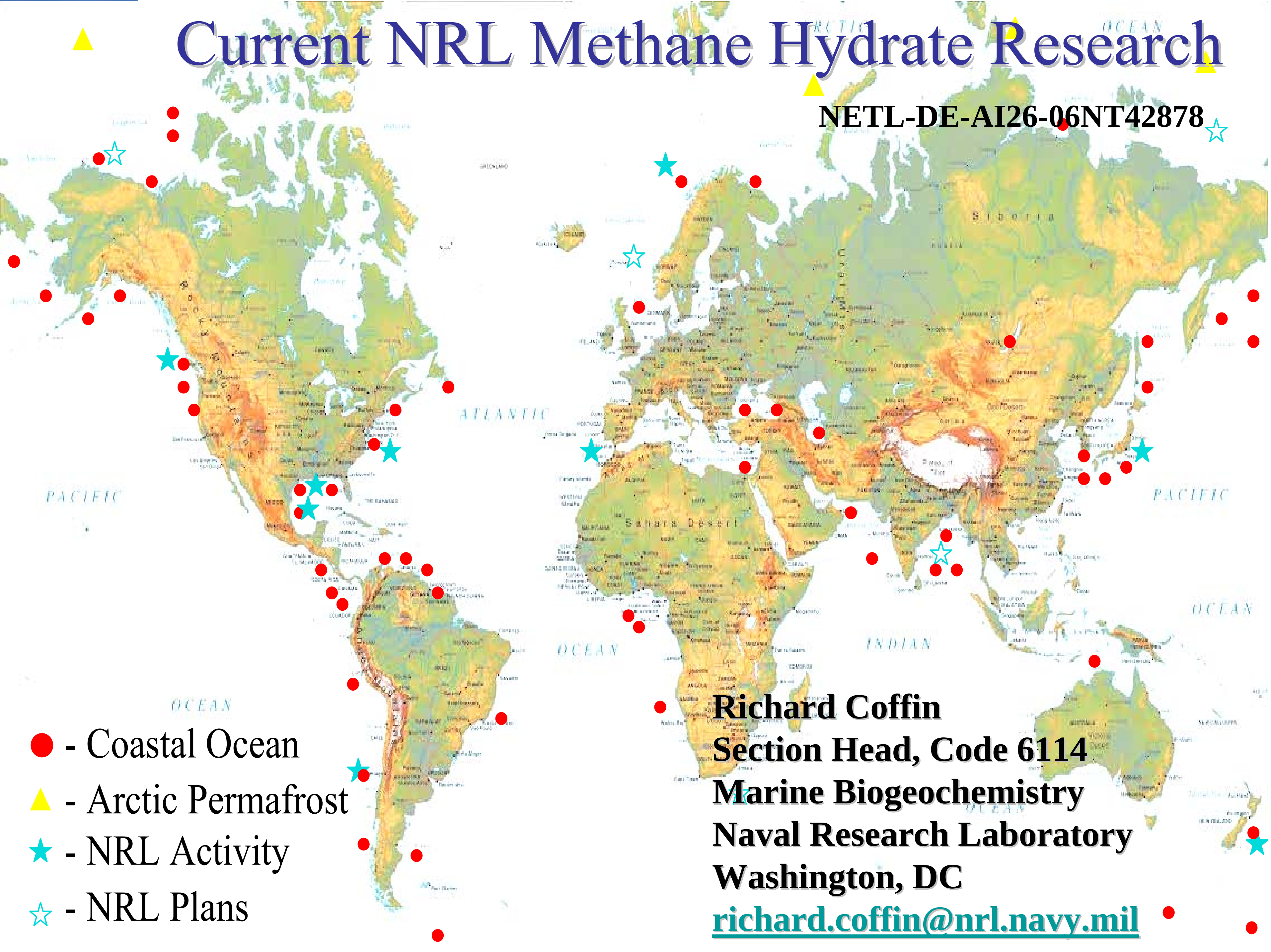
Current NRL Methane Hydrate Research

NETL-DE-AI26-06NT42878



● - Coastal Ocean

▲ - Arctic Permafrost

★ - NRL Activity

☆ - NRL Plans

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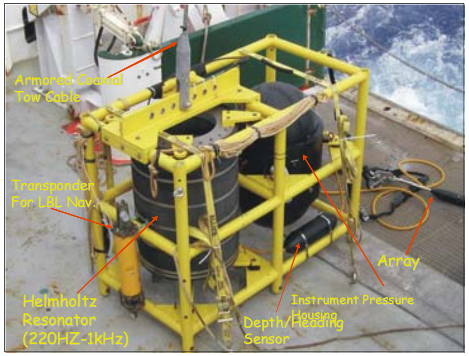
Presentation Outline

- Brief Overview
- Alaminos Canyon
- Hikurangi Margin
- Mid Chilean Margin
- Arctic Ocean planning

General Overview



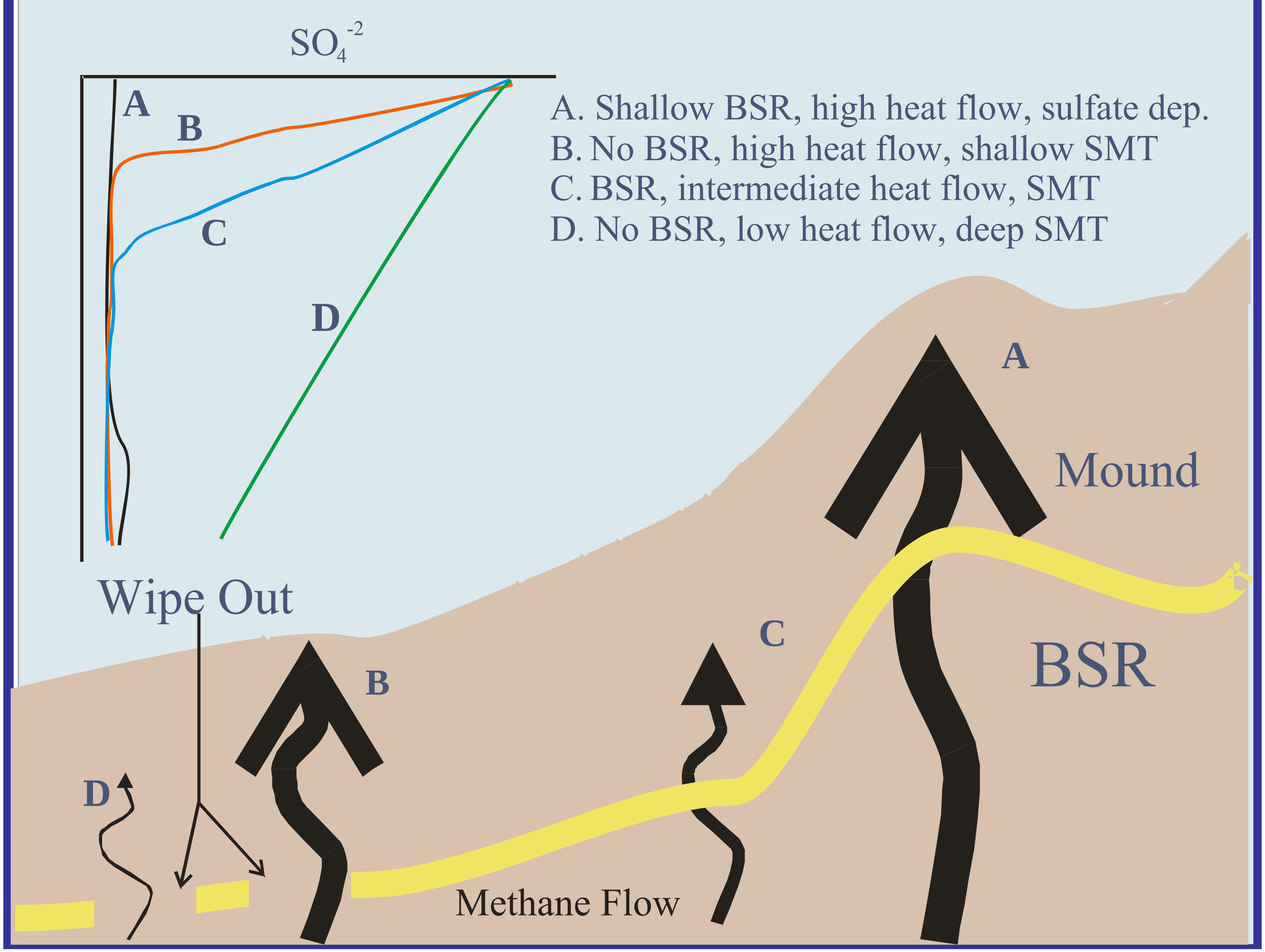
Seismic profiles – BSR and seismic wipe out

Piston coring – Porewater geochemistry, shallow sediment carbon cycling and porewater geochemistry and microbial ecology, community diversity, carbon flux to water column, stable and radio carbon, other elements

Heat flow – Vertical fluid migration

Vertical Methane Flux

$CH_4 + SO_4^{2-} \rightarrow HCO^{3-} + HS^{-} + H_2O$



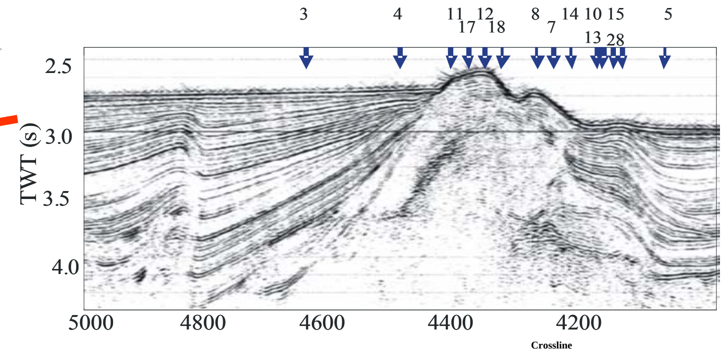
General Research Objectives

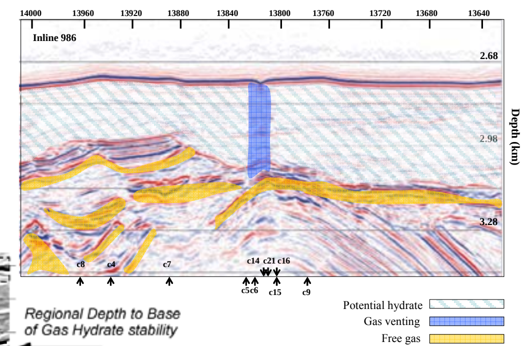
- Determine porewater gas source(s).
- Estimate the vertical methane flux in terms of the sulfate-methane transition (SMT) and sulfate gradients.
- Provide supporting data on vertical methane flux with comparison of chloride, sulfide, dissolved inorganic carbon (DIC), and $\delta^{13}C$ DIC analysis of porewater.
- Integrate data interpretation with seismic, heat flow and geochemical data.
- Study the shallow biogeochemical cycling of deep sediment methane.
- Relate the vertical methane flux to horizontal and vertical variation in the microbial community diversity.
- Characterize methane seeps into the water column.

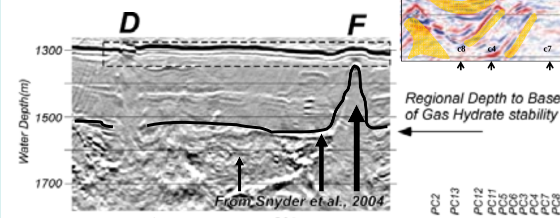
US Naval Research Laboratory
Marine Biogeochemistry

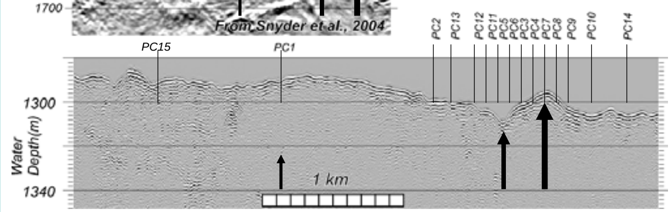
Coastal SMI Summary

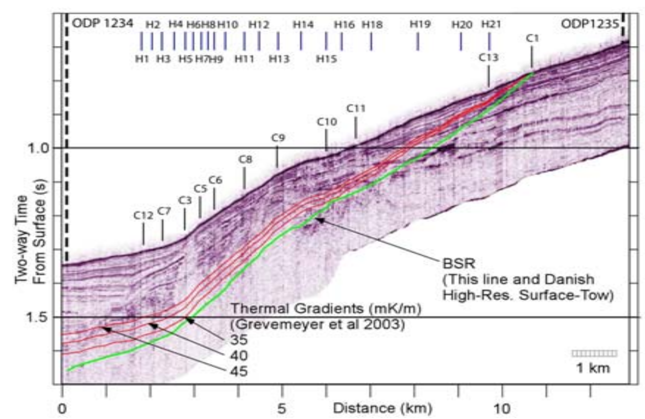
Chile Core	Chile SMT (cm)	New Zealand Core	New Zealand SMT (cm)	Atwater Valley Core	Atwater Valley SMT (cm)	Alaminos Can. Core	Alaminos Can. SMT (cm)
1	555	*2*	*3950*	1	288	1	633
13	733	3	1290	2	410	4	920
11	33.3	4	443	3	no SMI	5	800
10	189	11	309	4	no SMI	6	308
9	246	17	184	5	224	7	761
8	275	12	no SMI	6	45	8	949
6	235	18	806	7	no SMI	9	1550
5	248	8	357	8	59	10	469
2	212	7	211	9	291	11	621
3	194	14	381	10	385	12	672
7	292	10	87	11	246	13	995
12	266	13	268	12	317	14	642
14	*1011*	28	323	13	260	15	1793
		15	443	14	504	16	1242
		5	364	15	215	17	1628
						18	679
						19	828
						20	1107
						21	607
						22	589
	345		628		216		890





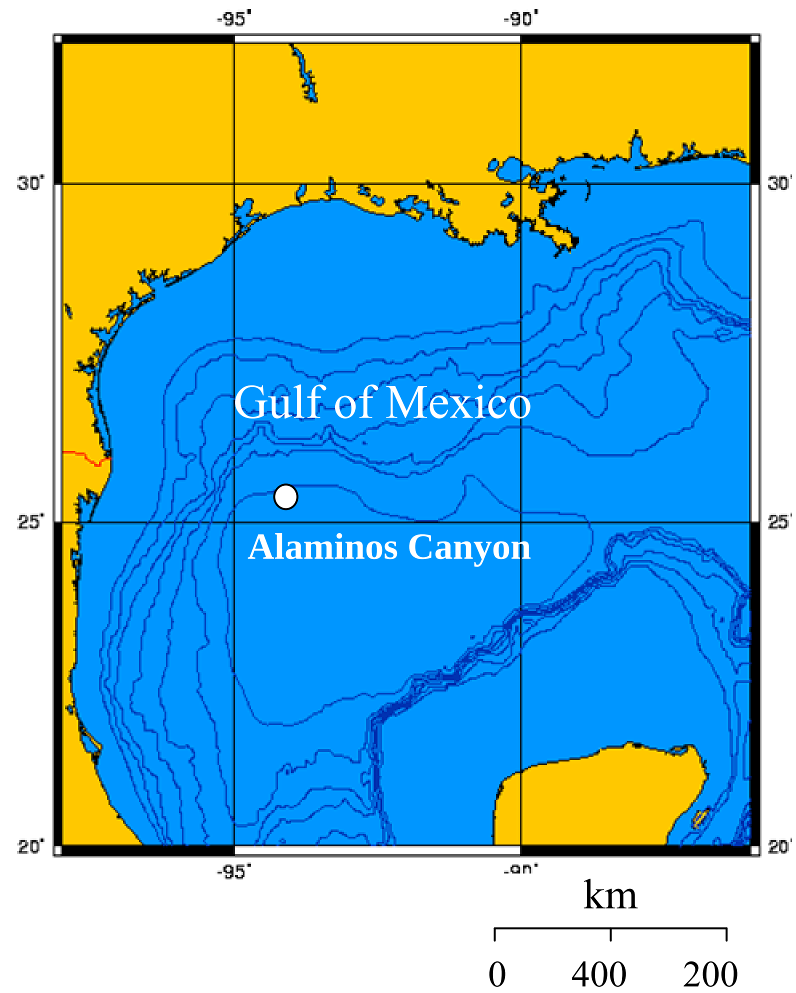






Alaminos Canyon, Block 818

Lead Scientists:
Richard Coffin, NRL
Leila Hamdan, NRL
Kelly Rose, NETL
Ross Downer, Milbar Hydrotest Inc.
Joan Gardner, NRL
Rick Hagen, NRL
Warren Wood, NRL



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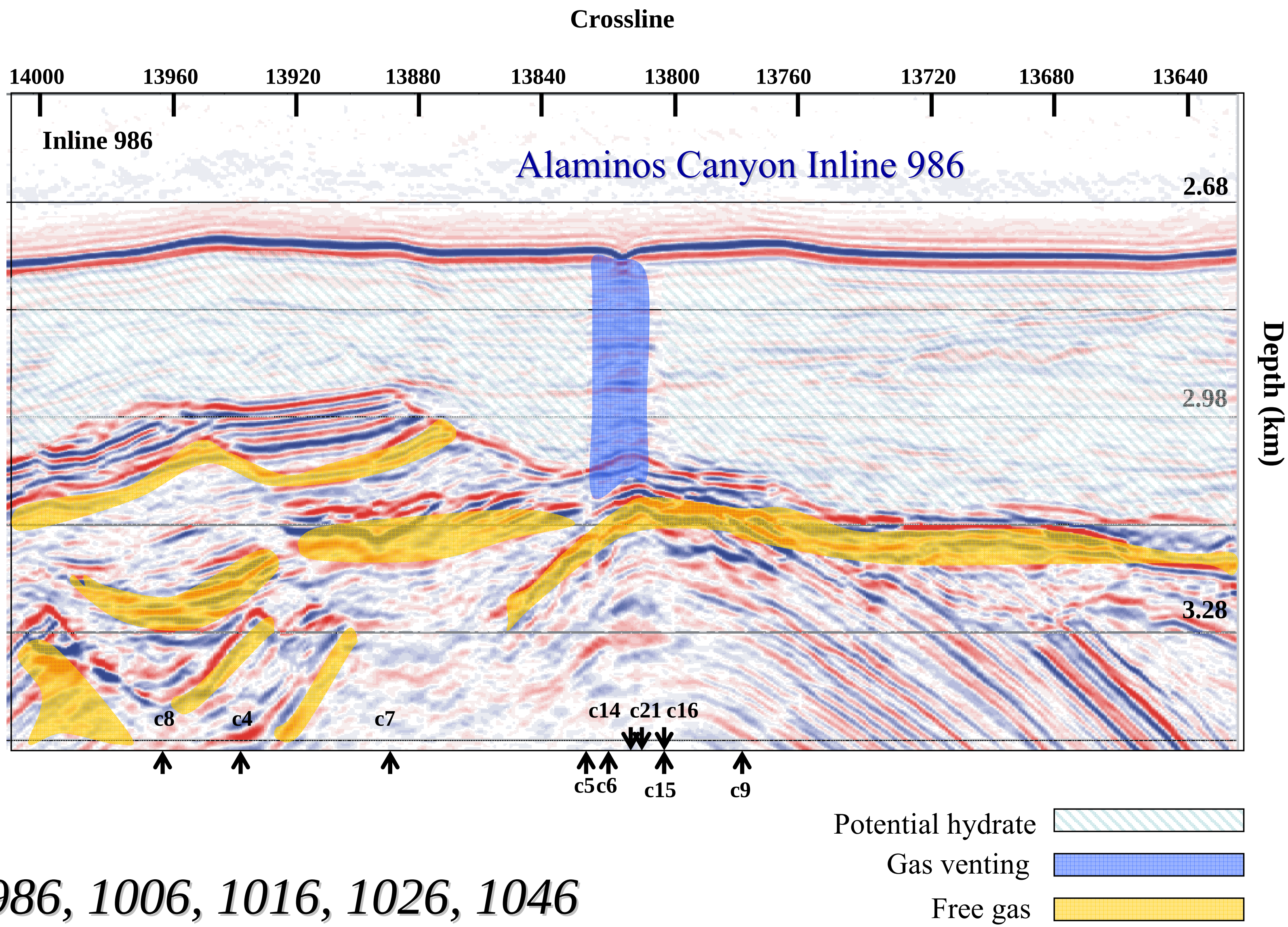
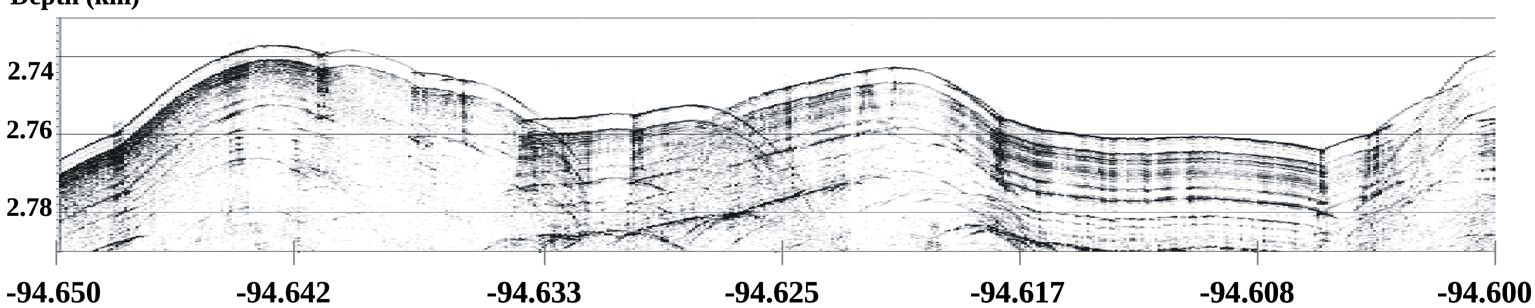
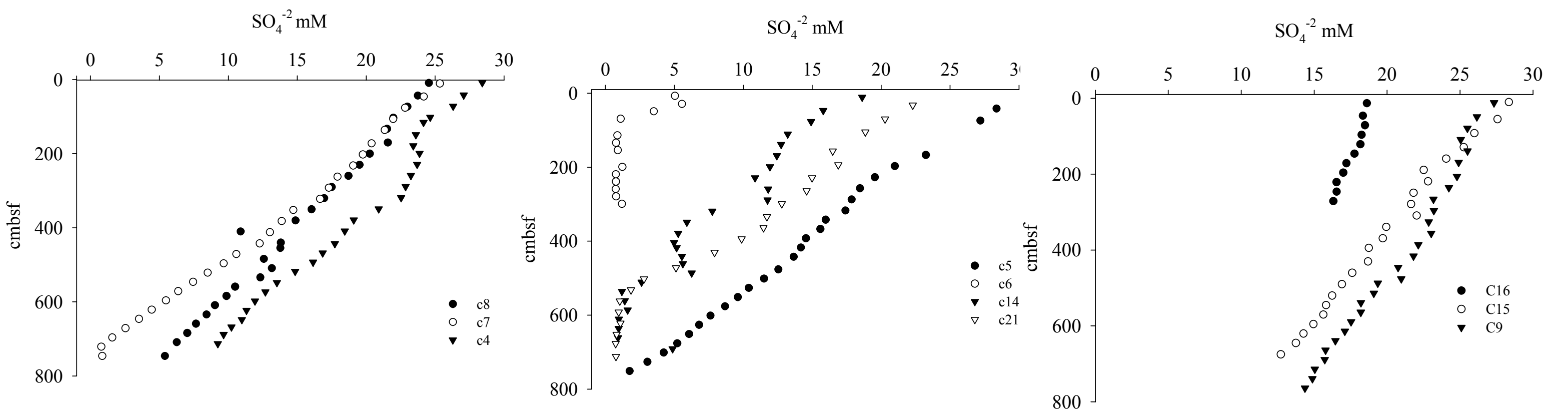
Seismic Profile Review

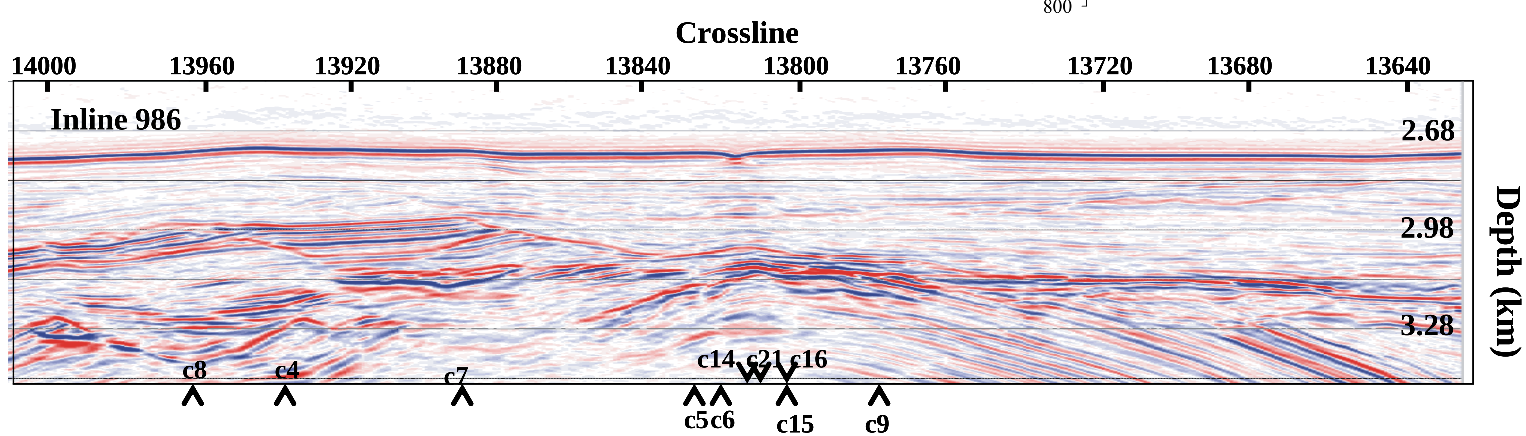


Inlines 986, 1006, 1016, 1026, 1046

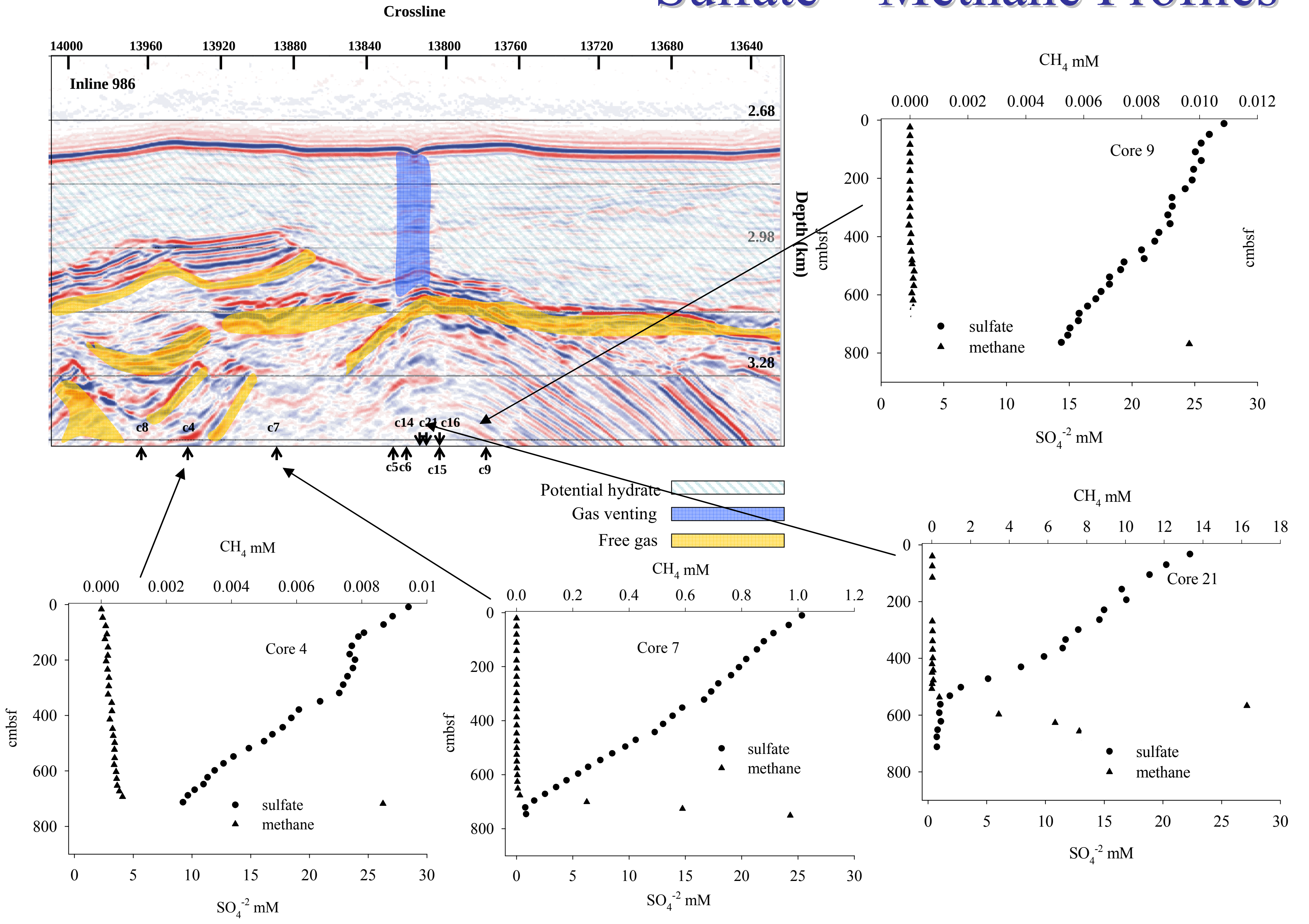
Geochemical – Seismic Overview



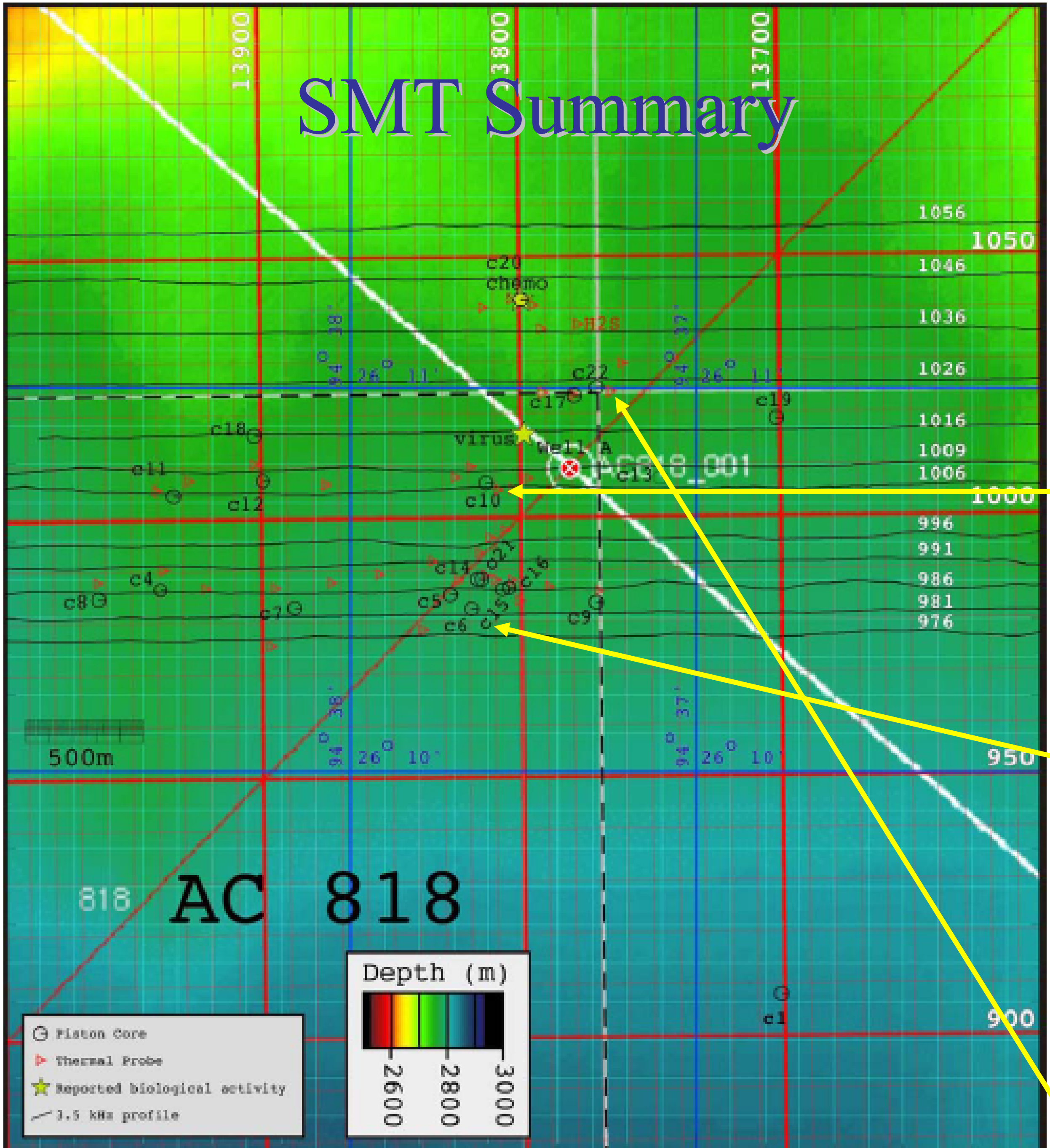




Sulfate – Methane Profiles

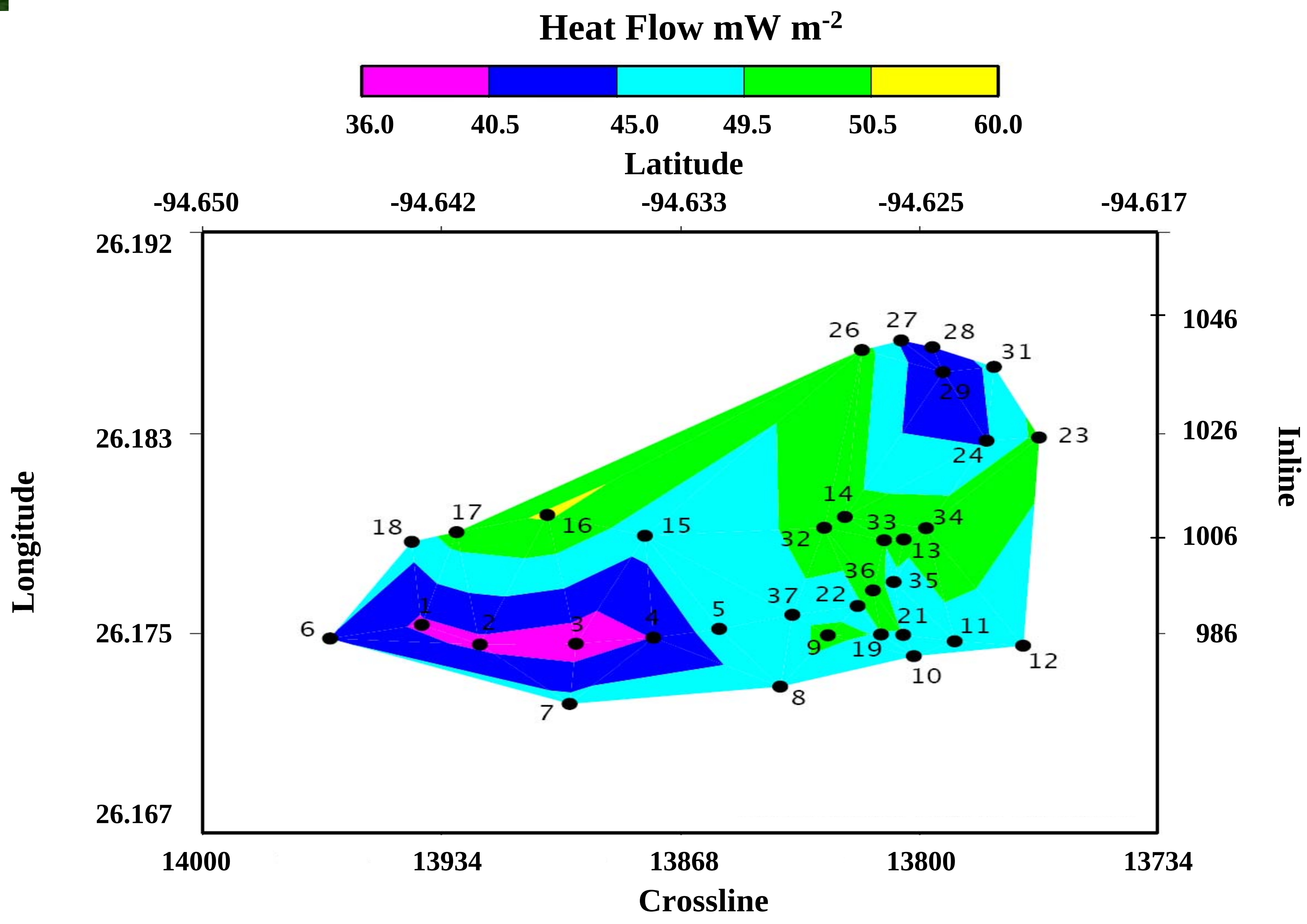


SMT Summary

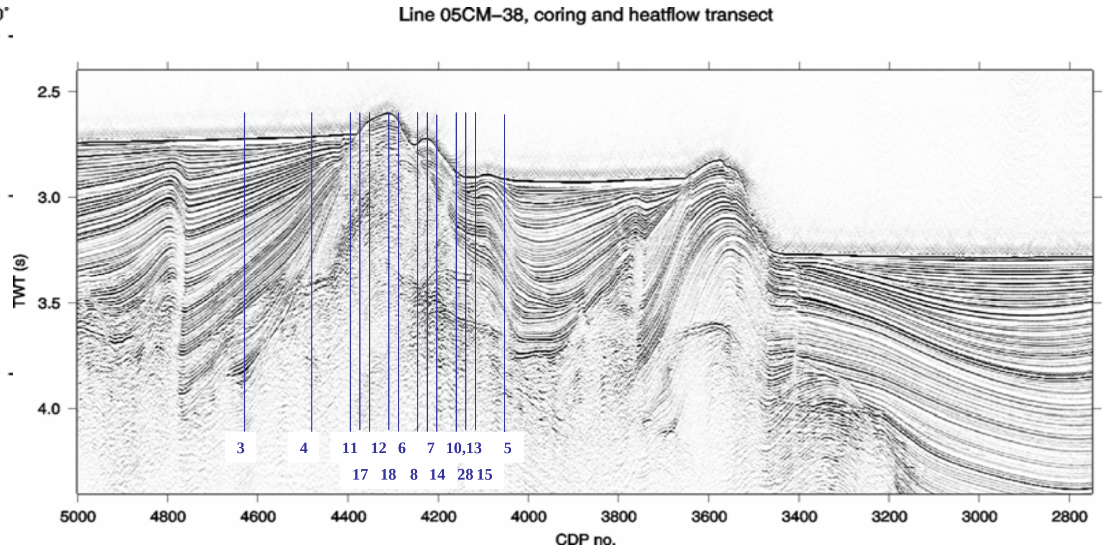


Core	SMT (cm)	R^2
C1	633	0.899
C4	920	0.981
C5	800	0.98
C6	***308***	***0.805***
C7	761	0.993
C8	949	0.973
C9	1550	0.972
C10	469	0.952
C11	621	0.992
C12	672	0.981
C13	995	0.996
C14	642	0.903
C15	1793	0.94
C16	1242	0.989
C17	1628	0.992
C18	679	0.994
C19	828	0.997
C20	1107	0.995
C21	607	0.971
C22	589	0.936

Alaminos Canyon Heatflow

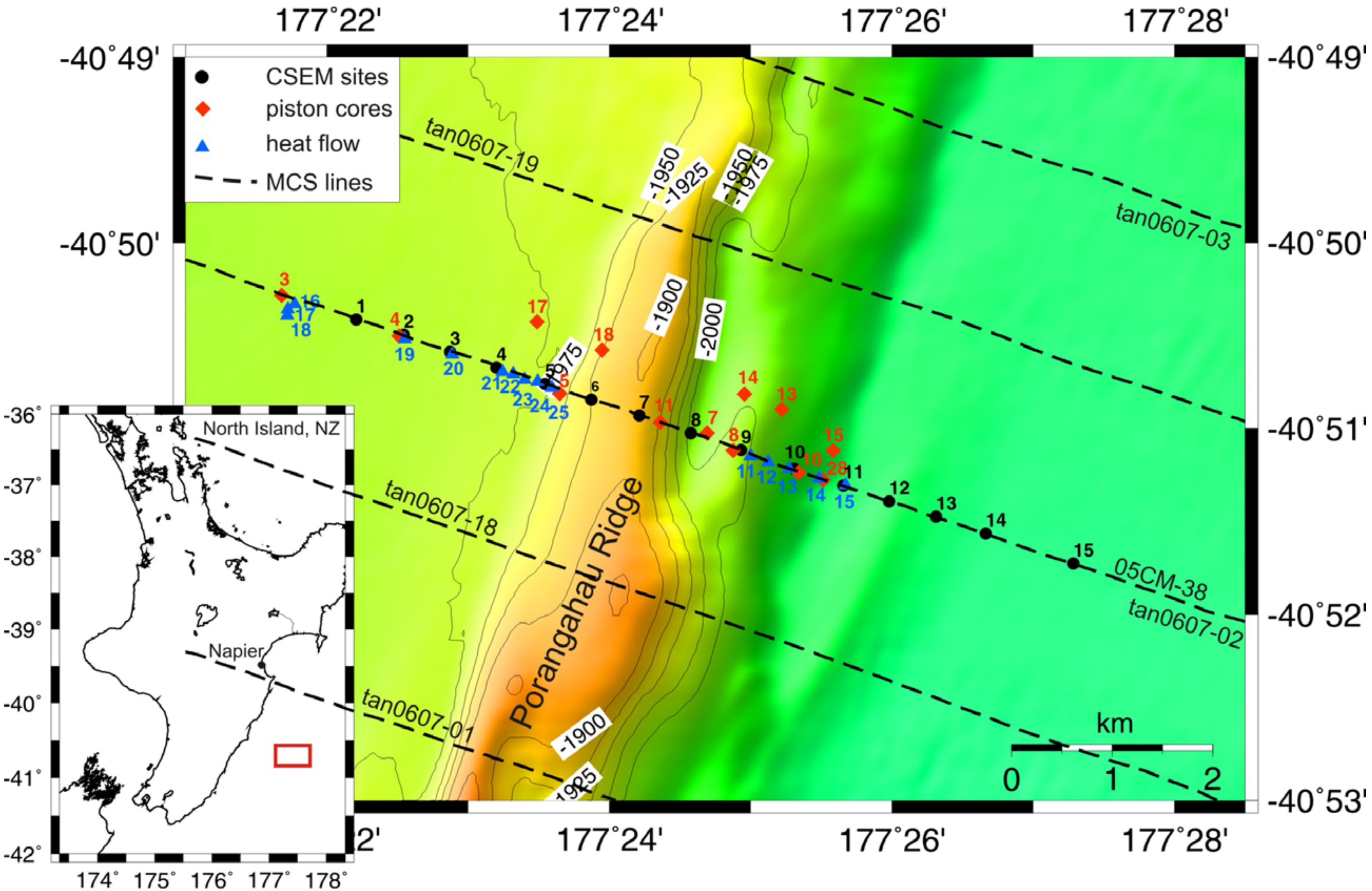


Poranghau Ridge, Hikurangi Margin New Zealand

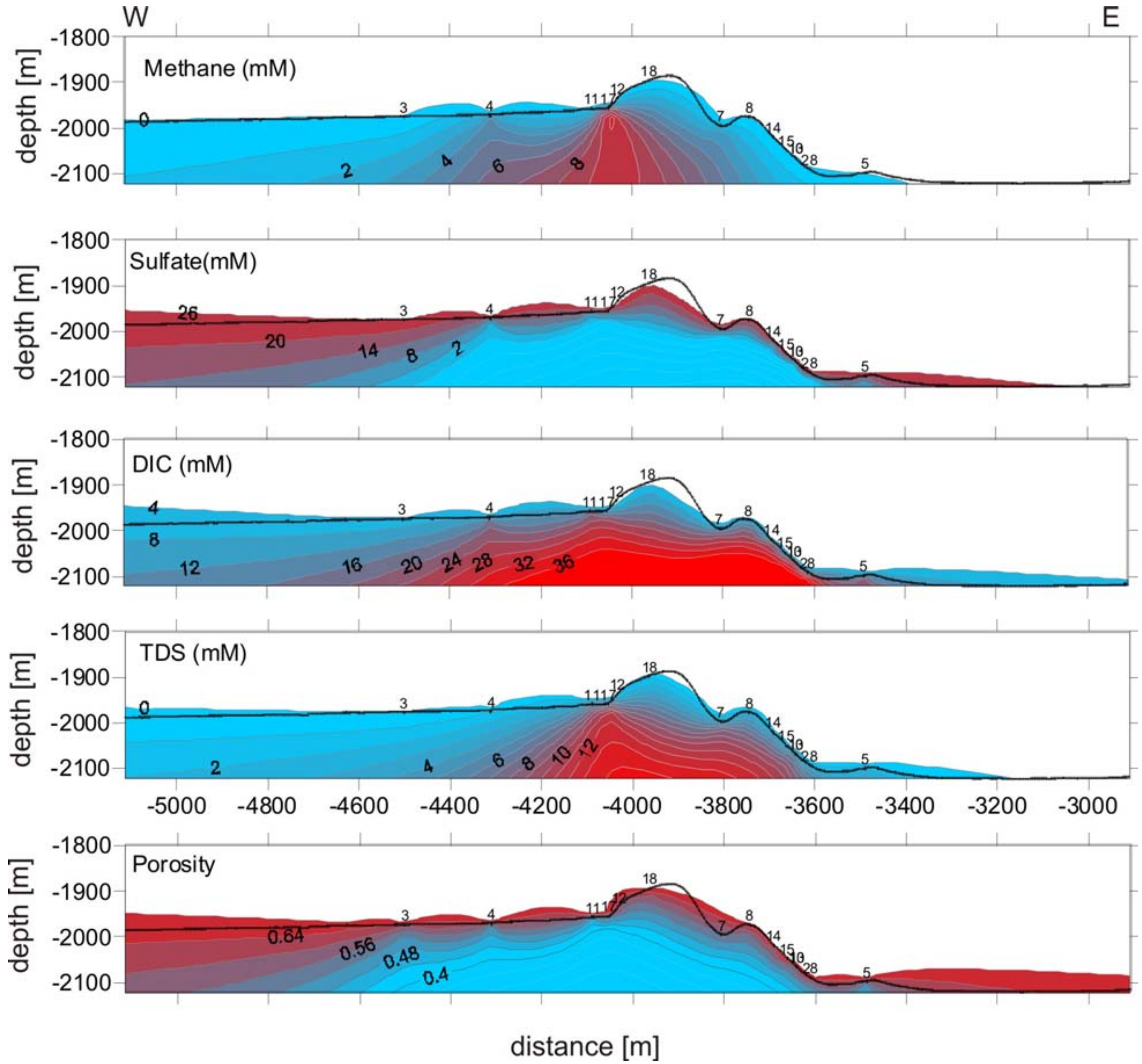


Richard Coffin, Leila Hamdan, John Pohlman, NRL, DC
Warren Wood, NRL Stennis
Ingo Pecher, Stuart Henrys and Jens Greinert, GNS, NZ
Andrew Gorman, University of Otago, NZ

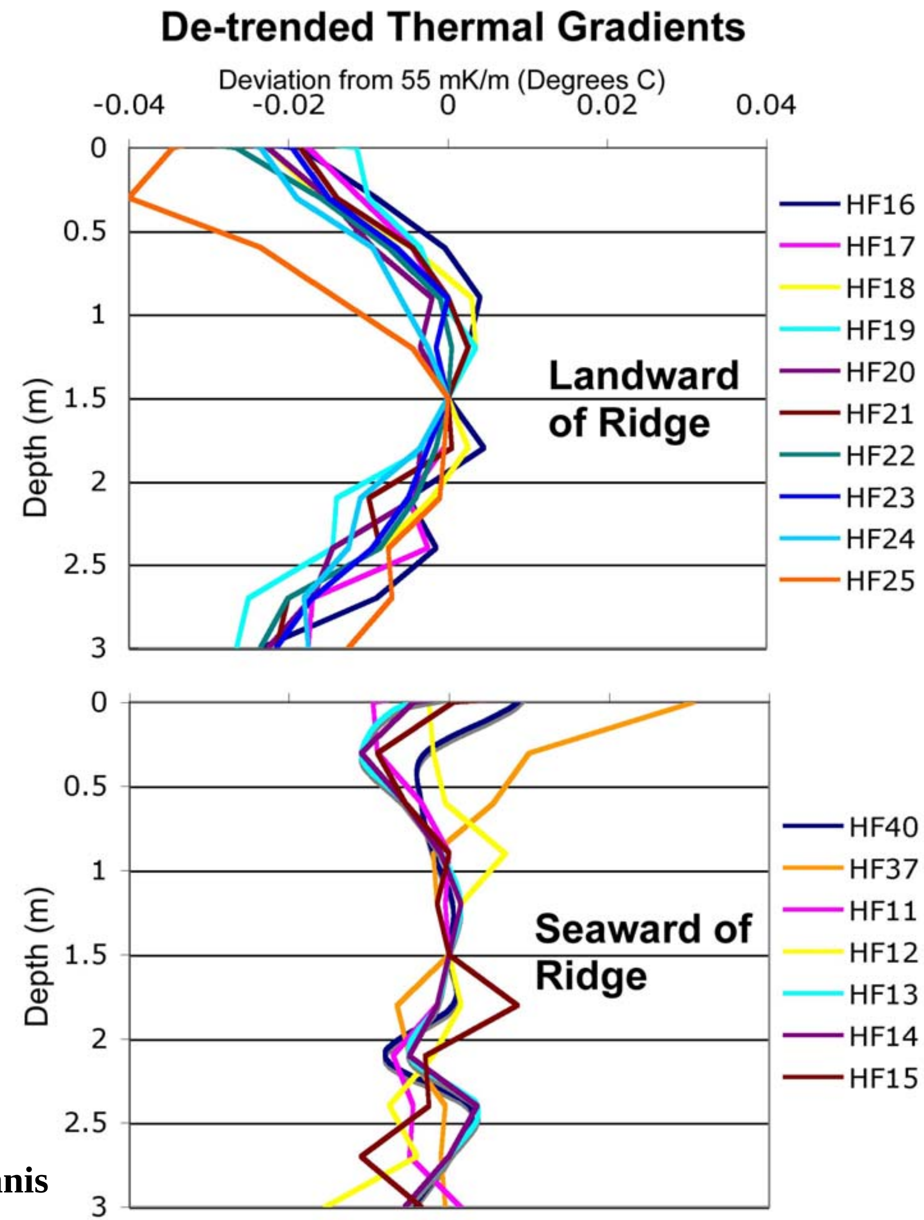
Porangahau Ridge Transect



Porewater Geochemical Profiles

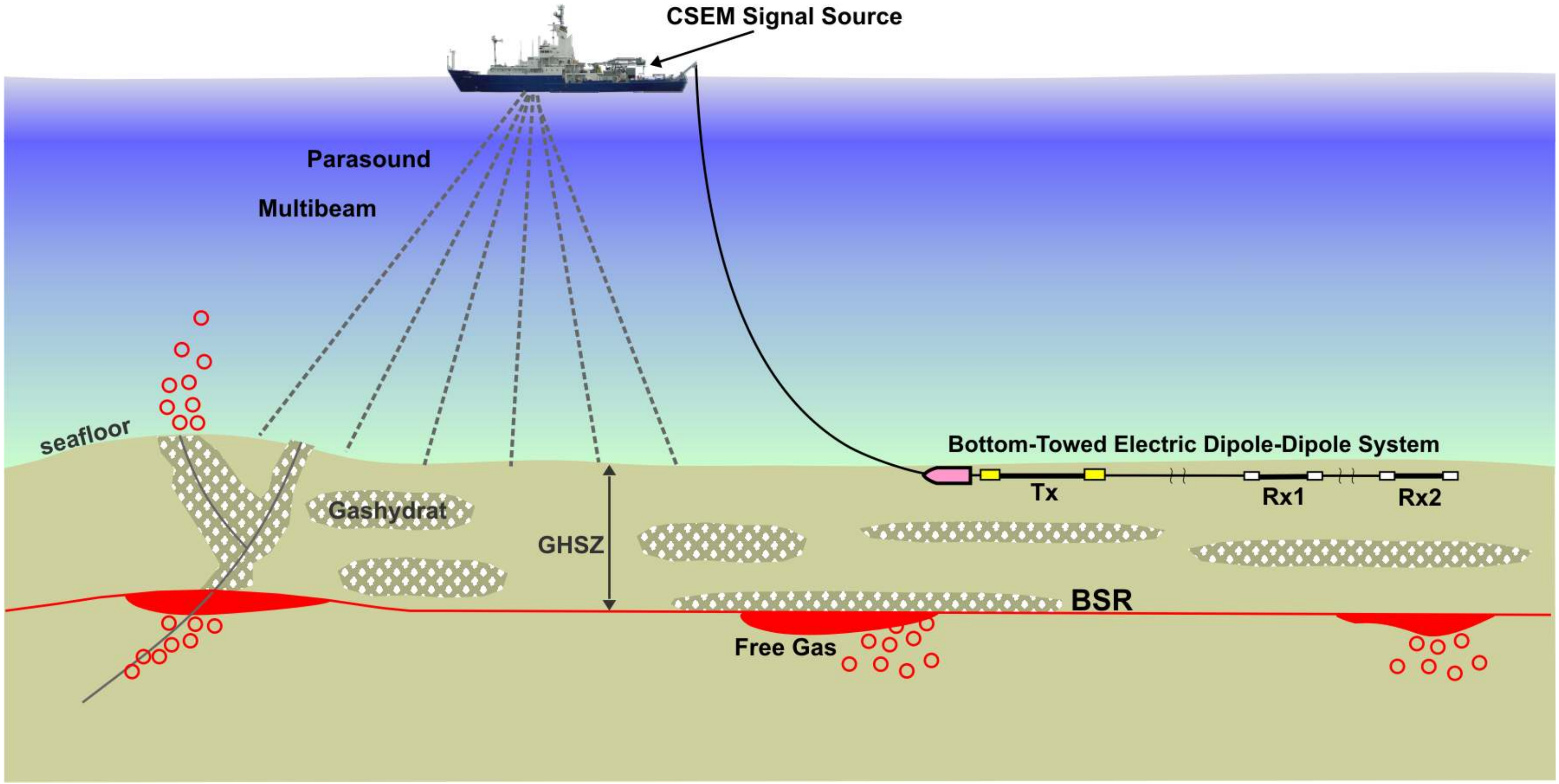


Thermal Gradients

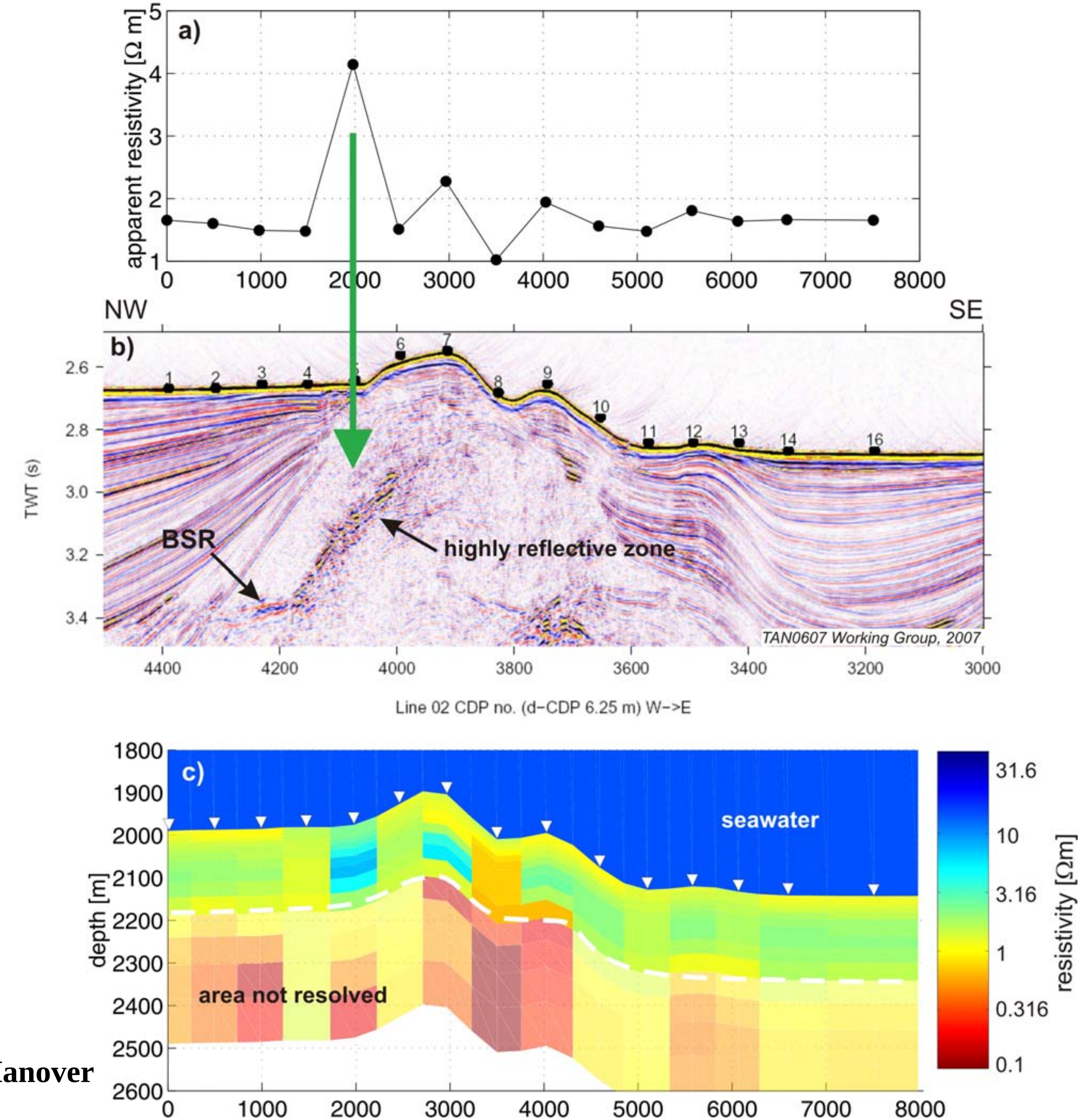


Warren Wood – NRL-Stennis

CSEM Application

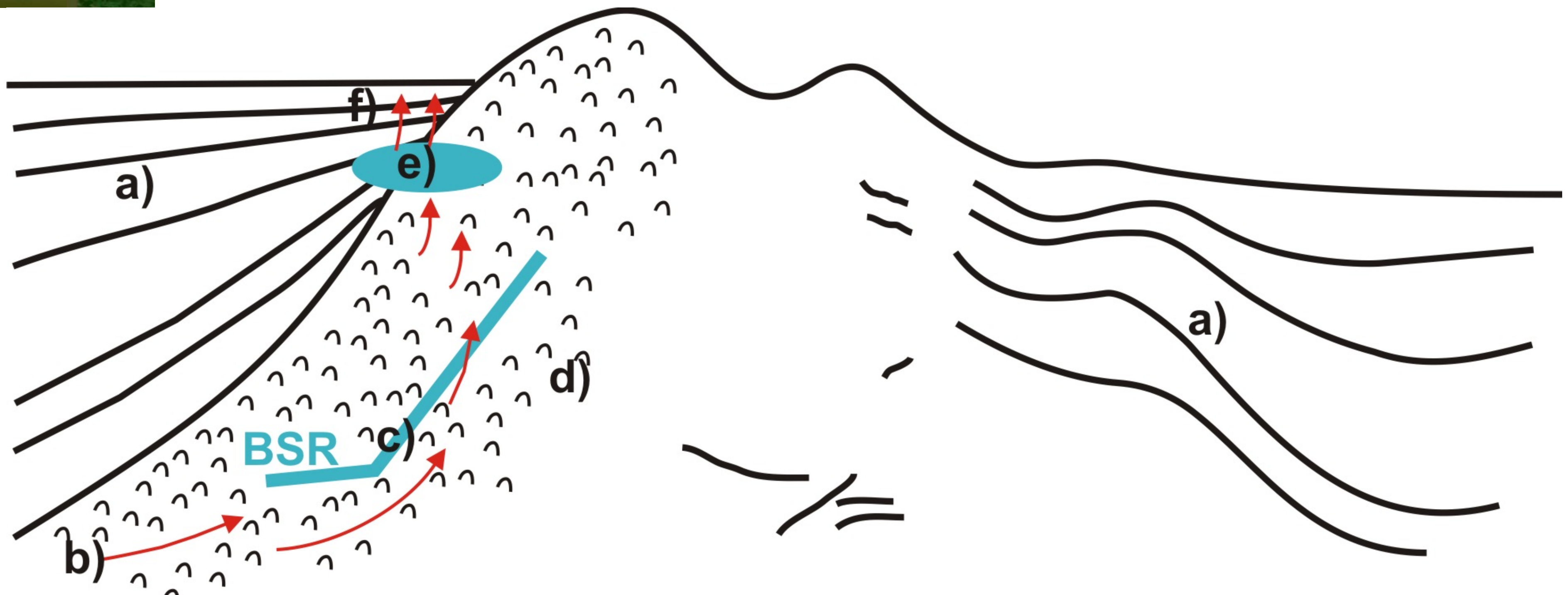


CSEM DATA



Katrin Schwalenberg, BGR - Hanover

Porangahau Ridge Overview



a) Low-permeability slope sediments.

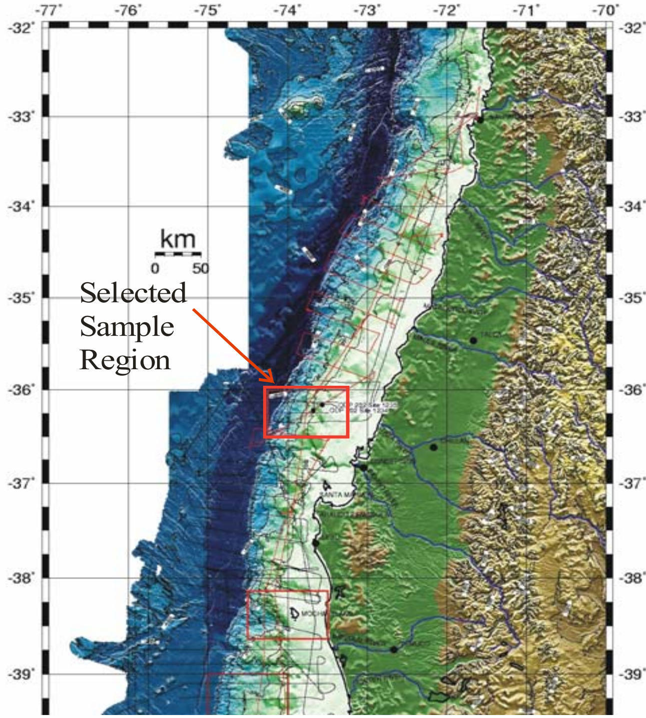
b) Expulsion of fluids sourced in the accretionary prism c) Seismic high reflectivity band marks local shoaling of the BGHSZ.

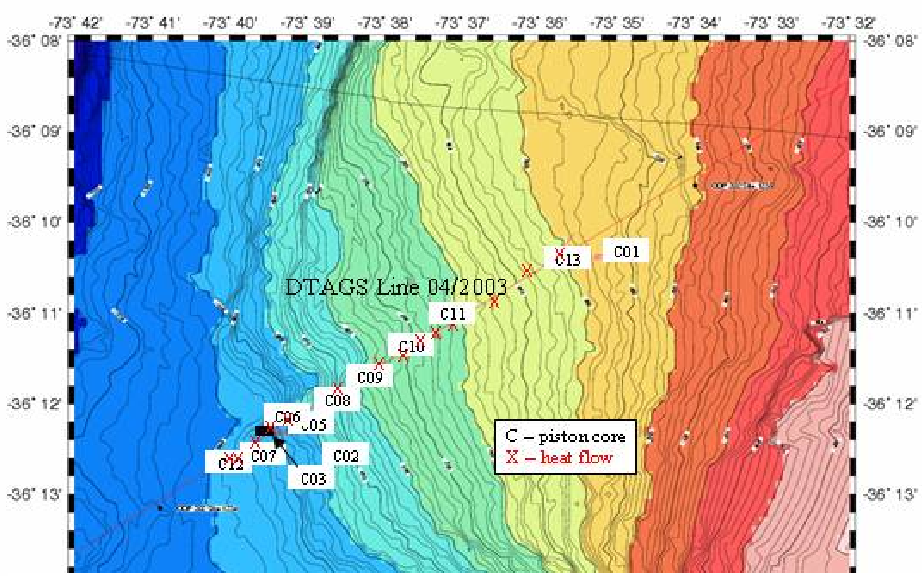
c) BSR observed on the landward side of the ridge

d) Core of the anticline with older, probably fractured and permeable material.

e) Resistivity anomaly above the high amplitude reflection band indicated elevated gas hydrate concentrations.

f) Advective heatflow and shallow sulfate profiles





Mid Chilean Margin

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Dr. Leila Hamdan	NRL, DC
Dr. Shelby Walker	NRL, DC
Dr. Joan Gardner	NRL, DC
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Ivana Novosel	Rice University, TX
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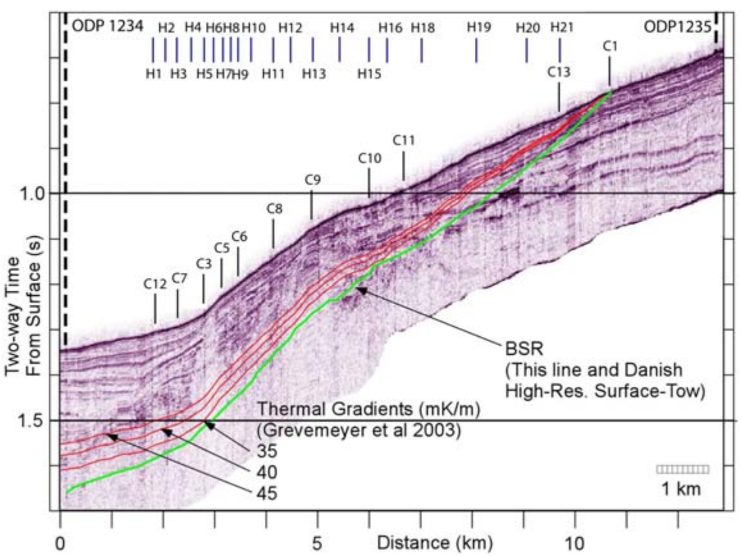
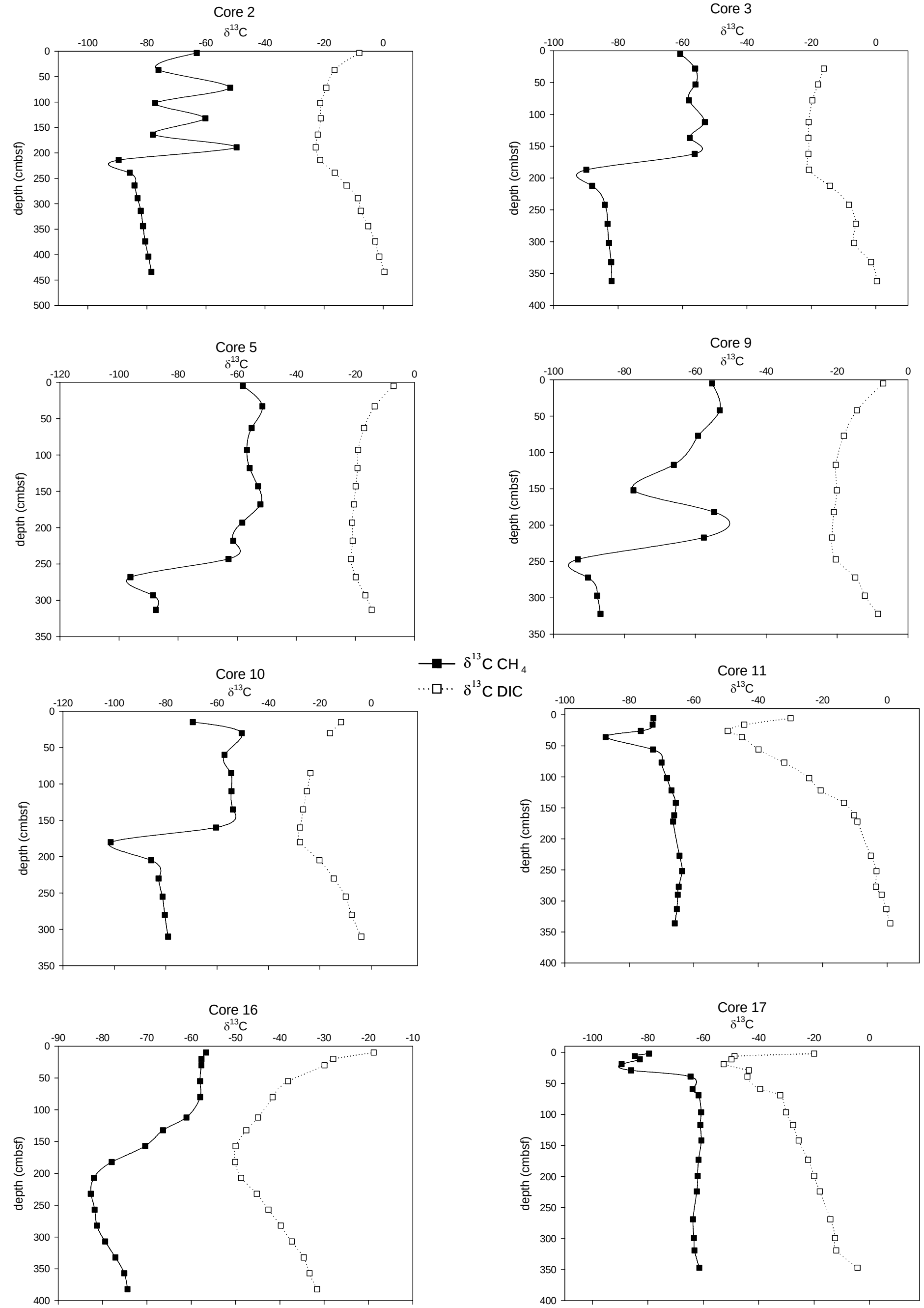
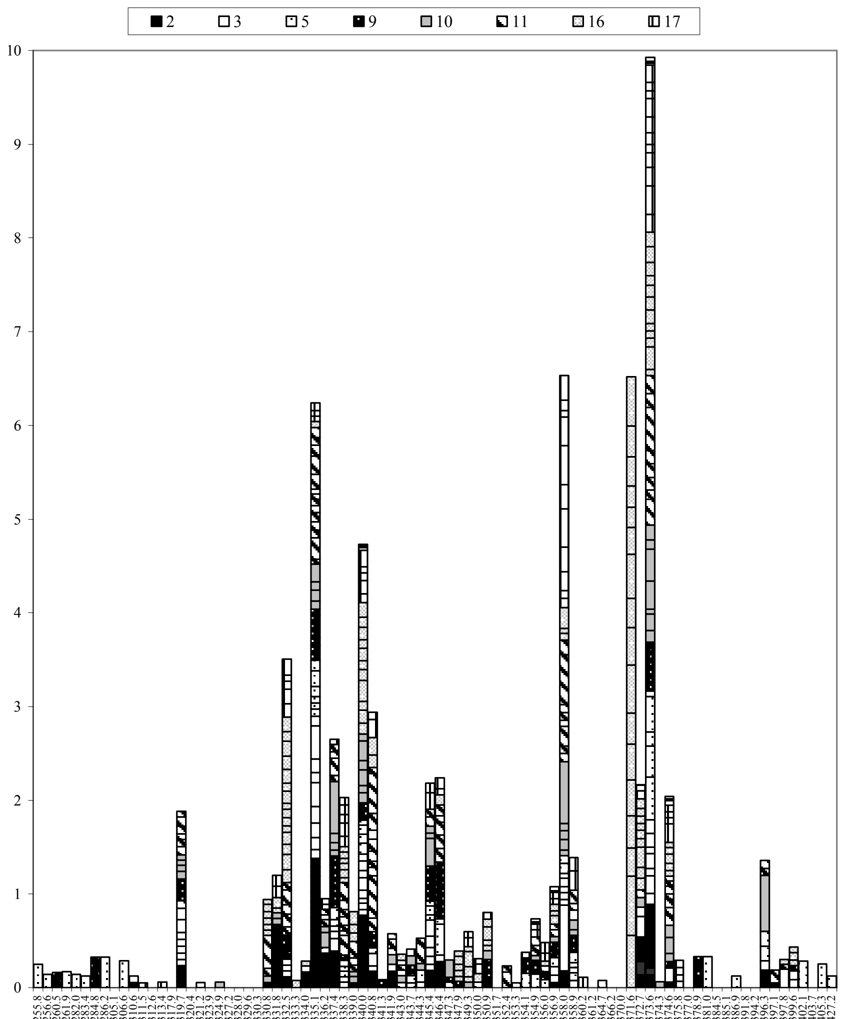
US Naval Research Laboratory
Marine Biogeochemistry

$\delta^{13}C$ DIC and CH_4



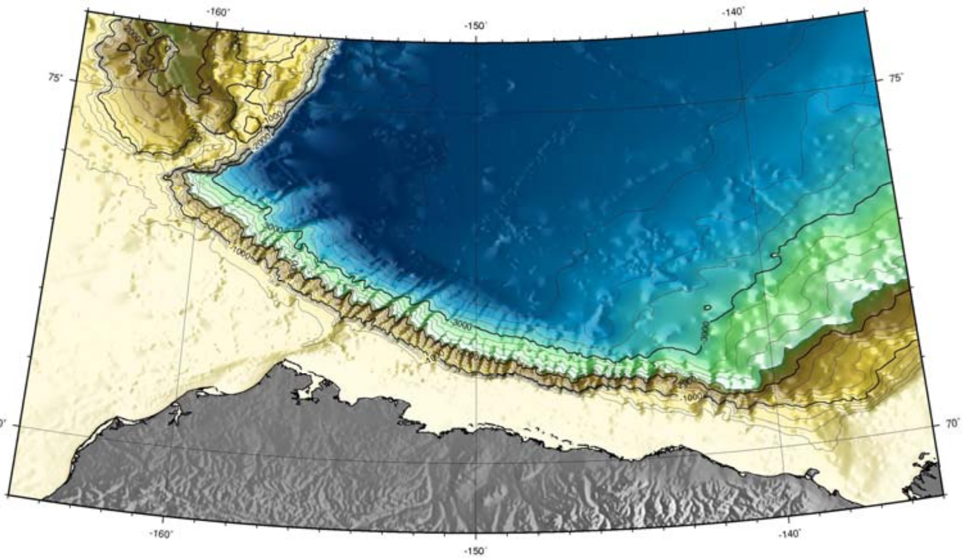


Molecular Ecology



Hamdan et al. 2008. Geomicrobiolial characterization of gas hydrate-bearing sediments along the mid-Chilean margin. FEMS 65:15-30.

Beaufort Sea Research Planning



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Jens Greinert, University of Ghent
Leila Hamdan, NRL
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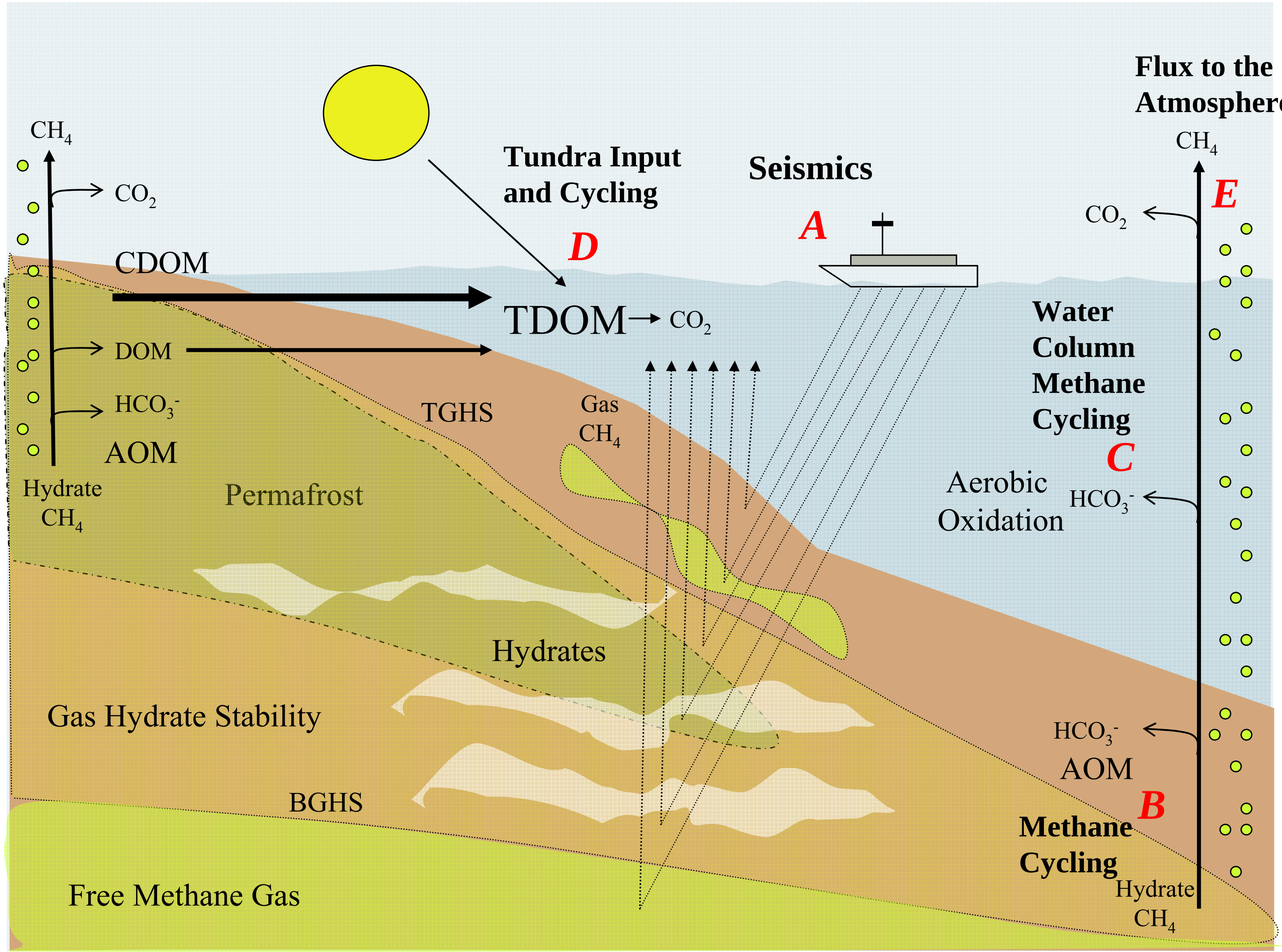
Research Plan



Publications

Pier Reviewed (Published, In Press and Submitted)

- Coffin, R B., Pohlman, J. W. Gardner, J., Downer, R., Wood, W., Hamdan, L., Walker, S., Plummer, R., Gettrust, J., Diaz, J. 2007. Methane Hydrate Exploration on the Mid Chilean Coast: A Geochemical and Geophysical Survey. Am. Chem. Soc., Div. Pet. Chem. doi:10.1016/j.petrol.2006.01.013.
- Hamdan, L.J., Gillevet, PM, Sikaroodi, M, Pohlman, JW, Plummer, RE, Coffin, RB. (2008) Microbial diversity of sediments associated with methane gas and hydrate along the mid-Chilean Margin. FEMS Microbiol Ecol 65:15-30
- Schwalenberg, K., W. Wood, I. Pecher, L. Hamdan, S. Henrys, M. Jegen, and R. Coffin. submitted. Preliminary interpretation of CSEM, heatflow, seismic, and geochemical data for gas hydrate distribution across the Porangahau Ridge, New Zealand . Marine Geology

Reports

- Coffin, R., L. Hamdan, J. Pohlman, W. Wood, I. Pecher, S. Henrys, J. Greinert, K. Faure. 2007. Geochemical characterization of concentrated gas hydrate deposits on the Hikurangi Margin, New Zealand: Preliminary Geochemical Cruise Report. NRL/MR/6110—08-9082
- Coffin, R., L. Hamdan, J. Smith, K. Rose, R. Downer, D. Edsall, J. Gardner, R. Hagen, and W. Wood, NRLGeochemical Evaluation of Deep Sediment Hydrate Deposits on Alaminos Canyon, Block 818, Texas-Louisiana Shelf. NRL/MR/6110-08-####.
- Kvamme, B., T. Uchida, S. Masutani, R. Coffin. 2008. 6th International Methane Hydrate Research and Development. NRL/MR/6110-08-####.
- Coffin, R. B., J. Diaz, Gardner, J. and J. Sellanes. 2006. Gas Hydrate Exploration, Mid Chilean Coast; Geochemical-Geophysical Survey. US Naval Research Laboratory Technical Memorandum, NRL/MR/6110—06-9075