

Characteristics of Marine Shallow Gas in the Korean Seas: Implications of Marine Geo-hazards and Environments

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What is gas?

	Classification	
Natural Gas	Conventional Gas	<ul style="list-style-type: none">- Found in gas reservoirs- Currently used most gas
	Nonconventional Gas	<ul style="list-style-type: none">- Water dissolved gas- Coalbed methane- Tight reservoir gas: <0.1 md- Gas hydrate- Shale gas- <i>Shallow gas</i>

What is shallow gas?

- ☐ Methane (CH_4) from the biodegradation of organic matter (biogenic) in near surface sediments, or emitted by and migrated from deeper sources (thermogenic)
- ☐ Generally,
 - Water depth: <1000 m
 - Subbottom depth: <200 m (<50 m typical)
- ☐ Bay, Estuary, Delta, Shelf, Upper Slope, Basin, etc.



Importance of shallow gas

1. Dramatic effect on geoacoustic properties of the seabed
2. Significant effect on sediment's geotechnical characteristics
3. Geo-hazard
4. Important green-house gas for global warming
5. Biochemical effect on marine ecosystem
6. Future energy resource?





Environmental Issues

Under provisions of UNCLOS*, and other international law, every country has an obligation to protect the marine environment *(Part XII : Article 192 to 237) :*

- to "*protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species, and other forms of marine life*" *(Article 194).*

*UN Convention on the Law of the Sea



Reason to study shallow gas

1. Green-house gas for global warming
 - one of important green-house gas
 - 4 times greater than CO₂
 - 12% of total green-house gas
2. Geo-hazard
 - triggering slope failure, collapsing coastal structures
 - disturbing and destruction ecosystem
3. Effect on the Korean Seas
 - a lot of structures in coastal region
 - coastal farming, seaway
 - narrow shelf and steep slopes developed in the east
 - flat and wide tidal region and shelf developed in the south and west.



Origin of Free Gas in Marine Sediments

Biogenic

Bacterial reduction, in-situ

Thermogenic

Thermal reduction, migrated

Hydrothermal/Igneous/Volcanic

Non-sedimentary source

% of Occurrences

Biogenic

41

Biogenic + minor/possible Thermogenic

24

Biogenic and Thermogenic

20

Thermogenic

10

Hydrothermal/Igneous

2.5

Unclear

2.5





Evidence of Free Gas in Marine Sediments

Subbottom Profiling (Seismo-Acoustic)

- Acoustic turbidity
- Enhanced reflectors
- Acoustic blanking
- Wipeouts
- Voids

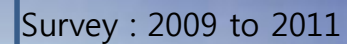
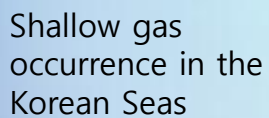
Visual, Imaging

- Diver, Video (Bubbles)
- Side-scan sonar (pockmarks, reefs, bubbles)

Sediment Sampling

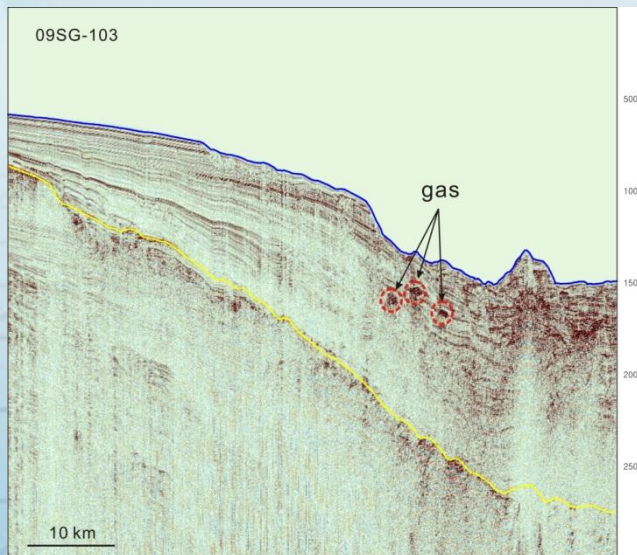
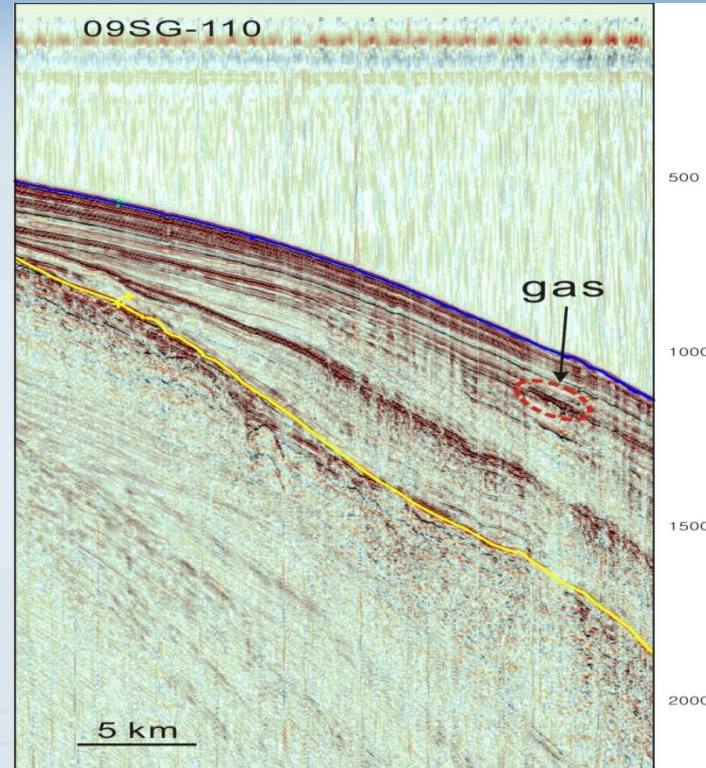
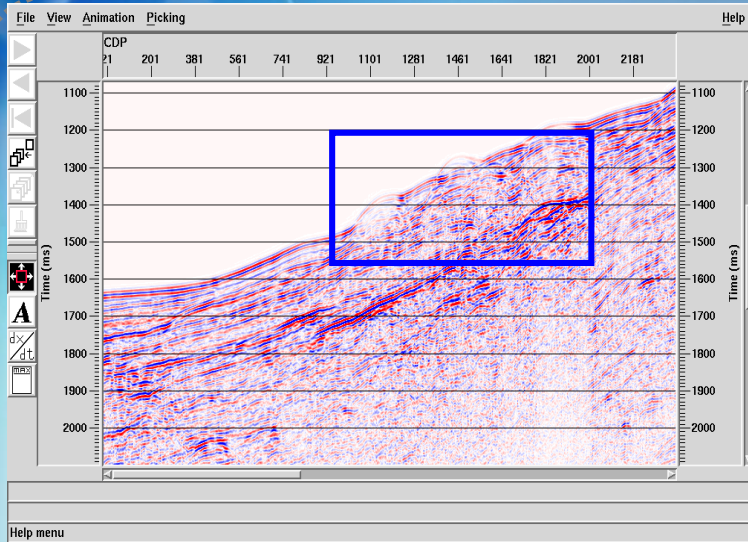
- Degassing, bubbles
- Headspace analysis
- Computer tomographic (CT) scans under in-situ pressure





Results

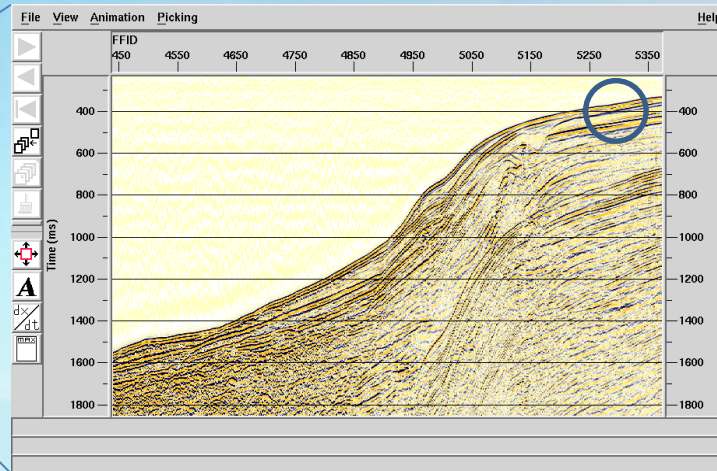
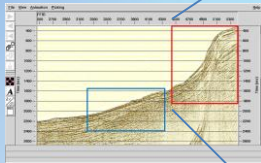
Multi-channel seismic characteristics of shallow gas



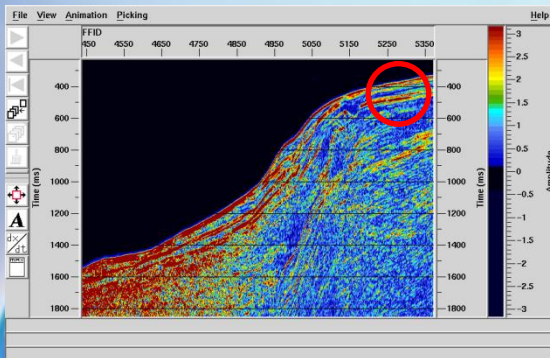
Seismic characteristics of shallow gas

Results

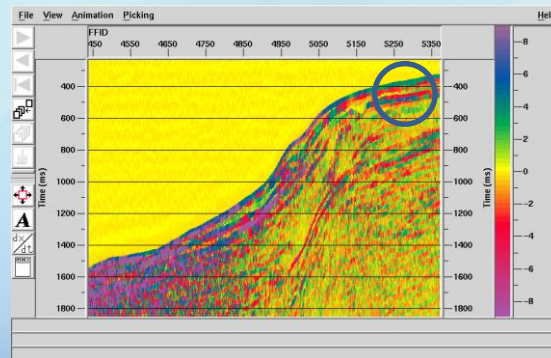
● Stack section



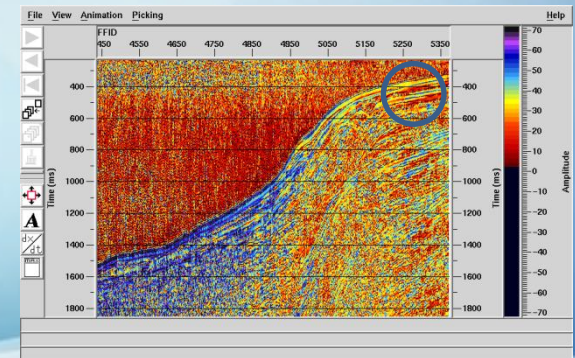
● results of complex analysis



Reflection Strength



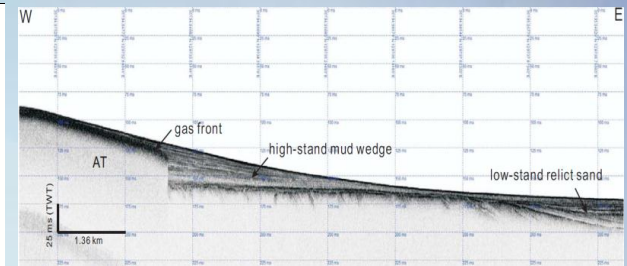
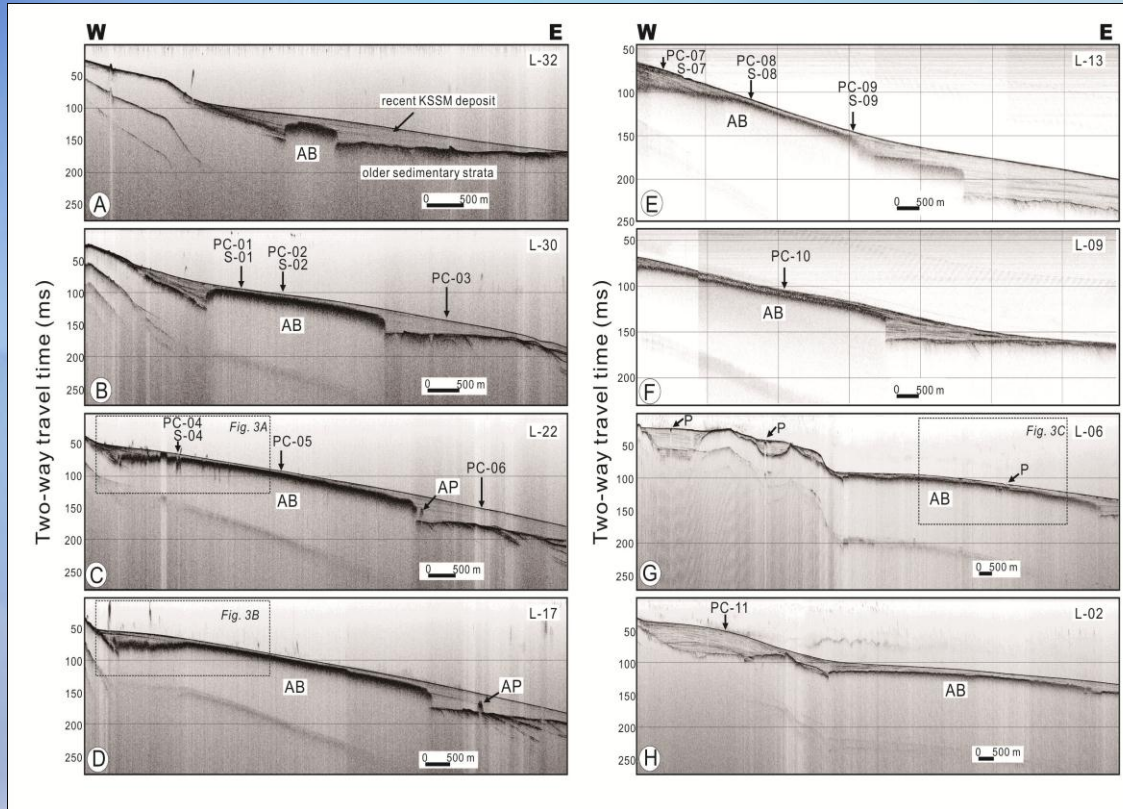
Apparent Polarity



Instantaneous Frequency

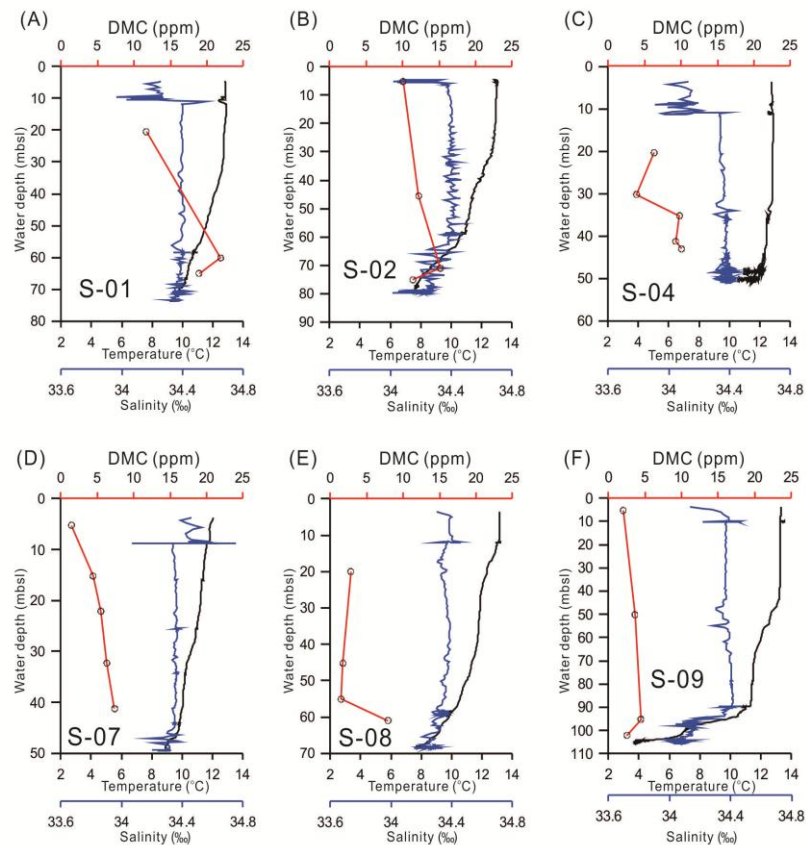
Shallow seismic characteristics of shallow gas

Results



- Wedge type muddy sediments have been developed since high stand (Holocene)
- Sandy sediments in low stand , offshore side

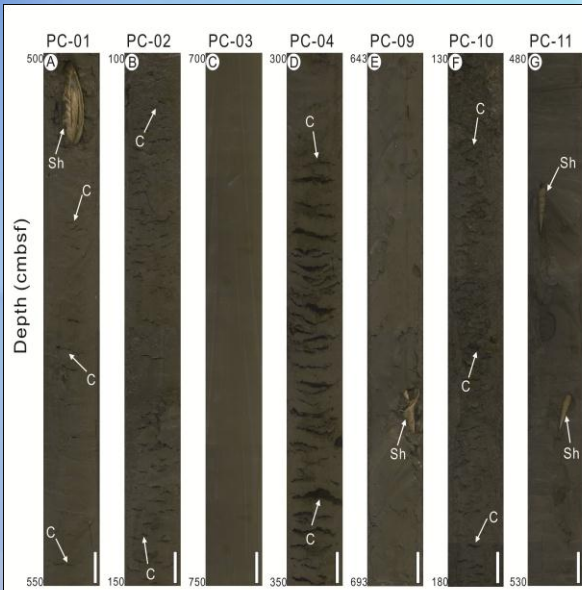
Shallow gas deposits (AB)
: decrease northward



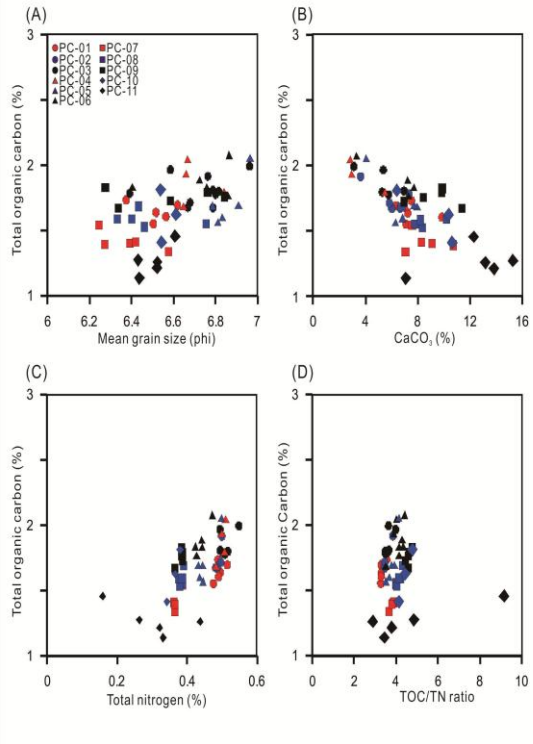
- Sea water : > 5 ppm
- South < North
- Lower > Upper

Physical properties of gassy sediments

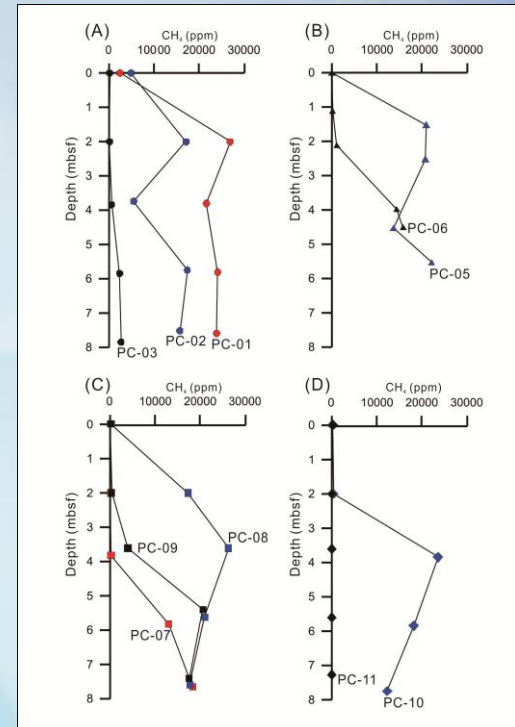
Results



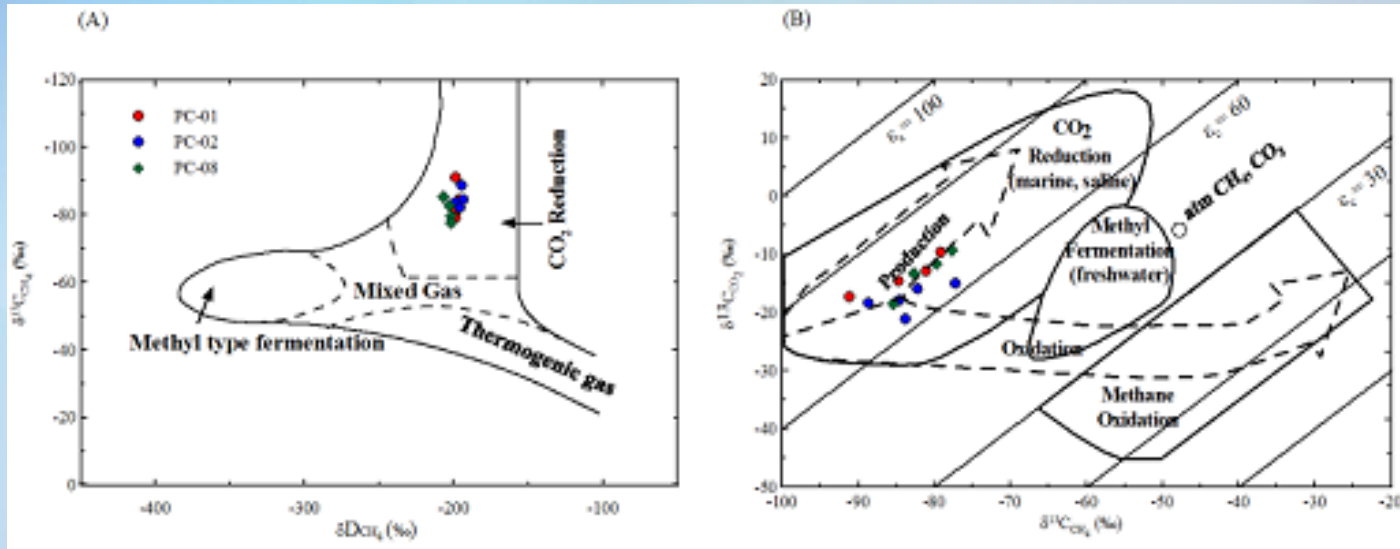
- Cracks(C) in AB deposits



- Relative high in total organic carbon & low in calcium carbonate
- TOC/TN : 2-6
- marine origin



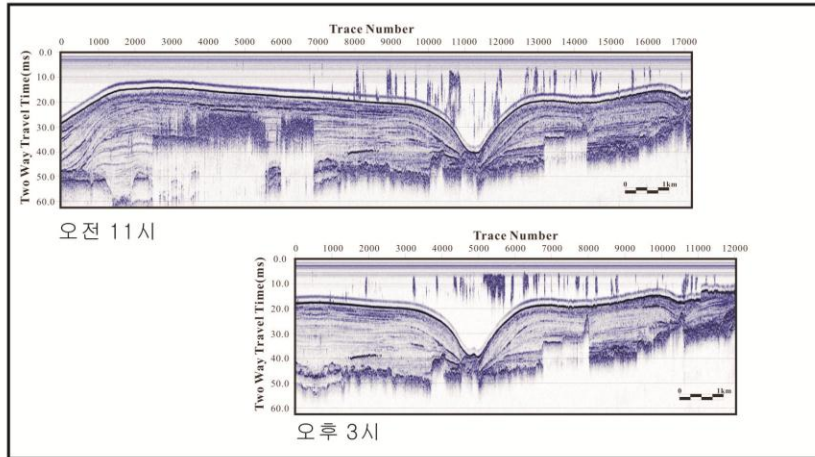
- high CH_4 in head space gas
- close relation between CH_4 peak & AB depth



C & H isotopes represent biogenic methane

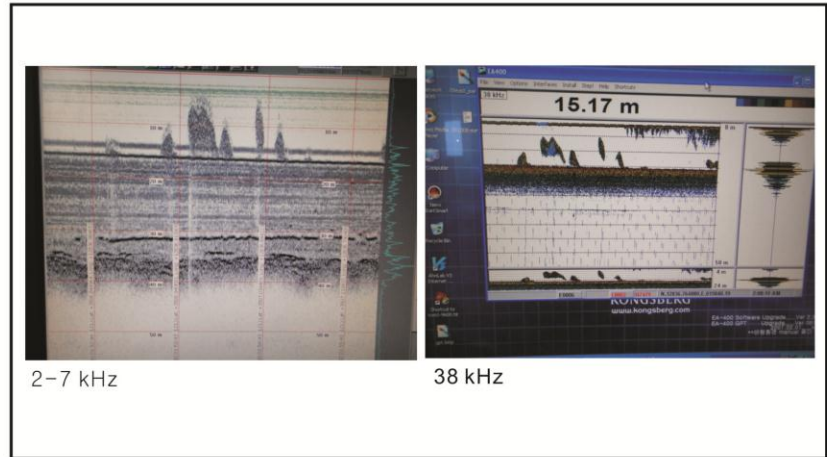


동일지역의 관측 시간 차이에 의한 변화



different observation time

동일시간의 주파수 차이에 의한 변화

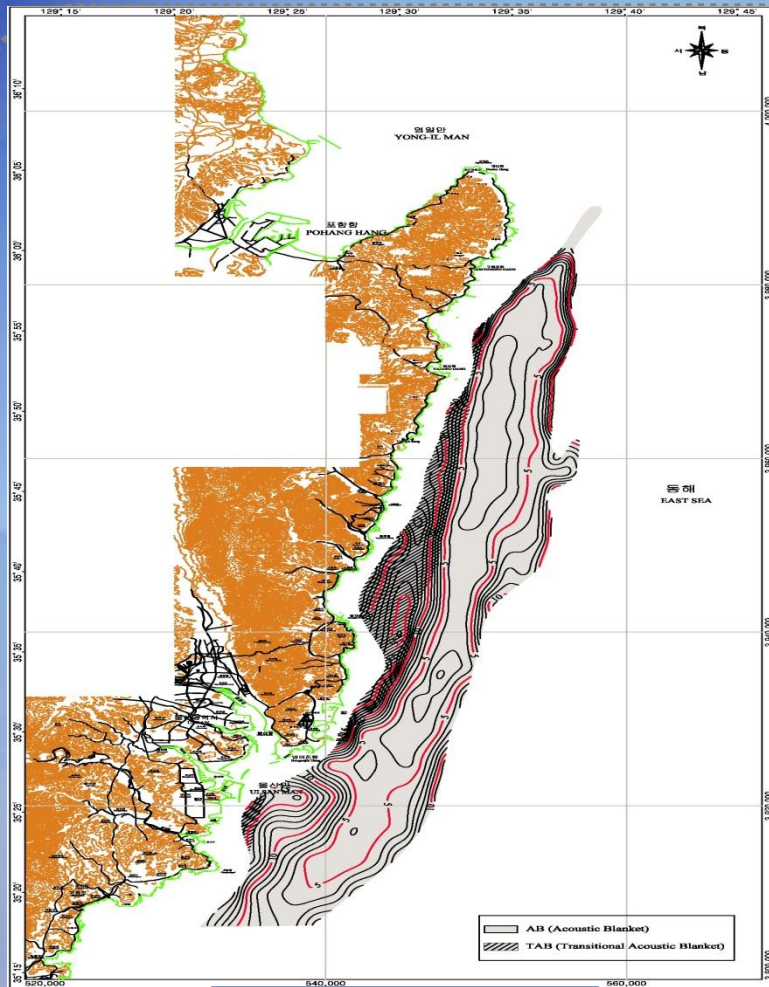


different frequencies

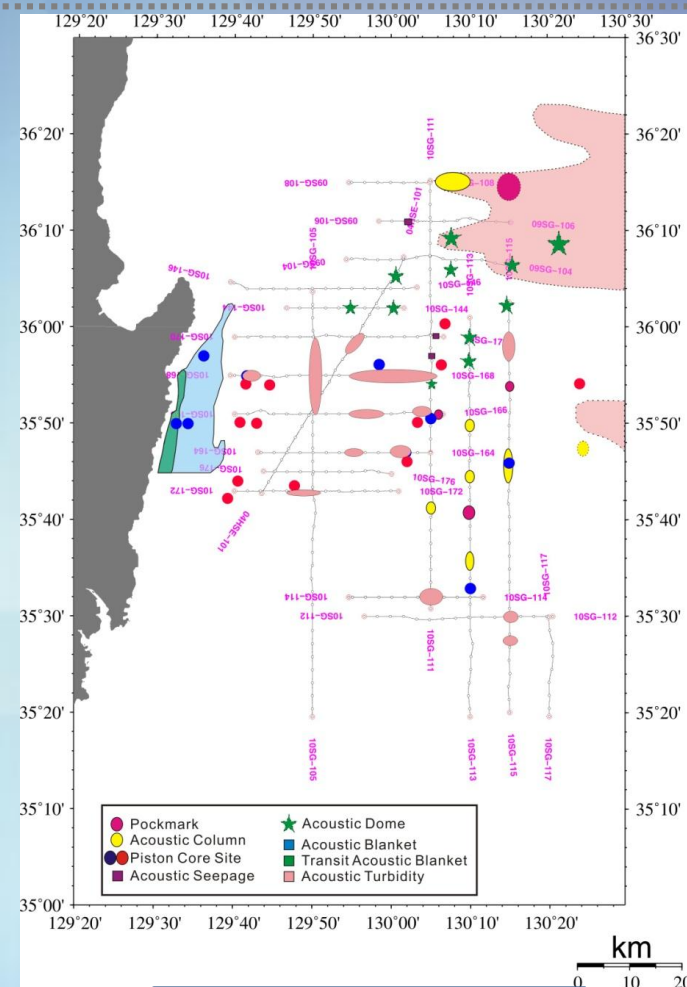


Distribution of shallow gas

Results



- Acoustic blanket area
 - water depth : 50-150 m
 - width : av. 3 km
 - thickness : 20-40 m
 - length : > 90 km



- AC : lower slope
- AT : upper & lower slope
- Pockmark : lower slope
- Acoustic Dome : little
- AB/TAB : coastal zone

Summary / Conclusion

- I. Environmental significance of gassy sediments is getting apparent. It affects on offshore operations and infrastructure. Thus, it changes geo-hazard stability.
- II. It causes atmospheric and climate changes as the one of the most effective green-house gas.
- III. It changes ecosystem affecting habitats, food web, and aquaculture.
- IV. Shallow gas around Korean Seas usually distributes along the coastal region and its shape is acoustic blanket.
- V. The dimension of the gassy sediments : 50~150 m in depth, av. 3 km wide, 20 ~ 40 m thick, and > 90 km in length.
- VI. It may be possible as a future energy.





감사합니다

THANK

YOU