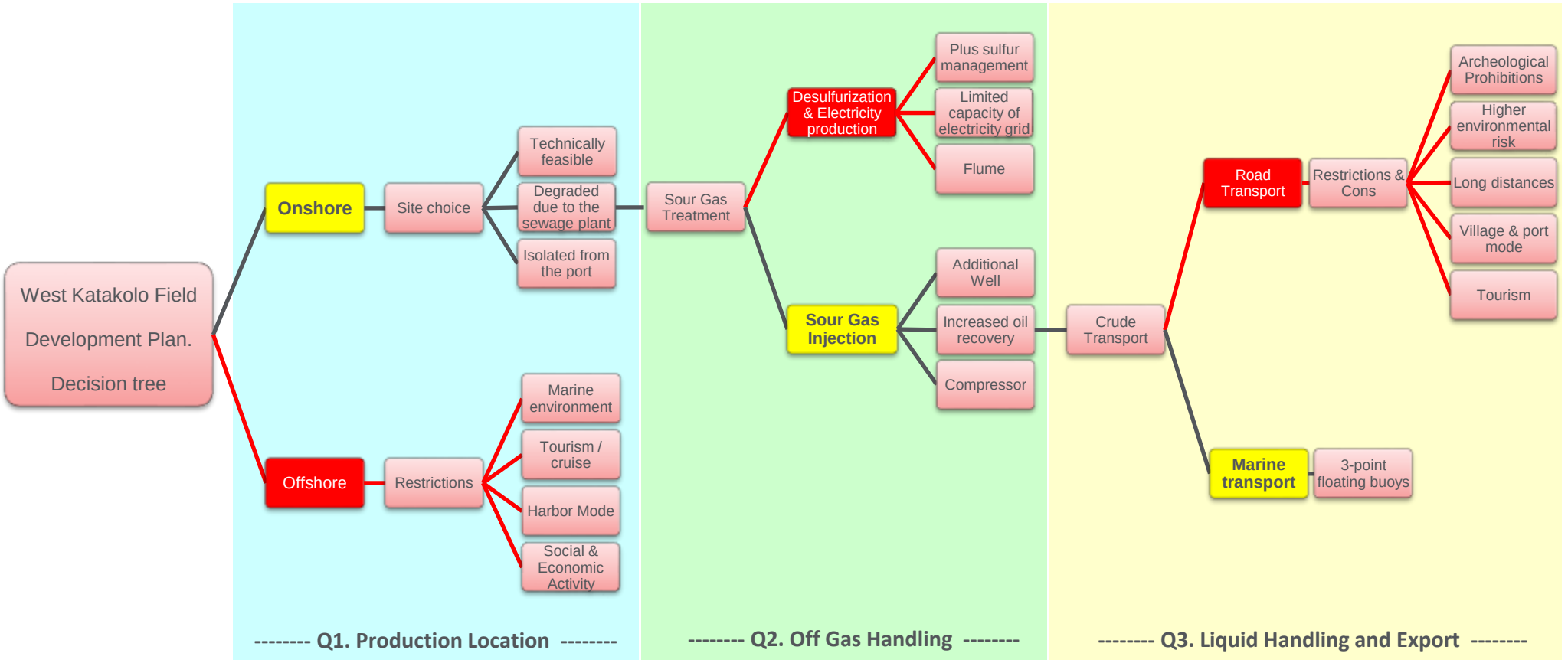
# Katakolo harbour: then and now

1975

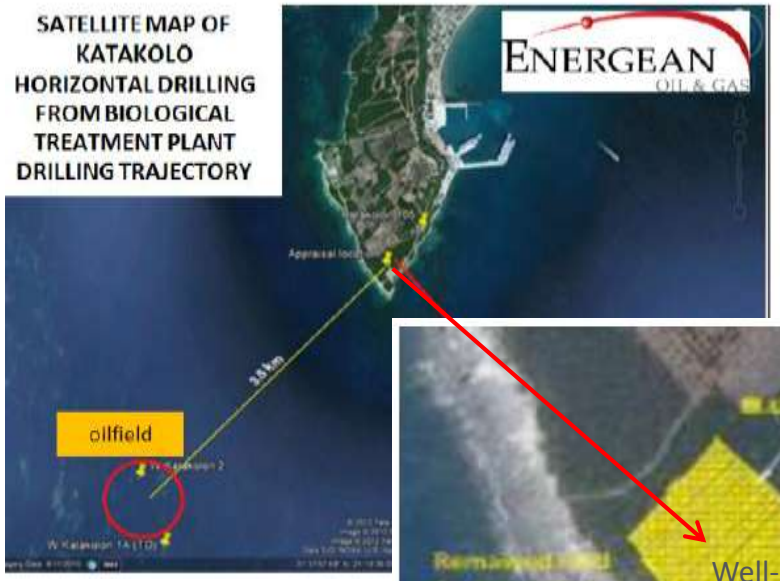
Today

- Tourist activity is the main economic activity in Katakolo
- Environmentally sensitive area

# West Katakolo Field Development Plan - Decision Tree



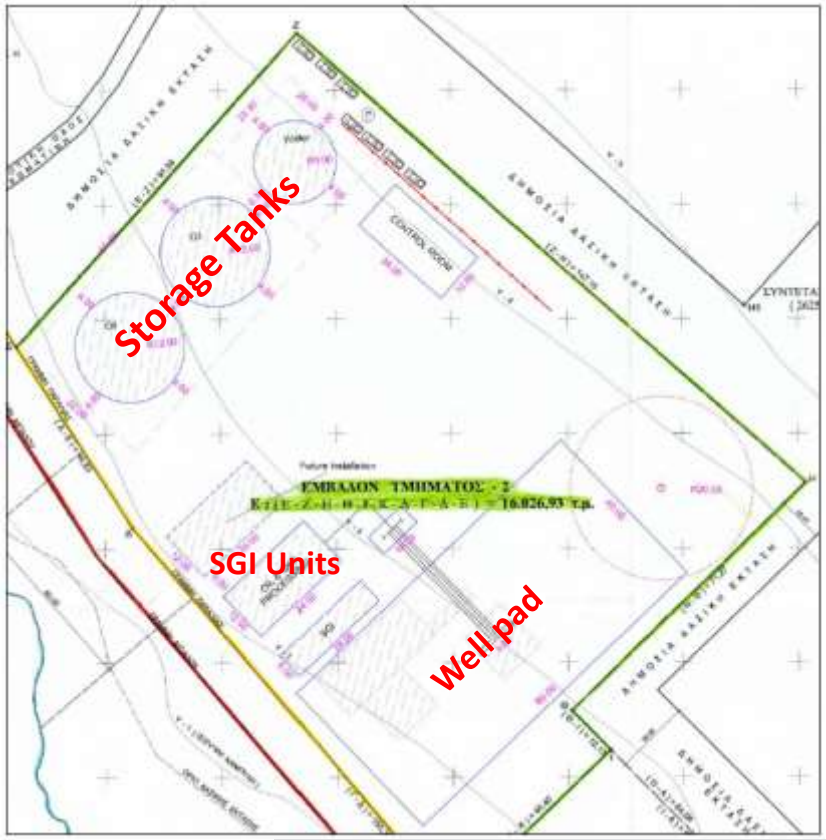
# Well-site selection





- Technically feasible to drill ERD wells
- Isolated from the port and areas of habitation
- Already impacted by the existing sewage plant

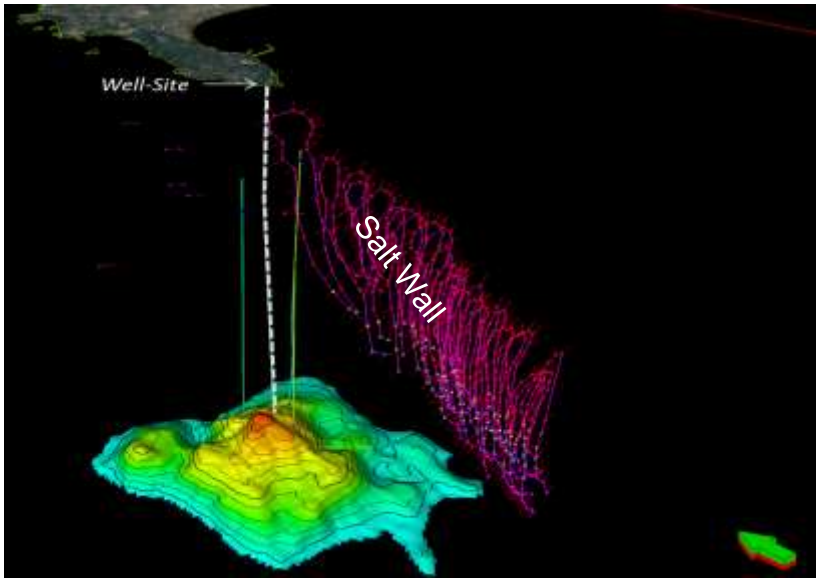
# Well-site layout

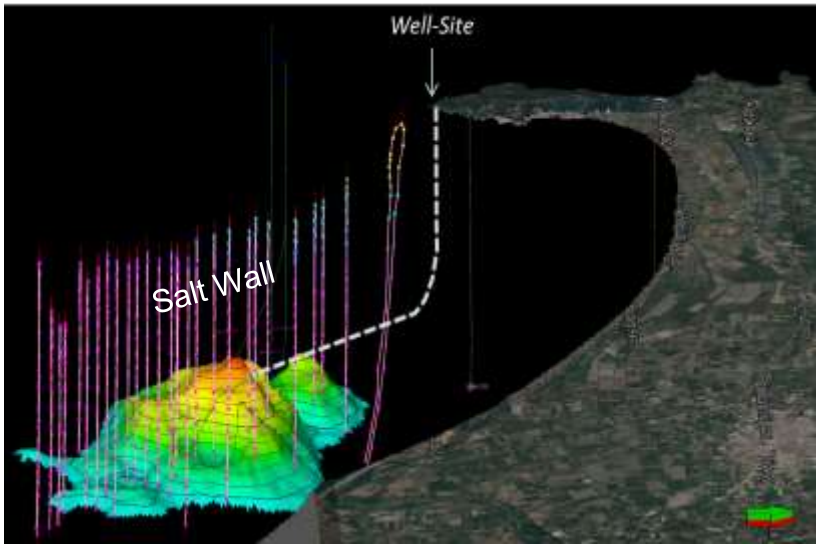


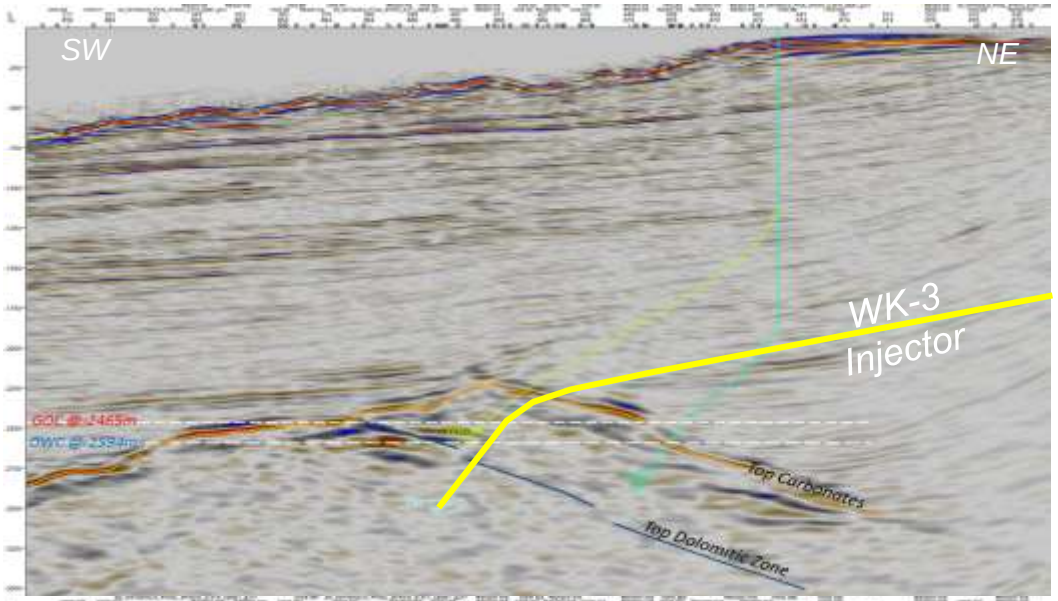


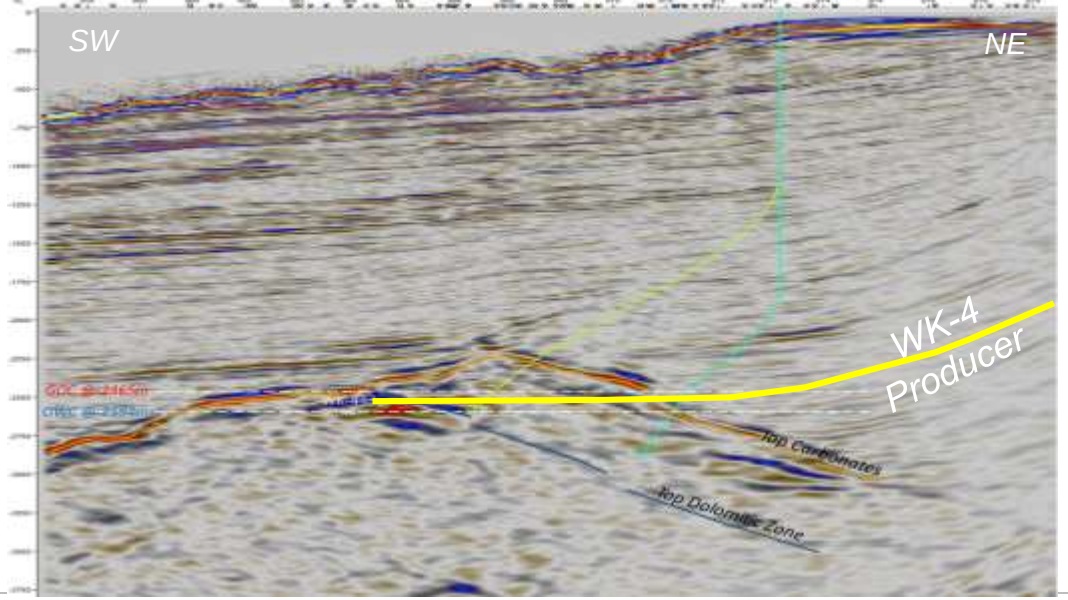
Skid-mounted units for minimum environmental impact and easy decommission

# Well Design of the first 2 wells

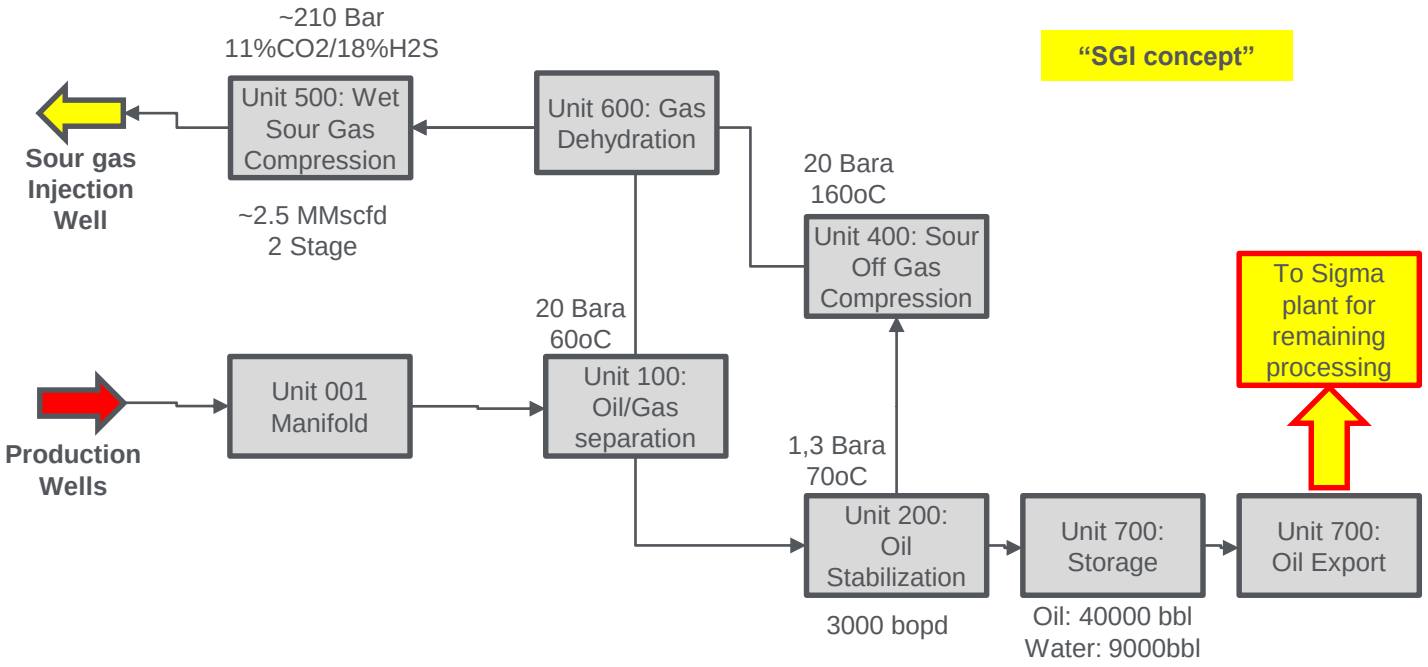


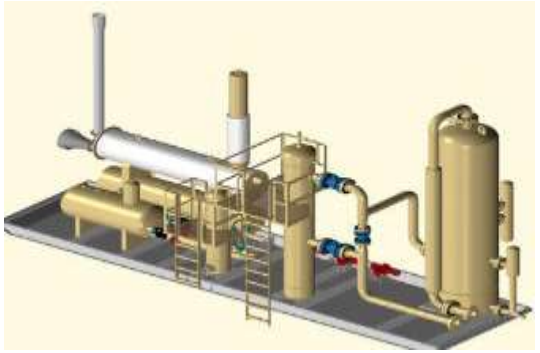



# SGI scheme: Gas dehydration & Sour Gas compression



Modular Construction Techniques deploying skid mounted units

Challenges:

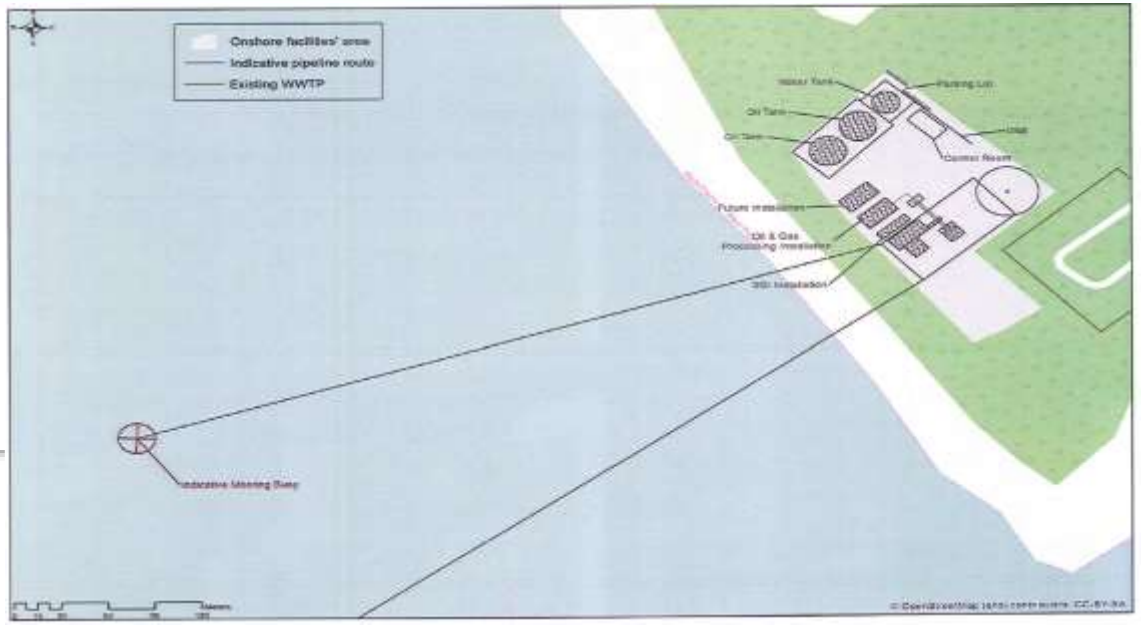
- Gas dehydration is required
- Dedicated gas injection well is required from day one
- Large safety contours due to HP sour gas

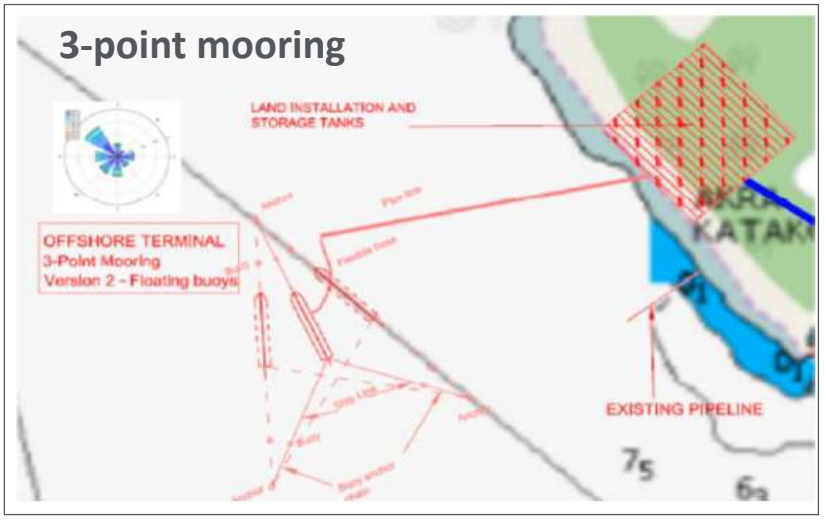
Technical Characteristics:

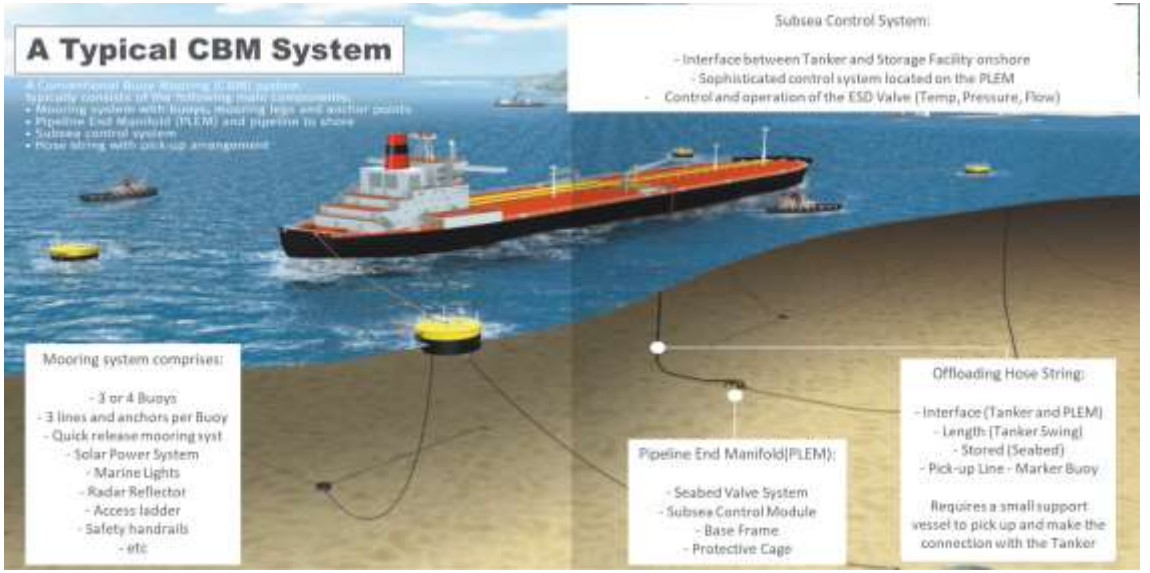
- Total Power Consumption ~0,65MWh
- Oil API ~30 Degree
- H2S mass %: ~1000mg/l

# Offshore off-loading to Sigma plant in Kavala

- A 3-Point Conventional Mooring System was selected
- One 10'' subsea pipeline
- 530m$^3$/h offload rate →offload duration of 6h

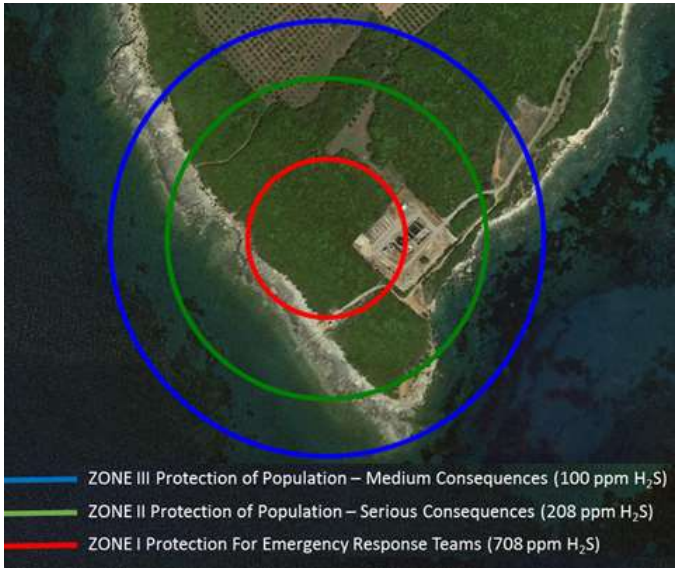


# Drilling impact zones – Seveso directive

**Worst Case Impact Zones: Toxic / H2S gas dispersion**




**Worst Case Impact Zones: Jet Fire Heat Radiation**

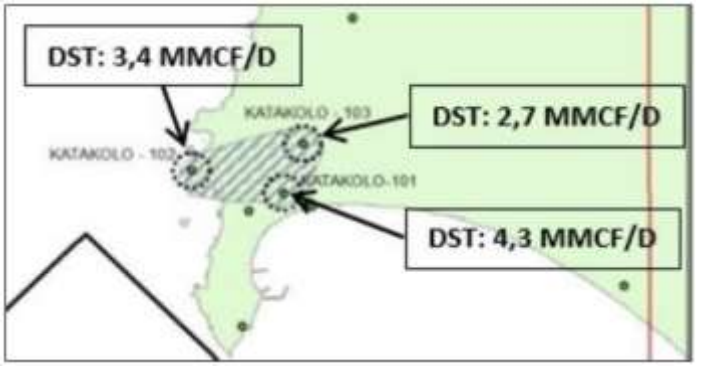

**Worst Case Impact Zones: Pool Fire Heat Radiation**


- The consequence modelling serves to assess the magnitude of the physical effects (heat radiation, overpressure, flammable and toxic gas ranges) associated with the Major Accidents Scenarios affecting people and environment

# Exploration Area

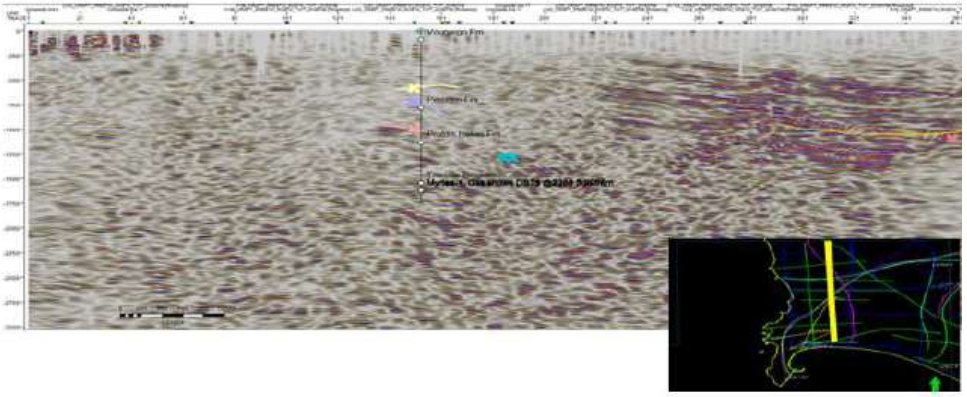
## DSTs onshore biogenic gasses

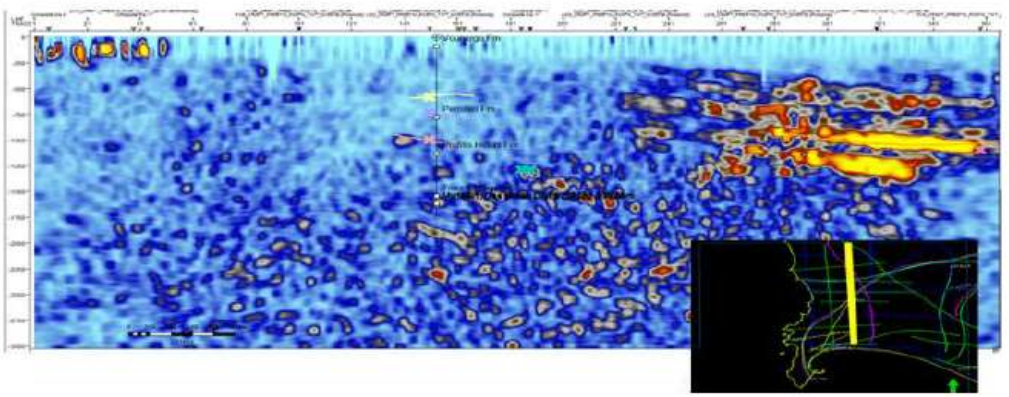





### Objectives

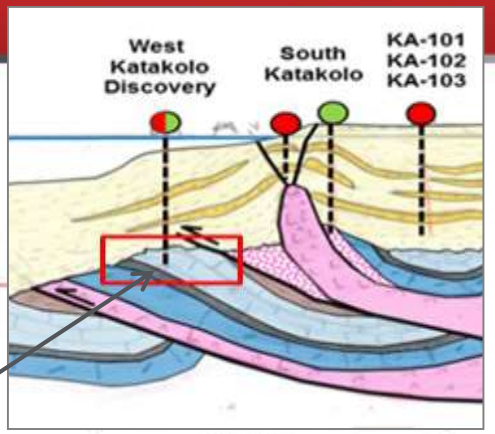
- To define and assess the upsides
- To add value on the license
- To co-exploit the upsides with W. katakolo Field

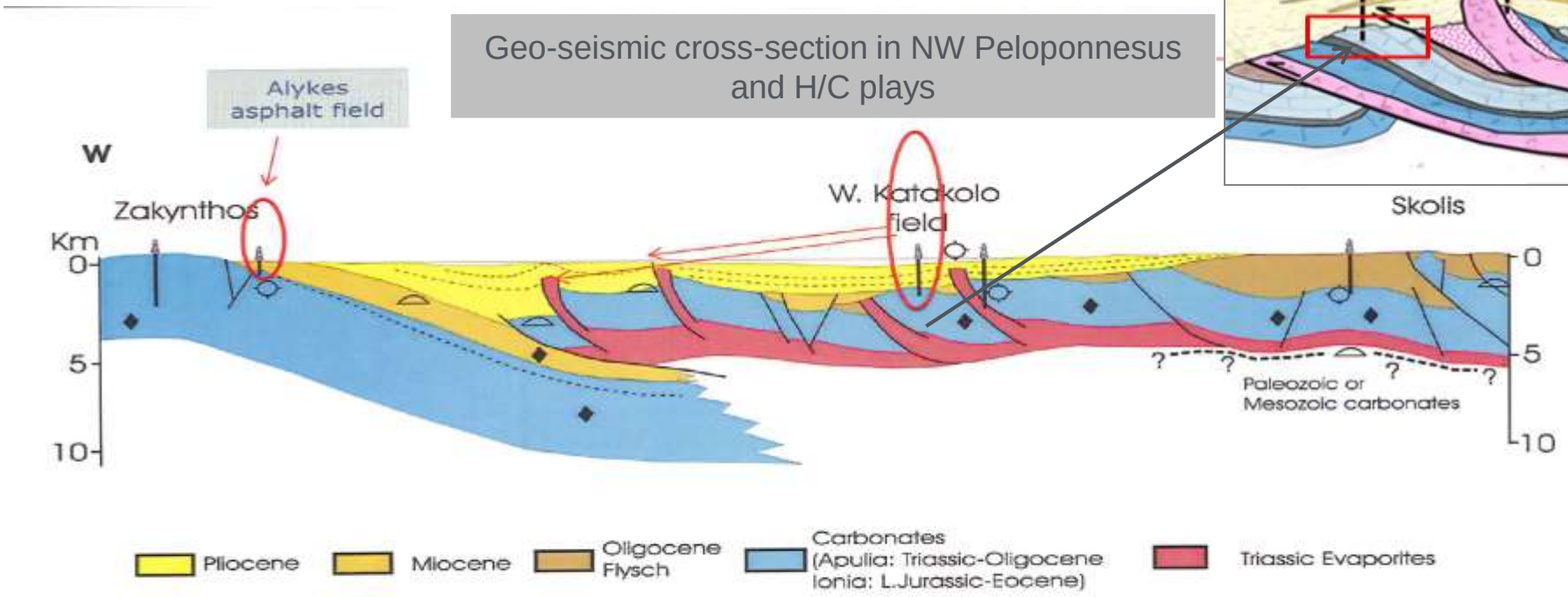




# A unique analogue for Western Greece

Geo-seismic cross-section in NW Peloponnesus and H/C plays




## West-Katakolo H/C Play

- Source: Triassic Evaporitic section
- Reservoir: Eocene-Cretaceous fractured/karstified Carbonates
- Trap: Carbonate paleo-relief beneath Pliocene unconformity
- Seal: Pliocene shales
- Timing: Post-Pliocene

# Thank you!

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