The evidences of gas in the sediment

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References

- Fabiano Gamberi and Marzia Rovere(2010), Mud diapirs,mud volcanoes and fluid flowin the rearof the Calabrian Arc OrogenicWedge (southeasternTyrrhenian sea), Basin Research (2010) 22, 452–464, doi: 10.1111/j.1365-2117.2010.00473.x
- Casas, D., Ercilla, G. & Baraza, J. (2003) Acoustic evidences of gas in the continental slope sediments of the Gulf of Cadiz (E Atlantic). Geo-Mar. Lett., 23, 300-310.

Outline

- Introduction
- The study area and methods
- Discussion and Conclusion

Introduction

- Gas hydrates are solid, ice-like substances, among which their use as a potential energy resource .

- Stable under conditions of high pressure and low temperature

- The gas-related acoustic features:acoustic turbidity and blanking, bright spots, strong multiple reflections, pockmarks, acoustic plumes and turbidity in the water column, bottom simulating reflectors (BSRs).

The study of area and methods

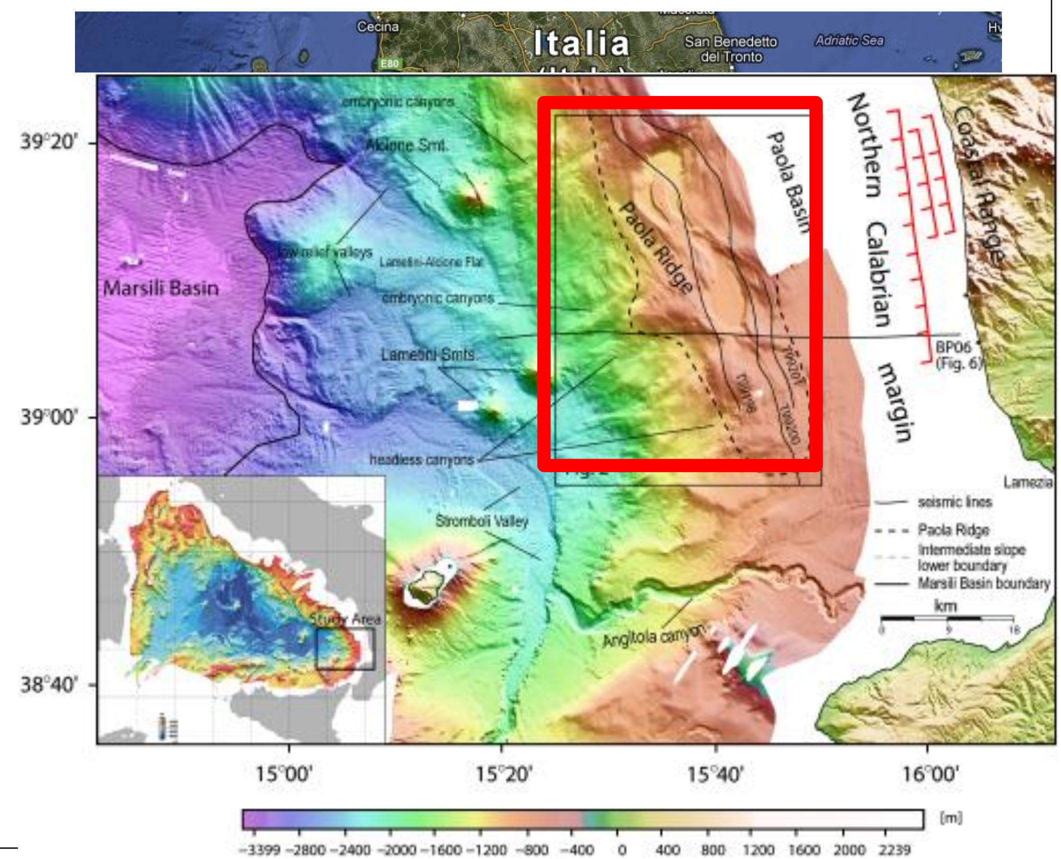
- Calabrian arc(Tyrrhenian sea)

- Gulf of Cadiz

Calabrian arc(Tyrrhenian sea)

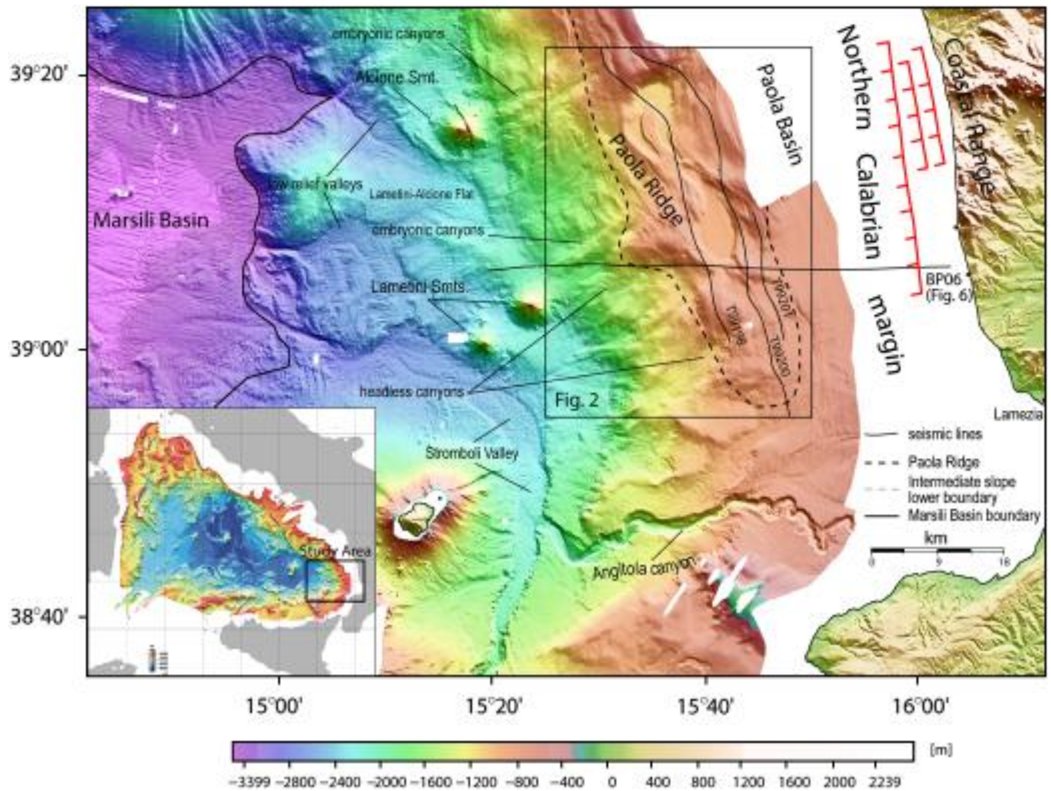
- The southern Tyrrhenian basin formed at about 4-2Ma as a consequence of rifting and back-arc extension of the Alpine/ Apennine suture above the north-westerly subducting Ionian oceanic slab.

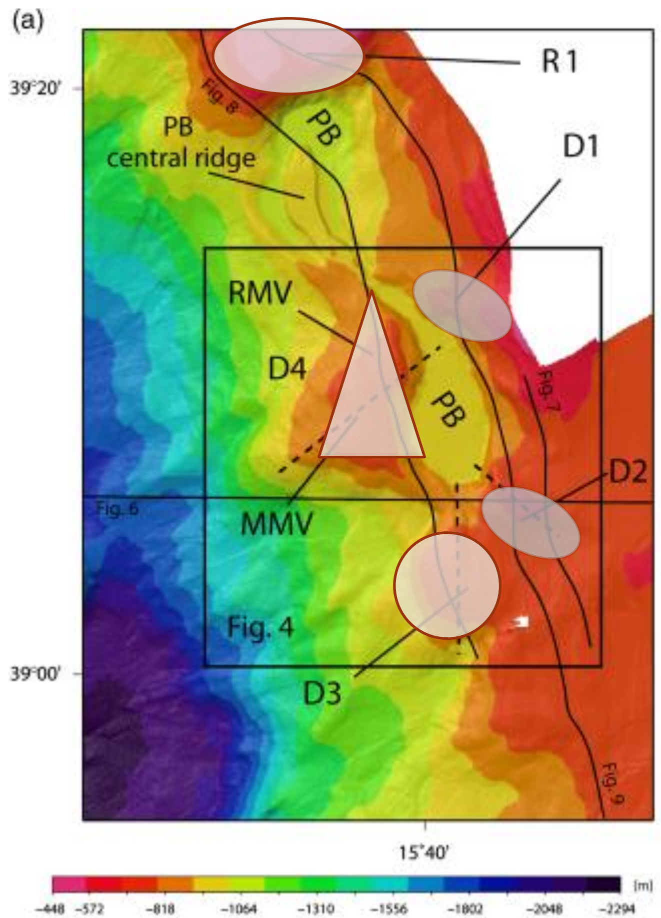
This area covers the upper slope, the Paola intraslope basin, the Paola ridge, the intermediate slope, the Lametini-Alcione flat and a further slope that marks the boundary with the Marsili basin

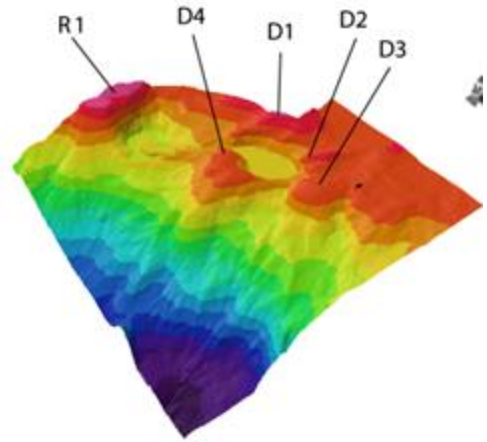


Data and Method

- Multibeam data
- Single- channel seismic data







The easternmost structures of the Paola Ridge:

D1(diapir 1): NW-SE,

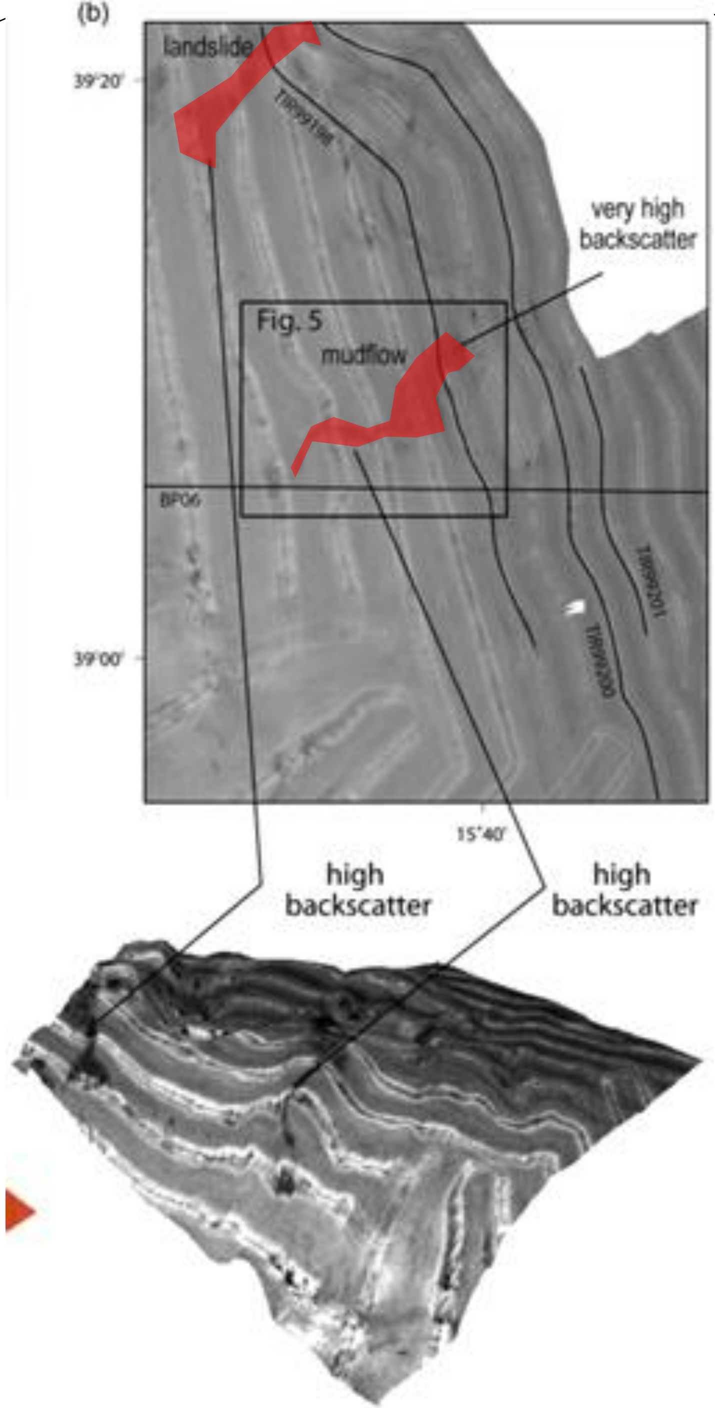
D2(diapir 2): NW-SE,

The west and the south of PB(Propeller Basin):

D3(diapir 3): a circular shape,

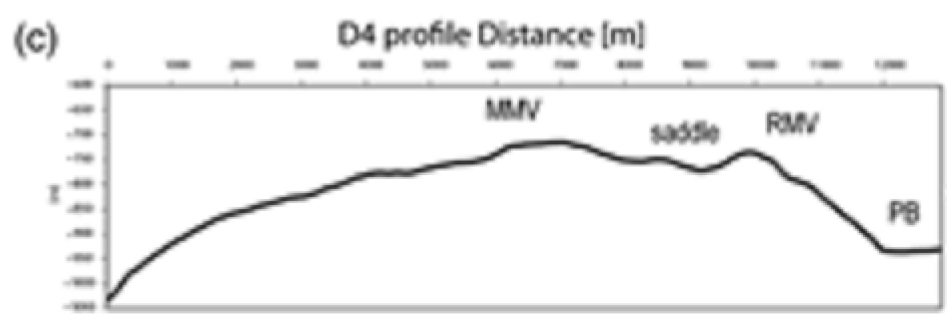
D4(diapir 4): a triangular shape

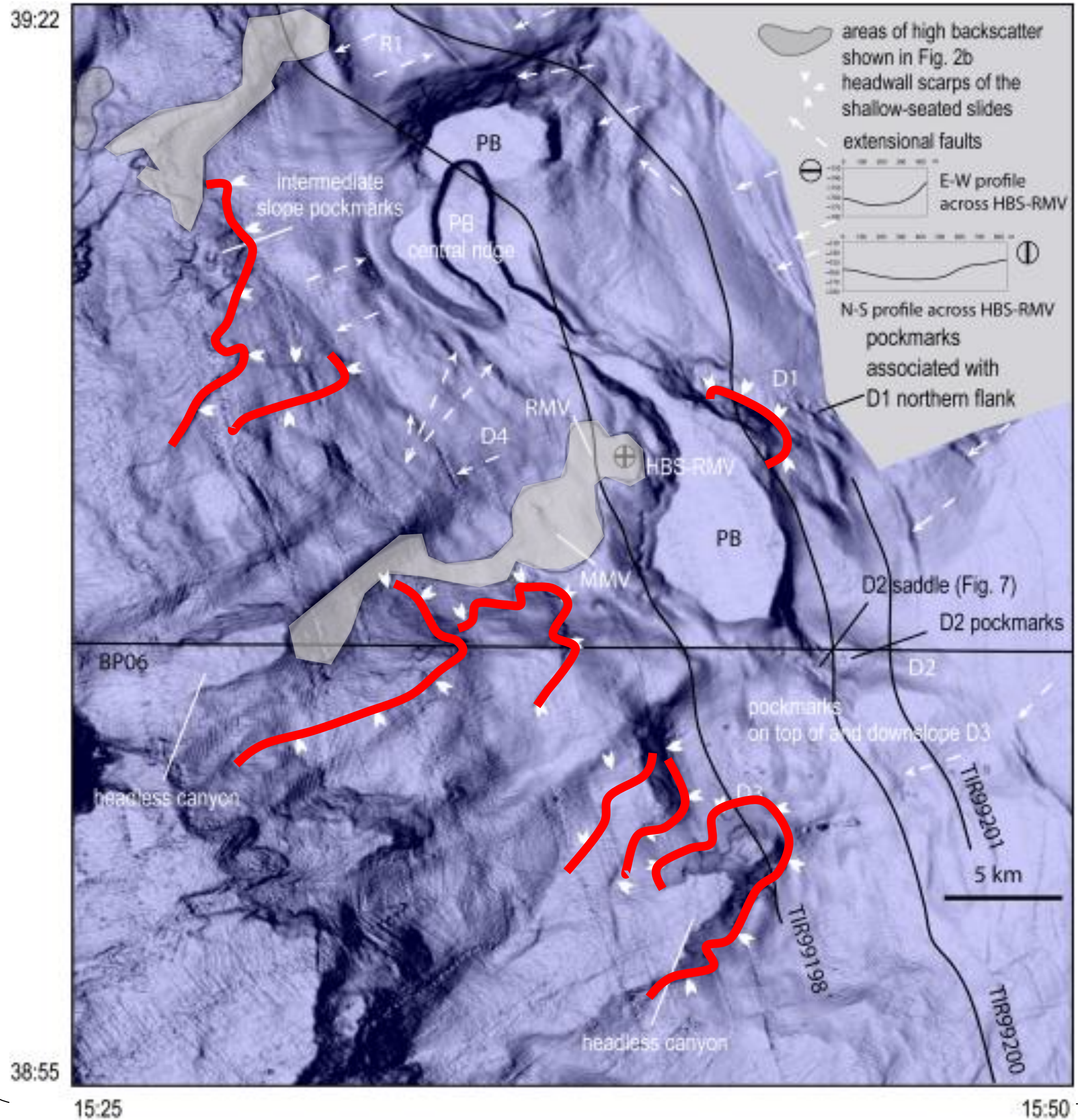
R1: flat-topped,



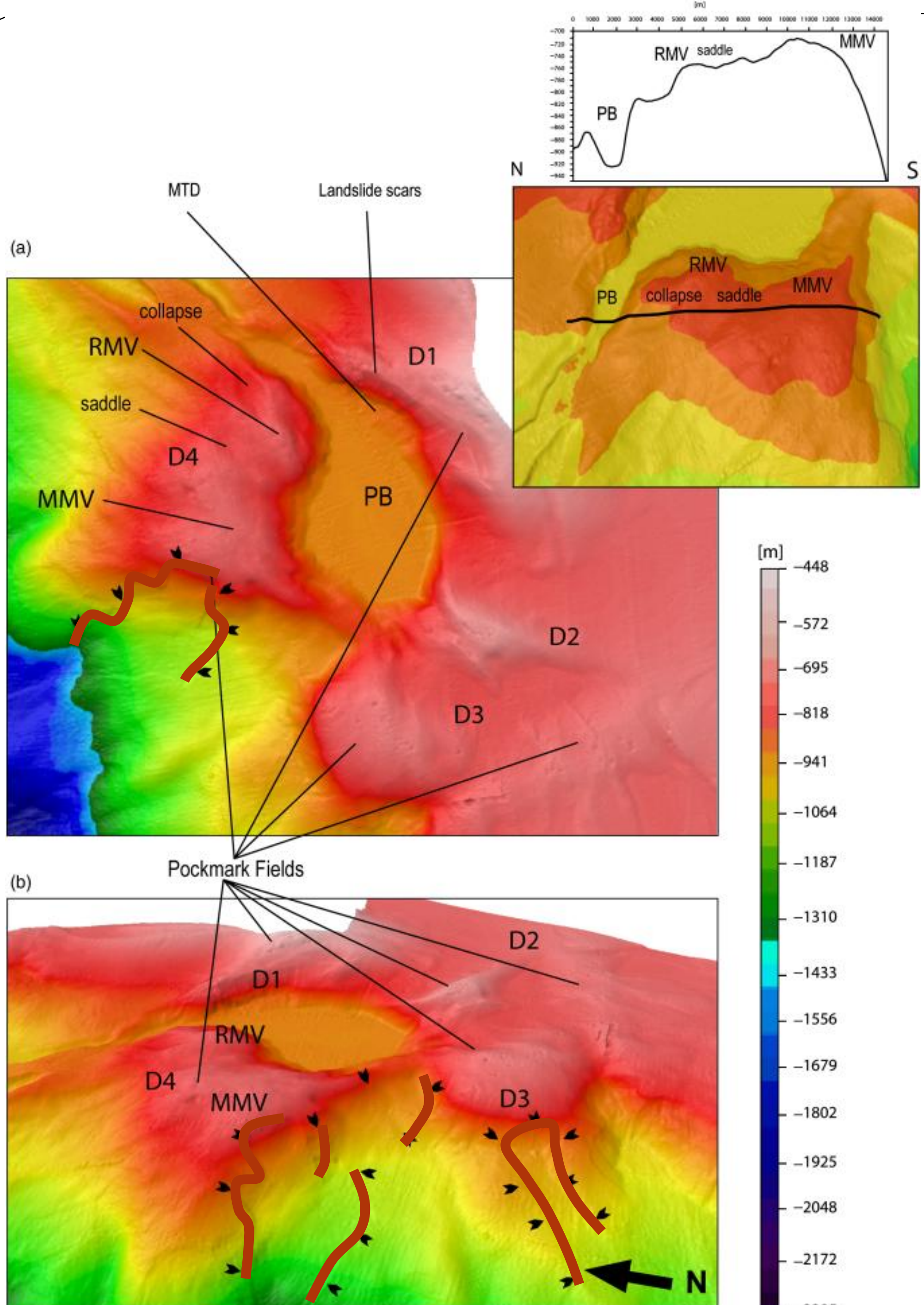
Two high backscatter features:
R1: amphitheatreshaped landslide scar
D4: RMV and MMV
(RMV: Richthofen mud volcano,
MMV: Mojsisovics mud volcano)

RMV is centred by a smaller very high backscatter spot.





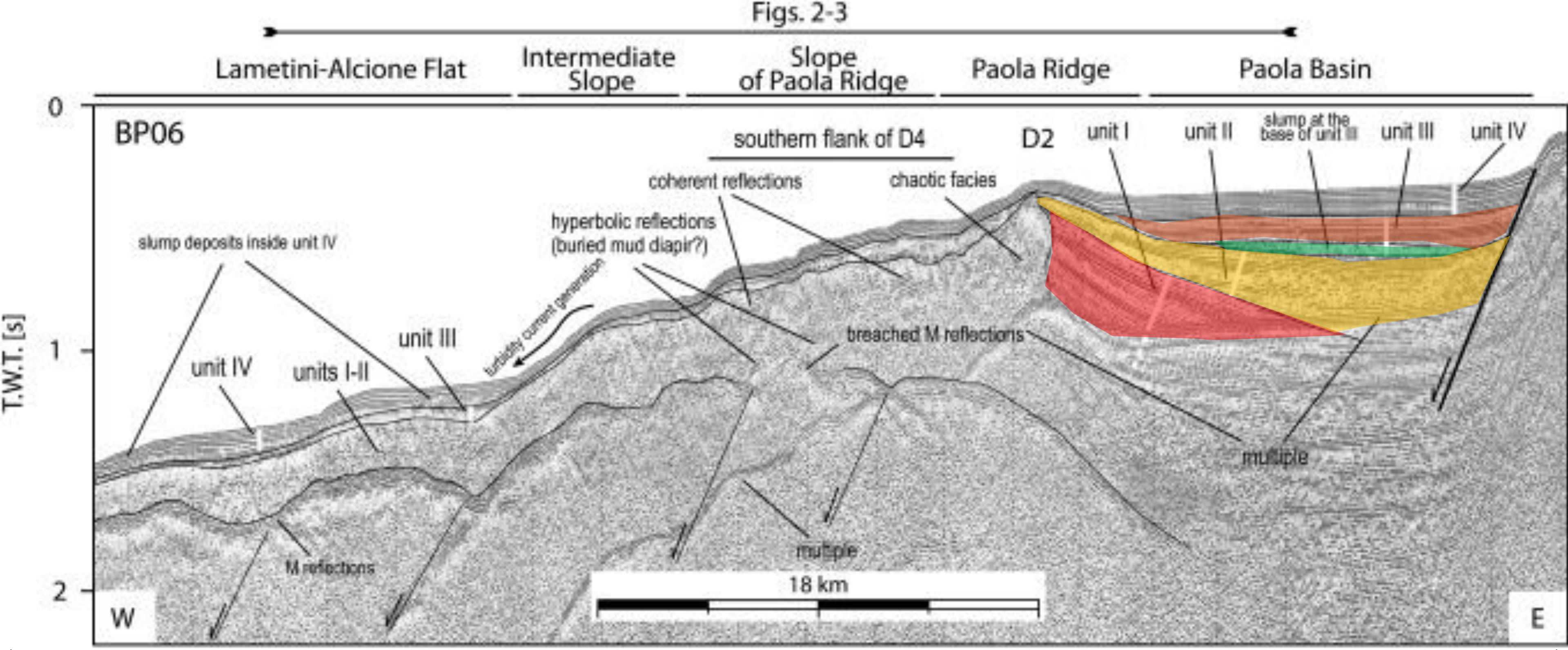
39:22
38:55
15:25
15:50
areas of high backscatter shown in Fig. 2b
headwall scarps of the shallow-seated slides
extensional faults
E-W profile across HBS-RMV
N-S profile across HBS-RMV
pockmarks associated with D1 northern flank
R1
PB
PB central ridge
intermediate slope pockmarks
RMV
D4
HBS-RMV
D1
PB
MMV
D2 saddle (Fig. 7)
D2 pockmarks
D2
BP06
pockmarks on top of and downslope D3
D3
headless canyon
headless canyon
TIR99201
TIR99198
TIR99200
5 km



Pockmark fields are present on top of D1,D2,D3 andD4

Three headwall scarps are also visible on the western flank ofD4 andD3

A landslide scar is also present in the western flank of D1



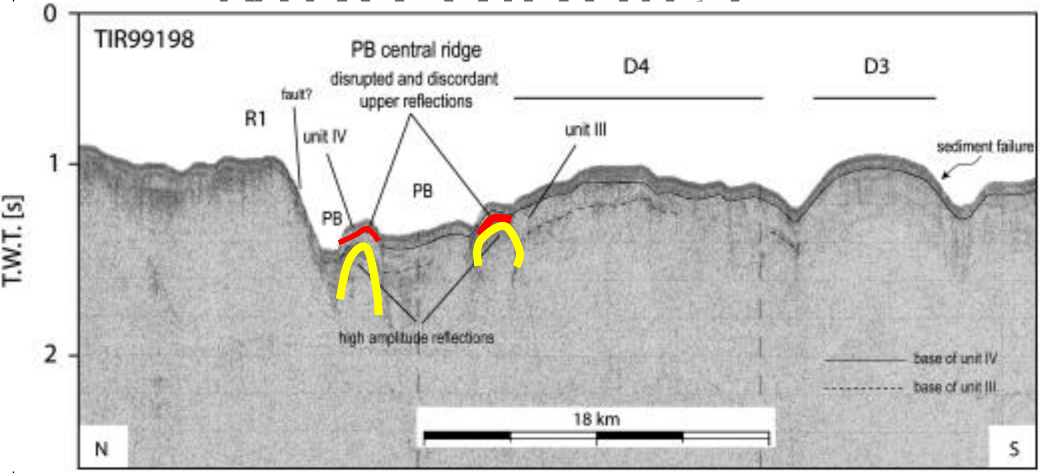
Unit I: rotated parallel reflectors

Unit II: wedge-shaped

Unit III , Unit IV : parallel and horizontal within most of the Paola basin

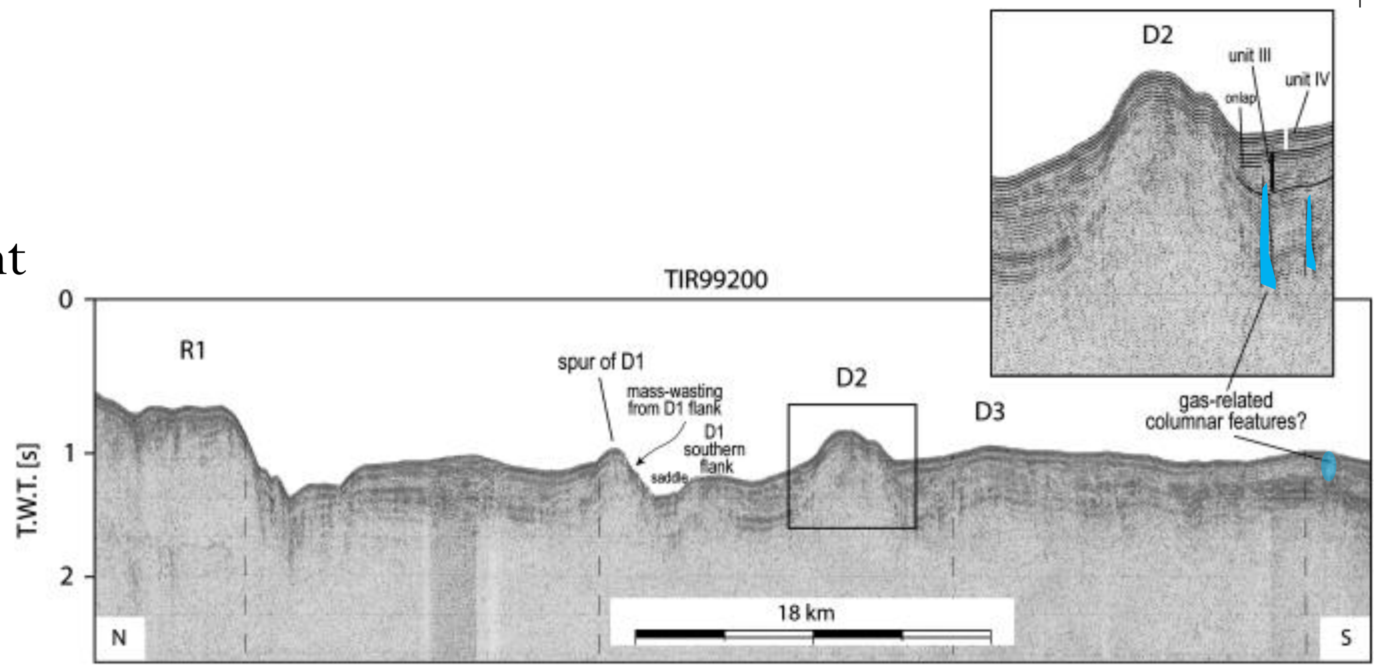
Mass transport deposits

Mud diapirs



The high amplitude reflections can be interpreted as the evidence of gas

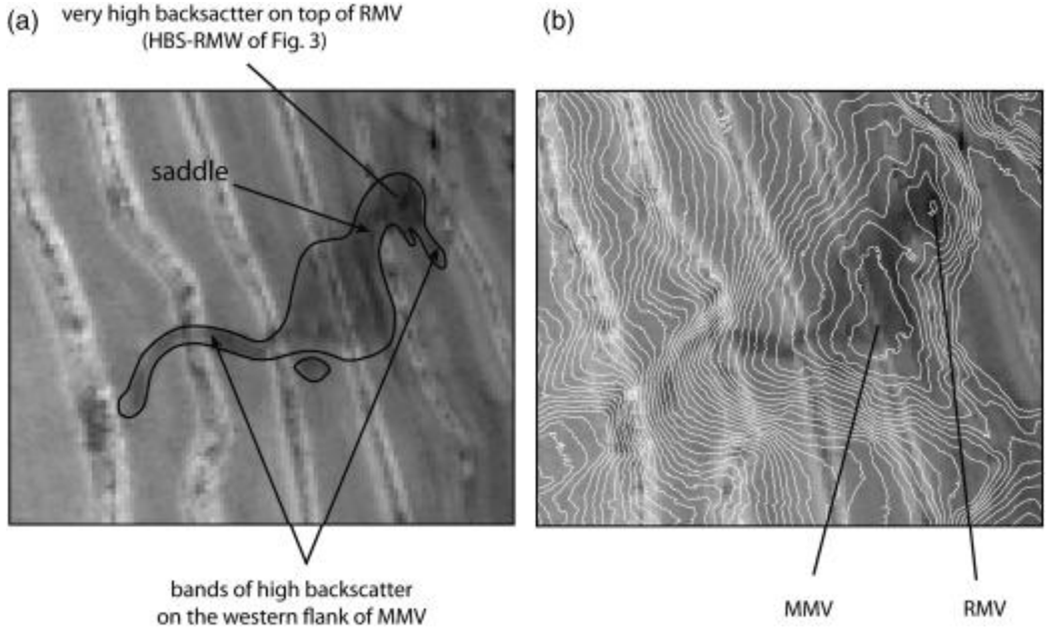
The vertical transparent columns interpreted as gas clouds



Mud volcanoes

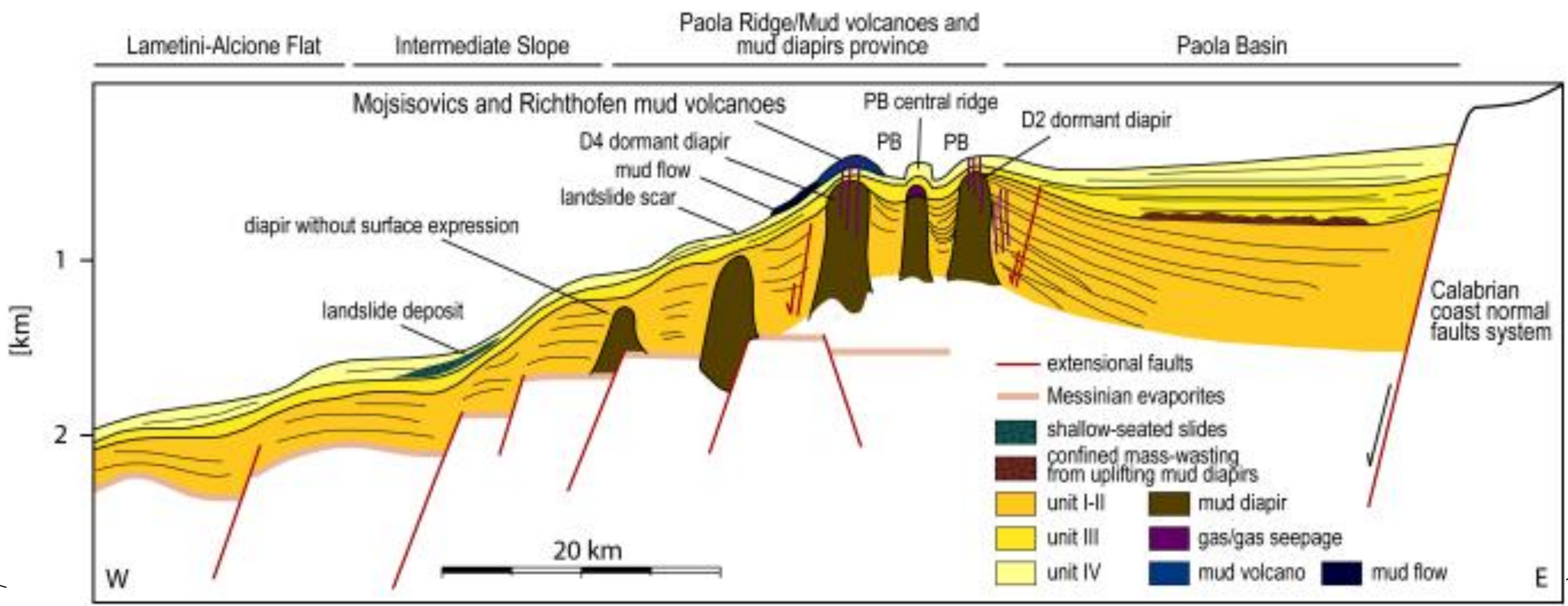
- There are different criteria for identifying mud volcanoes: direct sampling of mud breccia; side- scan sonar images of strong backscatter indicating mud flows or the crater of the volcano itself, seismic evidences of mud diapirs or feeding channels

- Fluid pressure rise to lithostatic value, narrower conduits consisting of fluidized sediments entrained in flowing gas or fluids form above a diapir and can feed overlying mud volcanoes



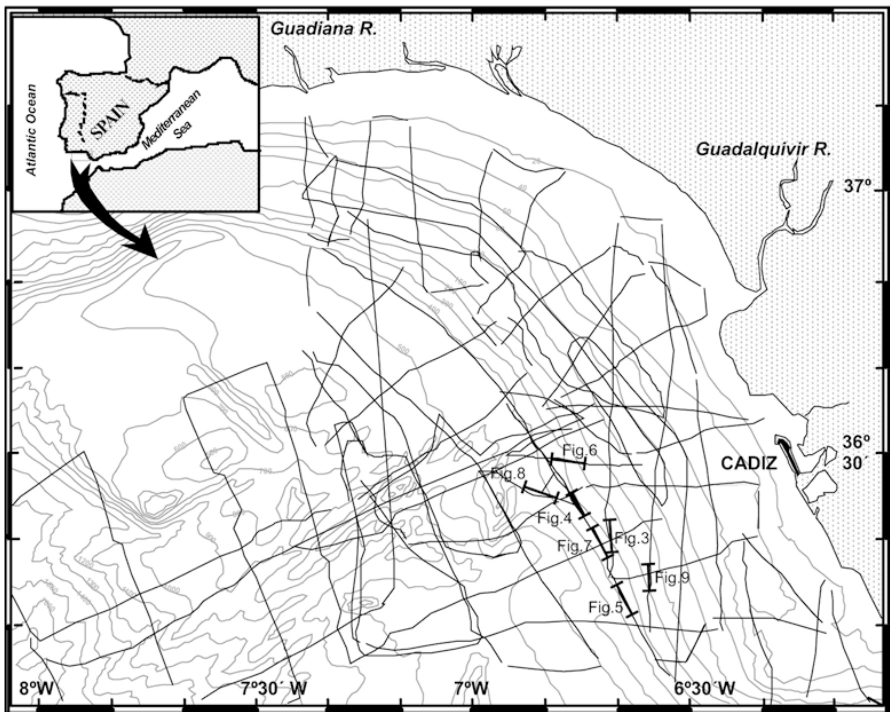
RMV : high backscatter spot.

The PB central ridge:
a primitive stage of the process
D1-D4 : in a later stage of activity



Gulf of Cadiz

- The Gulf of Cadiz occupies a focal position between the westernmost segment of the Mediterranean and the Iberian-African boundary.

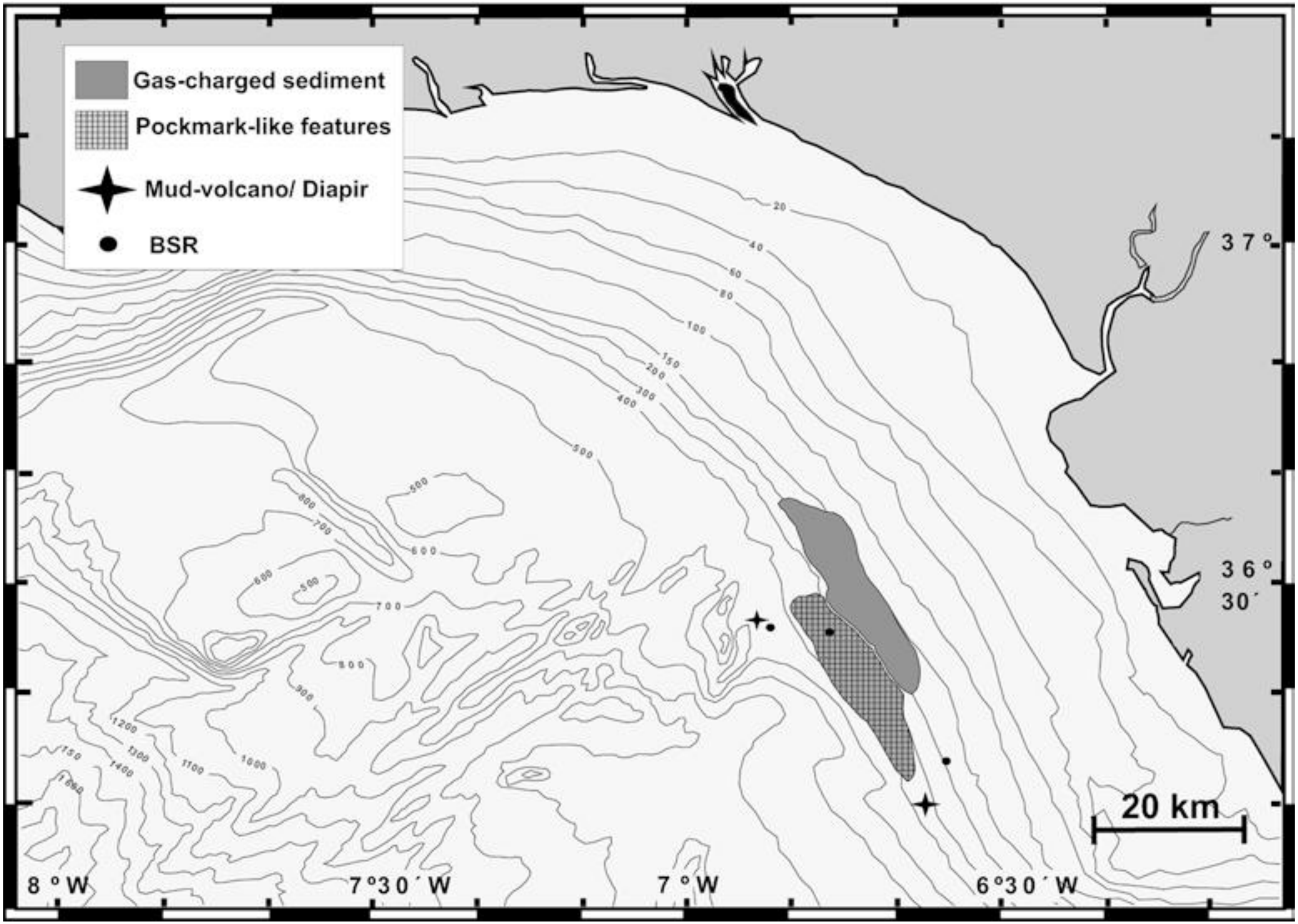


- clays and interbedded sand

- The presence of an eastward moving upper layer of light and cold Atlantic water, and a westward-moving lower layer of dense and warmer Mediterranean water characterises a dynamic system of water masses.

Data and Method

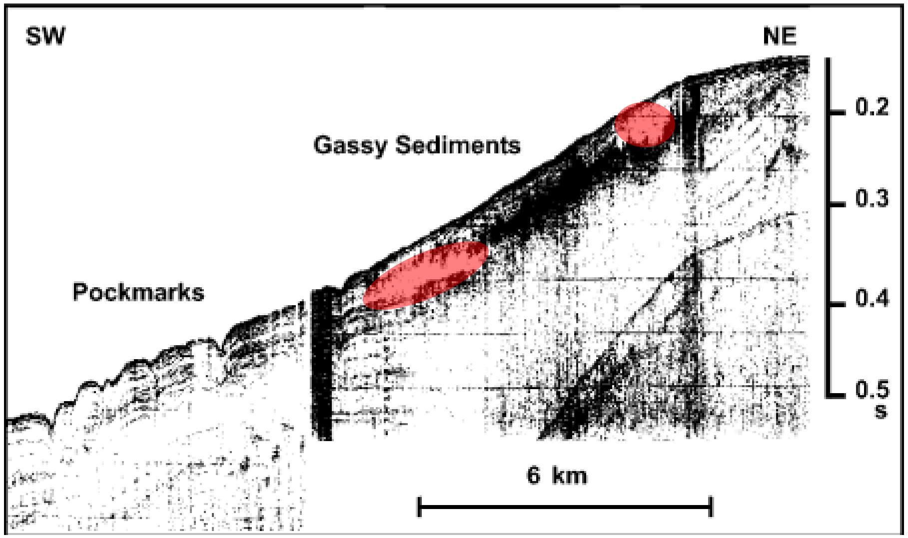
- Seismic reflection profiles
- Bathymetric echosounder
- High-resolution ORE 3.5 kHz sub-bottom profiler



Gas-charged sediment: 130-300m(deep), 35km(long), 5-7km(wide)

Pockmark-like features: 300-400m(deep), 30km(long), 2-7km(wide)

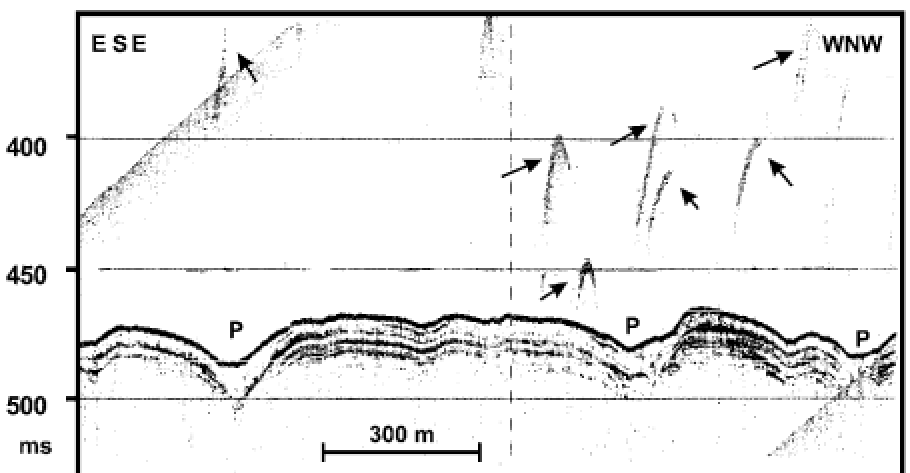
Pockmarks

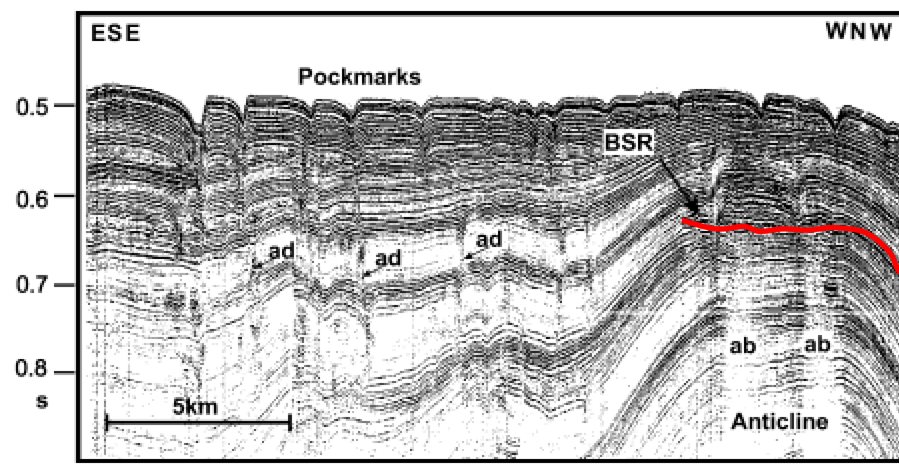


They are closed depressions

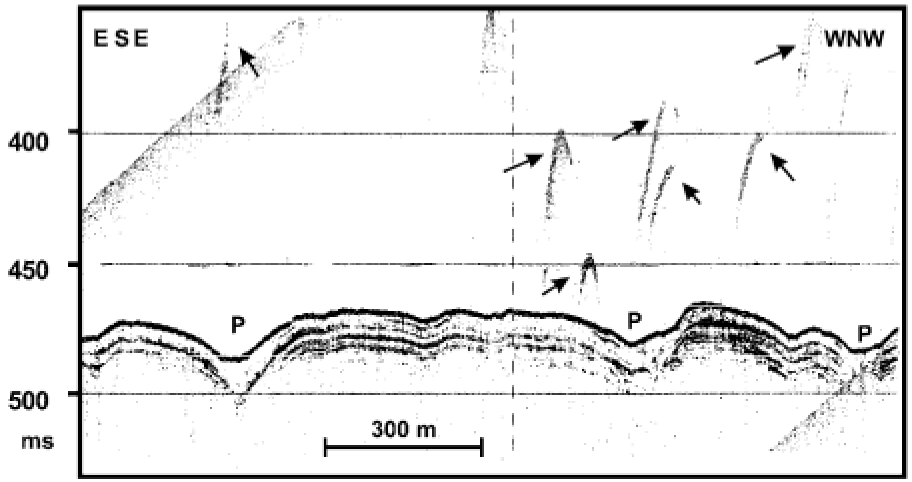
The pockmarks are both modern and ancient

These acoustic disturbances appear as diffractions mostly of high amplitude.



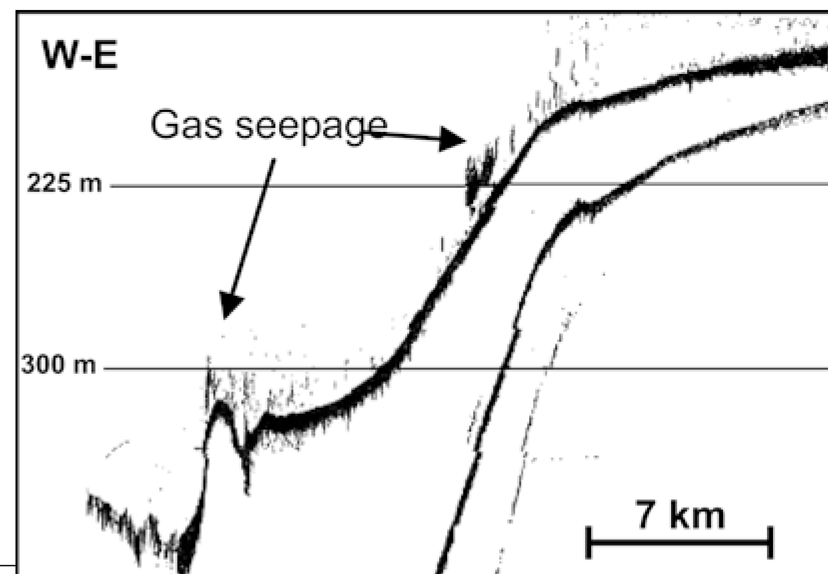


Gas seepage area

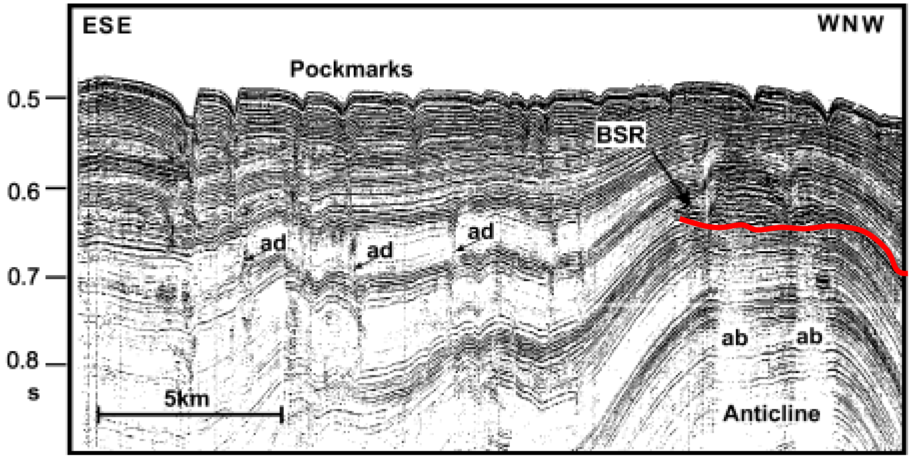


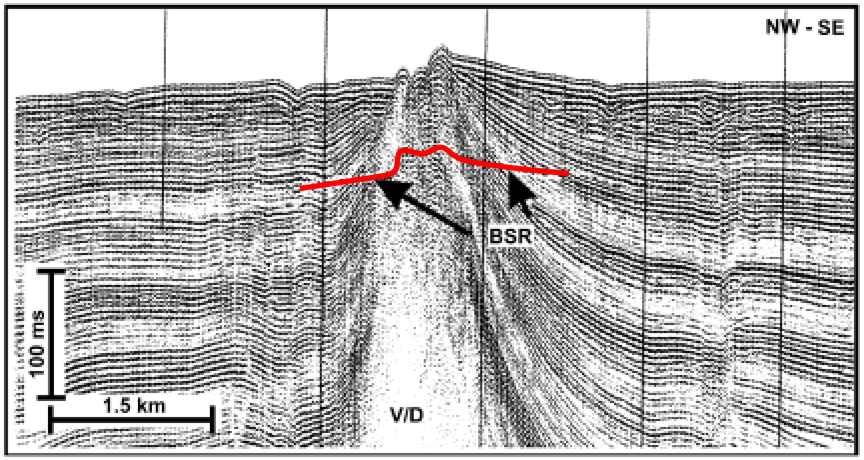
These plumes represent the actual seepage from the near-surface upper slope sediment

Similar features can be caused by the presence of fish shoals or concentrations of suspended sediment among other things



BSR-like reflections





1. A strong, discontinuous, high-amplitude reflection.

2. This reflector appears parallel to the seafloor surface.

3. The anomalous reflection shows a clear reverse polarity, compared to the seafloor reflection.

Discussion and Conclusion

- Diapiric rise is mainly quiescent and from the halted diapir masses possible degassing, shown by pockmark fields, is occurring.

- The gas-related features :seismic records include acoustic turbidity and blanking, bright spots, ancient and modern pockmarks, high amplitude diffractions, acoustic plumes and turbidity in the water column, and BSRs.

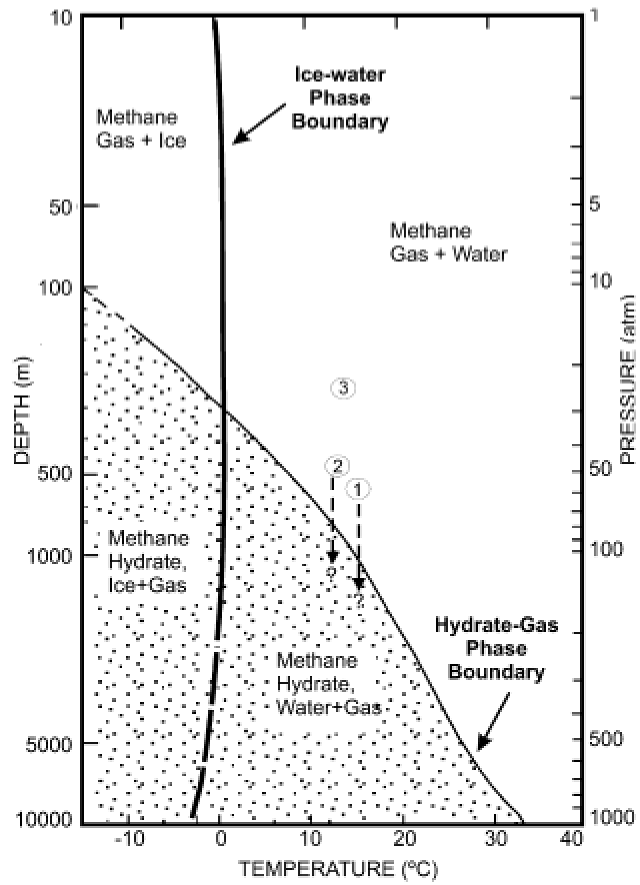
- The emission of gas to the water column occurs through permeability conduits (micro -fractures and - faults and interconnected pore paths) in the area of gas charged sediment, and through slump and pockmark development.

- This anomaly tends to occur in the vicinity of volcanoes/diapirs or immediately above anticline features formed as a result of diapir uplift.

Thanks for your attention

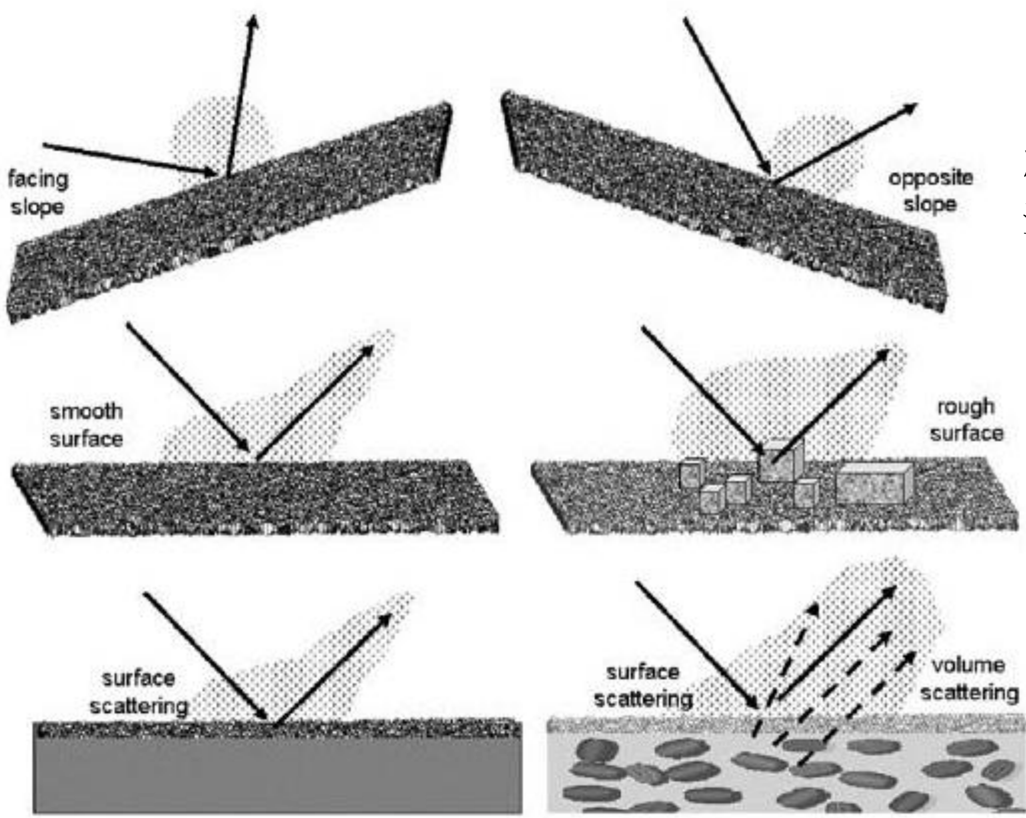
- “BSR” 主要有以下特徵:
- 一是具有與海底近於平行的強反射波，連續性較好
- 二是在局部地方(主要在地形坡度相對較大的地方)存在下覆沉積層與“ BSR”界面斜交現象
- 三是“BSR”界面與海底相比普遍存在反射極性反轉的現象。
- 四是“BSR”之上存在弱振幅或振幅空白帶。

- ①當氣體水合物帶之下有游離氣存在時，BSR往往可準確揭示氣體水合物藏的存在，反之若氣體水合物帶之下沒有游離氣，一般沒有BSR出現
- ②如果有BSR反射層的存在，可能是由於在地球物理處理中多種因素造成的反射假象



Ice-water Phase Boundary
Methane Gas + Ice
Methane Gas + Water
Methane Hydrate, Ice+Gas
Methane Hydrate, Water+Gas
Hydrate-Gas Phase Boundary
DEPTH (m)
PRESSURE (atm)
TEMPERATURE (ºC)

- 回散射:會向各方向發射,被測掃聲納接收.
- 主要因素:
- 1.聲波的入射角與大尺度的海床坡度,當海床面面向儀器時,所接收到的會較多
- 2.海床面細微的起伏程度,越平滑的海床面會使得散射當像遠離儀器
- 3.海床面的組成,密度,材質



聲波的入射角與大尺度的
海床坡度

海床面細微的起伏程度

海床面的組成

(The handbook of sidescan sonar , Blondel , Springer,2009)

- 振幅透明帶:位在BSR上方,是由於孔隙中出現水合物,充當膠結作用並減少地層間速度和密度的差異,使特定的沉積剖面的反射衰減