IODP-Industry Science Program Planning Committee Meeting

Minutes

19-20 January, 2007

Houston, USA

IIS-PPG Attendees:

Richard Davies, Richard.Davies at durham.ac.uk, IIS-PPG
Harry Doust, harrydoust at hotmail.com , IIS-PPG
Andrew Pepper, apepper at hess.com, IIS-PPG (Host)
Martin Perlmutter, mperlmutter at chevron.com, IIS-PPG
Kurt Rudolph, kurt.w.rudolph at exxonmobil.com, IIS-PPG
Ralph Stephen, rstephen at whoi.edu, IIS-PPG (Chair)
Osamu Takano: takano-o at japex.co.jp,
alternate for Yasuhiro Yamada: yama at electra.kumst.kyoto-u.ac.jp
Yoshihiro Tsuji ,tsuji-yoshihiro at jogmec.go.jp, IIS-PPG

Ex-Officio Attendees:

Keir Becker, kbecker at rsmas.miami.edu , SPC
Nobu Eguchi, science at iodp-mi-sapporo.org, IODP-MI
Manik Talwani, mtalwani at iodp.org, IODP-MI

Guests (*1st day only):

*Michael Grecco, mgrecco at chevron.com - RPSEA
*John Hopper, hopper at geo.tamu.edu, - Lead-PI on the Rifted Margins Mission Proposal
Young-Joo Lee, yjl at kigam.re.kr , Petroleum and Marine Resources Research Div., Korea Institute of Geoscience and Mineral Resources (KIGAM)
*Harm van Avendonk, harm at ig.utexas.edu - Lead-PI on BESACM Proposal

IIS-PPG Regrets:

Didier-Hubert Drapeau, didier-hubert.drapeau at totalfinaelf.com, IIS-PPG
David Roberts, d.g.roberts at dsl.pipex.com, IIS-PPG
Eugene Shinn, eshinn at usgs.gov, IIS-PPG

Executive Summary

This was the second meeting of the IODP/Industry Science Project Planning Group. To promote development of industry related drilling proposals, to facilitate communication, and to develop effective links between academic and industry scientists, we generated eight consensus statements at the meeting:

IIS-PPG Consensus 0701-1: IISPPG is promoting the submission of two projects for the April 1/07 proposal deadline: 1) A South Atlantic rifted margins project which will be included in a rifted margins mission proposal. 2) A pre-proposal on the theme of silica diagenesis, shallow compaction and fluid flow.

IIS-PPG Consensus 0701-2: IISPPG is promoting a proposal or pre-proposal on Mesozoic source rocks and paleo-oceanography for possible submission in April 1/08.

IIS-PPG Consensus 0701-3: The Arctic Basin is one of the last remaining scientific frontiers on a number of fronts, from basin evolution to paleo-oceanography and paleo-climate change. IISPPG believes this is an area of great mutual interest to academia and industry. The panel will prepare a 2-3 page white paper scoping out possible Arctic drilling of joint industry-academic scientific interest.

IIS-PPG Consensus 0701-4: IISPPG recommends that IODP-MI increase the awareness of IODP in the Japanese petroleum industry in addition to US and European efforts, for example by having a booth at the JAPT. In conjunction with the next meeting in Sapporo, IISPPG will participate in a mini-workshop in Tokyo on "Applications of IODP data in petroleum exploration".

IIS-PPG Consensus 0701-5: IISPPG supports the IODP data management efforts (SEDIS portal) which involve interoperable data portals. Coordination between US, Japanese, and European data management efforts is obviously essential. Specifically we request that the industry "user community" be involved in pilot projects to guide the development and to ensure the utility of the data management infrastructure.

IIS-PPG Consensus 0701-6: IISPPG will contact EGI (Energy Geoscience Institute - University of Utah) to identify whether they would have interest in developing with IODP scientists an integrated database of DSDP, ODP and IODP well data.

IIS-PPG Consensus 0701-7: IISPPG supports the membership of IODP-MI in the RPSEA and Deep Star projects. IISPPG will monitor developments on the Deep Star Technical Advisory Committees on Geoscience and Downhole Measurements.

IIS-PPG Consensus 0701-8: IIS-PPG members will identify alternates for themselves whom they know and with whom they can communicate easily. Ideally these alternates will meet the criteria for PPG membership outlined in the terms of reference. National committees (PMOs for US and Japan) should confirm that they will pay travel costs for the designated alternates if necessary. Action item for IIS-PPG members and Chair.

We thank Andy Pepper and Hess Corporation for graciously hosting the meeting.

Action Items

IISPPG members will be responsible for the various action items involved in the consensus statements.
0701-1: Stephen will continue to promote and monitor the BESACM project and its inclusion in the rifted margins mission proposal. Davies will be PI on the silica diagenesis pre-proposal.
0701-2: Doust will continue to be the lead on the mesozoic source rocks and paleo-oceanography pre-proposal
0701-3: Pepper will take the lead on drafting an Arctic Basin white paper.
0701-4: Tsuji-san will work with Nobu-san to encourage an IODP-MI booth at JAPT and to hold a mini-workshop in Tokyo on "Applications of IODP data in petroleum exploration" in conjunction with next IISPPG meeting.
0701-5: Pepper and Rudolf will work with Nobu-san to pursue connections between the industry "user community" and the US, Japanese and European data management efforts with the goal of establishing meaningful pilot projects.
0701-6: Perlmutter will contact EGI to pursue joint development of an integrated data base for all well data.
0701-7: Perlmutter and Stephen will monitor developments on the Deep Star Technical Advisory Committees on Geoscience and Downhole Measurements.
0701-8: Stephen will enquire from IODP-MI and the national agencies what is required to have "alternate" status. All committee members should contact the Chairman with suggestions for their own alternates.

Introduction

The focus of the first day's presentations was to review progress that the PPG had made since the last meeting. The focus of the second day was to develop strategies and mechanisms for future work.

Minutes of the Previous Meeting

The minutes of the previous meeting, in The Hague, 7-8 July, 2006 were accepted.

Feedback from SPC on Consensus Items from The Hague Meeting.

IIS-PPG Consensus 0607-1: The IIS-PPG requests the national funding agencies to consider mechanisms for funding small business participation on drilling expeditions (through separate grants or contracts, or some other mechanism). **No discussion at SPC. IISPPG will clarify this and resubmit.**

IIS-PPG Consensus 0607-2: IIS-PPG representatives have experienced some

difficulties in retrieval of measurements and other data from the legacy and electronic IODP databases. IIS-PPG requests IODP-MI to raise these concerns with the appropriate data custodians with a view to considering possible improvements**. SPC recommends contacting Roger Searle. Item 0701-5 (above) follows on this.**

IIS-PPG Consensus 0607-3: IIS-PPG will prepare 2-3 page white papers describing possible missions* on the following themes: i) rifted margins, ii) Mesozoic paleo-oceanography, iii) source-to-sink sediment transport processes, iv) high-scientific-value single wells, and v) shallow compaction and fluid flow. White papers are to be delivered by September 1 for rifted margins in time for the Continental Break-up and Sedimentary Basin Formation Workshop and by September 30 for the rest. **SPC supports this activity.**

Update on IODP activities and the August 2006 SPC meeting (Keir Becker)

Keir Becker gave an update on IODP activities (see Appendix 1). The short platform update is:

- Chikyu – accepted, tested, now operating for 3rd party offshore Kenya / Australia. 09/07 to start NANTROSEIZE (on time). Early wells shallow non-riser.
- Non-riser SOV – Joides Resolution accepted 06, with overhaul (stretched). To start operations 11/07 (Equatorial Pacific 626 – 603abc – 477 – 545 – 626(2))
- MSPs – To drill New Jersey margin, summer 07 (tentatively). Great Barrier Reef (519) targeted for FY 2008-2009 - site survey underway.

RPSEA presentation and discussion. (Mike Grecco, the RPSEA VP for Ultra-deepwater and the DeepStar Executive Director. See RPSEA web site - http://www.rpsea.org/)

Mike Grecco gave an overview presentation on RPSEA (Appendix 2). The Research Partnership to Secure Energy for America (RPSEA) is a non-profit corporation composed of a consortium of premier U.S. Energy entities. RPSEA's mission is to provide a stewardship role in ensuring the focused research, development and deployment of safe and environmentally sensitive technology that can effectively deliver hydrocarbons from domestic resources to the citizens of the United States.

RPSEA is a US national program concentrating on technology developments needed for deep-water and unconventional resource exploitation. It is affiliated with DeepStar, a more international program related to deep water technology development only. There is an opportunity for IIS-PPG to liaise with the Geoscience committee of DeepStar on possible issues of mutual interest.

Given the mutual interest of IODP-MI and RPSEA in deep water drilling and monitoring technologies, IISPPG is seeking to foster communication between the two groups. Greg Myers at IODP-MI has been in touch with Mike Grecco and IODP-MI is considering joining RPSEA.

Progress reports on IIS-PPG white papers.

a) Definition of IODP Missions (Keir Becker - Appendix 1)

"A Mission is an intellectually integrated and coordinated drilling strategy originating from the scientific community that addresses a significant aspect of an IODP Science Plan theme over an extended period and which merits urgent promotion in order to achieve overall IODP program goals. Missions must address scientific themes of global significance and must originate from, and must be strongly supported by, the international scientific community."

SPC will call for mission proposals as well as conventional proposals to be submitted 01/04 each year. Mission proposals will be reviewed by SSEPs/SASEC before going to SPC. SPC will then designate missions as appropriate and pass them to IODP-MI for formation of mission teams to prepare the component proposals. They will require extra financial resources (200-300k$/yr). For definition see www.iodp.org/missions

b) Rifted margins -

i) Pontresina workshop and history of the BESACM (Birth and evolution of the South Atlantic conjugate margins) white paper (Ralph Stephen).

As Chair of ISSPPG Stephen attended the Pontresina Workshop on Continental Break-up (Appendix 3). A white paper had been submitted by Garry Karner, Ian Norton and others from Exxon to drill the South Atlantic margins. There was considerable enthusiasm for this project from Dimas Coelho and Webster Mohriak from Petrobras and Patrick Unternehr from Total. This was an obvious area for IISPPG involvement. Stephen prepared some notes on the BESACM discussions at Pontresina and continued to work with the investigators through the Fall. It was clear that BESACM should be first introduced as a component of the Rifted Margins Mission proposal being prepared by John Hopper. Harm van Avendonc was indentified as the lead-PI for BESACM.

ii) Presentation on Rifted Margins Mission (John Hopper)

John Hopper gave an overview of the Rifted Margins Mission (Appendix 4). This relates to the "Solid Earth Cycle" theme of the IODP ISP. Six sub themes have been defined and the need is seen for a range of observations from different areas. As the current academic research on the rifting theme is areally splintered, there is an opportunity for IODP to provide integrational leadership. There is a need to involve more industry experience and expertise. The South Atlantic forms a component of this mission,

iii) Presentation on South Atlantic Rifted Margins proposal (Harm van Avendonc)

Harm van Avendonk (UT, Austin) gave an overview of the BESACM project (participants, goals, motivation, data and drilling requirements, etc - Appendix 5).

ACTION: A workshop is planned for 03/07 in Houston, hosted by Exxon, to draft the BESACM text for the Mission Proposal with potential industry partners. Exxon has volunteered to pay travel expenses, if necessary, for academic scientists involved in the project.

c) Mesozoic paleo-oceanography and source rocks (Harry Doust)

Harry Doust gave a presentation on the Mesozoic paleo-oceanography and source rocks theme (Appendix 6A) and the related draft white paper (Appendix 6B). There was general agreement on the contents, and HD will progress this further with a view to establishing a working group soon and submitting a (mission) proposal by 04/08. Becker noted that SSEP have submitted a request for an "Extreme Climates Workshop" to be held during the next year (07-08) – IIS-PPG will aim to participate. Perlmutter noted that the April 07 AAPG (Long Beach) will include a session on this subject (Perlmutter is co-chair). It was also noted that a number of service companies / industry groups are working with Mesozoic palaeoclimate models (eg Merlin of Robertson) – these should be approached to cooperate with this mission. Pepper, Perlmutter, Rudolph and Roberts have agreed to participate. Nick Stronach (UK-ILP is also interested). Harry **ACTION:** Doust will circulate the initial proposal, will form a working group, and will initiate liaison with SSEPs.

d) Silica Diagenesis, Shallow compaction and fluid flow (Richard Davies)

Davies has an advanced proposal to investigate compaction modification due to silica diagenesis and fluid release and flow (Appendix 7). He showed several seismic profiles in which this process is proposed to be occurring. He is working on a 2-location expedition in the Voring basin.

e) Source to Sink Theme
In the absence of Darpeau this was not discussed.
ACTION: Drapeau to develop proposal in Congo/Zaire fan system

6) Updates on national IODP-Industry Liaison efforts.
a) UK ILP meeting on October 5 (Richard Davies)

Approximately four proposals are being developed currently, arising from workshops held in June and October 2006 and links to the academic community (last page of Appendix 7). The rifting theme is prominent. In the UK-ILP all industry members have nominated alternates.
ACTION: Davies intends to submit at least a pre-proposal by 04/07

b) Japanese poll for industry participation (Yoshihiro Tsuji)

Tsuji-san and Yamada-san sent a questionnaire to 31 Japanese industry staff and received 20 replies (Appendix 8). In short 15 knew of IODP, 13 had used IODP results,

and 14 will possibly use IODP results in the future. 11 might contribute to IODP proposals. There are several areas of interest, similar to those of the IIS-PPG.

7) IIS-PPG Mandate, Membership and Mechanisms (Ralph Stephen).

Ralph Stephen lead a general discussion on industry/ academic partnership concerns and on mechanisms for accomplishing the charge to IIS-PPG. Becker made a presentation on SASEC which included a review of the IISPPG terms of Reference (Appendix 1).

Talwani gave a short presentation on "industry legs". For industry to partner with IODP, especially where the use of drill ships is involved, a number of sensitivities are involved. There are two end members of participation by industry scientists, for which there do not seem to be any issues. One end member is the present mode of industry scientists participating in IODP expeditions. Talwani sees no changes in this. The other end member is the use of the drill ships for non IODP purposes. IODP-MI is not involved and the drill ship operators can make any arrangements that they would like to, including leasing to industry (eg the recent use of the JOIDES Resolution to drill gas hydrates off India). The possibility of "hybrid" expeditions where both industry and IODP share the science objectives and costs is obviously of some interest and needs to be pursued by both sides.

Other comments from the group discussion were:

- Nothing in relation to IODP initiatives is likely to be endorsed by senior industry management unless previously proposed by IIS-PPG.
- There will be no IODP financial support for academics in white paper working groups tasked with maturation of proposals.
- There is an opportunity for industry to fund academics (for travel costs for example) to participate in proposal planning meetings. Such mechanisms should be informal and could be arranged ad hoc, arranged by the working group involved. (Perlmutter)
- IIS-PPG should limit its activity to identification of high-level initiatives and the facilitating working groups (Rudolph)
- Building relationships with industry is valuable for academics (Davies)
- Limiting the time between proposal submission and operation. See scheme by Pepper (Appendix 9), where tollgates trigger the next phase (eg. involving cost of studies / need for seismic data). Issues – it may be that currently, the large number of "active" proposals is slowing the system down. Is there a way to develop more bins or categories of acceptance/rejection? SPC to action?
- It appears that there are insufficient funds to keep IODP vessels continuously active (Talwani). This raises the possibility that Chikyu / SODV could be used occasionally for off-contract drilling. Is there scope for hybrid programmes to be jointly funded (IODP/industry), eg in the Arctic Ocean. SASEC would approve this, as long as confidentiality issues were honoured. It was noted that if industry were to participate, a change in the operational governance of IODP would be

required (Rudolph). IODP will come with a request to discuss these issues further with industry.

- Davies urged IIS-PPG to keep the list of “current active proposals with potential industry interest” evergreen.

8) Other business (Ralph Stephen)

a) NSF grant opportunities for academic liaison with industry
b) USSSP report on "Scientific opportunities in the deep subseafloor biosphere"

10) Next Meeting

The next meeting will be held in Sapporo Japan on July 24 and 25, 2007 (Tuesday and Wednesday). Nobu Eguchi, IODP-MI, volunteered to host the meeting. Prior to the next meeting, on Monday July 23, IISPPG will participate in a mini-workshop in Tokyo on "Applications of IODP data in petroleum exploration".

Acknowledgements

We would like to thank Andy Pepper and Hess for graciously hosting the meeting. Harry Doust took notes during the meeting which were invaluable in preparing the minutes.

Appendices

Appendix 1: Becker Presentations

Appendix 2: Grecco Presentation

Appendix 3: Stephen Presentation

Appendix 4: Hopper Presentation

Appendix 5: Avendonk Presentation

Appendix 6a: Doust Presentation

Appendix 6b: Doust White Paper

Appendix 7: Davies Presentation

Appendix 8: Tsuji-san Presentation

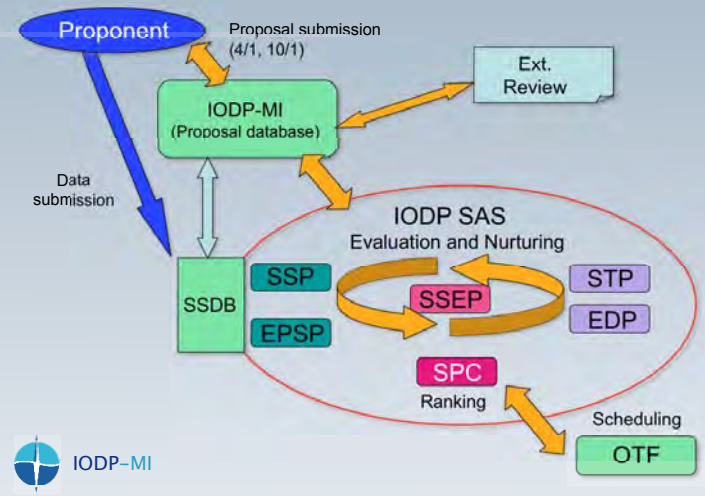
Appendix 9: Pepper Presentation

SPC/SASEC Report to Industry-IODP Science PPG

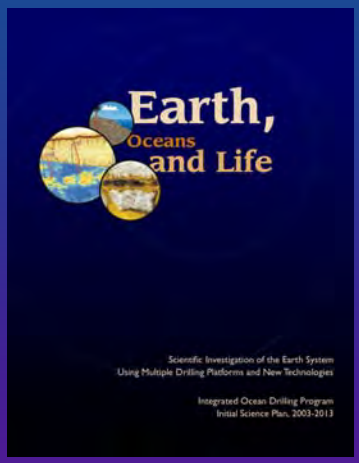
Houston, Jan 2007, K. Becker

1. Very brief summary of IODP proposal review and scheduling process
2. Update on FY07-10 schedule development
3. Proposals to be ranked at March 2007 SPC
4. Report from first two SAS Executive Committee (SASEC) meetings - including update on mission implementation
5. SASEC WG on SAS + IIS-PPG mandate

IODP Proposal Process



Initial Science Plan - SAS "Bible"



- The Deep Biosphere and the Subseafloor Ocean
- Environmental Change, Processes, and Effects
- Solid Earth Cycles and Geodynamics

With 8 Initiatives Deemed Ready for First 10 Years of IODP

8 ISP Initiatives Within 3 Themes

- Deep biosphere and subseafloor ocean
  - Deep biosphere
  - Gas hydrates
- Environmental change, processes and effects
  - Extreme climates
  - Rapid climate change
- Solid Earth Cycles and Geodynamics
  - Continental breakup + sedimentary basin formation
  - Large igneous provinces
  - 21st Century Mohole
  - Seismogenic Zone

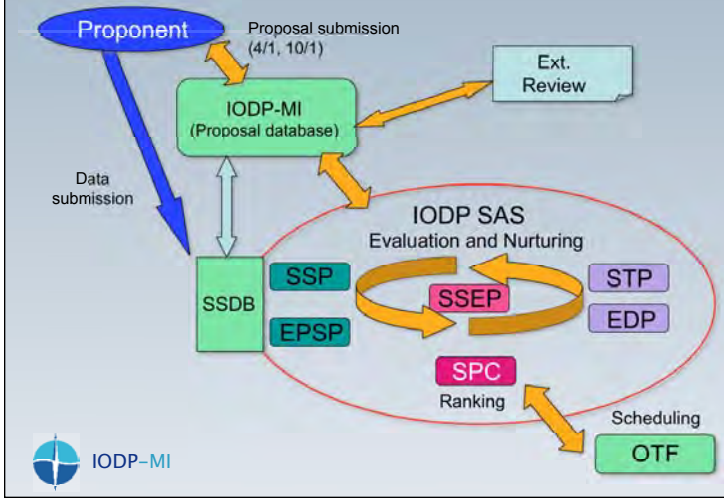
IODP Platform Update - unofficial

Chikyu -
- First half of 2006 - Shakedown and acceptance
- Aug-Oct 2006 - System Integrations Tests (SIT) offshore Shimokita
- Nov 2006 - Aug 2007 - Offshore Drilling SIT (ODS) not on IODP contract
  - currently offshore Kenya (2000 m; strong currents)
  - next offshore NW Australia
- Sept 2007 - begin IODP international operations with NanTroSEIZE

SODV -
- JOIDES Resolution selected in 2006
- Two models developed for overhaul:
  - stretch model with new lab module
  - non-stretch with complete remodel of lab/quarters
- Decision not yet made - awaiting third annual increment of NSF funding

MSP Operations
- Platforms selected on case-by-case basis, subject to market availability
- FY07 New Jersey platform and dates still to be officially confirmed

IODP Proposal Process



FY07/08/09 Schedule Development - Chikyu and MSP

SPC Consensus 0608-04: The SPC approves the science plan and operations schedule of the Chikyu for NanTroSEIZE non-riser and riser operations (Proposals 603A-Full2, 603B-Full2, 603C-Full) in FY2008 and early FY2009 as recommended by the NanTroSEIZE Project Management Team in July 2006 and the Operations Task Force (OTF) in August 2006.

SPC Consensus0608-5: The SPC approves the mission-specific platform operations for the Great Barrier Reef component of Proposal 519-Full2 South Pacific Sea Level in FY2008-09, provided that (a) the proponents complete the proposed site surveys and submit the site-survey data in a timely and satisfactory manner and that (b) a successful EPSP review is completed in a timely manner as defined by the Operations Task Force (OTF).

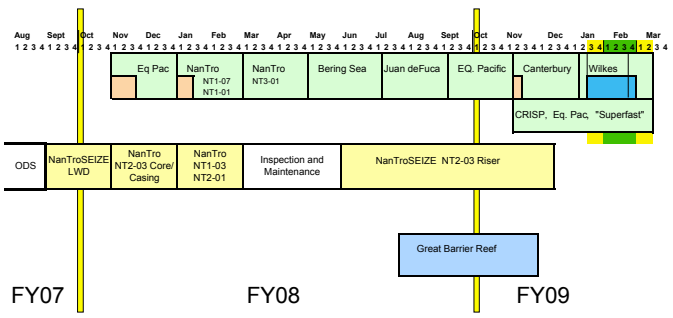
FY07/08/09 Schedule Development - SODV (start date delayed to Nov 1 2007)

SPC Consensus 0608-03: The SPC approves the science plan and operations schedule of the U.S. scientific ocean drilling vessel (SODV) as recommended by the Operations Task Force for FY2008 and earliest FY2009, as well as the readjustments required in the event of a delay in the starting date for SODV operations. The recommended expeditions will begin in November 2007 and proceed as follows:

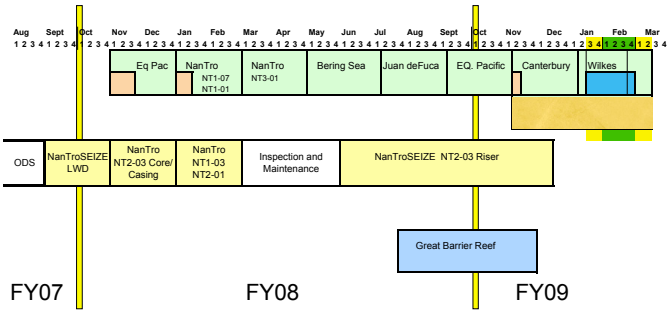
- Equatorial Pacific Paleogene Transect I (626-Full2)
- NanTroSEIZE Stage 1 (603A-Full2, 603B-Full2, 603C-Full)
- NanTroSEIZE Stage 1 continued
- Bering Sea Plio-Pleistocene Paleoceanography (477-Full4)
- Juan de Fuca Flank Hydrogeology II (545-Full3)
- Equatorial Pacific Paleogene Transect II (626-Full2)

In the event of a slight delay in the start of SODV operations, the entire schedule should simply shift later, as long as good weather windows remain open for the Bering Sea and Juan de Fuca expeditions. In the event of a longer SODV delay that would preclude such a simple shift, the first Equatorial Pacific expedition would be deferred until later and the schedule would begin with NanTroSEIZE Stage 1 operations.

Summary FY07-09 Schedule as of August SPC



Summary FY07-09 Schedule as of Jan 2007



Successful Canterbury Basin gas hazard review at January 9-10, 2007 EPSP meeting

Programs from 2005 OTF pool now in FY07/08/early09 Science Plan

Sept 2003
- ✓ 519-Full2 S. Pacific Sea Level (Great Barrier Reef)
- ✓ 545-Full3 Juan de Fuca Hydro (2nd expedition)
- ✓ 564-Full New Jersey Sea Level (FY06?)
- • 589-Full3 Gulf of Mexico Overpressures (2nd exp.)

June 2004
- ✓ 603A-F2 and 603B-F2 NanTroSEIZE Phase I and II
- ✓ 477-Full4 Okhotsk/Bering Pliocene/Pleistocene
- ✓ 482-Full3 Wilkes Land
- • 553-Full2 Cascadia Hydrates (2nd expedition)
- ✓ 600-Full Canterbury Basin
- • 621-Full Monterey Bay Observatory

March 2005
- ✓ 603C-Full NanTroSEIZE Phase III
- • 595-Full3 Indus Fan and Murray Ridge
- ✓ 626-Full2 Pacific Equatorial Age Transect

Results of March 2006 Rankings

	Proposal #	Short Title	Mean	Stdv
1	677-Full	Mid-Atlantic Ridge Microbiology	2.4	2.06
2	603D-Full2	NanTroSEIZE Observatories	2.9	1.85
3	637-Full2	New England Shelf Hydrogeology	3.9	3.57
4	605-Full2	Asian Monsoon	5.9	3.57
5	549-Full6	Northern Arabian Sea Monsoon	6.0	3.22
6	537A-Full5	Costa Rica Seismogenesis Project Phase A	6.6	3.50
7	537B-Full4	Costa Rica Seismogenesis Project Phase B	8.6	3.37
8	552-Full3	Bengal Fan	9.7	3.89
9	505-Full5	Mariana Convergent Margin	10.5	3.61
10	659-Full	Newfoundland Rifted Margin	10.6	3.08
11	654-Full2	Shatsky Rise Origin	11.1	3.40
12	555-Full3	Cretan Margin	11.5	4.69
13	667-Full	NW Australian Shelf Eustasy	11.8	3.99
14	535-Full5	Atlantis Bank Deep	12.2	3.54
15	584-Full2	TAG II Hydrothermal	12.5	4.24
16	618-Full3	East Asia Margin	13.0	3.39
17	547-Full4	Oceanic Subsurface Biosphere (OSB)	13.8	2.91

Red = identified for forwarding to OTF for FY08/09/10 schedule development
Green shading = site survey issues to be resolved before forwarding

Forwarded to OTF for FY08/09/10

		Proposal #	Short Title	Mean	Stdv
Group 1	1	677-Full	Mid-Atlantic Ridge Microbiology	2.4	2.06
	2	603D-Full2	NanTroSEIZE Observatories	2.9	1.85
	3	637-Full2	New England Shelf Hydrogeology	3.9	3.57
	4	605-Full2	Asian Monsoon	5.9	3.57
	5	549-Full6	Northern Arabian Sea Monsoon	6.0	3.22
	6	537A-Full5	Costa Rica Seismogenesis Project Phase A	6.6	3.50
Group 2	7	537B-Full4	Costa Rica Seismogenesis Project Phase B	8.6	3.37
	8	552-Full3	Bengal Fan	9.7	3.89
	9	505-Full5	Mariana Convergent Margin	10.5	3.61
	10	659-Full	Newfoundland Rifted Margin	10.6	3.08
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	13	667-Full	NW Australian Shelf Eustasy	11.8	3.99
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	16	618-Full3	East Asia Margin	13.0	3.39
	17	547-Full4	Oceanic Subsurface Biosphere (OSB)	13.8	2.91

Group 1 proposals remain at OTF until scheduled.
Group 2 proposals re-ranked at March 2007 SPC if not scheduled.
Green-shaded proposals await resolution of site survey issues.

FY09/10 Schedule Development

Projected SODV Operations

OTF presented trade-offs for several ship-track models based on existing pool of approved proposals. One model was a clear favorite, based on the critical mass of highly-rated proposals and the imperative to maximize IODP science.

SPC Consensus 0608-17: The SPC approves a ship-track model for SODV operations in FY2009-10 that would proceed clockwise through the Pacific Ocean, assuming a start at Wilkes Land.

FY09/10 SODV schedule to be developed from pool of proposals remaining at OTF plus those ranked and forwarded at the March 2007 SPC meeting.

Projected Chikyu and MSP Operations

Chikyu: Some combination of further NanTroSEIZE work and riserless operations in Indian and W. Pacific Oceans, to be developed by OTF.
MSP - to be determined after March 2007 rankings.

Proposals to be ranked, March 2007 SPC

Deep biosphere and subseafloor ocean
- 505-Full5 Mariana convergent margin
- 547-Full4 Oceanic subsurface biosphere
- 555-Full3 Cretan margin
- 584-Full2 TAG II hydrothermal
- 633-Full2 Costa Rica mud mounds * newly forwarded from SSEP

Environmental Change, Processes, and Effects
- 548-Full2 Chixculub K-T impact crater MSP - strong ICDP link
- 552-Full3 Bengal Fan
- 581-Full2 Late Pleistocene coralgal banks MSP
- 618-Full3 East Asia margin MSP (with riser?)
- 644-Full2 Mediterranean outflow * newly forwarded from SSEP
- 661-Full2 Newfoundland sediment drifts * newly forwarded from SSEP
- 667-Full NW Australian shelf eustasy

8.3. Solid Earth Cycles and Geodynamics
- 522-Full5 Superfast Spreading Crust * newly forwarded from SSEP
- 535-Full5 Atlantis Bank
- 537B-Full3 Costa Rica seismogenesis phase B Chikyu
- 612-Full3 Geodynamo * newly forwarded from SSEP
- 654-Full2 Shatsky Rise origin
- 659-Full Newfoundland rifted margin

Highlights of First SASEC Mtg (July 2006)

- SASEC formally approved FY07 program plan (MSP: New Jersey Sea Level, Chikyu: initial NanTroSEIZE LWD operations)
- SASEC formed a WG to reevaluate SAS structure, to report at March 2007 SASEC meeting
- SASEC decided to update Initial Science Plan by 2008, building on IODP workshops in 2006/2007 (This is a separate activity from process that will start in a few years to write a new science plan for the second 10 years of IODP.)
- For IODP-MI sponsored workshops in 2007, SASEC recommended proposed geological hazards workshop, and asked for a revised proposal for LIPs workshop
- SASEC asked SPC to continue with expedition science assessments and approved a process for long-term IODP evaluation via thematic review committee(s)

Highlights of Second SASEC Mtg (Nov 2006)

- Mission Implementation: SASEC modified slightly and then approved the draft implementation plan produced by the mission implementation WG. Lead agencies asked for two wording changes, and final plan posted at www.iodp.org/missions.
  - Call for mission proposals (and normal proposals) to be issued over winter with April 1 deadline.
  - SSEP will review these proposals at May 2007 meeting.
  - An external review panel appointed by SASEC will independently review the mission proposals.
  - SPC will review mission proposals at August 2007 meeting, rank them if necessary, and may designate initial mission(s).
  - IODP-MI would then form missions teams to write component proposals that would be reviewed by SAS.
- SASEC asked its SAS WG to poll the IODP community in considering how SAS should be best structured for Phase II.

Mission - Definition

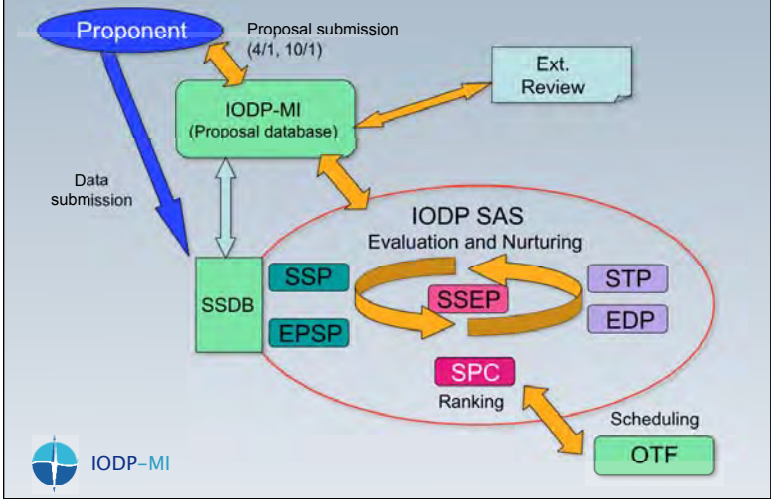
A Mission is an intellectually integrated and coordinated drilling strategy originating from the scientific community that addresses a significant aspect of an IODP Science Plan theme over an extended period and which merits urgent promotion in order to achieve overall IODP program goals.

Missions must address scientific themes of global significance and must originate from, and must be strongly supported by, the international scientific community.

SASEC Working Group on SAS

- SASEC Consensus 0706-07: SASEC appoints a subcommittee consisting of Yoshi Kawamura (non-voting), Mike Bickle, Keir Becker, Jim Mori, David Divins (non-voting), and Hans Christian Larsen (non-voting) to review the Science Advisory Structure and recommend any changes to optimally configure its activities as IODP enters Phase II. The subcommittee should also recommend any changes in structure necessary to integrate missions into the IODP proposal review process. The subcommittee should submit its recommendation to SASEC at its spring 2007 meeting. The committee should select a chair at or before its first meeting.
- KB elected chair; first meeting Oct 31 before Nov 1-2 SASEC.
- Mission implementation working group did not recommend any signficant changes to SAS for implementing missions.
- IODP-MI BoG formed committee to review IODP-MI (chaired by past SPC chair Mike Coffin), and that mandate includes reviewing "efficiency" of SAS and SAS/IODP-MI relations.

IODP Proposal Process



SASEC Working Group on SAS - Questionnaire

Looking forward to SAS performance as IODP enters Phase II with full multi-platform operations:

(1) Describe up to three issues you (might) have with SAS in terms of its quality and efficiency in (a) reviewing IODP proposals and/or (b) delivering advice to IODP-MI and the IODP Implementing Organizations.

(2) Describe up to three ways in which you think the performance and efficiency of SAS evaluation of IODP drilling proposals might be improved.

SASEC Working Group on SAS - Questionnaire

(3) Are there aspects of the SAS advisory activities for which (a) more resources are needed for more effective performance or (b) less resources could produce satisfactory (or even better) performance. (In this question, SAS "resources" could encompass panels per se, panel meeting schedules, levels and terms of panel membership, or new concepts you might suggest.)

(4) Are there ways to improve the effectiveness of SAS interactions and communications with any elements of the IODP community (IODP agencies, IODP-MI, IO's, PMO's, proponents, expedition participants)?

Please respond directly to the chair of the working group, kbecker@rsmas.miami.edu by 31 January 2007.

IIS PPG Terms of Reference (approved June 2005)

General Purpose. The Industry-IODP Science Program Planning Group (IIS PPG) reports to the Science Planning Committee (SPC). The IIS PPG shall identify subjects of cooperative scientific research between the IODP and selected industries, and promote development of IODP drilling proposals to address these objectives within the context of the IODP Initial Science Plan (ISP). Industrial sectors of interest may include oil and gas and related services, mining, biotechnology, and research and development organizations in these fields.

Mandate. The IIS PPG shall:

- Most important, define industrial priority research of joint academic/industry interest within the IODP context using high quality industry datasets, and promote development of IODP drilling proposals to address such objectives within the context of the ISP.
- As appropriate, develop effective links between academic and industry scientists, facilitate communication and cooperative scientific and technical development activities between the IODP and industry, and foster integrated multidisciplinary research projects.
- Engage industry professionals as ambassadors in communicationg and promoting IODP activities.

Generic PPG Terms of Reference (approved June 2005 after IIS-PPG ToR)

General Purpose. Program Planning Groups (PPG) are small focused planning groups proposed by either SSEP or SPC when there is a need to develop drilling programs or technological strategies to achieve the goals of the various planning documents.

Mandate. PPGs will advise upon drilling/ technology strategies and proposals for major scientific objectives that are not adequately covered by existing drilling strategies or proposals. Drilling proposals arising from PPG meetings must be submitted to the IODP-MI office by individual proponents or groups of proponents. PPGs will also foster communication between the IODP and other major geoscience initiatives. PPGs will report to the appropriate panel in the Science Advisory Structure as directed by SPC. A final written report will be delivered to the SPC chair, reviewed by the SPC, and the final revised version posted on the web.

SASEC Update of Initial Science Plan

- SASEC Consensus 0706-11: SASEC, as the executive authority of SAS, plans to update the Initial Science Plan by the end of 2008. Workshops and symposia to be held in 2006 and 2007 will provide input to this process, and community input will be solicited through the national committees, an article in the Scientific Drilling journal, an EOS advertisement, and at the AGU Town Meetings. A subcommittee of editors will be appointed by SASEC at their spring 2007 meeting and will be expected to deliver a final manuscript by summer 2008. SASEC will evaluate the final draft at its summer 2008 meeting. Evaluation may consist solely of SASEC review or may require external evaluation by summer 2008.
- This is a separate activity from the process that will start in a few years to write a new science plan for the second 10 years of IODP. That new plan will be needed ~1-2 years in advance of renewal in 2013.

Mission Implementation WG Report

- Mission Implementation WG members: S. Humphris and Y. Tatsumi for SASEC, K. Becker for SPC, M. Underwood for SSEP, and M. Talwani for IODP-MI.
- Mission Implementation WG met mid-August, came to agreement on several important aspects, and on August 25 released draft report for SPC review.
- WG agreed not to proceed with "fast-track" special process in first year to designate 1-2 initial missions.
- At August SPC meeting, several critical comments received and working group revised plan accordingly.
- Revised Mission Implementation Plan posted on IODP-MI site in September, approved by SASEC Nov 1-2.
- Two wording changes requested by Lead Agencies as of Dec 5; revised plan posted at www.iodp.org/missions.

Structure of Mission WG Report

- Introductory Statement
- Goals of Missions
- Mission Definition - from Nov 2005 SSEP
- Overarching Principles of Mission Designation + Implementation
- Call for Mission Proposals - annual, first call for April 1 2007
- Content and Structure for Mission Proposals
- Review of Mission Proposals and Mission Designation
- Mission Implementation - three stages + support levels
  - Stage 1 Mission Scoping
  - Stage 2 Mission Implementation (i.e., actual execution)
  - Stage 3 Phasedown
- Mission Evaluation Process within SAS (after initial designation)
- Critical Needs for Successful Implementation of Mission

January 19, 2006

The Energy Policy Act of 2005 and Section 999:

RPSEA / DeepStar Partnership

RPSEA
Research Partnership to Secure Energy for America

GLOBAL DEEPWATER TECHNOLOGY DEVELOPMENT
DEEPSTAR PROJECT

Mike Grecco
VP Offshore RPSEA
Director DeepStar

What is Section 999?

The Energy Policy Act of 2005 and Section 999:

A Public/Private Partnership for R&D in the Ultra-Deepwater in the Gulf of Mexico and in Unconventional Onshore Natural Gas and Other Petroleum Resources of the United States

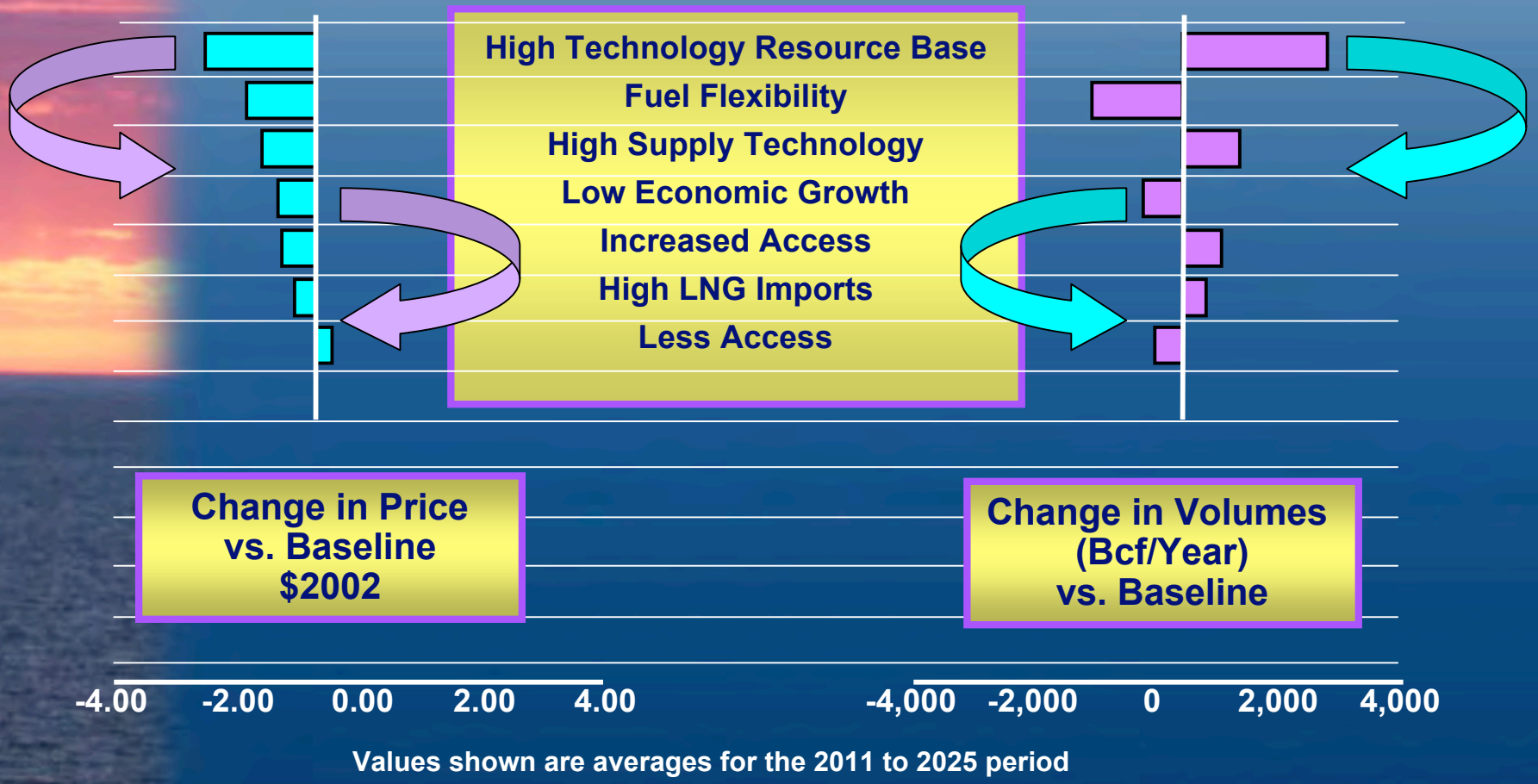
A new federal collaborative R&D partnership, managed by industry and academia, engaging all stakeholders in the value chain to benefit consumers and enhance domestic productivity and competitiveness

1999 NPC Gas Supply Study

- Two regions—deepwater Gulf of Mexico and the Rockies – will contribute most significantly to new supply."
- "Deeper wells, deeper water, and nonconventional sources will be the key to future supply."
- "Technology improvements are particularly important given the difficult conditions accompanying new resources."
- "This study assumes that technology improvements will continue at an aggressive pace. However, recent industry trends in research and development have raised concerns regarding this assumption."
- "The government should continue investing in research and development through collaborations with industry, state organizations, national laboratories and universities."

NPC 2003 Technical Resources (TCF)

NPC Selected Sensitivity Analyses: 2003 Natural Gas Supply Report



Values shown are averages for the 2011 to 2025 period

Specifically, the law directs :

- … research, development, demonstration, and commercial application of technologies for ultra-deepwater and unconventional natural gas and other petroleum resource exploration and production. (Sec.999A.a)

- … to maximize the value of natural gas and other petroleum resources of the United States, by increasing the supply…, …reducing the cost … increasing the efficiency of exploration for and production of…, while improving safety and minimizing environmental impacts. (Sec.999B.a)

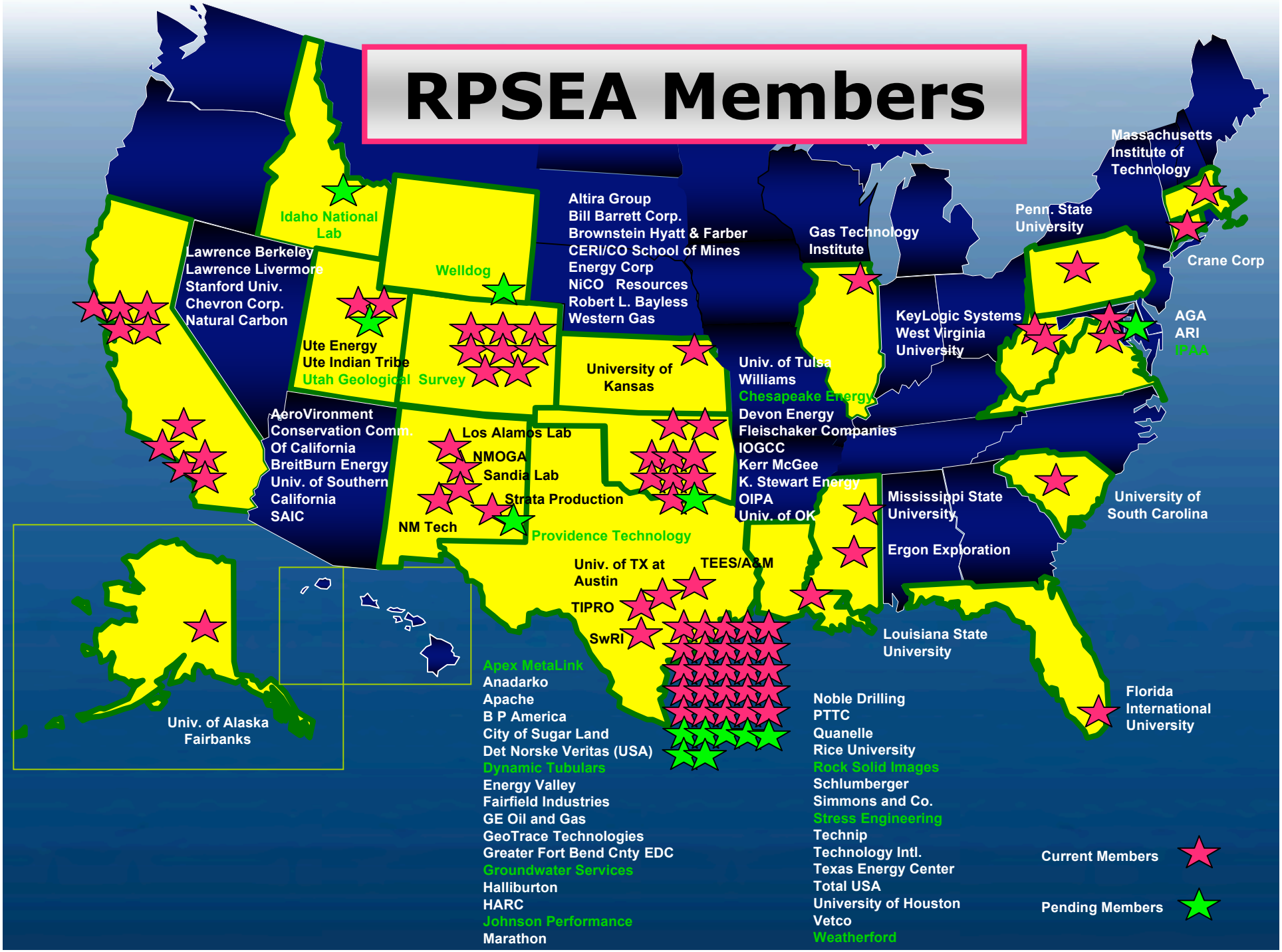
This Public/Private Research Partnership will be managed through a "Program Consortium"

Who is RPSEA?

What are its Statutory Features?

A 501c3 not for profit

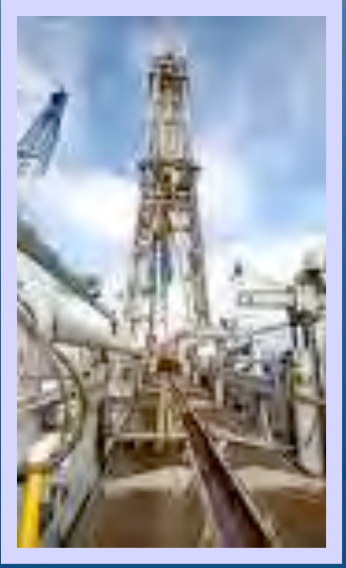
Competitively selected by DOE as the Program Consortium Manager


RPSEA Members
Idaho National Lab
Lawrence Berkeley
Lawrence Livermore
Stanford Univ.
Chevron Corp.
Natural Carbon
Welldog
Ute Energy
Ute Indian Tribe
Utah Geological Survey
Altira Group
Bill Barrett Corp.
Brownstein Hyatt & Farber
CERI/CO School of Mines
Energy Corp
NiCO Resources
Robert L. Bayless
Western Gas
University of Kansas
AeroVironment
Conservation Comm.
Of California
BreitBurn Energy
Univ. of Southern
California
SAIC
Los Alamos Lab
NMOGA
Sandia Lab
Strata Production
NM Tech
Providence Technology
Univ. of TX at Austin
TEES/A&M
TIPRO
SwRI
Univ. of Alaska Fairbanks
Apex MetaLink
Anadarko
Apache
B P America
City of Sugar Land
Det Norske Veritas (USA)
Dynamic Tubulars
Energy Valley
Fairfield Industries
GE Oil and Gas
GeoTrace Technologies
Greater Fort Bend Cnty EDC
Groundwater Services
Halliburton
HARC
Johnson Performance
Marathon
Gas Technology Institute
Univ. of Tulsa
Williams
Chesapeake Energy
Devon Energy
Fleischaker Companies
IOGCC
Kerr McGee
K. Stewart Energy
OIPA
Univ. of OK
Mississippi State University
Ergon Exploration
Louisiana State University
Noble Drilling
PTTC
Quanelle
Rice University
Rock Solid Images
Schlumberger
Simmons and Co.
Stress Engineering
Technip
Technology Intl.
Texas Energy Center
Total USA
University of Houston
Vetco
Weatherford
Penn. State University
Massachusetts Institute of Technology
Crane Corp
KeyLogic Systems
West Virginia University
AGA
ARI
IPAA
University of South Carolina
Florida International University
Current Members
Pending Members

What is the Program's focus?

The Program has three program elements:

- **Ultra-deepwater 35%**
  - (> 1500 Meters)
- **Unconventional Onshore 32.5%**
  - (Economic accessibility)
- **Small Producers 7.5%**
  - (< 1000 BOPD)



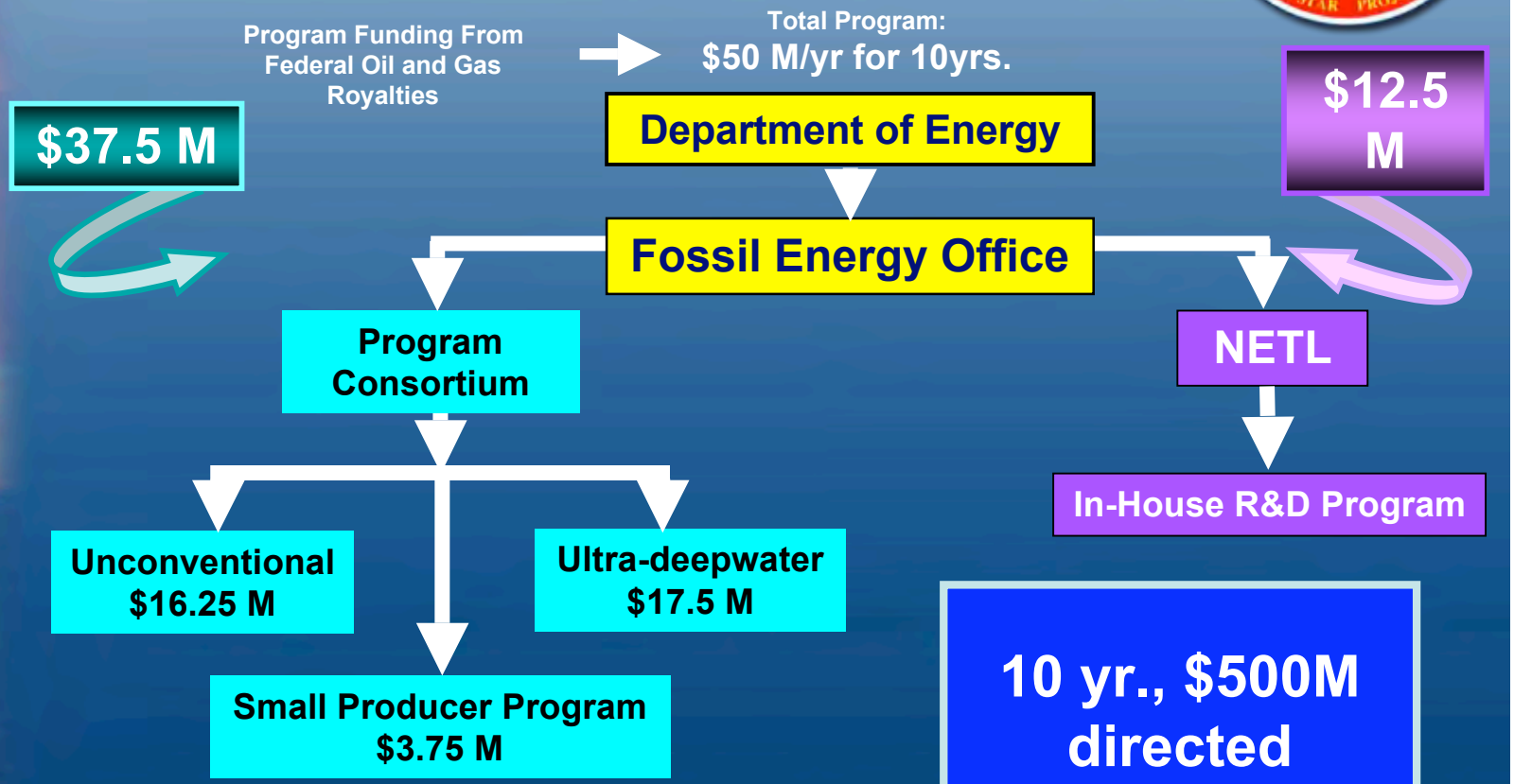
Statutory Description of Program Elements

- **Ultra-deepwater program focus**
  - **Technologies and architectures**
- **Unconventional onshore focus**
  - **Resource perspective**
- **Small producer focus**
  - **Consortia addressing unique needs of small producers**

Responsibilities of the Program Consortium?

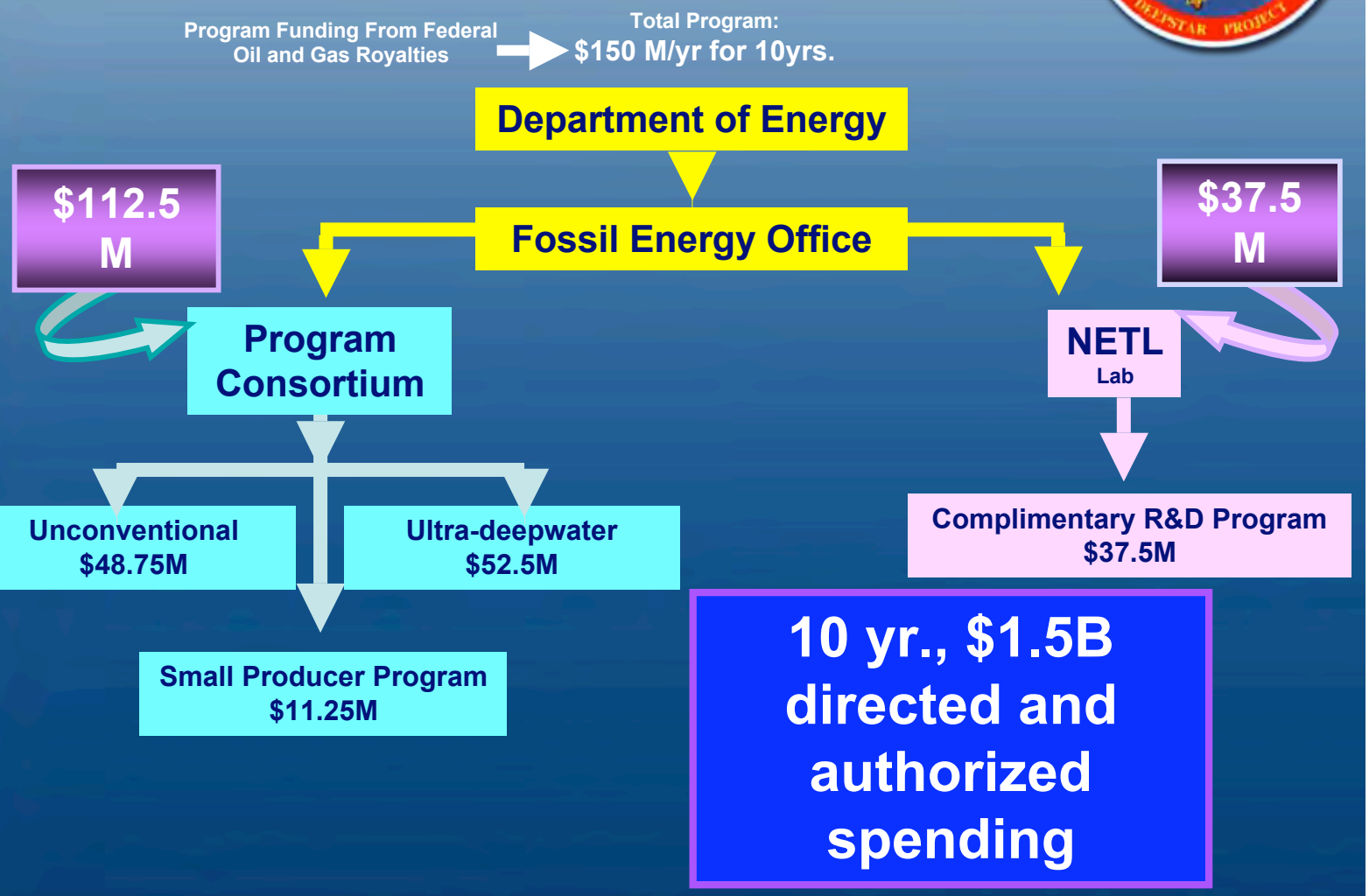
- Prepare draft annual plan for the SOE
- Recommend award recipients
- Develop project specifications
- Oversee implementation of awards, including monitoring activities to ensure compliance with conditions of awards
- Disburse funds to awardees
- Manage technology transfer

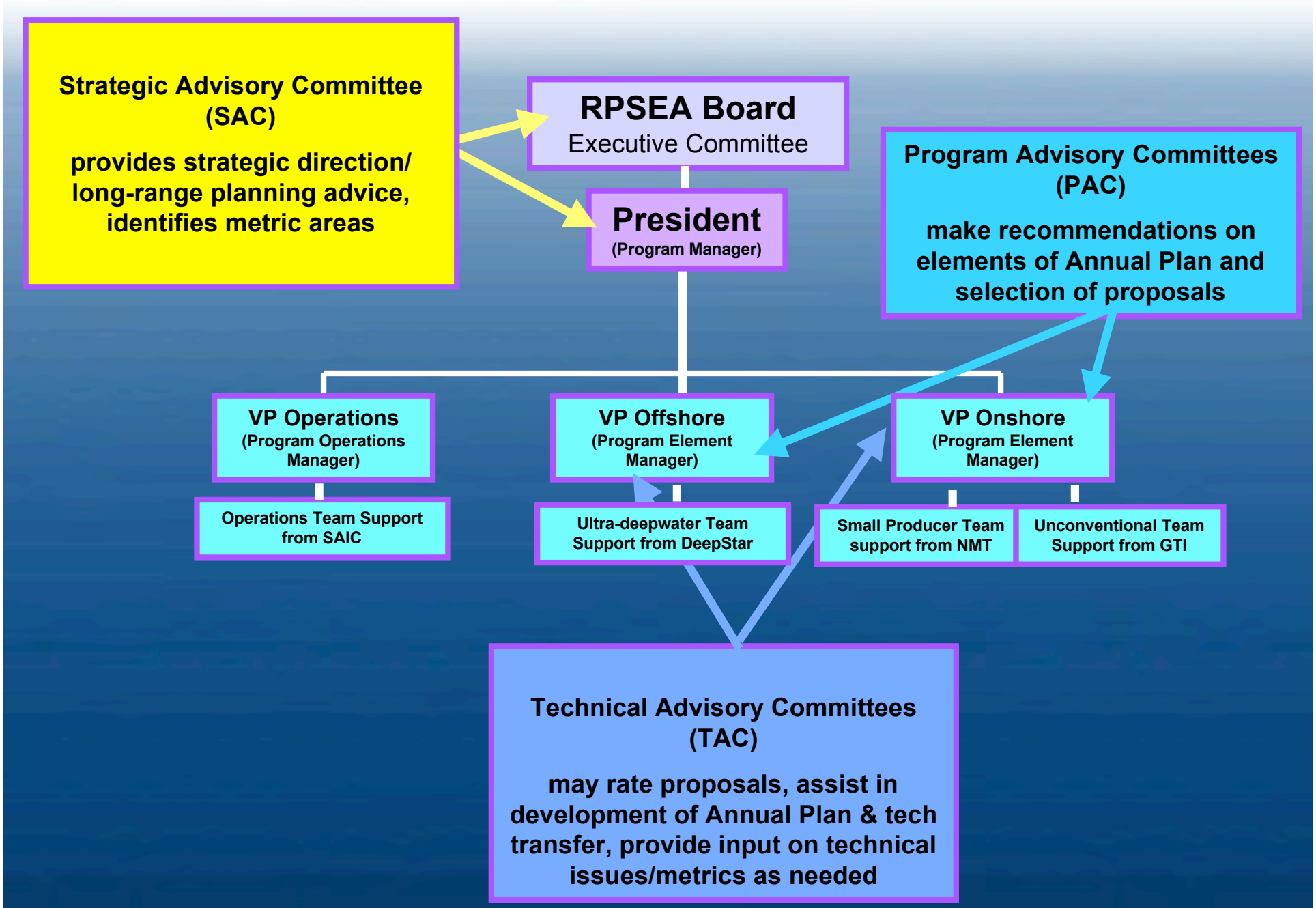
Current Program Structure/Funding



10 yr., $500M directed spending

Potential for Program Funding



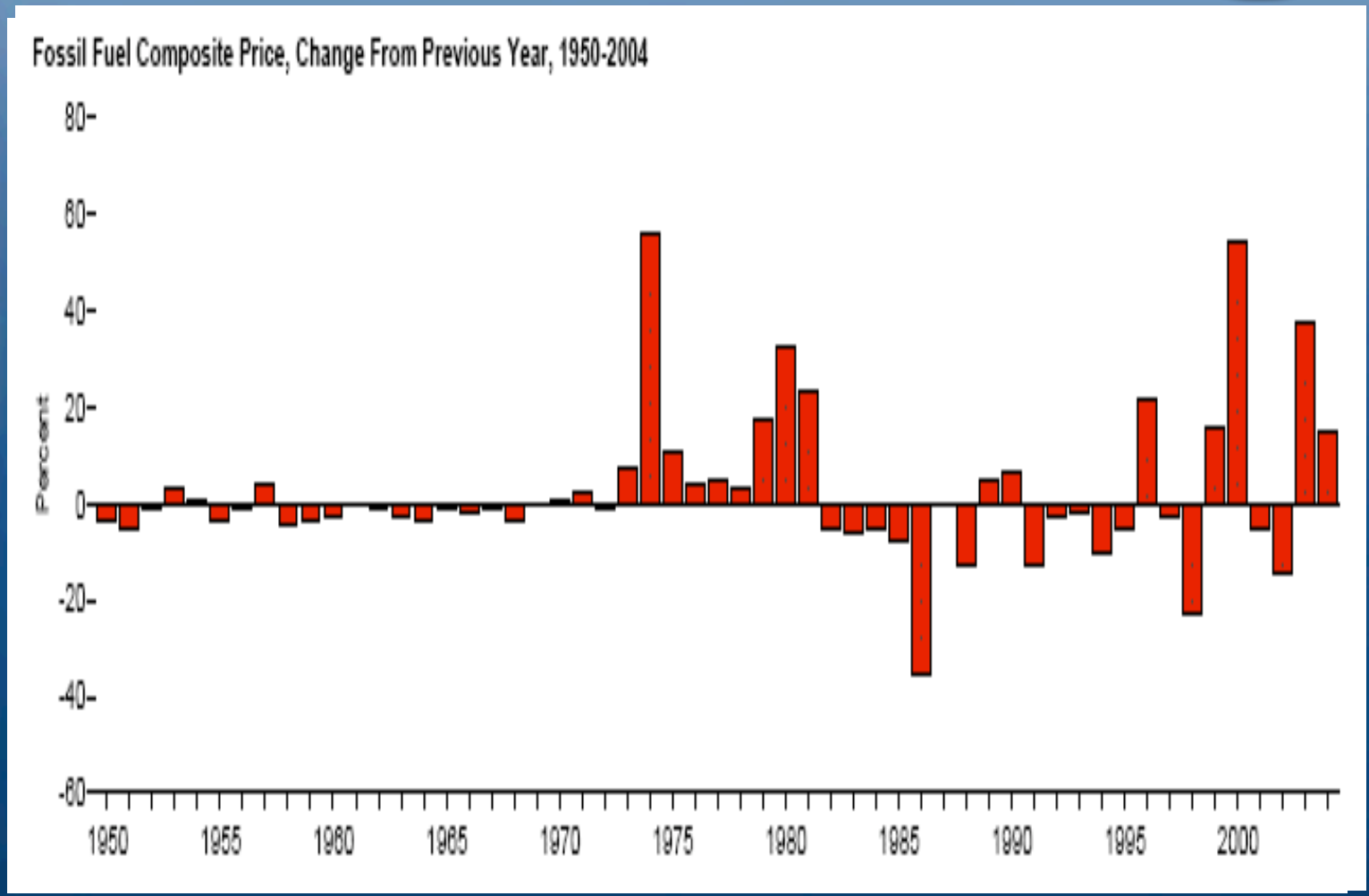

Strategic Advisory Committee (SAC)
provides strategic direction/ long-range planning advice, identifies metric areas
RPSEA Board
Executive Committee
President
(Program Manager)
Program Advisory Committees (PAC)
make recommendations on elements of Annual Plan and selection of proposals
VP Operations
(Program Operations Manager)
VP Offshore
(Program Element Manager)
VP Onshore
(Program Element Manager)
Operations Team Support from SAIC
Ultra-deepwater Team Support from DeepStar
Small Producer Team support from NMT
Unconventional Team Support from GTI
Technical Advisory Committees (TAC)
may rate proposals, assist in development of Annual Plan & tech transfer, provide input on technical issues/metrics as needed

Why Does Industry Need This?

- Significantly increased E&P costs
- Continued price volatility
- Increasing personnel constraints
- Rig & service availability
- Environmental opposition & scrutiny
- Lack of research infrastructure
- Broad need for technology transfer

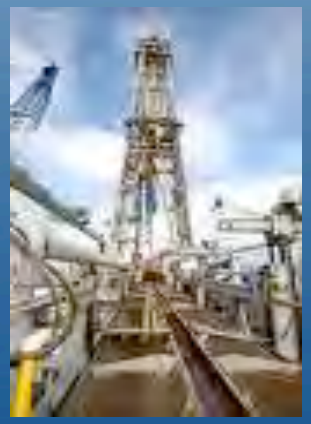
It's a very challenging business environment and it's getting even more so.

EIA Annual Energy Review 2004



Rigs & Equipment

- Has your rig(s) been short handed lately? (And more new rigs are being built or reassembled)
- Technology and improved understanding of processes must generate leverage on the existing fleet by extracting more footage and productive wells per rig

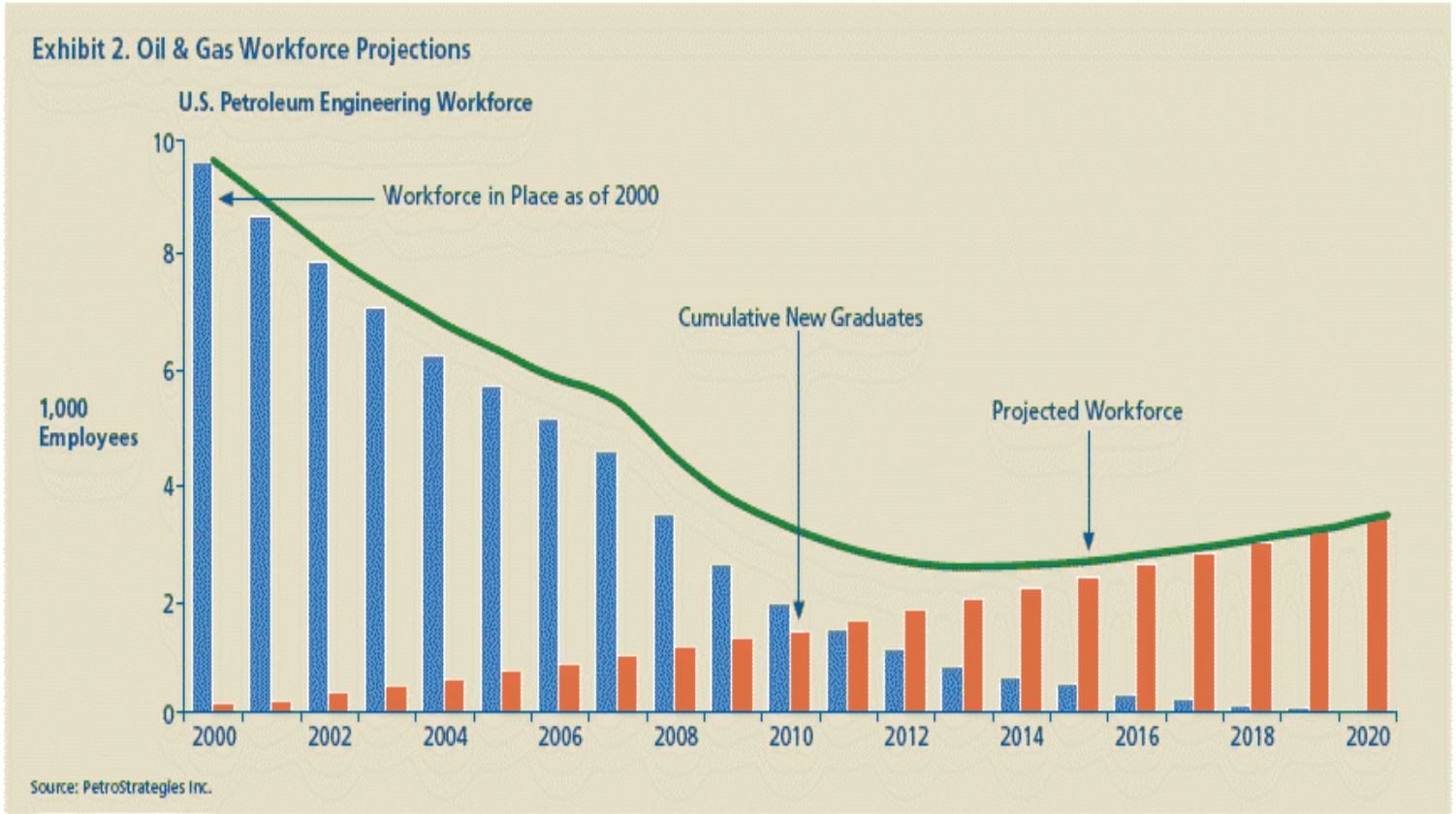


- Improved reservoir characterization leverages the rig fleet by optimizing the value of every well bore

Environmental Constraints

- A mandate - lessen the footprint and overall impact of all operations
- Technology and improved processes allow the development of more reserves per unit of activity
- Technology to address public policy concerns

Workforce Constraints



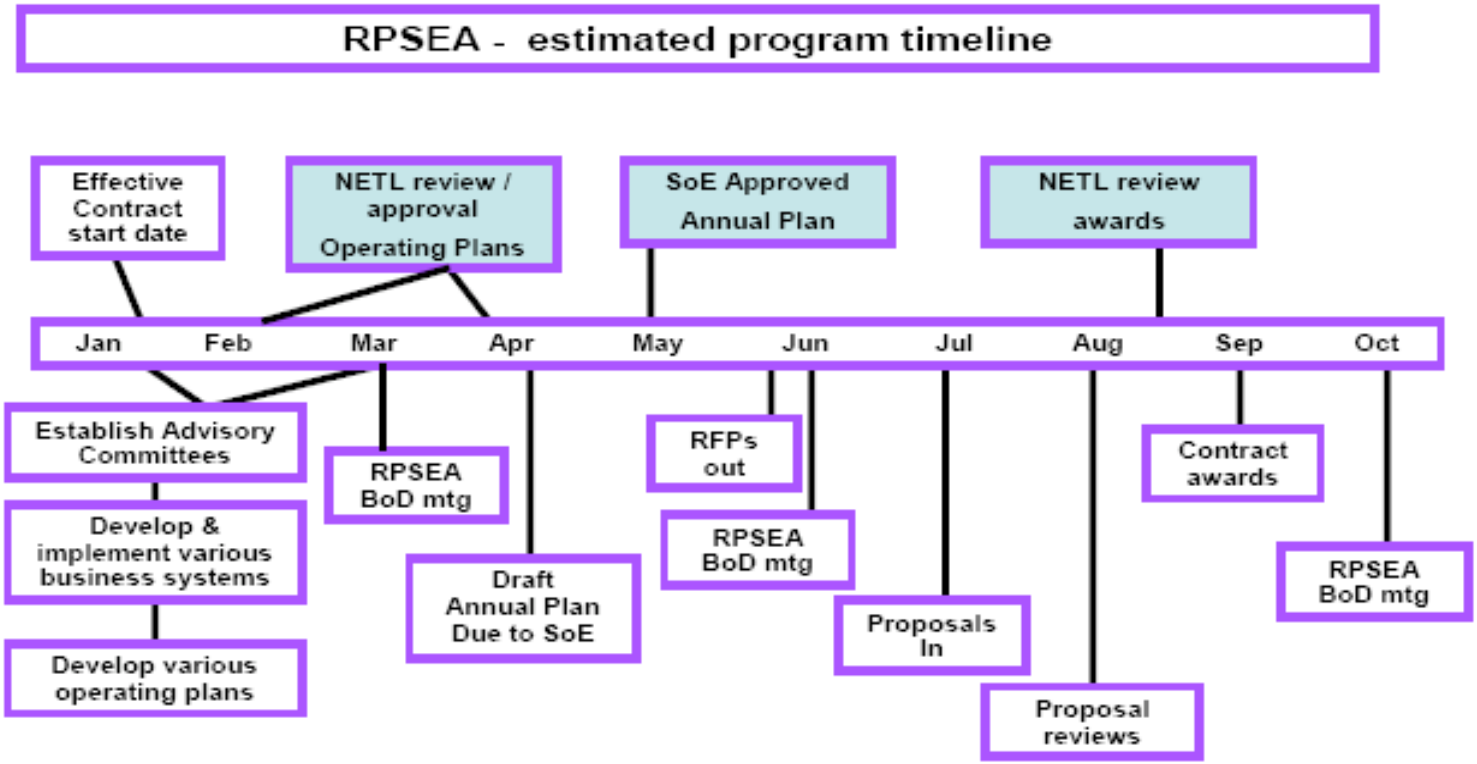
From "Deloitte Research – The Talent Crisis in Upstream Oil & Gas"

Solutions, not Rhetoric

- It starts with commitment - $50M per year in stable directed spending with potentially an additional $100M per year plus industry matching funds.
- Unique publicly funded opportunity to determine industry's needs and then utilize industry's leadership in partnership with universities, researchers, and technologists to develop solutions for the American consumer.
- Generate multiples by forging new partnerships and leveraging the value of new supplies with, for example, end use efficiency.

The time for action is now!

RPSEA 2007 Schedule



Any Question Regarding RPSEA?

DeepStar: Deepwater Technology Needs

Mike Grecco
DeepStar

RPSEA
Research Partnership to Secure Energy for America

January 19, 2006

http://www.deepstar.org

Scope and Objective

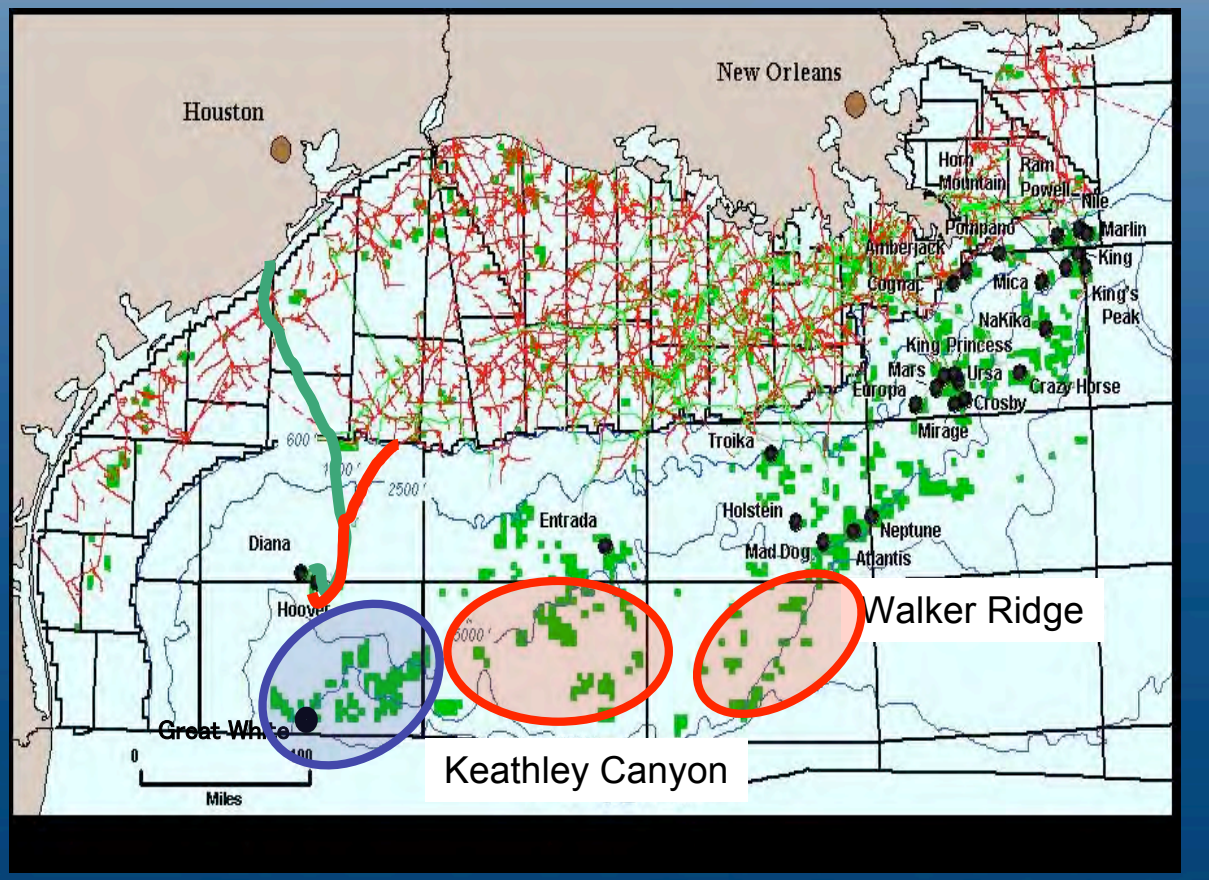
- DeepStar needed to identify emerging technology needs to guide their Technology Development plans.
- Future field developments will be built upon or be technology extensions of current deepwater field development systems.
- Facility designs are driven by the reservoir and its location in the world.
- By identifying exploration targets, facility technology gaps and needs could then be listed which need development work.
- This paper outlines the process used and the findings of the work performed by DeepStar.

GoM Challenge Fields of Interest

- 2 Target Fields with 4 development Scenarios
- Gulf of Mexico (HPHT Oil) – Canopy Field
  - Semi
  - FPSO EPS
- Gulf of Mexico (HPHT Sour Gas) – Diablo Field
  - Semi with In-Field Sweetening
  - Produce to Beach

GOM Deepwater Trends

- Subsalt
- Deeper wells
- Geohazards
- Higher pressure
- Lacking infrastructure
- Higher Drilling Costs
- Challenging Economics

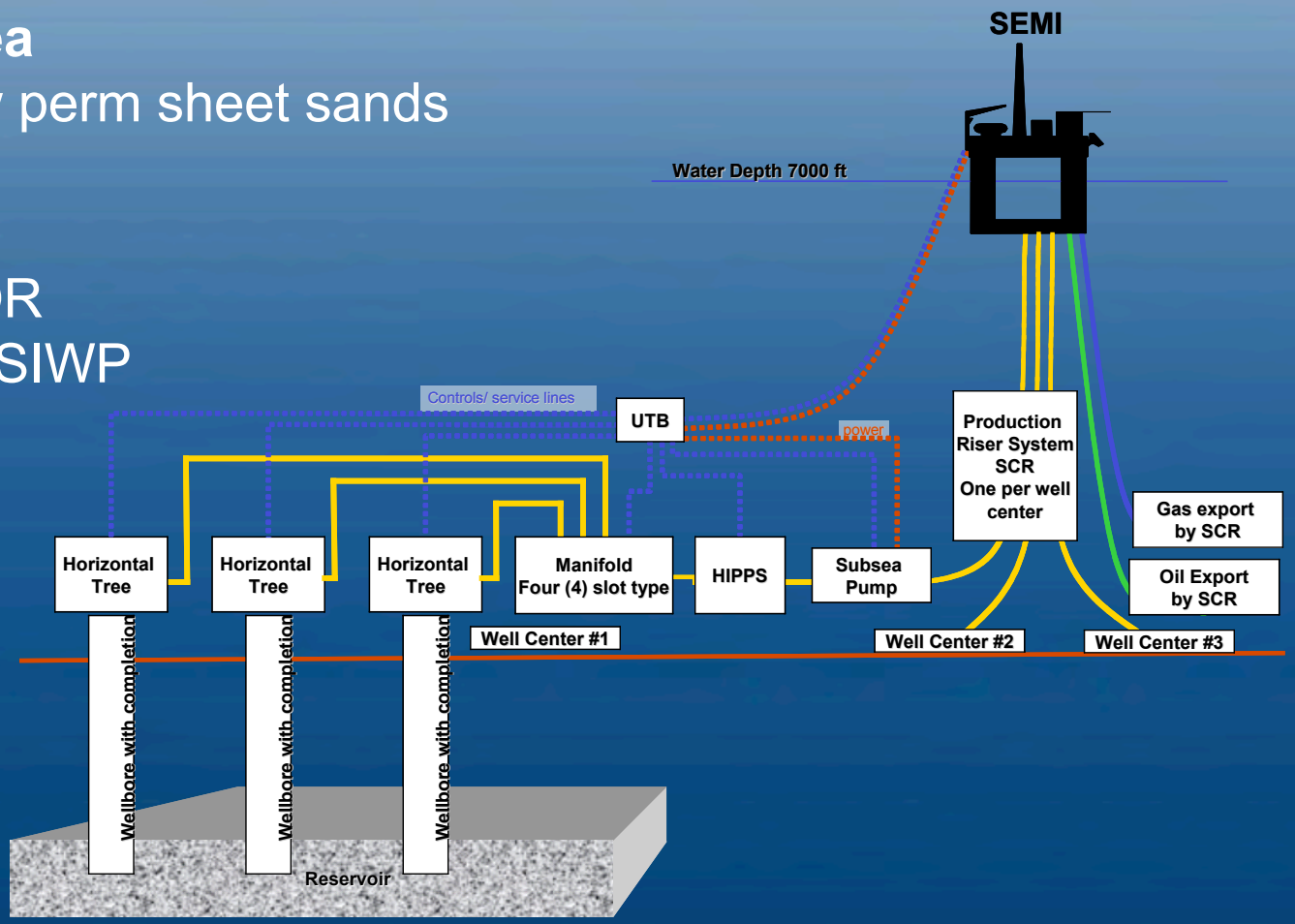


DeepStar/BP (Nov04)

Canopy
GOM Sub Salt HPHT Oil

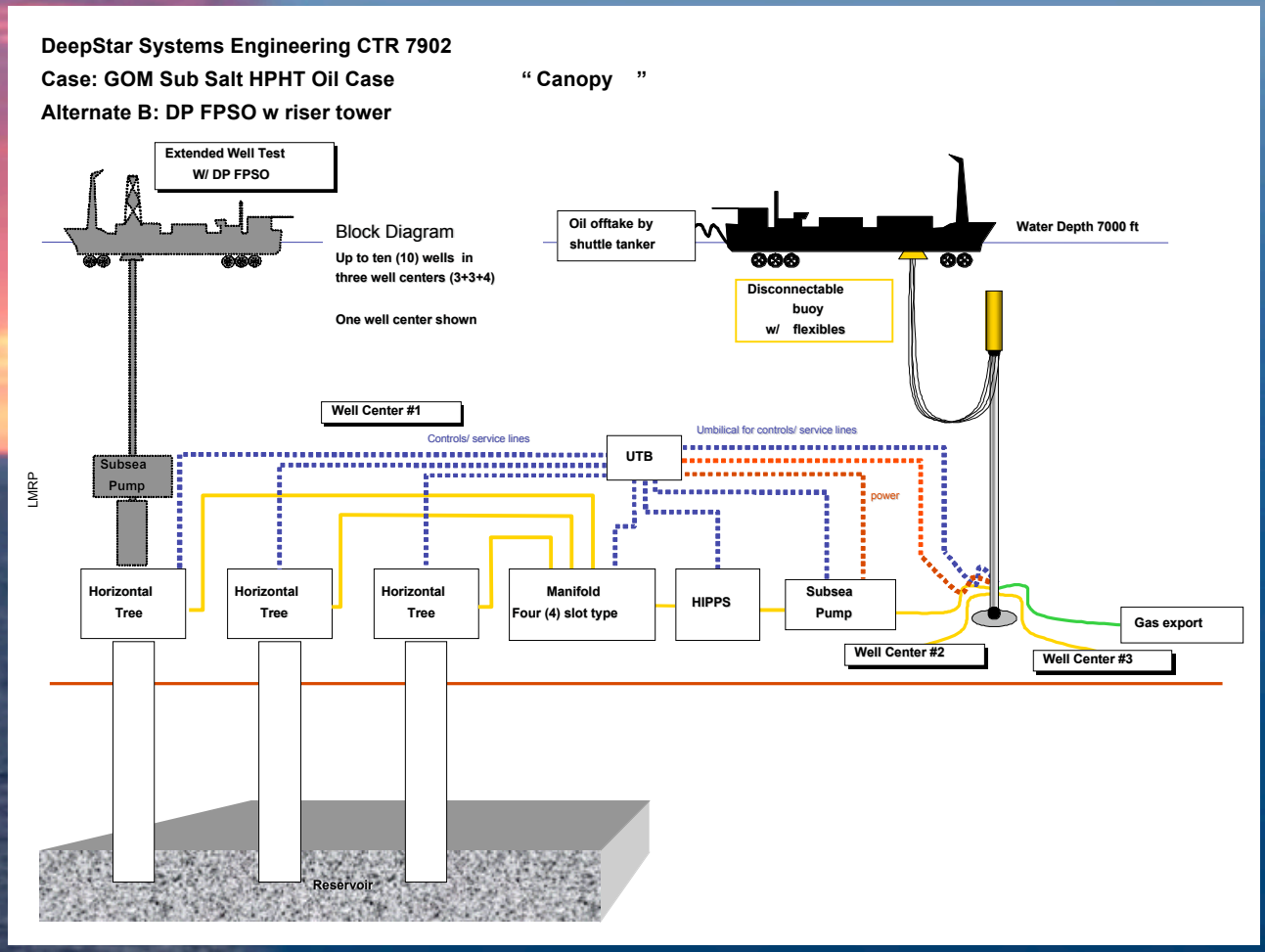
Walker Ridge Area

- Thick subsalt low perm sheet sands
- 7,000 fwd
- 30,000+ TVD
- Oil with ~300 GOR
- 14,500 psi initial SIWP
- 285°F BHT



Key issue is well deliverability and high drawdown pressure

Canopy – EPS Alternate Case



Walker Ridge Area

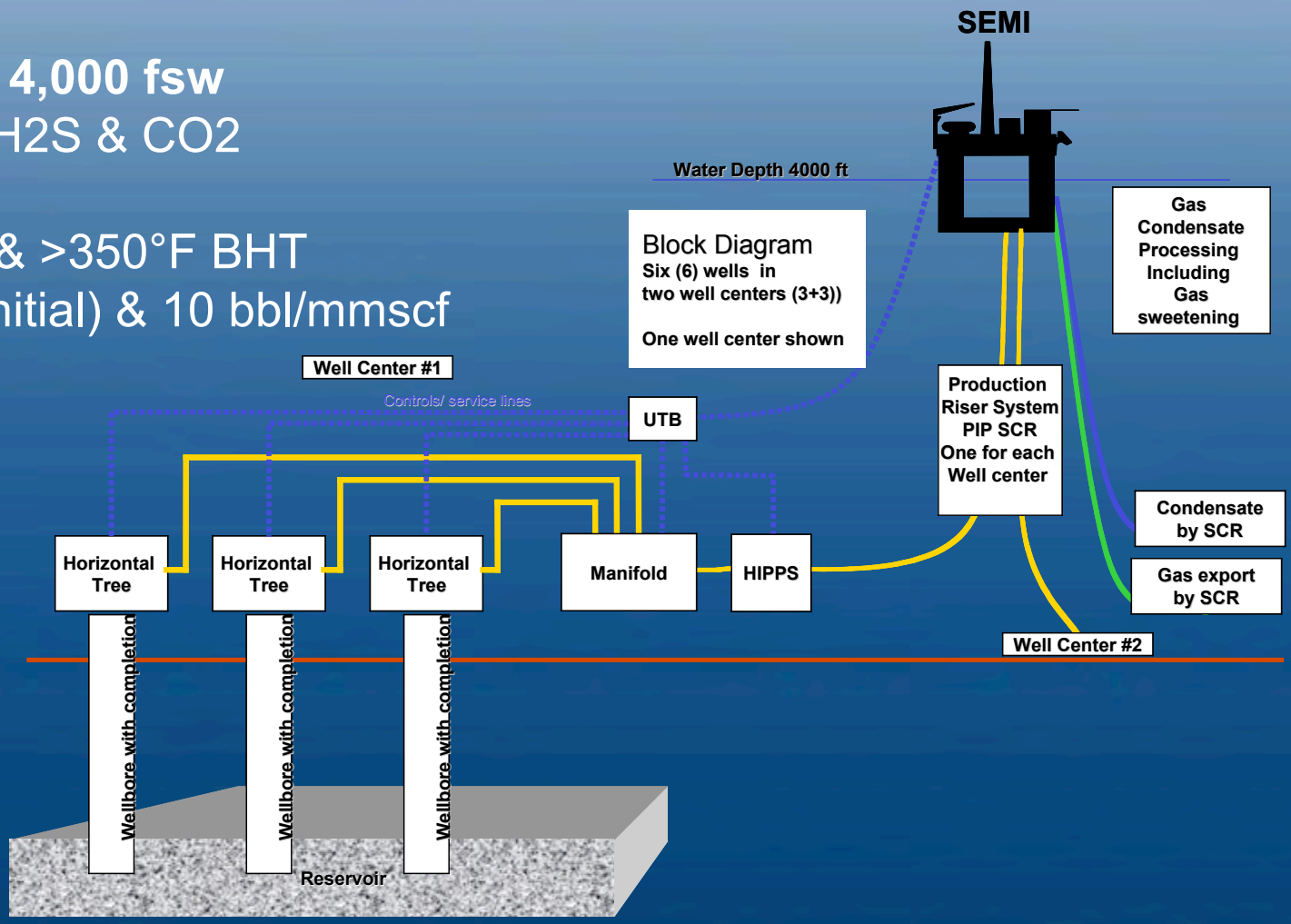
Extended Well Test maturing into an Early Production System (A Risk Management Strategy.)

Key issue is well deliverability and high drawdown pressure

Diablo
HPHT Sour Gas Field

Eastern Gulf - 4,000 fsw

- Deep Gas w/ H2S & CO2
- 30,000+ tvd
- 21,000 SIWP & >350°F BHT
- 100 mmscfd (initial) & 10 bbl/mmscf liquids



Issues are high deliverability, pressure and sour gas.

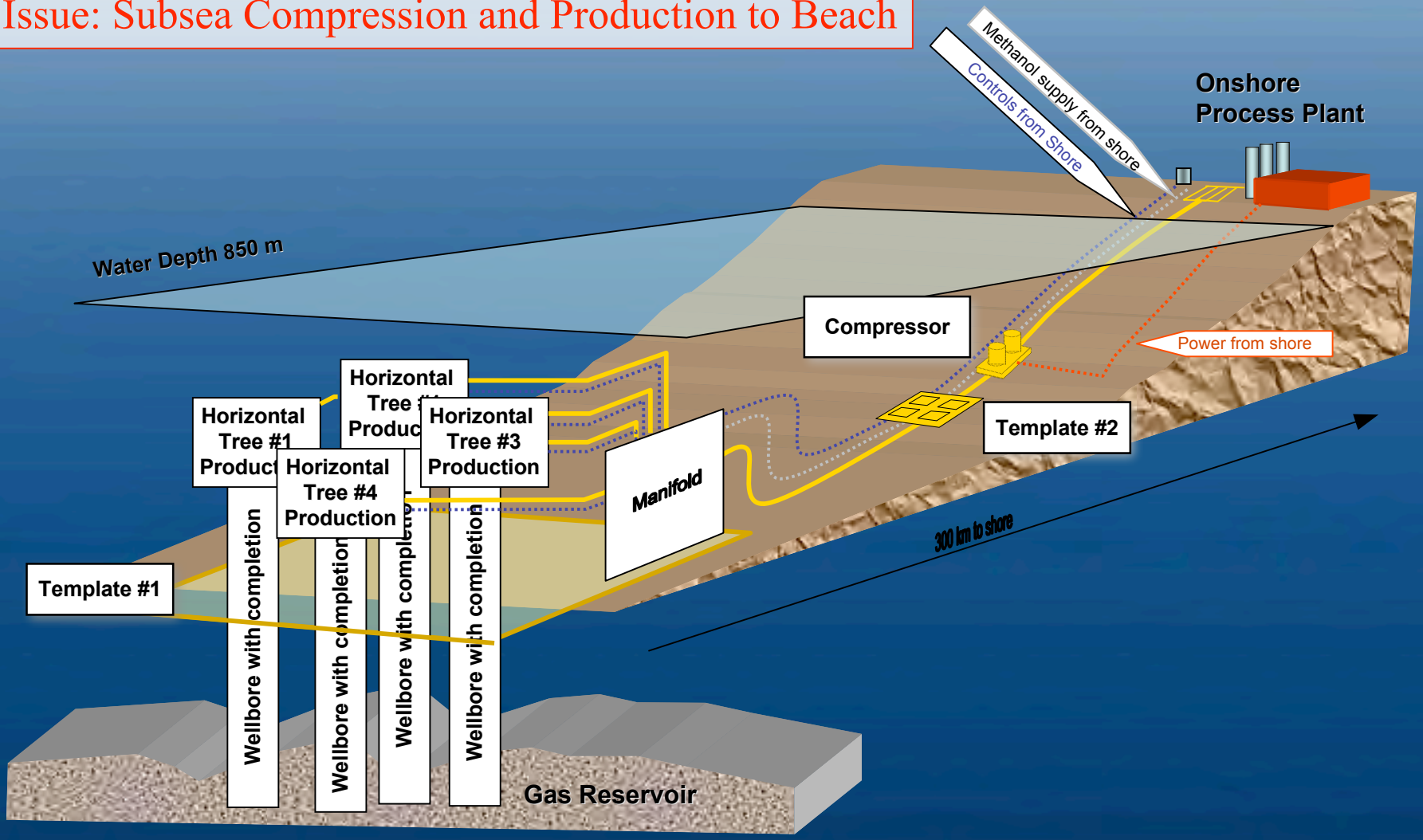
Diablo
HPHT Sour Gas Field

Subsea Systems

- Pipeline & Riser Sizing
  - Fully rated X70 welded limits to 5.80” ID, 8-5/8” OD
  - Installation and hang-off weight limitations
  - Flowline buckling and riser fatigue
  - Rig Deployed T&C
- HIPPS
  - Enabler
  - Cost reduction
  - Tie-in to existing lo-pressure infrastructure

Diablo- HPHT Sour Gas Field

Issue: Subsea Compression and Production to Beach



Technology Gap Assessment

- Evaluated by technical experts both in workshops and in key individual interviews
- Over 350 separate Technology Needs and Gaps were identified
- To manage this amount of information, similar Needs and Gaps were grouped together in Common **Themes**
- A total of 28 Themes were identified
  - 5 Enabling Themes
  - 20 Enhancing Themes
  - 3 Science Themes

General Results

- ***Enabling Themes***
  - (Not Ranked)
- HPHT Drilling and Production Technologies
  - (22.5 ksi wp x 350+ ^{o}F)
- Subsea downhole artificial lift for heavy oils & large drawdown pressures.
- **Enabling technology is required before the development may be realized.**

- ***Science Themes***
  - (Not Ranked)
- Materials and Services for H_2S & CO_2
- Facility Global Analysis
- Flow Assurance – Viscous Oils & HPHT fluids
- **Science delivers methods, procedures and tools that are subject to continuous improvement through R&D**

Priority Formula for Ranking Enhancing Themes

- **Each Theme was identified with:**
  - Technology Value or Prize
  - Cost to Develop
  - Schedule to Develop
  - Development Risk
- **Development Factor (DF)**
- **DF = Cost * Risk / Schedule**

- **Application data for each Theme:**
- Ave IRR Impact on Projects
- Project Risk (1 – 5)
  - Functionality Risk
  - Failure Consequence
- **Economic Factor (EF)**
- **EF = IRR * Risk**

Priority Rank = Development Factor * Economic Factor

Enhancing Themes

- **HPHT risers and flowlines**
  - HP risers (for working pressures in the 15+ ksi range.)
  - Threaded flowlines and risers (both for exotic materials and for installation resources)
- **Completion & Well Maintenance**
  - Operational efficiencies, high drawdown capabilities and reliability
  - Rigless well intervention
- **Offshore installation & Maintenance**
  - Technology, practices and risks
- **Subsea Metering & high bandwidth communications**
  - Important for GOM for allocation

Enhancing Themes

- **Improve reservoir productivity**
  - Reservoir water flooding & water management
  - Production flow assurance – How are viscosity, emulsion and scaling managed?
  - Artificial lift – add pressure boosting closer to the reservoir
- **Subsea pressure boosting**
  - Gas and Liquid dominated systems
  - High power distribution
- **Subsea Processing & water handling**
  - Installation issues
  - Control & Monitoring
  - Solids Management

Economic Impact

Figure 8 - Type of Benefit Distribution

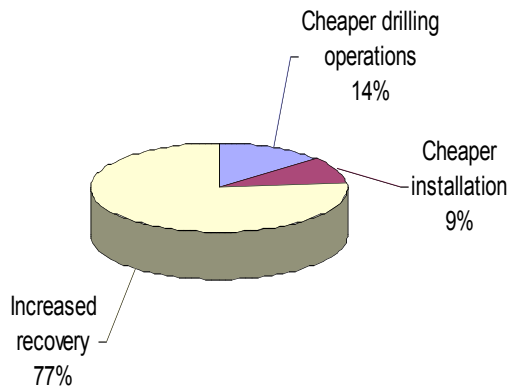
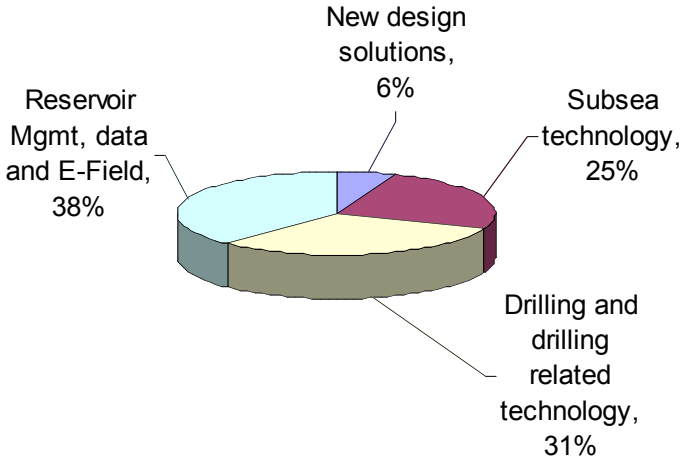


Figure 9 - Technology Discipline Distribution

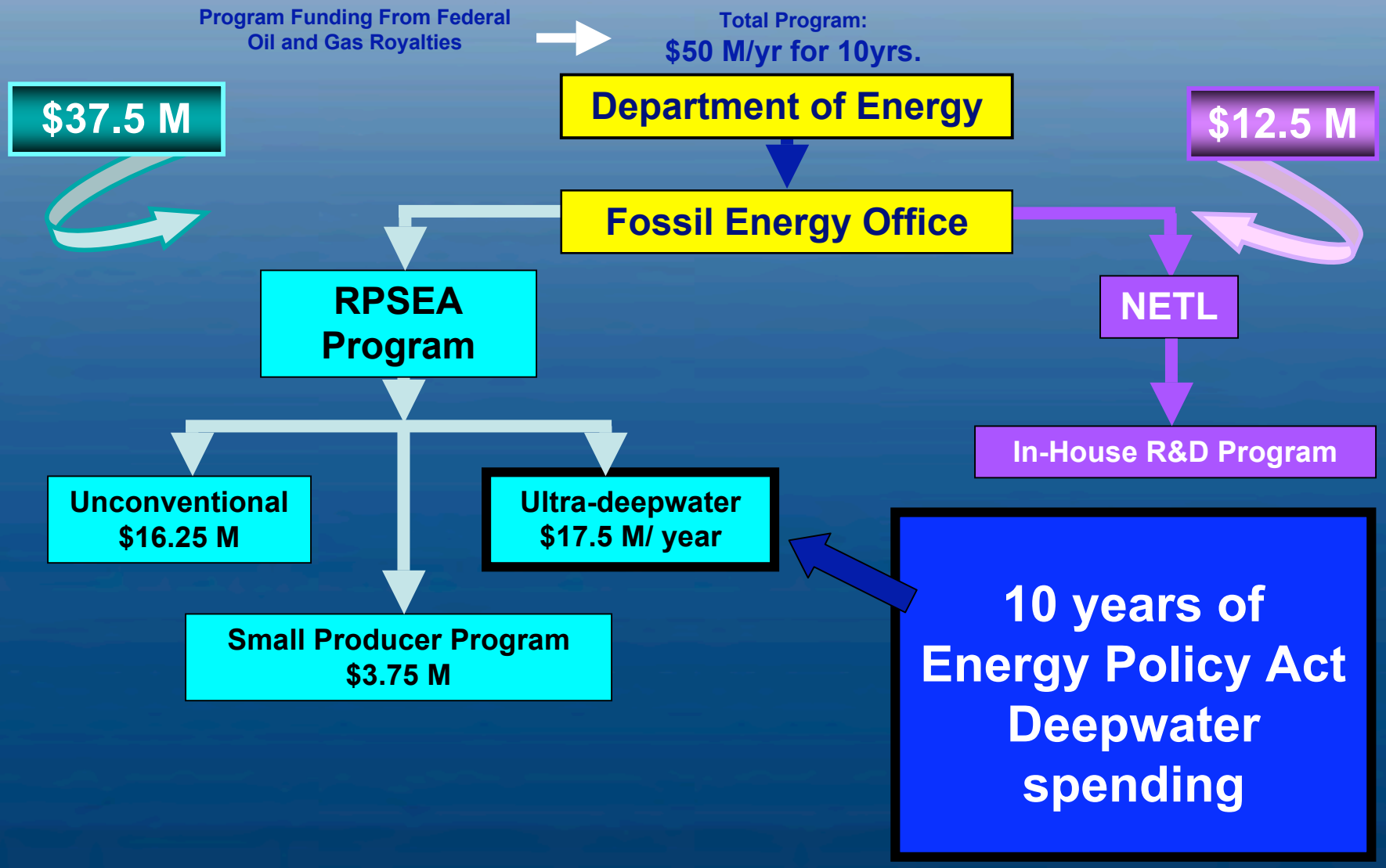


- Economic life-cycle evaluations demonstrate REVENUE enhancing technologies have greatest impact when compared to OPEX and CAPEX Technologies (Figure 8).
- CAPEX (like drilling) have significant project economic impact.
- Potential for improvement exists in all technical disciplines

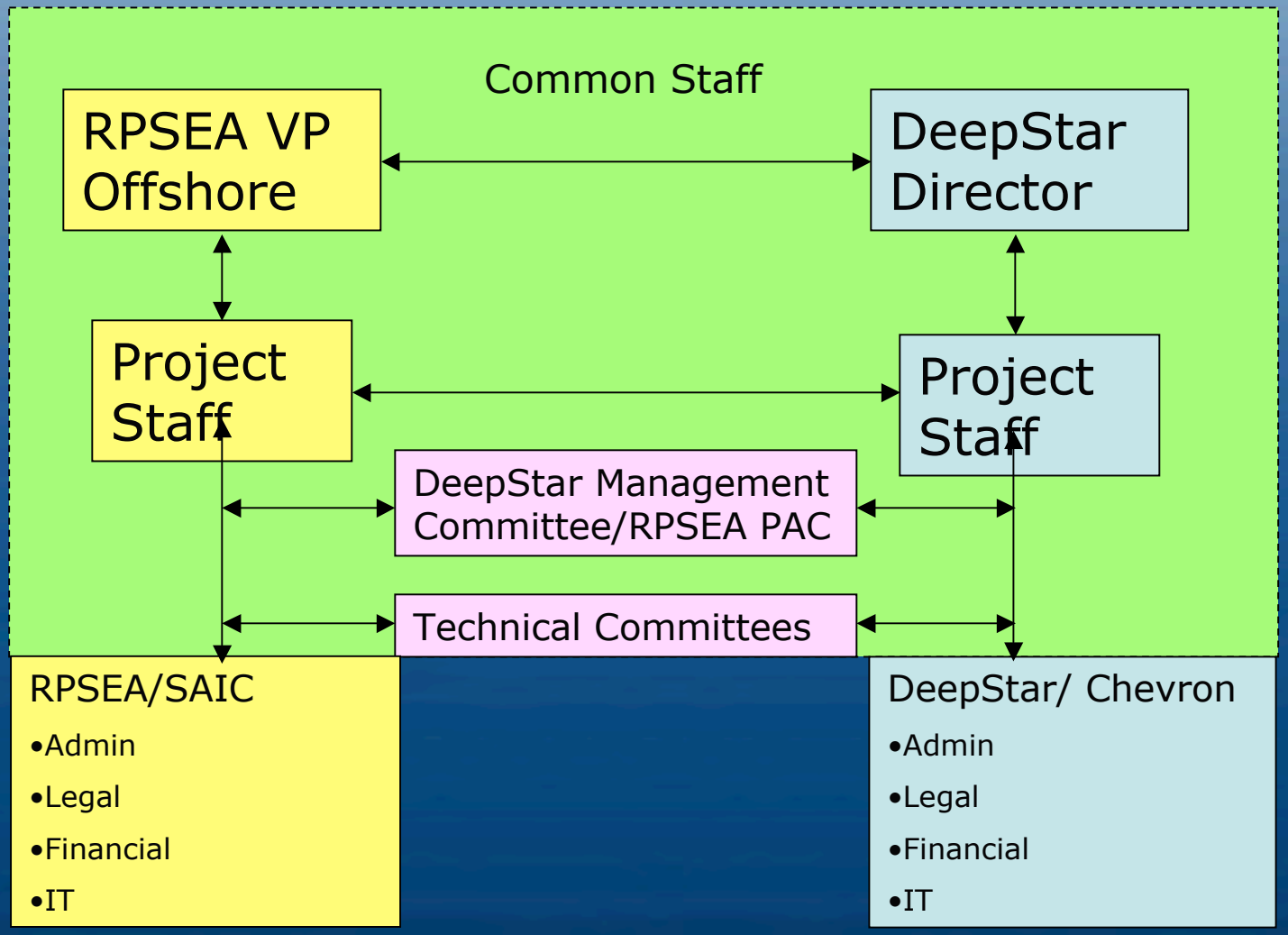
Technology Readiness Level (TRL)

- TRLs will provide a new DeepStar Metric to quickly identify the maturity of a technology.
- TRLs range from TRL 0 (Concept) to TRL 7 for General Field Usage and Qualification.
- Builds upon the new Standards and Guidelines for Development, Field Qualification and Reliability Assessment for a technology.
- Expected to enhance communications between the various stakeholders interested in deepwater developments.

Future Deepwater Funding - RPSEA



RPSEA – DeepStar Relationship



Thank You

Any Questions?

DRAFT NOTES

Birth and evolution of South Atlantic conjugate margins

(Based on material prepared and presented at the IODP Workshop on Continental Breakup, Pontresina, Switzerland, September 14-19, 2006)

Co-proponents (Attendees at the Pontresina break-out session on the South Atlantic - Alphabetical order):

Jamie Austin, jamie@utig.ig.utexas.edu
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Webster Mohriak, webmohr@petrobras.com.br
Ian Norton, ian.o.norton@exxonmobil.com
Ralph Stephen, rstephen@whoi.edu
Patrick Unternehr, patrick.unternehr@total.com

Narrative:

Drilling the distal, conjugate margins of the South Atlantic is a good potential project for IODP-Industry collaboration. Models for the formation of the sedimentary basins can be obtained by backstripping the stratigraphy similar to work done with data from the original COST wells drilled off the east coast of the US in the early 70's. The petroleum industry is interested in sedimentary basin formation because of their potential for oil and gas production. Academic scientists are interested in the South Atlantic because these margins represent important ground-truth for their models of continental breakup - one of the fundamental processes of plate tectonics.

There is extensive seismic data (at 5km spacing) on the Brazilian side with which to define the regional context for the drilling. Sufficient interpreted seismic data exists to define areas where the water depth is shallow enough for the Chikyu to drill (less than 2,500m) and where upper basement is still within the total drill depth capability of the ship (8,000m). In order to avoid petroleum traps during IODP drilling detailed 3-D seismic would still need to be run at the proposed site. One goal of siting is "to minimize the salt and to maximize the sag". Since there is no guarantee that oil or gas will not be encountered, riser drilling with blow-out prevention capability is still recommended. Any oil or gas encountered during drilling would, of course, be the property of the host country and all data from the drilling would be made public.

On the African side some data is available (eg the Congospan spec data and the Contrucci et al French survey) but it is much less dense than on the Brazilian side. (Manik was going to contact Sujata, regarding the availability of the data and interpretation of the GXT lines off Africa. A preliminary interpretation of this data was

made by Steve Henry.) More seismic may need to be shot in order to set the regional context for drilling. The data on the African side has been acquired by a consortium of oil companies so getting permission to the release the data may be more difficult.

If a company or consortium of companies is to spend money on acquisition and/or interpretation of 3-D seismic data, then they need some assurance from the IODP SSEP's that the drilling will actually take place. Resources also need to be allocated post-cruise to work-up and publish the results. We recommend that the Birth and Evolution off the South Atlantic Conjugate Margin (BESACM) project be submitted first as a Pre-Proposal (see below) for the April 1, 2007 submission date. Then companies can assess their level of commitment based on the feedback from the SSEPs.

The primary motivation for this proposal is to study continental break-up and the formation of sedimentary basins. Important secondary goals will be to provide constraints on the paleo-circulation of the South Atlantic and its effect on paleo-climate as well as studies of the deep biosphere. Ties to long term borehole observatories to study the time dependence of local, regional and global processes could also be made as the proposal evolves.

Personnel:

We need a "champion" or "hero" on this project. (At the Fall AGU in San Francisco Harm van Avendonk agreed to lead the charge on the South Atlantic drilling proposal.) It would also be important to have strong supporting academic geologists from Brazil, France, and Angola (or whichever African country owns the territory where we would like to drill). Participation should also be sought from other petroleum companies such as BP and Shell. Ian's co-authors on his white paper for the workshop (see below) were Bill Powell and Garry Karner.

How does this proposal contribute to the 'Birth of Oceans' mission?

What distinguishes the proposed South Atlantic research with respect to the other basins?
There are undeformed sediments next to the ocean-continent boundary that have no analogs in the North Atlantic There is also salt.
The syn-rift sections and sag sections are thicker in the South Atlantic and that could enable an understanding of the temporal and spatial thinning of the lithosphere.
There is an opportunity here to study the timing of volcanism with respect to rifting.

Describe world-class scientific objectives.

We propose a set of wells that will try to answer the following relevant scientific questions:
Use the stratigraphic evidence to quantify the lithospheric thinning.

The nature of the syn-rift and immediate thermal subsidence sediments over hyper-extended crust.
The relationship between sag sediments and extension.
The relationships between the salt, thinning and extension.
Evaluate the diachronism of South Atlantic breakup.
Characterization of the basement rocks below the salt.
The relationship of the implacement of the volcanics in the margin with respect to the hot-spot.
Subsidence, paleo-geothermometry and paleobathimetry over the hyper-extended crust.

Additional material is available in the Karner et al workshop white paper - see below.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

Drill "close"to previous ODP, DSDP and IODP wells
Drill on intermediate crust.
Avoid areas close to transform zones. Drill in between
Drill where there are syn-rift sediments and immediate presumed thermal subsidence sediments
Drill at least two wells to characterize eventual diachronism in the breakup
Do extensive compilation of data and bibliography
Workflow of a exploration company: geophysical acquisition, geophysical processing, interpretation, numerical and physical modeling, choosing the site, planning the well and the acquisition workplan

Figure 1: Proposed Sites (COST- Continental Offshore Stratigraphic Test)

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	

COST – SA - 1	Northen Campos Basin	Less than 2500m	5000m	500m	5500m (TD = 8000m)	To evaluate the baseme syn rift, including sag basin sediments, as wel as some salt and volcan to constrain the thinnin process with the stratigraphy.
COST – SA – 2	Offshore Angola (Kwanza basin)	2000m	5000m	500	5500m (TD=7500m)	The site objective is the same as COST – SA – well but globally it will evaluate the asymmetry the geologic evolution the South Atlantic marg
COST – SA- 3	?	?	?	?	?	To study the hinge zon that controls the detachment for the crus faults.

[We need some figures here. 1) A cartoon, similar to the drawing on the white board (Figure 2), showing the principle features of the South Atlantic continental margins - thinning zone, Moho, salt, OCT, igneous basement, sag basement, etc. 2) A map of the two margins re-constructed at M0 showing the seismic coverage and the most promising seismic transect. 3) Some of the interpreted and previously published seismic profiles from the Brazilian side (Dimas). 4) An interpretation of the African side similar to figures that Ian showed at the meeting.]

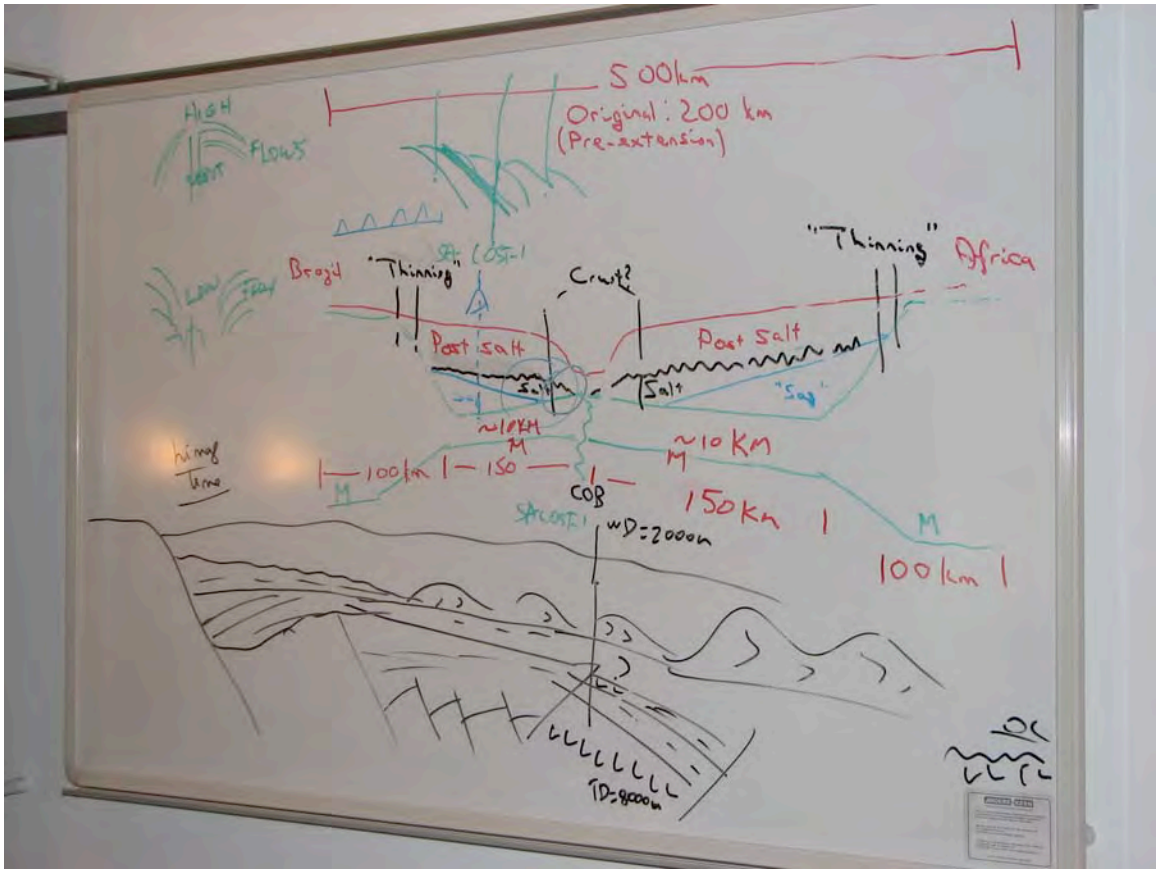


Figure 2

Tentative Time Line

October 1/06 - Expressions of intent to participate in the "Breakup Mission" should be sent to John Hopper (hopper@geo.tamu.edu) preferably with a named "champion". (Note that John Hopper has been designated as the lead-PI for the Breakup Mission umbrella proposal.) If all else fails Ralph could be used as a placeholder POC.

December 11-15/06 (AGU - San Francisco) - IODP-MI will have a town hall meeting where plans for the "Breakup Mission" will be presented.

January 1/07 - Drafts of Pre-proposals for the components of the "Breakup Mission" should be submitted to John Hopper

January-February/07 - IISPPG meeting in Houston (TBD)

April 1/07 - Submission date for Pre- and Full- Proposals.

Pre-proposal Format (from "SAS_Guidelines_2.0.pdf" at the IODP Web Site):

" Preliminary Proposals

An individual scientist or group of scientists with a new idea for scientific ocean drilling should initially submit a preliminary proposal. Preliminary proposals must not exceed 10 pages in length, including text, tables, and figures, but excluding references. Preliminary proposals must also include the following items that do not count against the page limit:
– an official proposal cover sheet, complete with an abstract of 400 words or less, a statement of the scientific objectives, and a list of the proposed drill sites,
– an initial site summary form for each proposed drill site, with designated site names conforming to established policy (see below).

In addition, a well-prepared preliminary proposal should:
– state the scientific objectives and explain how those objectives relate to, or advance beyond, the IODP Initial Science Plan,
– justify the need for drilling to accomplish the scientific objectives,
– present a well-defined strategy for addressing the scientific objectives through drilling, logging, or other down-hole measurements,
– describe the proposed drill sites, penetration depths, expected lithologies, and available site-survey data,
– describe briefly any relationships to other international geoscience programs.

Shortly after each proposal deadline, all new and revised preliminary proposals go to the Science Steering and Evaluation Panels (SSEPs) for review. The SSEPs assess each preliminary proposal in terms of its relevance to the IODP Initial Science Plan, the suitability of the study area and study sites for addressing the proposed scientific objectives, and whether the achievement of those objectives would likely result in any fundamental scientific advances. The SSEPs also determine whether a given preliminary proposal provides a satisfactory basis for developing a complex drilling project (CDP). Proponents receive a written summary of the SSEPs review instructing them whether to revise their preliminary proposal, develop it into a full proposal or a CDP, collaborate with another group of proponents, or perhaps rethink their scientific objectives. "

Other information on proposal preparation is available in "Best_Practice.pdf" and "InitialSciencePlan.pdf".

White paper for workshop "Investigating Continental Break-Up and Sedimentary Basin Formation", September 15-18, 2006.

Garry Karner, Ian Norton, Bill Powell, ExxonMobil Upstream Research Co.

Problems addressed: This proposal addresses the formation and architecture of hyper-extended passive continental margins. Such margins often host prolific hydrocarbon systems; examples include the Gulf of Mexico, the African Atlantic margin from Gabon to Angola, and portions of the Brazilian margins. Specific problems to be addressed by drilling are: 1) The geometry of extensional faults that thin the crust from normal continental thicknesses to 7-15 km. 2) The composition and mechanism of emplacement of the wide zone of thin crust located landward of true oceanic crust in hyper-extended margins.

Observations: Seismic reflection and refraction data on the West African margin from Gabon to Angola shows that crust thins dramatically from 30-40 km onshore to about 10 km within 100 km of the coast. Overlying this thinning crust is a wedge of sediments culminating in a salt layer. Salt deposition is coincident with the end of the continental extension ("rift") phase of margin development, so the sedimentary wedge is chronologically 'syn-rift'. Stratal geometries in the wedge, however, indicate subsidence with no syn-sedimentary faulting. The term 'sag phase' has been applied to the wedge, which has led some to incorrectly infer that these sediments are accommodated during the post-extension thermal subsidence phase of the margin. How this crustal thinning and unfaulted sedimentation pattern develops through time is poorly understood. Do upper crustal faults play a major role in this thinning process? If so, where and what is the geometry of these extensional faults? Likewise, the nature of the wide zone of uniformly thin and high-velocity crust which lies outboard of the zone of rapidly-changing crustal thickness is unknown.

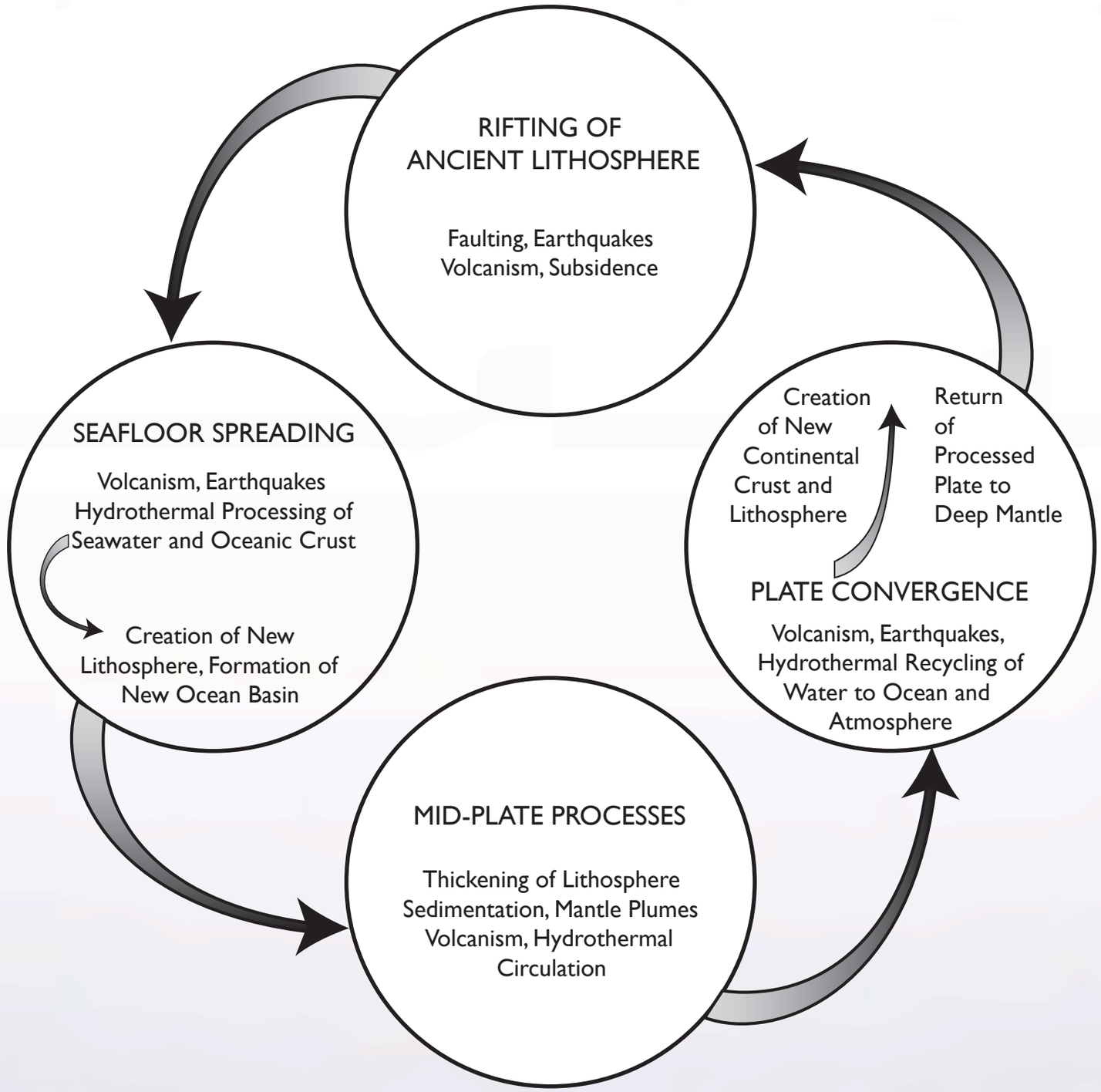
Drilling targets: A transect across the West African margin is proposed. To address the crustal thinning component, sampling will be focused on age and environment of deposition of the wedge sediments and on the unroofing history of the basement. Some scenarios for development of the crustal thinning zone would predict a substantial age difference between the sediments and age of exposure of the underlying basement, while others would predict them to be virtually synchronous. In the zone of uniformly thin crust we propose that basement itself be sampled. The question to be answered here is whether this area is another example of continental separation that involves crustal delamination and exhumation as in Galicia.

Continental Breakup and Birth of Oceans Mission

Summary Report on the IODP Sponsered Workshop

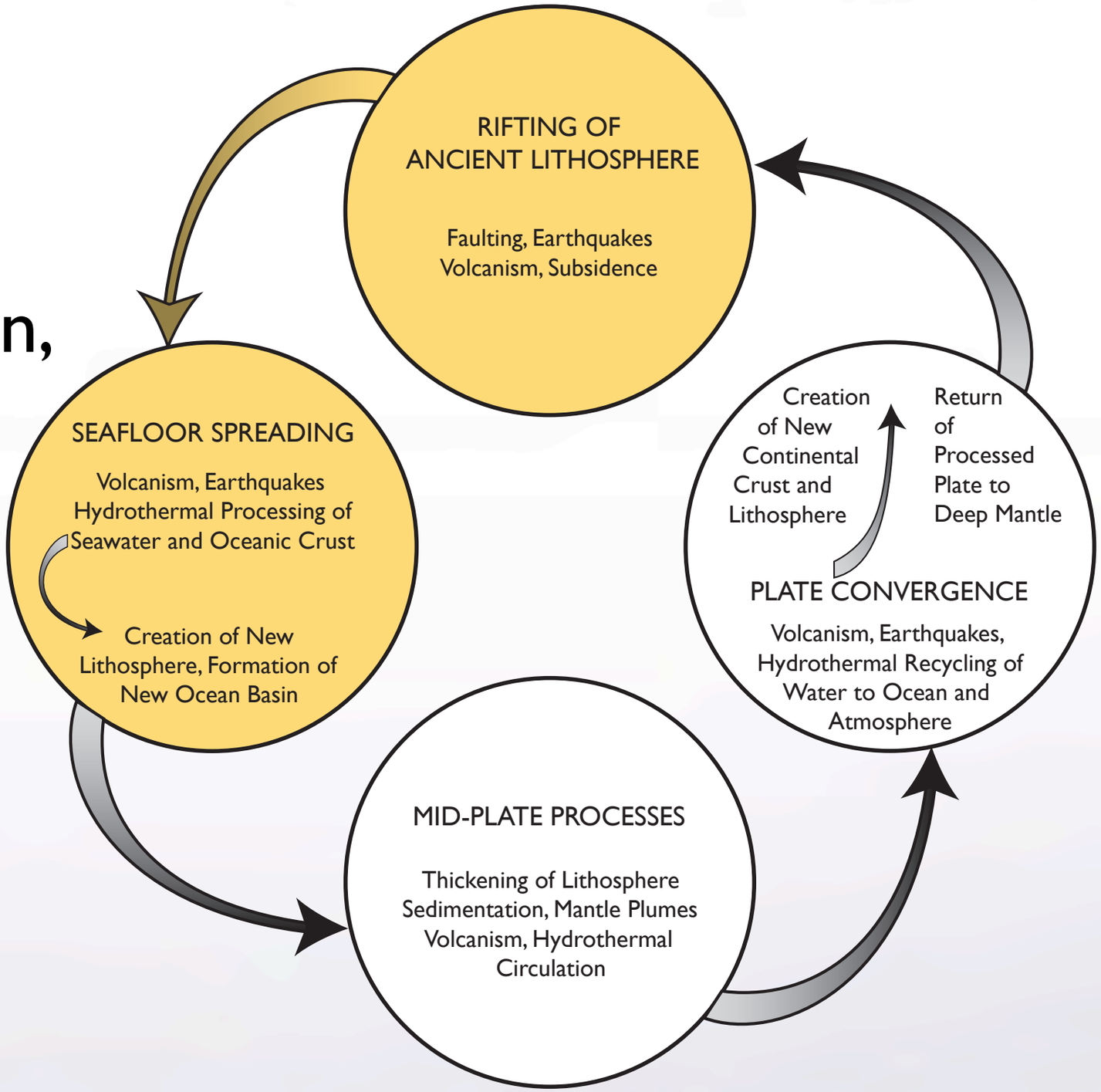
September 15-18, 2006, Pontresina, Switzerland

IODP Initial Science Plan 2003-2013: Solid Earth Cycles

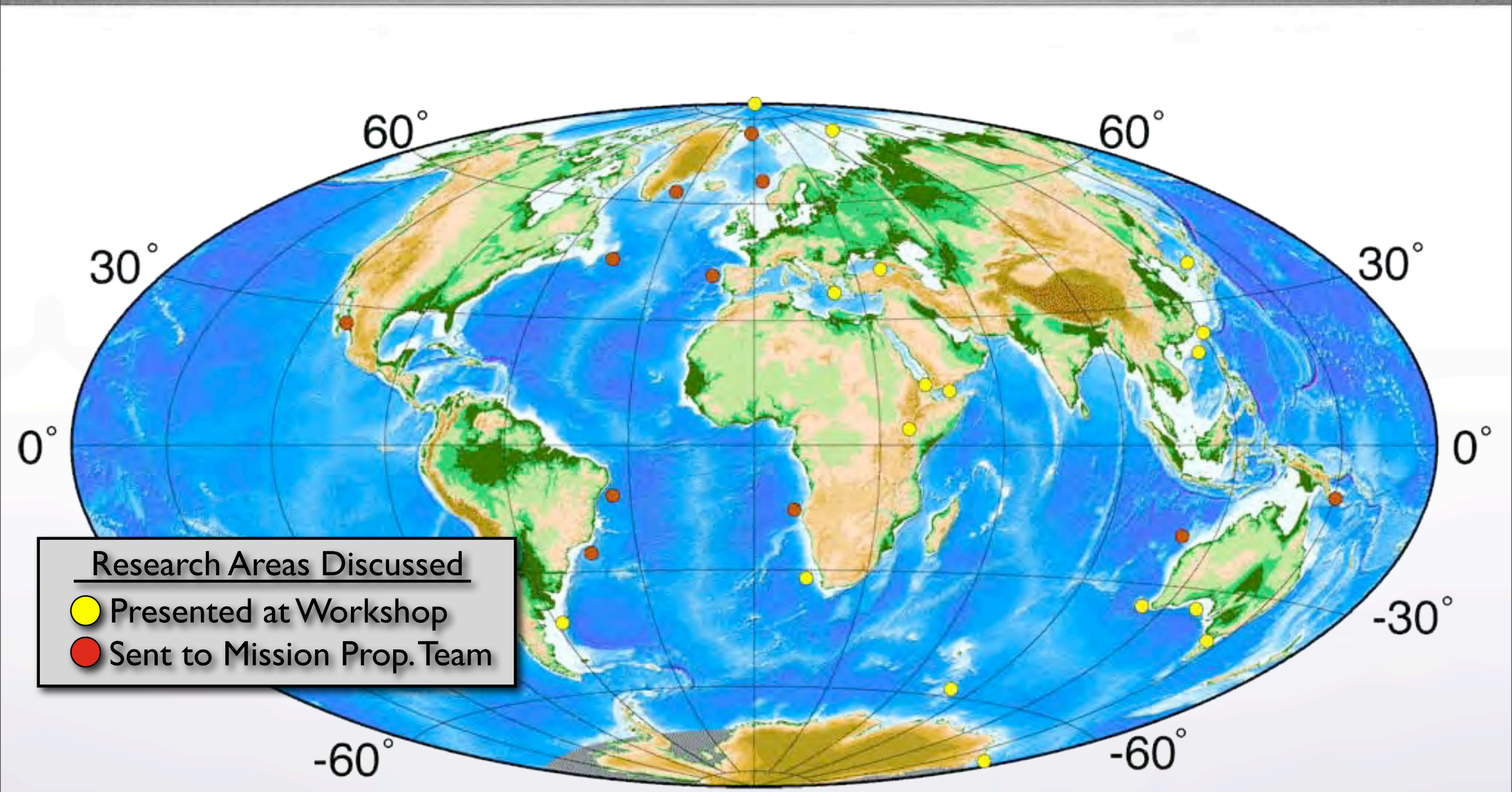


IODP Initial Science Plan 2003-2013: Solid Earth Cycles

Key initiatives on continental breakup, sedimentary basin formation and evolution, and the creation of new divergent plate boundaries.



Continental Breakup and Rifting - Global Overview



Background: Rifted margins show great variability

- Magmatic variability
  Greenland/Norway/UK: 20-35 km thick igneous crust
  Newfoundland/Iberia: mantle exhumation - magma poor

- Tectonic variability
  Variable widths of rifted margins
  Variable amounts of crustal thinning
  Depth dependent stretching
  Extreme thinning and detachment faulting

- Sediment variability
  Sediment starved vs. sediment rich

Six overarching themes

- Rift Initiation
- Tectonics of Rifting
- Magmatism and Rifting
- Initiation of Seafloor Spreading
- Sedimentary Processes and Basin Evolution
- Environmental Consequences of Rifting

Overarching Themes

Rift Initiation:

- What are the driving forces of continental rifting?
- What controls where rifts localize?
- How does lithospheric strength evolve during rifting?
- What is the thermal structure of regions prone to rupture?

Overarching Themes

Tectonics of rifting

- How is strain partitioned as rifting evolves to seafloor spreading?
- What processes control the transition to seafloor spreading?
- What controls fault strength and evolution and how do faults influence the rift geometry through time?

Overarching Themes

Magmatism during rifting

- When does melt significantly influence the rift system?
- How important are mantle heterogeneities?
- At what stage are heterogeneities most important?
- How does melt productivity evolve through time as steady-state seafloor spreading is established?
- What controls melt productivity through time?

Overarching Themes

Initiation of seafloor spreading

- How does magma supply relate to the development of magnetic spreading anomalies?
- What is the thermal structure of the mantle during initial seafloor spreading?
- What is the difference between continental lithospheric mantle and oceanic lithospheric mantle?

Overarching Themes

Sedimentary processes and basin evolution

- What is the breakup unconformity and how does it relate to the first oceanic spreading anomalies?
- What is the stratigraphic response to rifting and breakup?
- How do stratigraphic patterns relate to:
  strain rate?
  underlying mechanical response of the crust?
  fault patterns and fault evolution?
- What is the feedback between erosion, sedimentation, and tectonism?

Overarching Themes

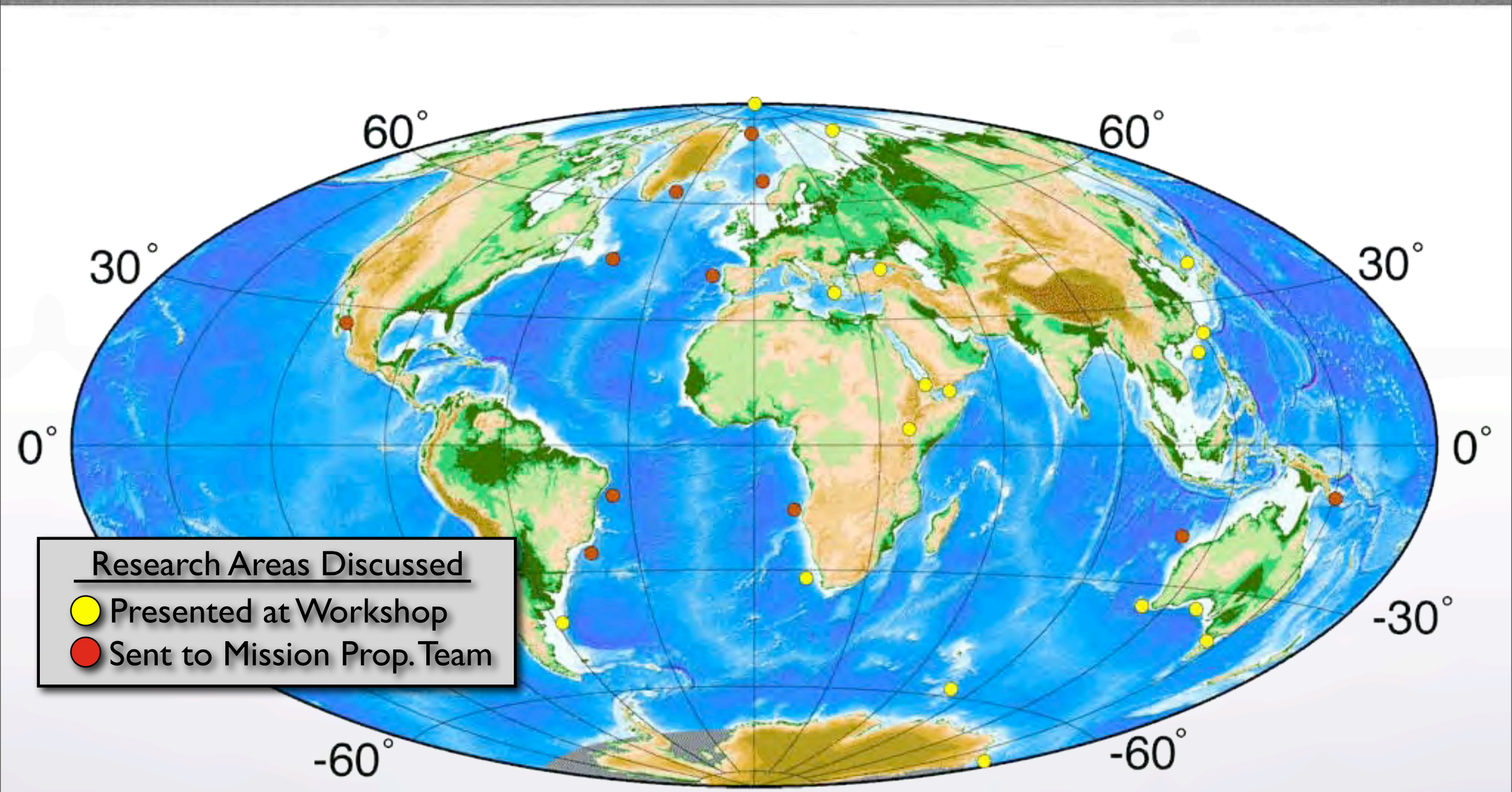
Environmental consequences and impact

- How does magma and interact with sediments?
- What are the tectonic controls on oceanic gateways?

Key conclusions based on global overviews

- No single rift system can answer all questions
- Comparison studies are critical
  to answer fundamental questions

Continental Breakup and Rifting - Global Overview



Key aspects of these systems to characterize fully:

- Subsidence and Uplift History
- Spatial and Temporal Distribution of Strain
- Age and Stratigraphy of Syn-rift Sediments
- Age and Stratigraphy of Post-rift Sediments
- Deformation Fabrics and Faults

Key aspects of these systems to characterize fully:

- Timing, Volume, and Style of Magmatism
- Magma Chemistry: Primitive and Evolved
- Melting Region: Depth, Mantle Composition and origin

Key regions identified at Pontresina*

- Australian margins
- Gulf of California
- Newfoundland-Iberia conjugate margins
- Norwegian-Greenland-UK conjugate margins
- South Atlantic margins
- Woodlark basin

*These have active proponent groups developing drilling proposals that address aspects of the global mission.

Birth and evolution of South Atlantic Conjugate margins (BESACM)

A model for collaboration between industry and academic scientists to investigate continental rifting, including drilling under IODP.

Pontresina workshop breakout group:

Jamie Austin (UTIG)
Dimas Coelho (Petrobras)
Dieter Franke (BGR)
Webster Mohriak (Petrobras)
Ian Norton (ExxonMobil)
Ralph Stephen (WHOI)
Patrick Unternehr (Total)

Harm Van Avendonk (UTIG)

General goals of continental rifting studies:

Depth dependent extension

Interaction of near-surface and deep mantle processes

Timing of geological processes

Feedbacks between deformation and rheology

Thermal history of the margins

Motivation:

South Atlantic differs from other rifted margins covered in the IODP mission proposal:

Thicker sediments, thick salt, sag basins

Various amounts of volcanism:

Magma-poor equatorial margins

Magma present central Brazilian-Angola margins

Volcanic margins south of Walvis Ridge /Rio Grande Rise

Thick sediments

Less seismic penetration
More difficult to see structure in basement

Stratigraphic tool
Measure subsidence

Academic scientists have focused on sediment-starved margins

Large oil fields found near large sediment deposits

Seismic data

Regional seismic reflection profiles are available from industry on both South American and West-African margins.

Additional seismic reflection/refraction studies will be proposed in the South Atlantic over the next several years?

Will these data be sufficient for site surveying?

Tie lines are necessary

3-D seismic data for Chikyu.

Chikyu requirements:

3-D seismic reflection data

Water depth less than 2.5 km

Basement depth less than 8 km

Caution with hydrocarbons as a drilling hazard.

Some South Atlantic margins qualify.

For a successful mission in South Atlantic…

Staged geophysical data acquisition in focus area.

Brazilian - Angolan conjugate margins?

Data sharing between research groups and companies.

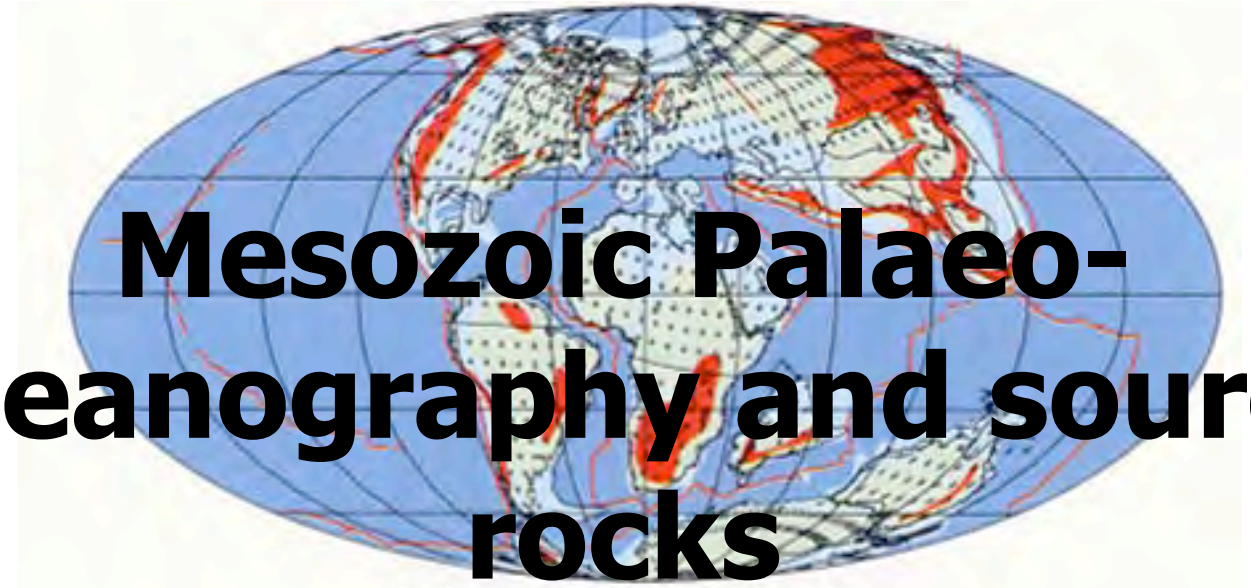
Dissemination of results.

Integrated research programs.

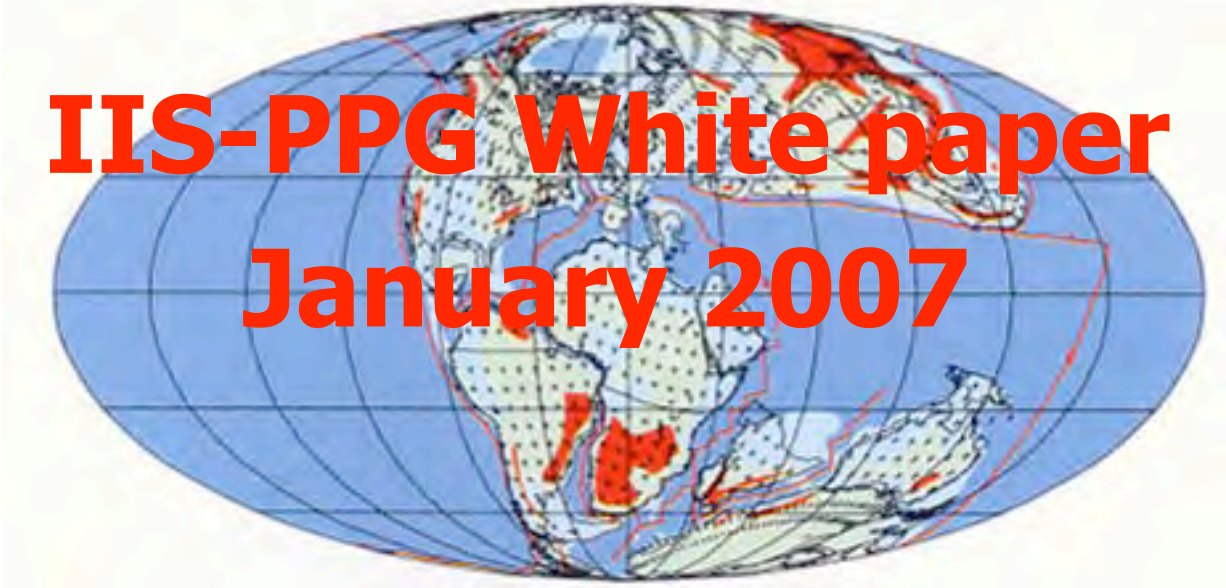
Assistance from national science foundations.

Development of science not related to continental rifting.

Mesozoic Palaeo-oceanography and source rocks



CENOMANIAN (94 Ma)



APTIAN (118 Ma)

IIS-PPG White paper

January 2007

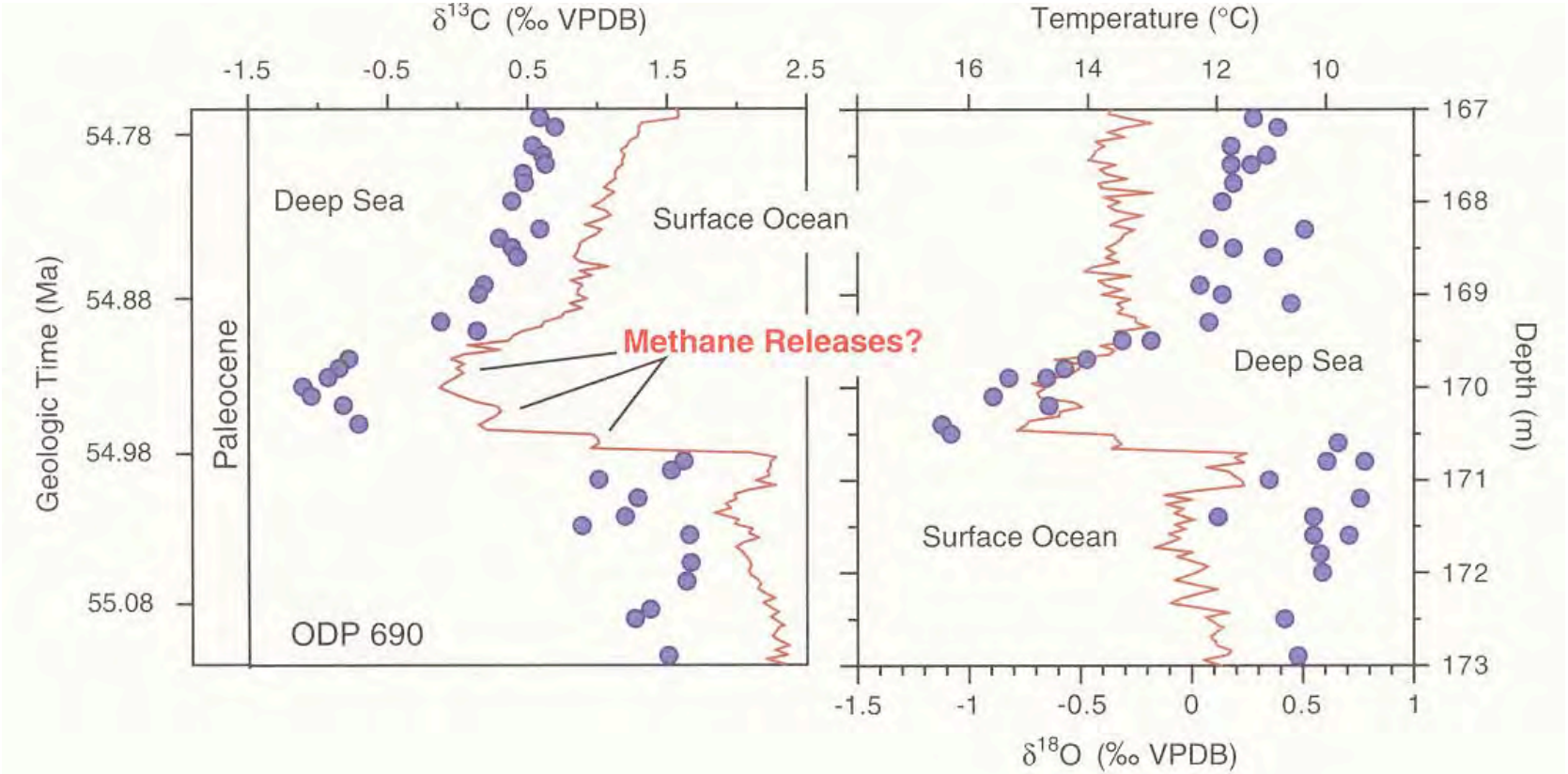
The issue

- The Mesozoic
  - A mainly greenhouse world with repeated periods of apparently global thermal maxima (or extreme climate excursions) - Ocean Anoxic Events or OAEs -widespread deposition of black shale deposits.
  - Some of these organic rich shales are among the most important source rocks for oil and gas known, responsible for much of the petroleum discovered in such prolific provinces as the Middle East, the North Sea, Western Siberia and Venezuela.
- For future discoveries of petroleum in both well-explored and frontier areas and basins we need to fully understand the origin of these deposits, so that their development and distribution, where presently poorly or totally unknown, can be predicted.
- These organic rich shales are palaeo-environmental indicators and tell us much about the causes of extreme climate change and the Earth's responses and recovery mechanisms
  - By contributing to our knowledge in this sector, research into Mesozoic OAEs may have wider societal impact
  - understanding the causes and effects of disturbances in the steady-state carbon cycle is a primary objective of ocean science.

State of knowledge 1

- OAE intervals range in age from Toarcian to Santonian. They are characterized by Oxygen18 isotope excursions from (-) to (+) and by the deposition of laminated organic-rich claystones.
  - Detailed knowledge of Mz OAEs is limited mainly to repeated intervals in the Aptian to Early Campanian (120 – 80Ma), penetrated in several ODP legs (older sequences have hardly been penetrated). <5 OAEs have been recorded from several of the world's oceans in both shallow basins and on the deep ocean floor.
  - The duration of these events means that cyclical orbital forcing cannot be a causal mechanism, while the apparent absence of Mesozoic ice caps makes present-day climate models difficult to apply. The sea-bottom appears in many places to have been unstable, as evidenced by intercalations of glauconitic, mass waste and bioturbated sediments.
- Currently, our thoughts on causal mechanisms are projected from the Paleocene-Eocene thermal maximum (55.5Ma), when, over a 200,000 year interval, ocean temperatures rose by 5-8 degrees. The event may have been triggered by release of large quantities of methane, suddenly injected into or taken up by the oceans, causing a runaway greenhouse reaction. This methane then oxidized, removing O2 from the deep ocean.

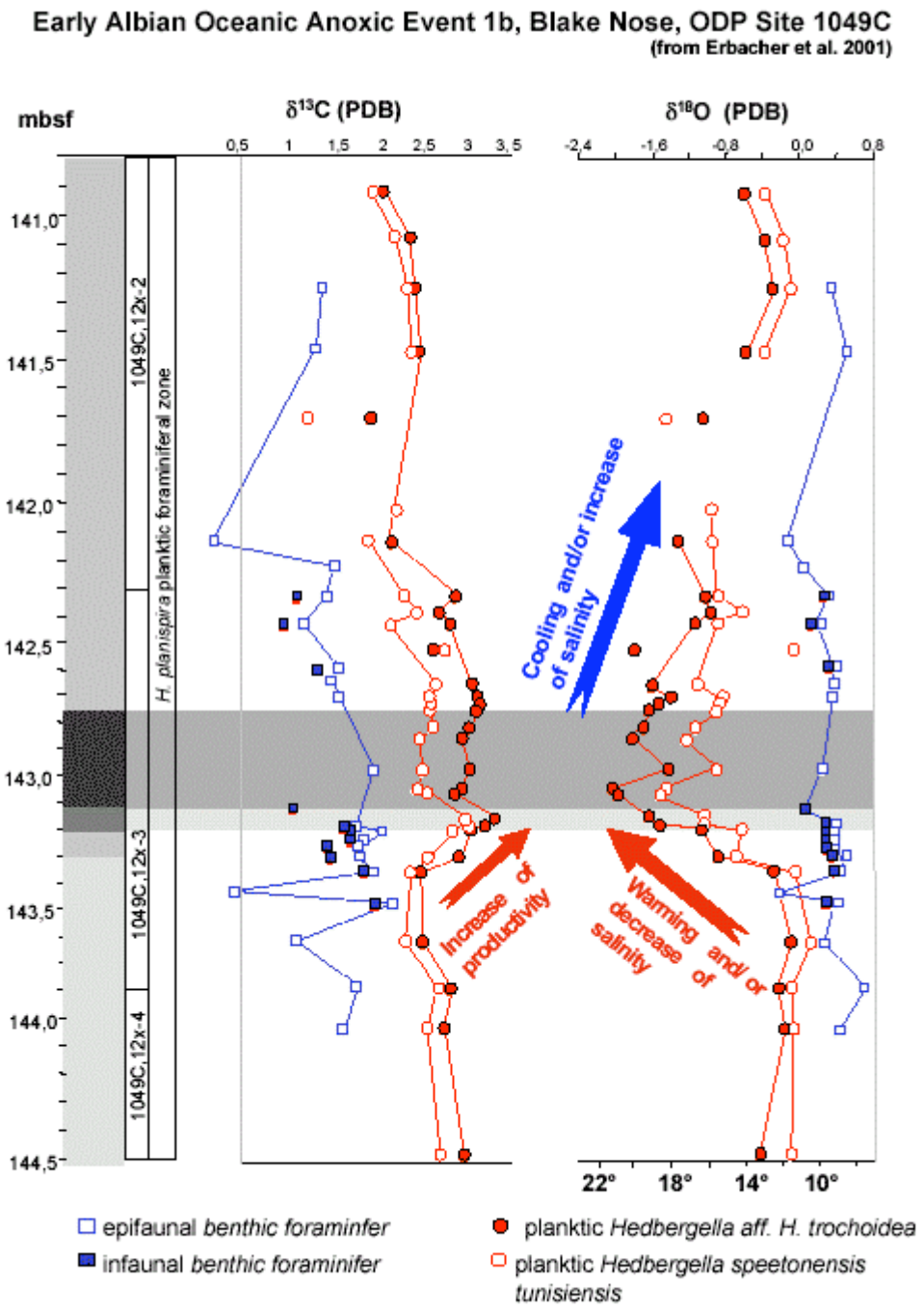
Stable isotope records of surface-ocean carbonate (red line) & bottom-dwelling forams (blue circles) across the PETM, ODP site 690, reflecting massive input of greenhouse gas (methane) at start of global warming.



PETM = Paleocene-Eocene Thermal Maximum with a transient temperature excursion of 4 – 8 deg C. A major extinction of deep sea biota at this time resulted from ocean temp/chemistry changes.

State of knowledge 2

- Similar perturbations may have characterized the Cretaceous
  - However, foraminifera from ODP cores from the Albian OAE 1b (112Ma tropical Atlantic) suggest that the water column was layered and that surface waters changed from cool and salty to warm and more fresh. Green sulphur bacteria demonstrate evidence for very extensive anoxia, reaching up to and including the photic zone in several Jurassic and Cretaceous OAEs.
- Aptian black shale located in ODP leg 198 on the Shatsky Rise in the Pacific Ocean, suggests that at least this event may be truly global.
  - Improved age determinations suggest the possibility of a temporal link between Cretaceous OAE development and the formation of Large Igneous Provinces (LIPs): This raises the possibility that global warming may have been triggered by periodic increases in submarine volcanism.
- The distribution, thickness and organic composition of OAE shales is of critical importance to their generative potential.
  - The Late Jurassic Kimmeridgian-Tithonian interval is exceptional, but several of the Cretaceous intervals have less clear potential: What, for instance, is the regional significance of intervals between 50 and 100m thick with TOCs of 5 – 50% recorded on the Demarara Rise?
- On continent margins, one of the main contributors to the widespread development of black shale deposition is expansion of the Oxygen Minimum Zone (OMZ).
  - This occurs at periods of elevated ocean temperature, such that extensive areas stagnate. Conversely, the OMZ contracts during cold periods.



Ocean Anoxic events are typical of the mid-Cretaceous (120-85Ma):

periods of high draw-down of atmospheric CO2 and high ocean biological activity over periods of about 50kyr.

Aptian OAE 1a (Selli event) recognized widely as laminated black shale with TOC <14%

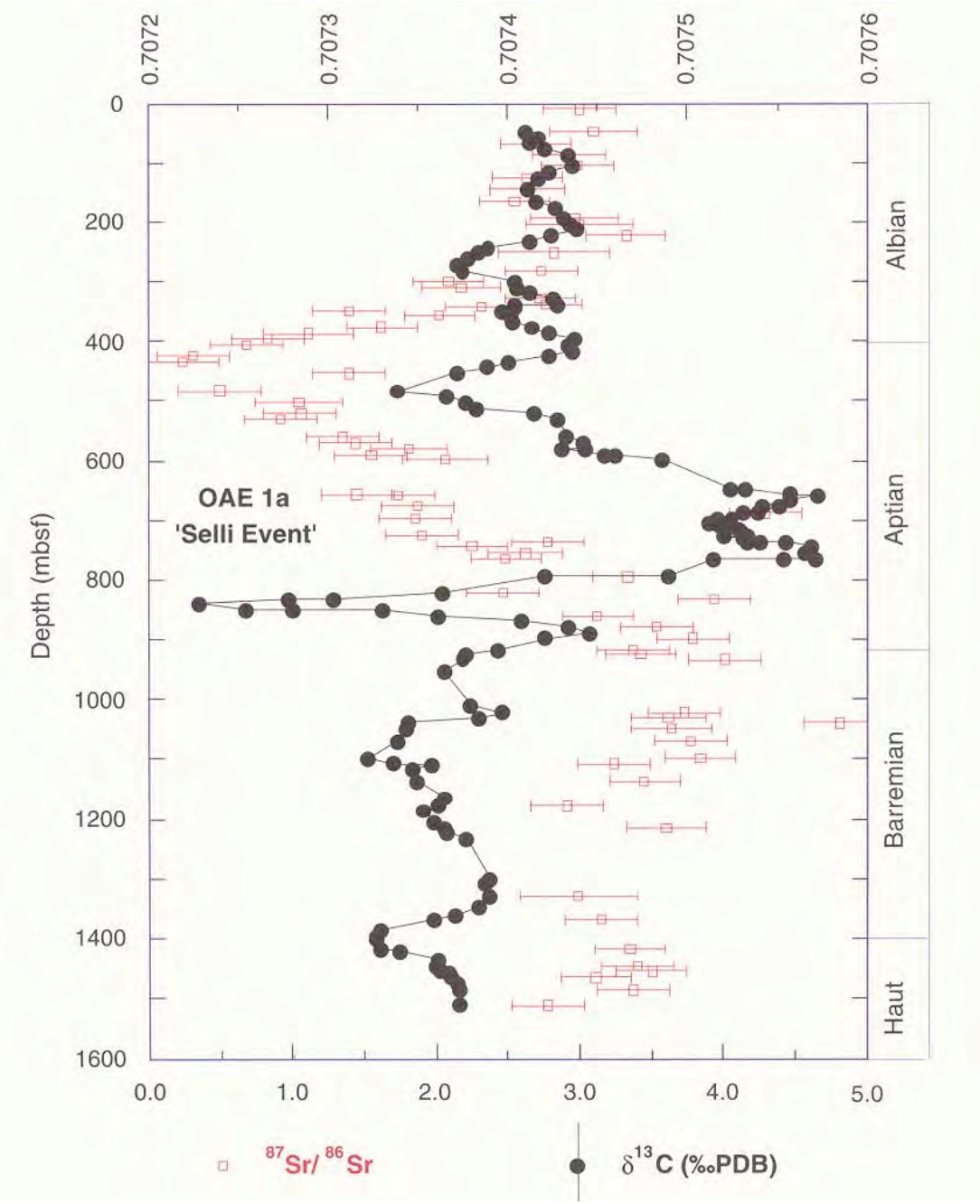
Albian OAE 1b may have resulted from increased thermohaline stratification

<80% of the OAB1b OM is derived from Archaea.

The oxygen minimum zone
(2% of continent margins)

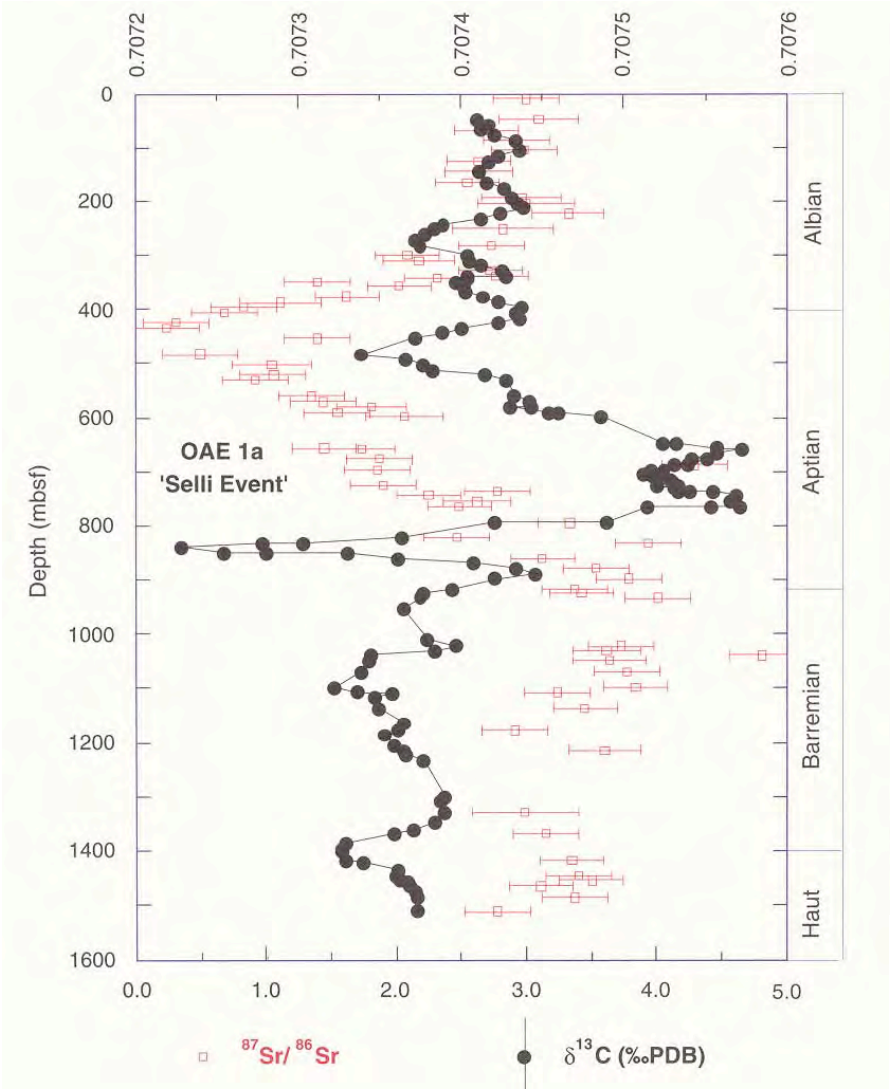
Ocean volcano with oxygen concentrations Ranging from ~0 - 0.5mlO2/l in dark zone to 3mlO2/l at volcano base

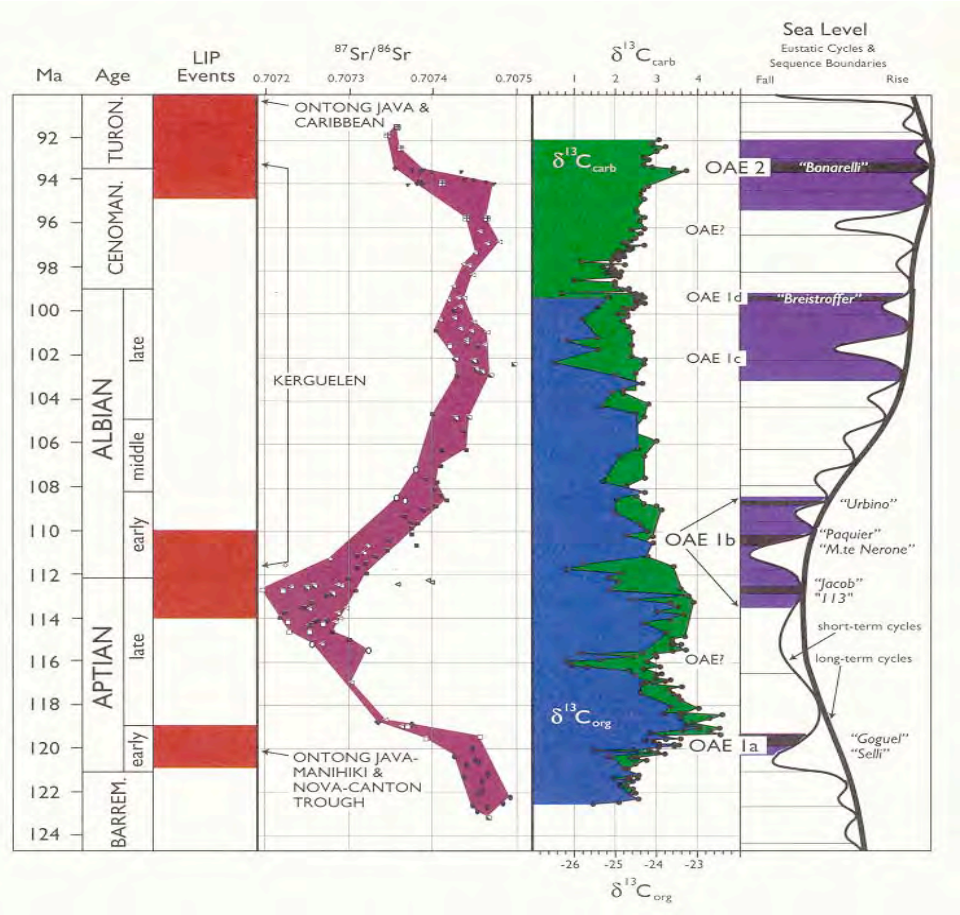
mid-level waters depleted of oxygen by decay of organic matter from surface highly productive waters (fed by deep nutrient-rich upwelling)
From: Levin, Amer Sci **90** (5)



Strontium & carbon isotope stratigraphy of Cretaceous platform carbonates from Resolution guyot.

The carbon isotope record can be correlated with the European deep water sea-level reference curve. The Early Aptian Selli event (120Ma, OAE 1a), which forms a laminated organic-rich black shale (<14%TOC) global in nature. Its origin has been attributed to submarine volcanism linked to the Ontong Java superplume



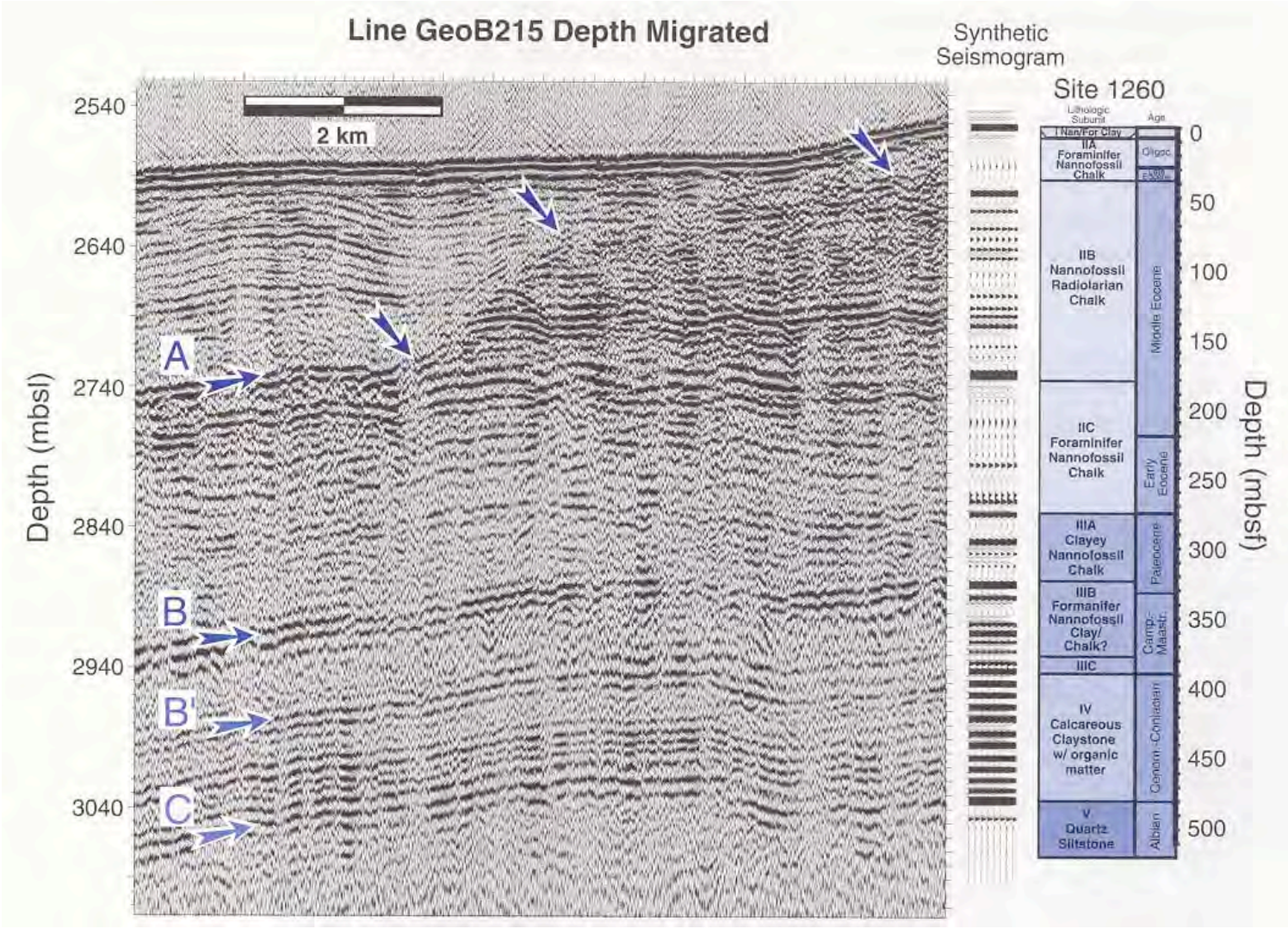


<7 high temperature periods characterized by OAE's recognized in the Mesozoic

From ODP publications

The mid-Cretaceous record of black shales and Ocean Anoxic events (OAEs) correlated with the Sr / C isotopic record, changing global sea-level and seawater chemistry, and emplacement of Large Igneous Provinces (LIPs)

The Late Cretaceous OAEs 2 (Bonarelli event) and 3 on the Demerara Rise, offshore Surinam, drilled in ODP Leg 207 (2001)



The C horizon unconformity separates shallow marine synrift Albian from postrift Cenomanian.

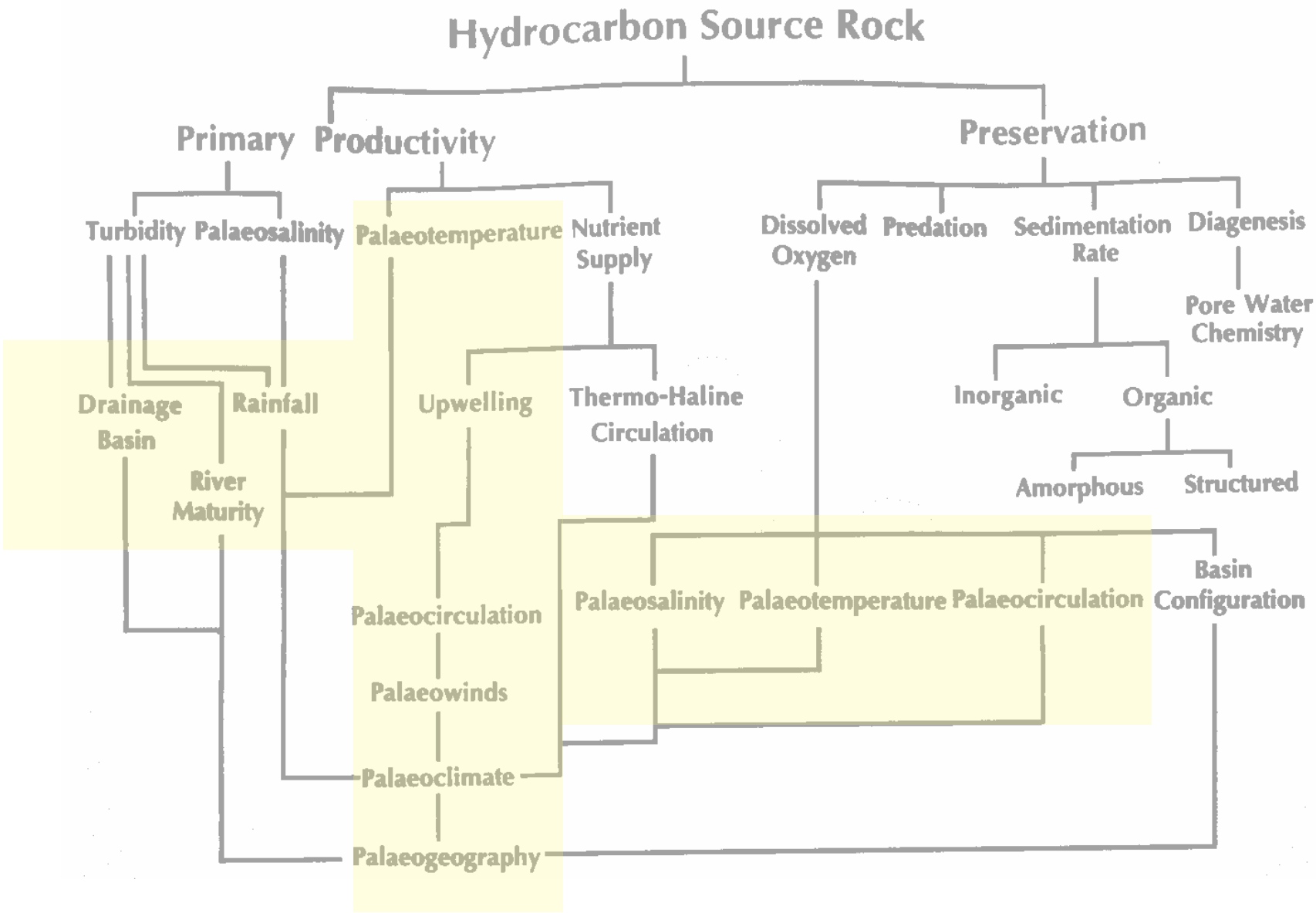
Between the C and B' horizons are Cenomanian to Santonian laminated black shales with <30% TOC alternating with mass flow deposits

Horizon B is the K/T boundary, and horizon A represents a deep channeling event associated with the late Oligocene

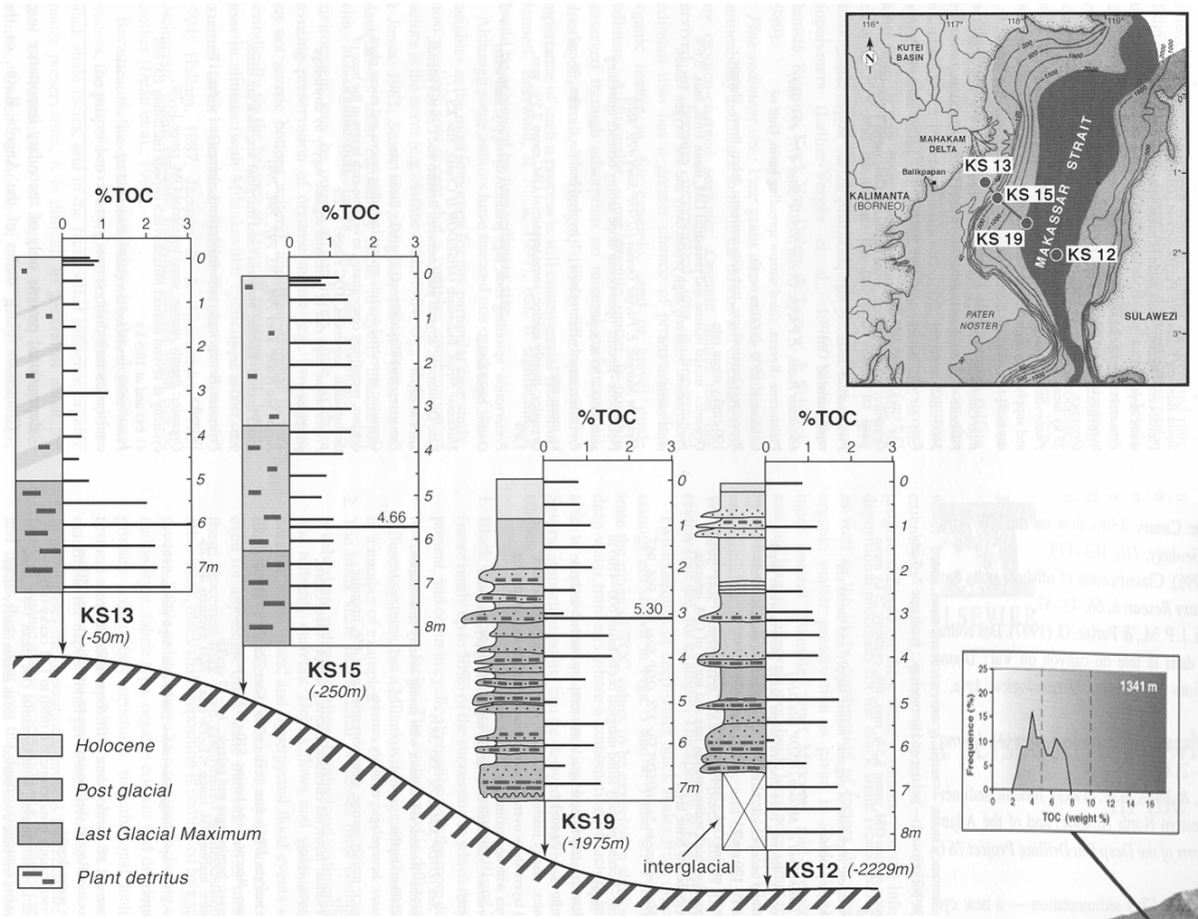
From J.Jl. 30(1)

Climate and Source rocks

- Climatic influence on volume of river / air derived nutrients into the marine realm
  - Cooler and drier periods allow more erosion from continents
- Climatic effect on development of thermohaline circulation
  - Impact of circulation patterns on development of weak THC in deep basins
- Climate effect on palaeogeography
  - Widespread development of high productivity shelves during high stands (especially warm periods leading to volume increase?)
  - Palaeolatitude of Mz source rocks – confined to +/- 45 degr?
- Relationship of black shale development to solar activity
  - Higher radiation increases photosynthesis and productivity
  - Signs of Milankovich cycles in deeper marine Mesozoic source rocks
- Decomposition of organic material and changes in ocean chemistry
  - Link carbon and sulphur cycles
  - Sea water alkalinity
  - Possible contribution of volcanic-derived dissolved phosphate in OAE development

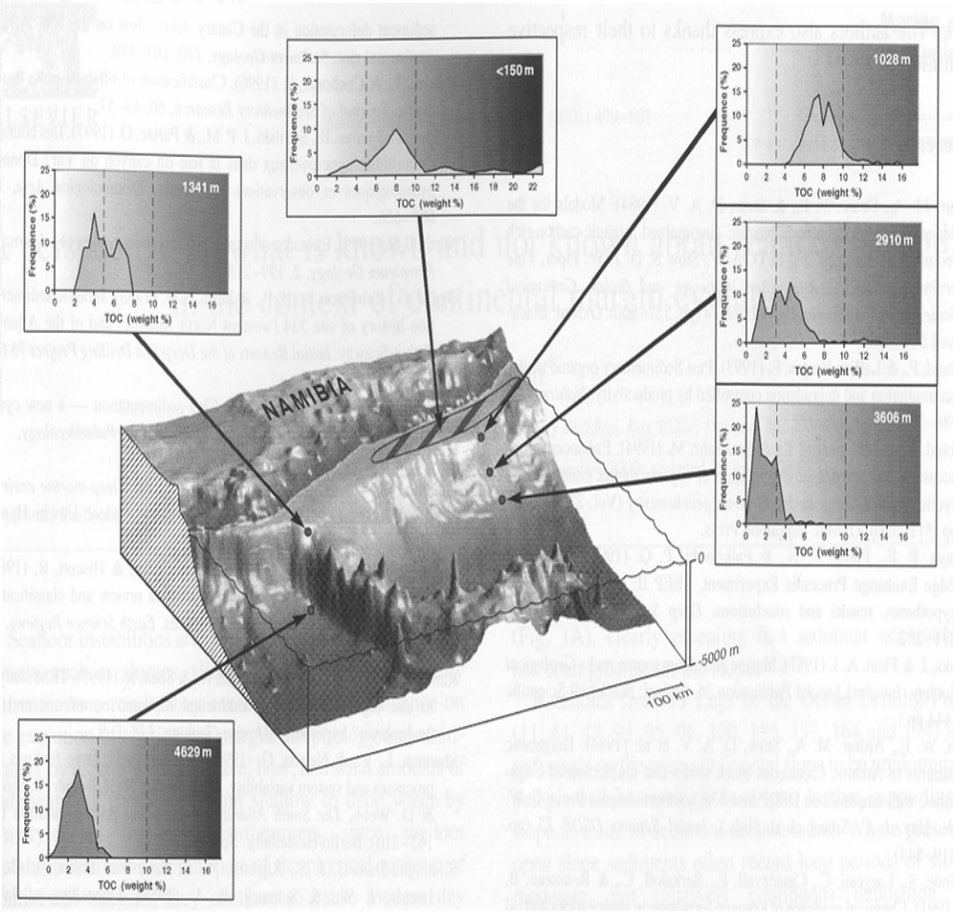


Interrelationships between factors controlling the deposition and preservation of organic-rich sediments. From Katz 1995, Geol Soc Sp Pub 80



Left: Makassar Strait, variation in organic content and sedimentary facies.

Below: Namibian Margin, TOC at various depths



Depositional processes leading to deeper water organic-rich shales.

From Stow et al. 2001 Mar & Petr Geol 18(4):491-498

The IODP Science Plan & initiatives

Environmental change, processes & effects

Internal forcing of environmental change / extreme climates

- Conditions that led to transient extreme climate events & deposition of organic carbon-rich sediments / greenhouse anoxia (and recovery)
- Forcing mechanisms for development of greenhouse & icehouse Earth conditions (eg tectonics, igneous activity, sea-level change)

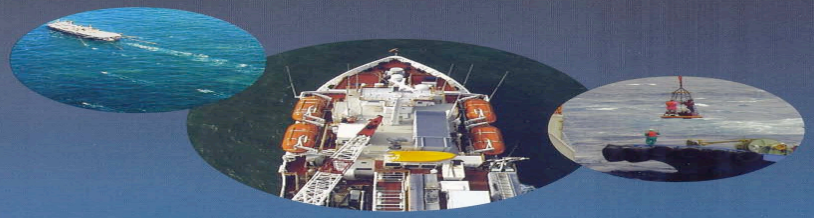
External forcing of environmental change

- Climate system interaction with orbital forcing in Cenozoic and older, where no ice – Milankovitch cycles (also impact events)

Rapid climate change

- Millennial and decadal scale climate events & ocean circulation
- Recovery of laminated marine sediments, coral reefs and deep water drift deposits are needed to develop realistic models

Opportunities for Scientific and Industry Cooperation in the Integrated Ocean Drilling Program



Environmental Change, Processes, and Effects

Industry Theme: Hydrocarbon Reservoir & Source Rock Prediction

The geologic record documents long-term climatic change from extreme global warmth in the late Mesozoic, to cooling during the Cenozoic. At present, Earth is experiencing a brief interlude of warmth in an otherwise extreme cold climate characterized by bi-polar glaciation. Climate change set the stage for the deposition of hydrocarbon source and reservoir rocks. Widespread anoxic conditions resulted in the accumulation of large quantities of organic carbon during the warm Mesozoic. Over half of the world's petroleum reserves were generated during these warm episodes. Information on the timing and magnitude of climate change is needed to predict the occurrence of undiscovered natural resources.

Earth's radiation balance and thus atmospheric and oceanic circulation patterns are affected by: (a) the distribution of land and sea; (b) the extent and elevation of plateaus and mountain ranges; and (c) the changes in the composition of the atmosphere resulting from volcanic emissions and catastrophic decomposition of gas hydrates. Climate change is one of the major controls on sea level that impacts the distribution, magnitude, and quality of petroleum systems. Eustatic sea-level falls are characterized by gravity-flow sand deposition in the lower continental slope and rise, forming potential deep water hydrocarbon reservoirs. Sea-level rise is characterized by shoreline sand deposition, shelf carbonate accumulation, and basin-wide mudstone deposition. Enhanced preservation of organic carbon is associated with mudstones accumulating in basins during sea-level highstands. Porous shallow water sands and carbonates form potential hydrocarbon reservoirs, and the muds can also serve as seals over hydrocarbon traps. IODP objectives encompass the study of all of the processes and consequences of sea-level and climate change.

Breaking the Language Barrier:
Different Words, Similar Meaning

Academia	Industry
Geophysical attribute analysis	Hydrocarbon indicator
Paleo-productivity	Source rock
Heat flow & kinetic models	Maturation
Fluid flow	Migration
Sedimentary processes	Reservoir, seal, source rock
Physical properties	Seal
Deformation style	Traps & migration paths
Geochronology	Timing & basin modeling
Microbial biology	Biodegradation
Basin analysis	Exploration
Margin architecture	Petroleum systems

Industry and Academia and the IODP objectives

The main questions 1

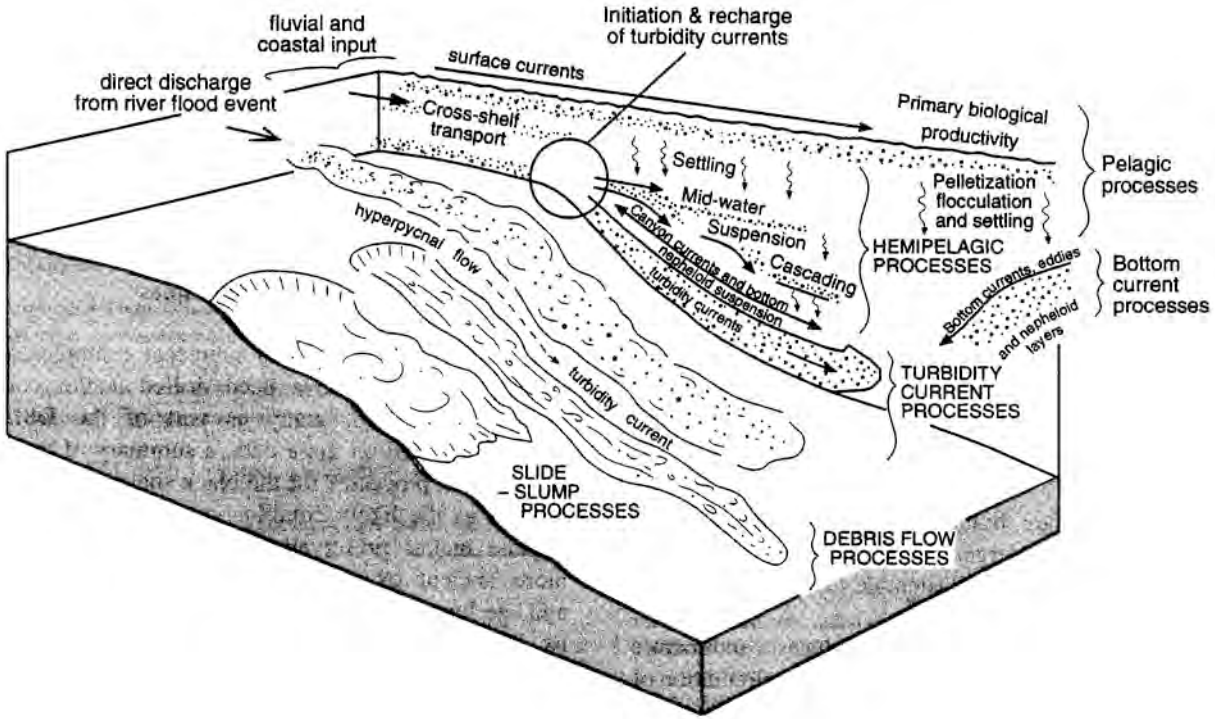
- What were the dominant mechanisms that led to perturbations in the global carbon cycle and the development of global ocean anoxic events (OAEs) in the Mesozoic? Were they primarily oceanographic, sedimentary, geodynamic or tectonic?
  - What was responsible for the special character of the Late Jurassic and late Cretaceous OAEs?
  - Can this be related to specific geodynamic events, such as Atlantic rifting and break-up?
  - What was responsible for the high biologic production and what type of organisms were involved?
  - Which specific depositional environments were particularly ideal for accumulation and preservation of organic material?
- What was the nature of the climate prior to, during and following the OAE excursion? Is there indeed a close relationship between OAEs and greenhouse warming?
- Is there a clear link to the eustatic sea-level curve or to formation of LIPs, and can a systematic shoaling of the CCD (Calcite compensation depth) be correlated with OAEs?

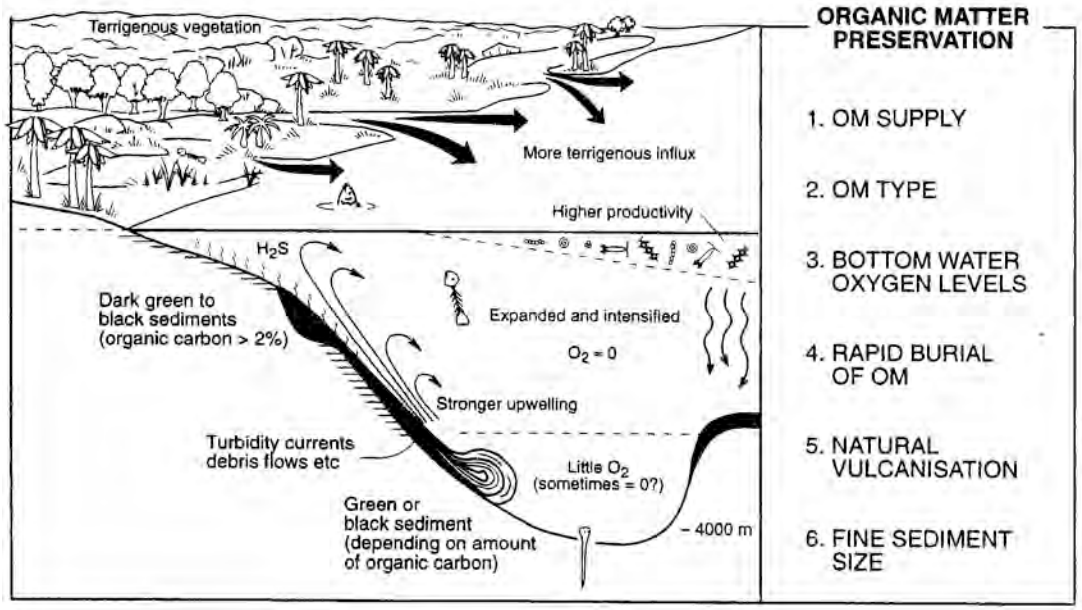
The main questions 2

- What can we conclude about the lateral and vertical extent of oxygen deficiency?
- What was the relative importance of organic production versus preservation?
  - High biological productivity involves rapid supply of organic matter overwhelming the oceanic dissolved oxygen. ODP studies have shown that this mechanism is dominant in the mid-Cretaceous episodes at least.
  - Ocean stagnation, where external processes such as temperature or evaporation lead to stable stratification of the water column and reduced oxygen supply to the ocean bottom
- Were these events indeed (semi-)global or were they locally triggered?
  - eg by gas hydrate release,
  - mantle plume activity (as suspected for the Shatsky Rise)
- What dictated the time these events lasted and their periodicity?
  - Mid Cretaceous events appear to have lasted for periods of 50.000years on average
  - Why did some last longer than others?

The main questions 3

- What can we learn from the biological affinities of the organisms that contribute the organic material? Similarly, how did the anoxia affect biological systems?
- How efficient is pelagic settling across a range of water depths? How important is slumping as a mechanism for accumulation?
  - The role of the continental slope as major carbon sink.
- Can climate variations be correlated with mineral composition?
  - In the deep water Kimmeridge Clay, kaolinite-rich source levels have been correlated with warmer, humid periods. During more arid conditions (less run-off) lower sedimentation rates leads to higher carbonate content (JU of northern hemisphere shows a northward expansion of low latitude arid belt)





Main processes affecting OM and sediment transport to deep marine environments

Depositional processes leading to deeper water organic-rich shales. From Stow et al. 2001 Mar & Petr Geol 18(4):491-498

Principal factors affecting preservation of organic material in deep water

Where IODP can contribute: Proposals:

- Specific proposals need to be developed, but currently several potential directions can be envisaged. We need penetrations of stratigraphically complete and undisturbed OAEs (typically located in the deep oceans), particularly:
- Older, ie Early Cretaceous and Late Jurassic OAEs. This means oceanic locations with little sedimentary cover in the northern Atlantic, western Pacific or Timor Sea.
- High resolution age determinations from OAEs, including isotope stratigraphy, allowing correlations with other well-dated Mesozoic events, such as LIP developments.
- A number of depth and latitudinal transects to study black shale development and quality in specific environments and areas in three dimensions
- Dedicated well sampling to allow study of palaeo-ocean chemistry prior to, within and following OAE events, as well as the impact on the biota.

Some proposed actions for IIS-PPG

- Decisions
  - Discuss and rank main areas of industry interest
  - Investigate the academic interest in Mesozoic black shales amongst the climate-modelling community
  - Group of proposals (eg transect) covering number of aspects or single sites per issue?
  - Geographic location and location on continent margin / deep sea
  - Do we need a workshop with academics?
- Test Mesozoic oceanographic models for main periods of OAE development
  - C. Scotese for Plate models
  - Involve climate modellers and IODP "black shale" community to prepare sequential models (with perturbations due to gas release, volcanic ash, Sulphur aerosols, etc)
  - Involve ocean water chemists

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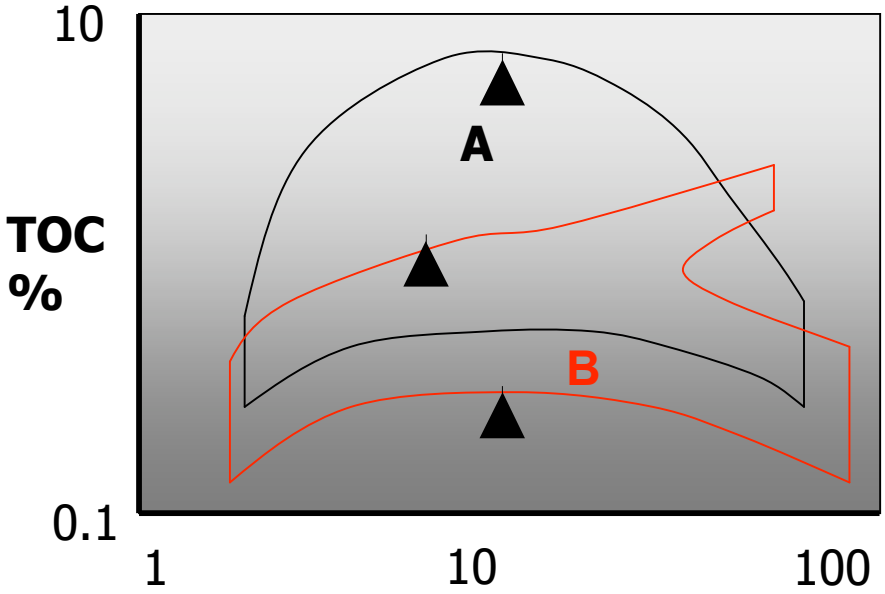
Support slides

Sequence stratigraphic location of source potential in normal marine oceanic realms

Some thoughts by John Armentrout (Cascade Stratigraphics)

- 88% of oil and gas is sourced from 2nd order transgressive facies in 3rd order low-O2 cycles.
- Best potential is not necessarily the Max Flooding Surface, where TOC is high, but the organic material may be degraded (eg California borderlands model)
- In upwelling zones of high productivity, the role of zooplankton faecal pellets may be important (they suffer minimal degradation)
- Productivity is nutrient-dependent, optimised on shallow flooded shelves over shelf basins (fed by river/upwelling-derived nutrients)
- Preservation needs balanced rate of sedimentation - fast to bury, but slow so as not to dilute



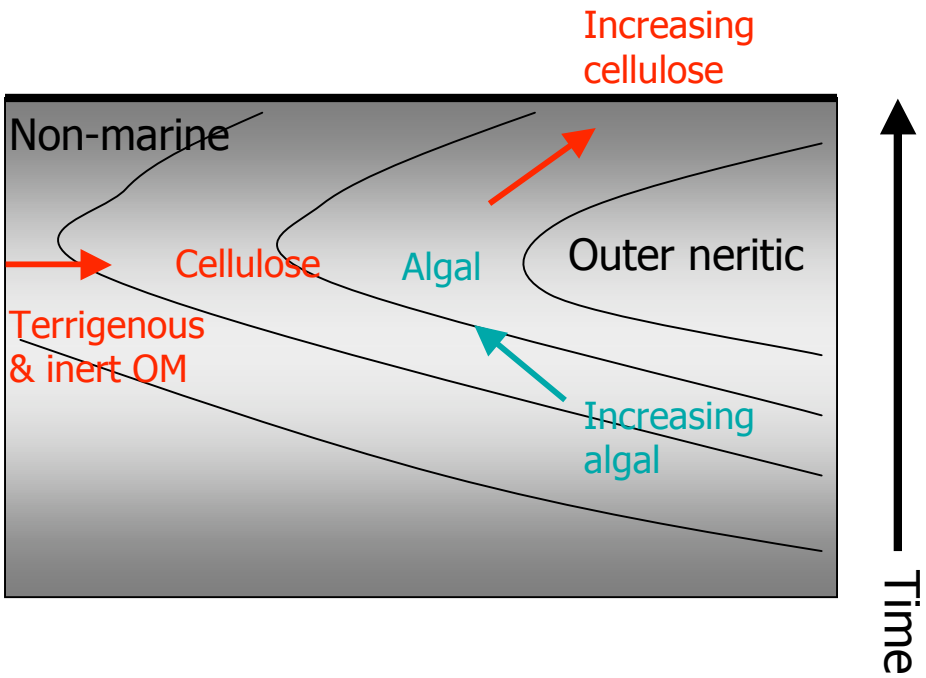
Sedimentation rate m/my

A: Black shales

B: Siliceous shale

▲ : **Critical sedimentation rate**

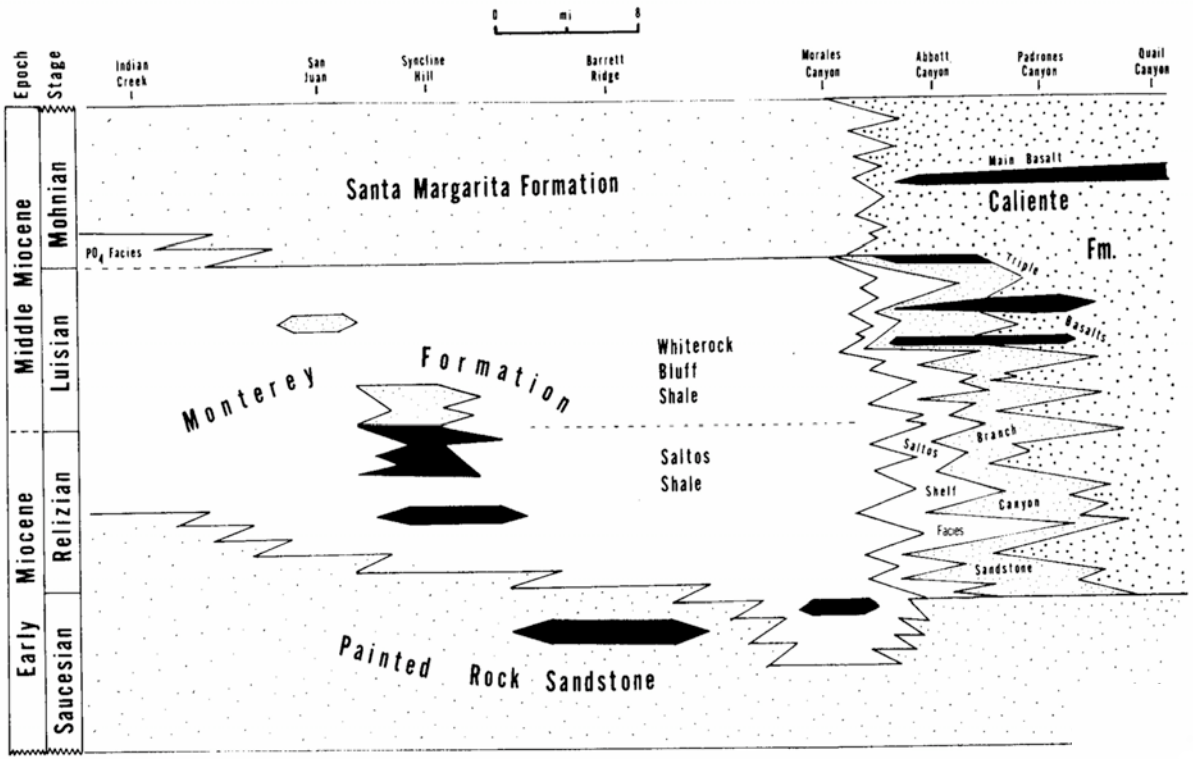
Preservation potential



Sequence stratigraphy and type of organic material

Sketches from Armentrout poster
AAPG Perth 2006

Southern California: Monterey formation, stratigraphic relationships, source facies and model for diatomite accumulations



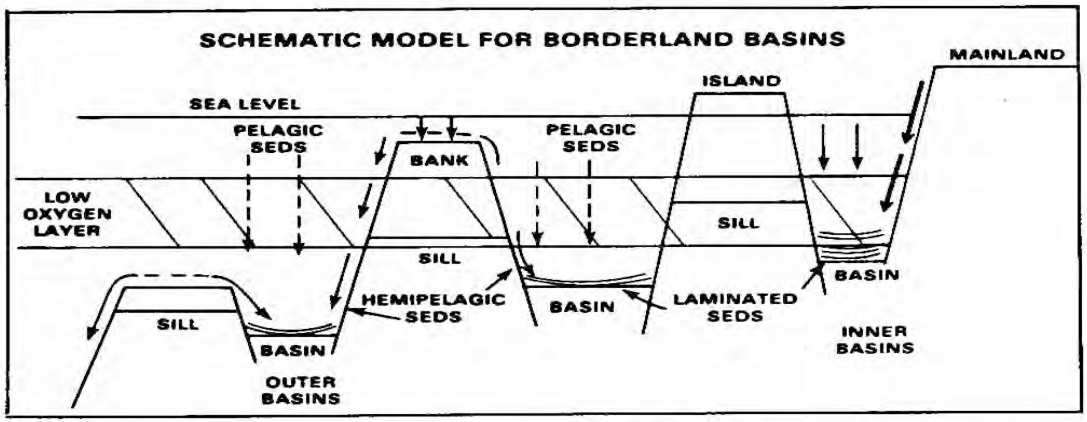


Figure 3—Modes of deposition in borderland basins, like those that developed during Miocene in central and southern California. San Joaquin basin would be analogous to "inner basins," whereas Salinas and Santa Maria basins are examples of "outer basins" (from Blake, 1981).

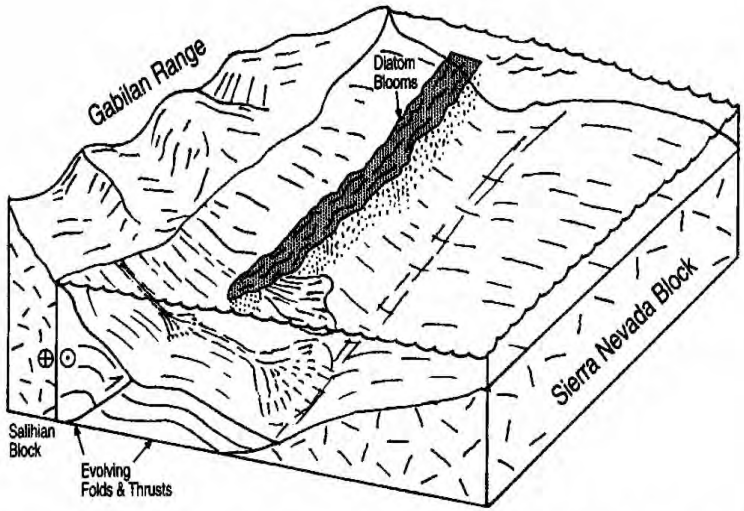
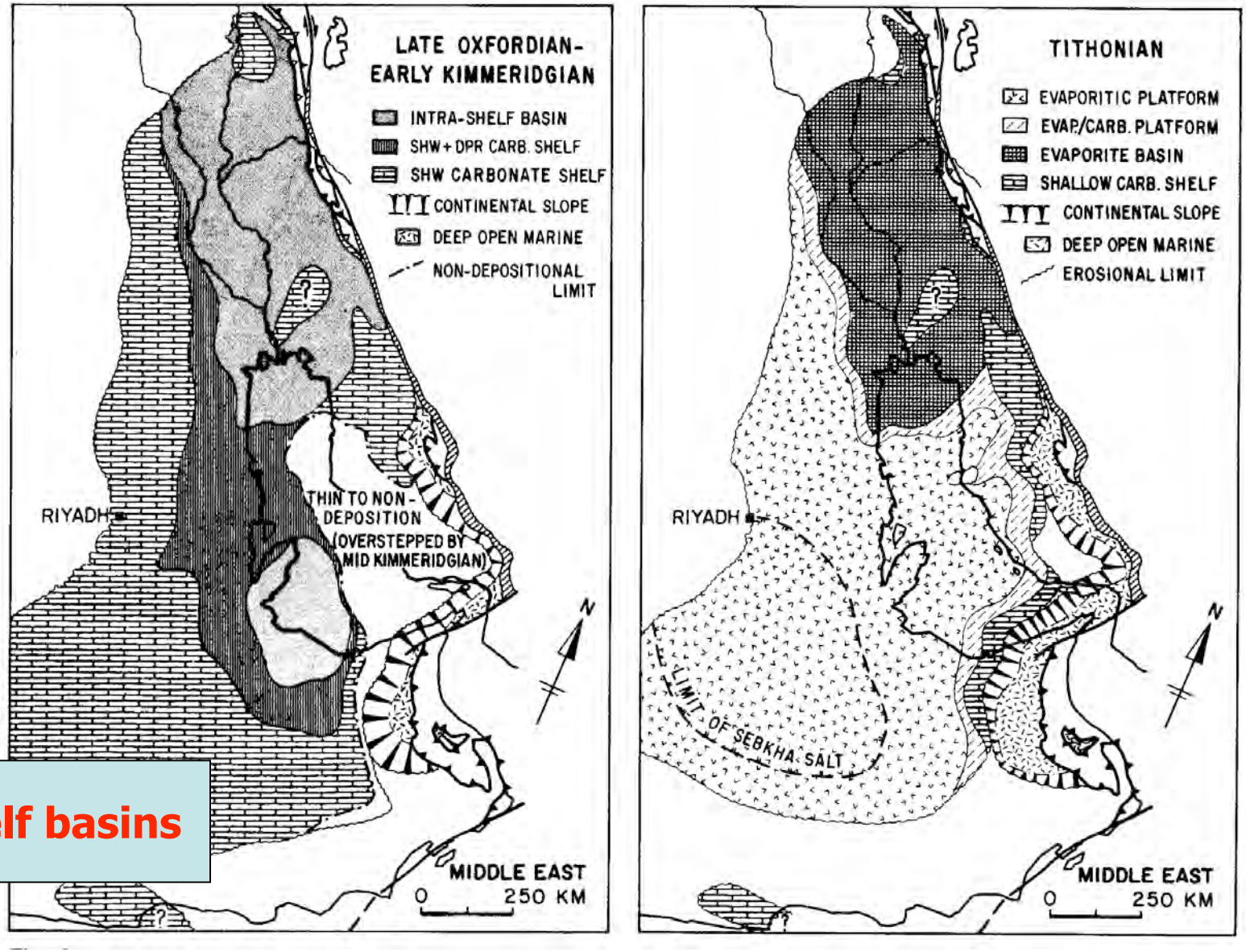


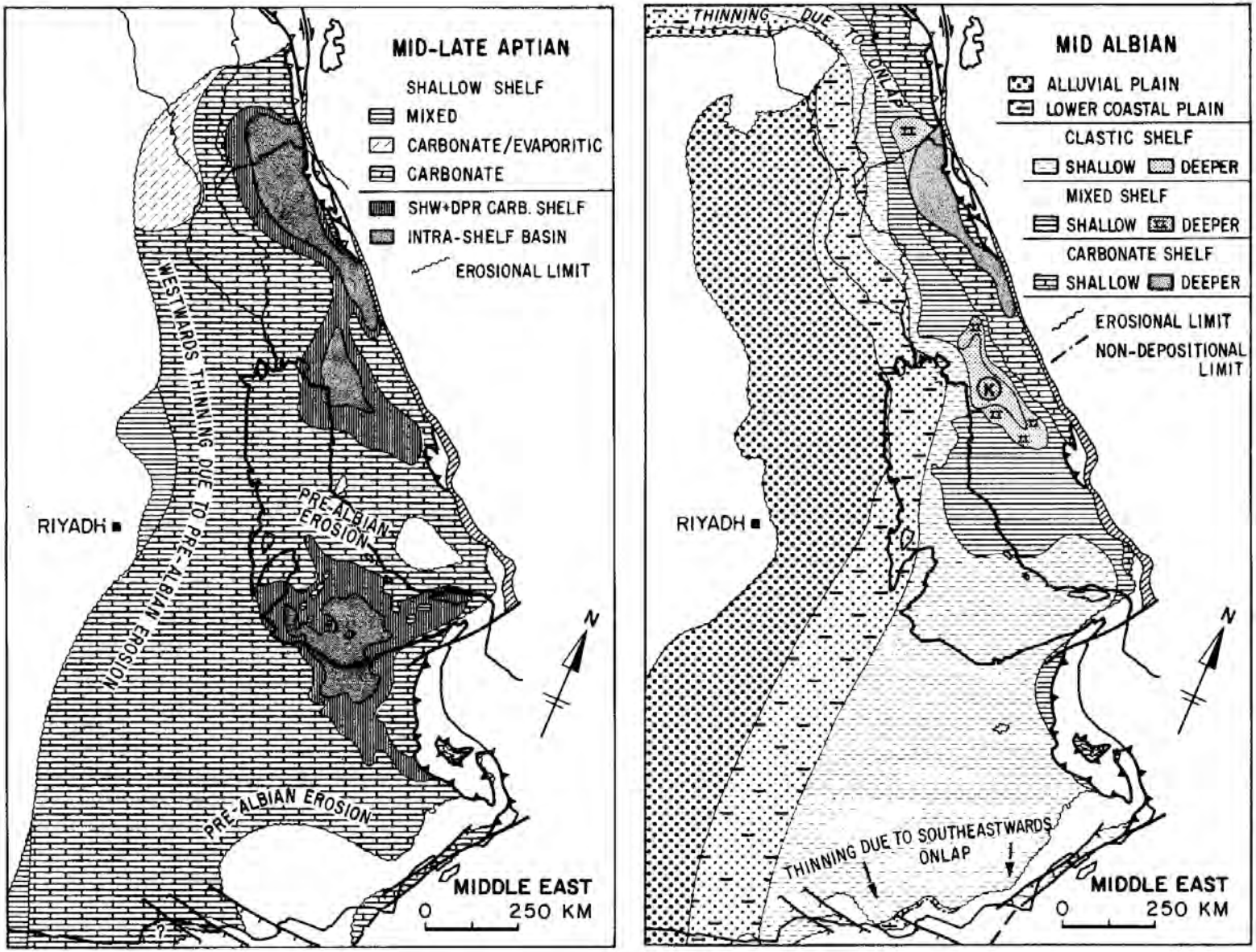
Figure 4. Block diagram showing generalized depositional model, Monterey Formation, southern San Joaquin basin (modified from Schwartz [1988]). See text for discussion.



Shelf basins

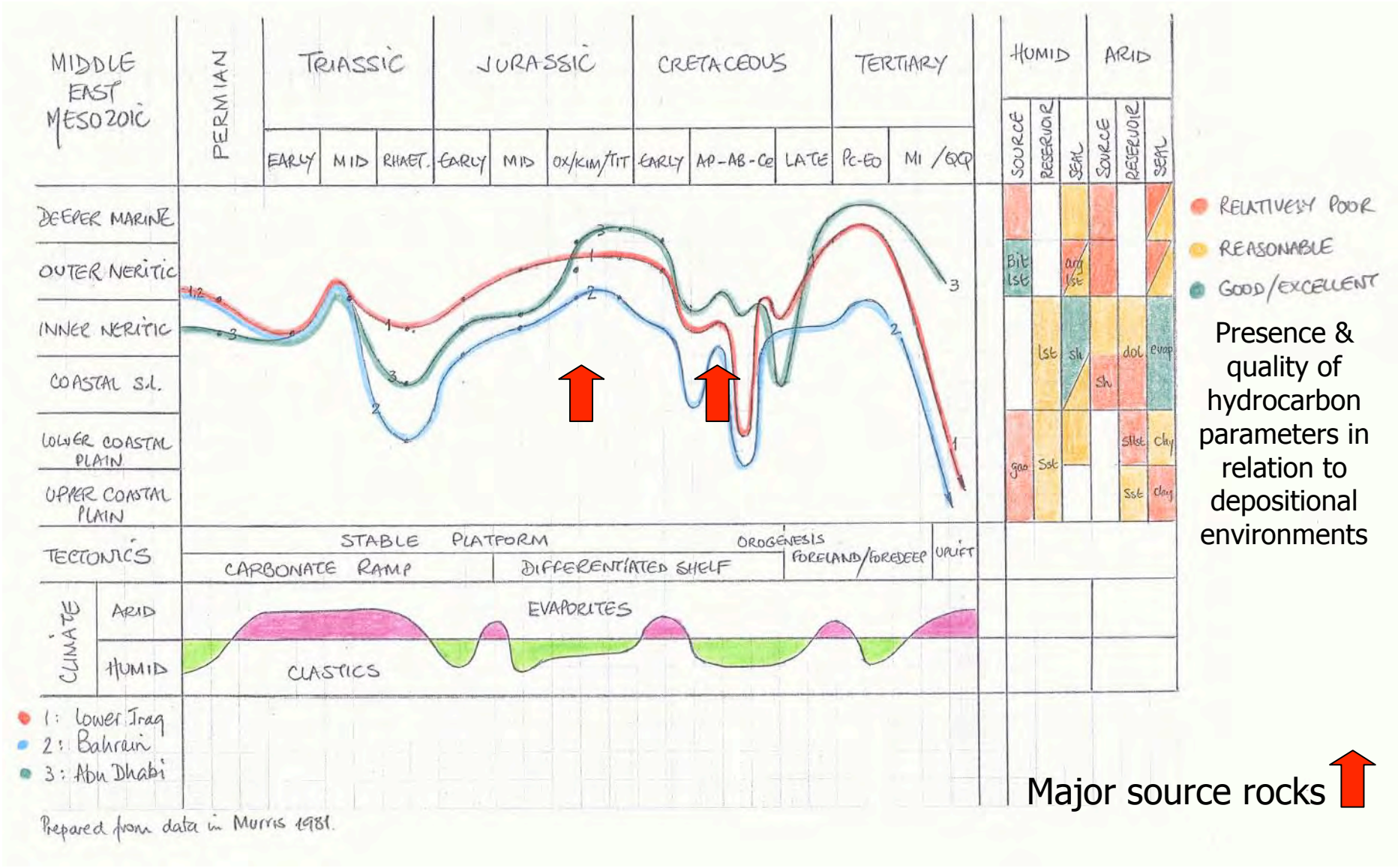
Middle East: Late Jurassic palaeogeography

Oxfordian – differentiated shelf with Lurestan Basin (intra-shelf basin, *Hanifa* source); Tithonian high stand – carbonates fill the shelf and culminate in evaporites

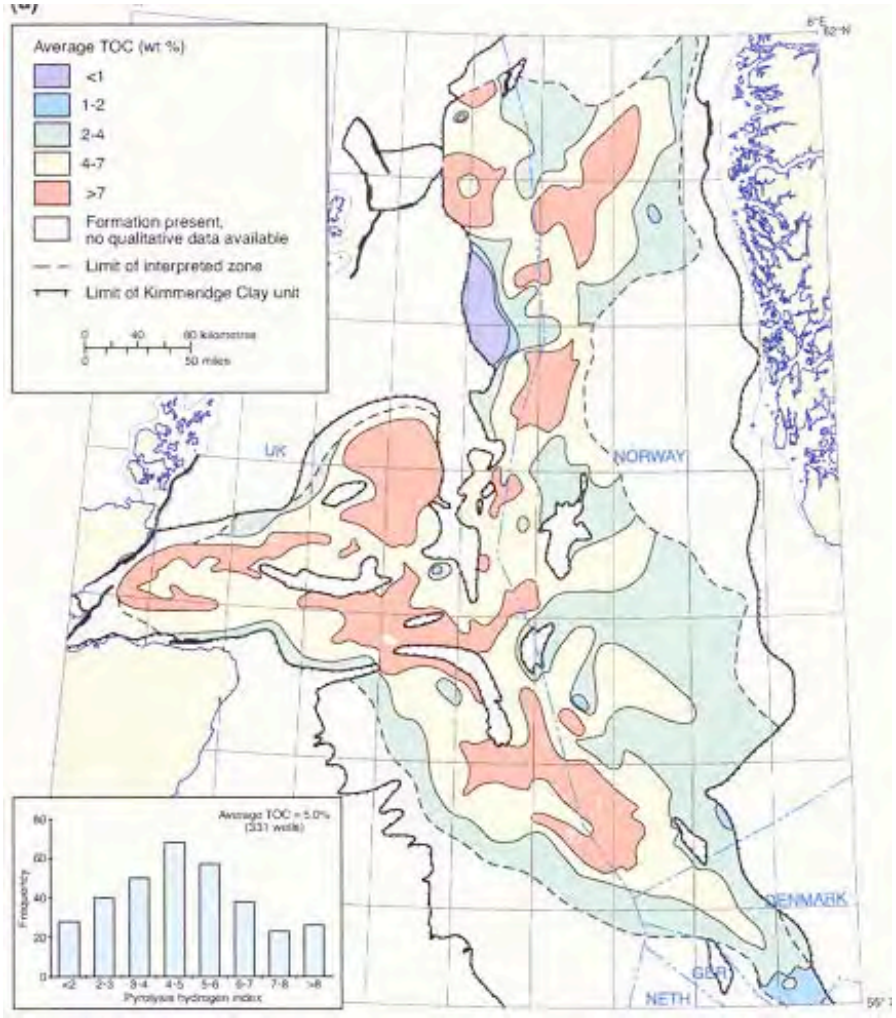


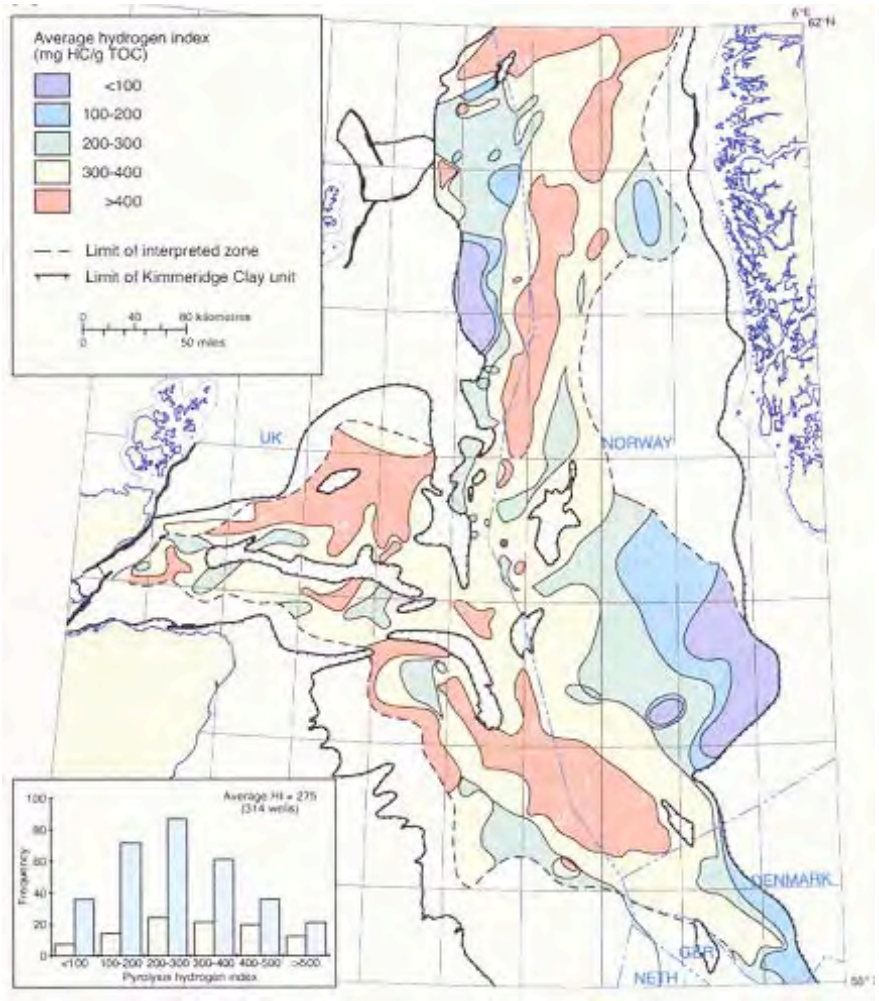
Middle East: Mid Cretaceous palaeogeography & climate change

Aptian transgression and differentiated shelf accumulation (*Shu'aiba* source), more humid than in Late JJ.
Substantial Albian sea-level fall results in widespread clastic deposition



The Middle East Mesozoic – relationships of depositional environment evolution to tectonic history and climatic fluctuations (arid-humic): 1: Lower Iraq 2: Bahrain 3: Abu Dhabi





North Sea: Kimmeridge Clay : properties (pre-maturation): left – average TOC, right – average hydrogen index (the higher the better the oil-generating potential). Note that richest areas lie in the basin axes. A correction for maturity reached has been applied

Millenium Atlas Fig 17-30,31

IIS-PPG White paper

Mesozoic Palaeo-oceanography and Source rocks

The issue

During the mainly greenhouse world of the Mesozoic, repeated periods of apparently global thermal maxima (or extreme climate excursions) occurred, the so-called Ocean Anoxic Events or OAEs. These are recorded in the geological succession in the form of widespread intervals of black shale deposits. Some of these organic rich shales are among the most important source rocks for oil and gas known, responsible for much of the petroleum discovered in such prolific provinces as the Middle East, the North Sea, Western Siberia and Venezuela.
It is vital for future discoveries of petroleum in both well-explored and frontier areas and basins to fully understand the origin of these deposits, so that their development and distribution, where presently poorly or totally unknown, can be predicted.
These deposits are palaeo-environmental indicators and tell us much about the causes of extreme climate change and the Earth's responses and recovery mechanisms: By contributing to our knowledge in this sector, research into Mesozoic OAEs may have wider societal impact – understanding the causes and effects of disturbances in the steady-state carbon cycle is a primary objective of ocean science.

The state of knowledge:

Several OAEs, ranging in age from Toarcian to Santonian are known from the Mesozoic. They are characterized by Oxygen18 isotope excursions from (-) to (+) and by the deposition of laminated organic-rich claystones.
Detailed knowledge of these events is limited mainly to repeated intervals in the Aptian to Early Campanian (120 – 80Ma), which have been penetrated in several ODP legs (older sequences have hardly been penetrated). Up to five such events have been recorded from several of the world's oceans in the Middle Cretaceous in both shallow basins and on the deep ocean floor. The duration of these events makes it impossible to invoke cyclical orbital forcing as a causal mechanism, while the apparent absence of Mesozoic ice caps makes present-day climate models difficult to apply. The sea-bottom environment does in many places appear to have been unstable, as evidenced by intercalations of glauconitic, mass waste and bioturbated sediments.
Currently, some of our thoughts on causal mechanisms are projected from the Paleocene-Eocene thermal maximum (55.5Ma), during which, over a 200,000 year interval, ocean temperatures rose by 5-8 degrees. It is thought that the event may have been triggered by large quantities of methane that were suddenly were injected into or taken up by the oceans, causing a runaway greenhouse reaction. This methane then oxidized, removing O2 from the deep ocean. Similar perturbations appear to have characterized the Cretaceous, although foraminiferal populations from ODP cores from the Albian OAE 1b (112Ma) of the tropical Atlantic suggest that this OAE was caused by intense layering of the water column induced by a change of surface waters from cool and salty to warm and

more fresh. Evidence for very extensive anoxia, reaching and including the photic zone, comes from green sulphur bacteria found in several Jurassic and Cretaceous OAEs.
One of the most intriguing occurrences of Aptian black shale was located in ODP leg 198 on the Shatsky Rise in the Pacific Ocean, which suggests that at least this event may be of truly global extent. Improved age determinations have in fact made it possible to see a temporal link between Cretaceous OAE development and the formation of Large Igneous Provinces (LIPs): This raises the possibility that global warming may have been triggered by periodic increases in submarine volcanism.
Clearly, the distribution, thickness and organic composition of the black shales is of critical importance to their generative potential. While the Late Jurassic Kimmeridgian-Tithonian interval lies at one extreme, several of the Cretaceous intervals are of less clear potential: What, for instance, is the regional significance of the intervals between 50 and 100m thick with TOCs of 5 – 50% recorded on the Demarara Rise?
On continent margins, one of the main contributors to the widespread development of black shale deposition is known to be an expansion of the Oxygen Minimum Zone (OMZ). This is known to occur at periods of elevated ocean temperature, such that extensive areas stagnate. Conversely, the OMZ contracts during cold periods.

The main questions:

- What were the dominant mechanisms that led to perturbations in the global carbon cycle and the development of global ocean anoxic events (OAEs) in the Mesozoic? Were they primarily oceanographic, sedimentary, geodynamic or tectonic?
    - What was responsible for the special character of the Late Jurassic and late Cretaceous OAEs?
    - Can this be related to specific geodynamic events, such as Atlantic rifting and break-up?
    - Which specific depositional environments were particularly ideal for accumulation and preservation of organic material?
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Specific proposals need to be developed, but currently several potential directions can be envisaged. We need penetrations of stratigraphically complete and undisturbed OAEs (typically located in the deep oceans), particularly:

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References:

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Paytan, A. 2004(?). Tales of Black Shales. ODP highlights. Brochure, Joint Oceanographic Institutions: 11

Shallow Compaction and Fluid Flow

Richard J. Davies

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Durham University

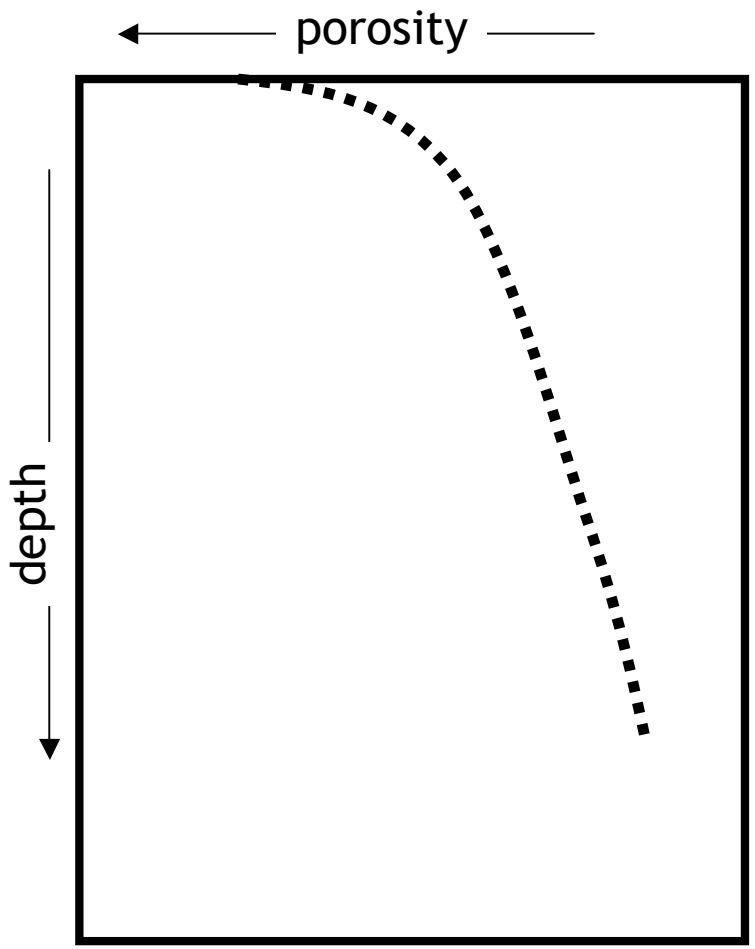
CeREES

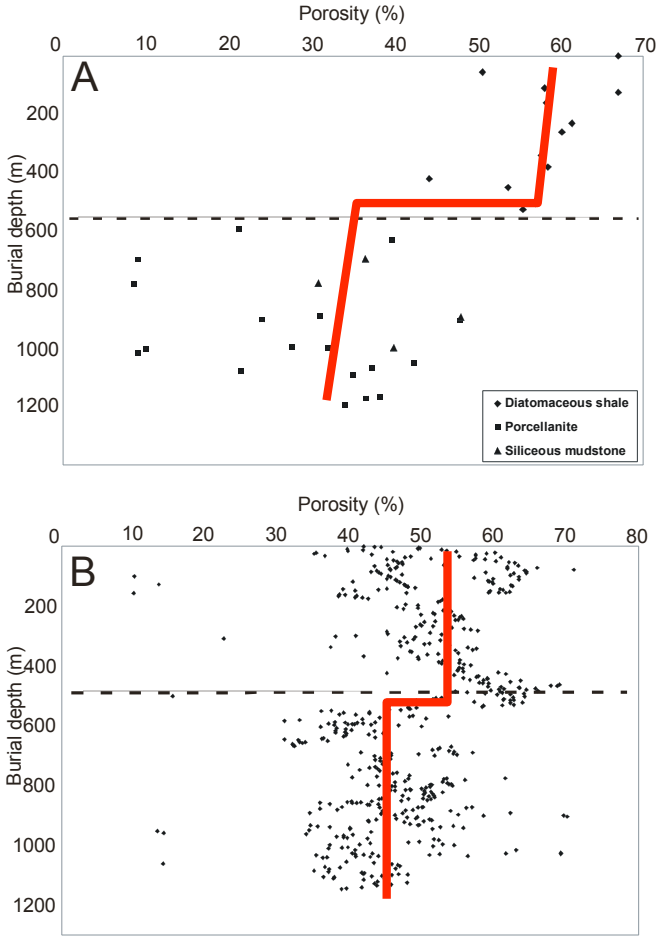
White paper

- Rather than white paper have devoted time to developing academia industry IODP proposal

Objectives in Designing Proposal

- Good and testable hypothesis
- Unique in the IODP inventory of opportunities
- Drilling is straightforward (incl. no major safety concerns)
- 3D seismic data coverage to provide site survey available





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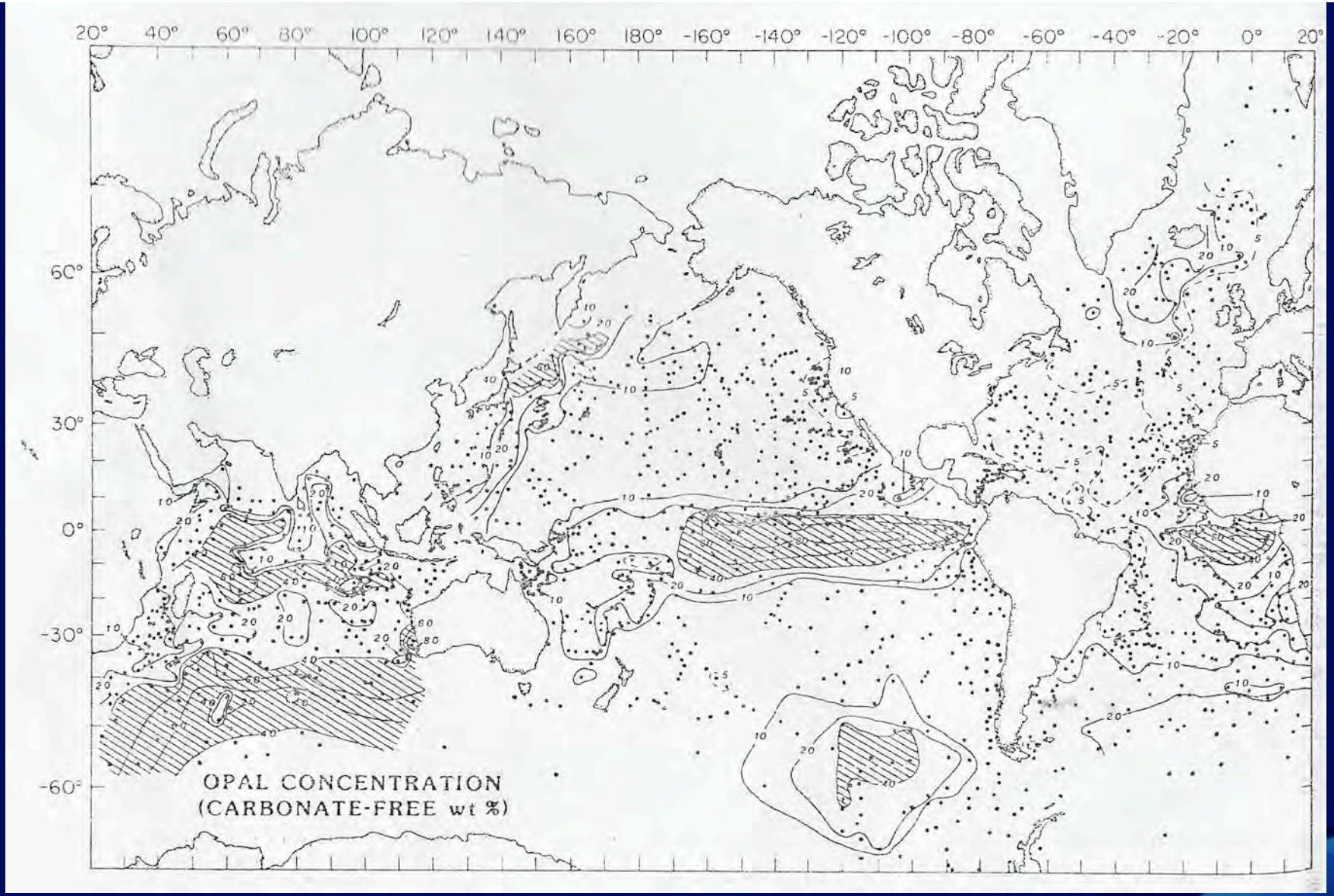

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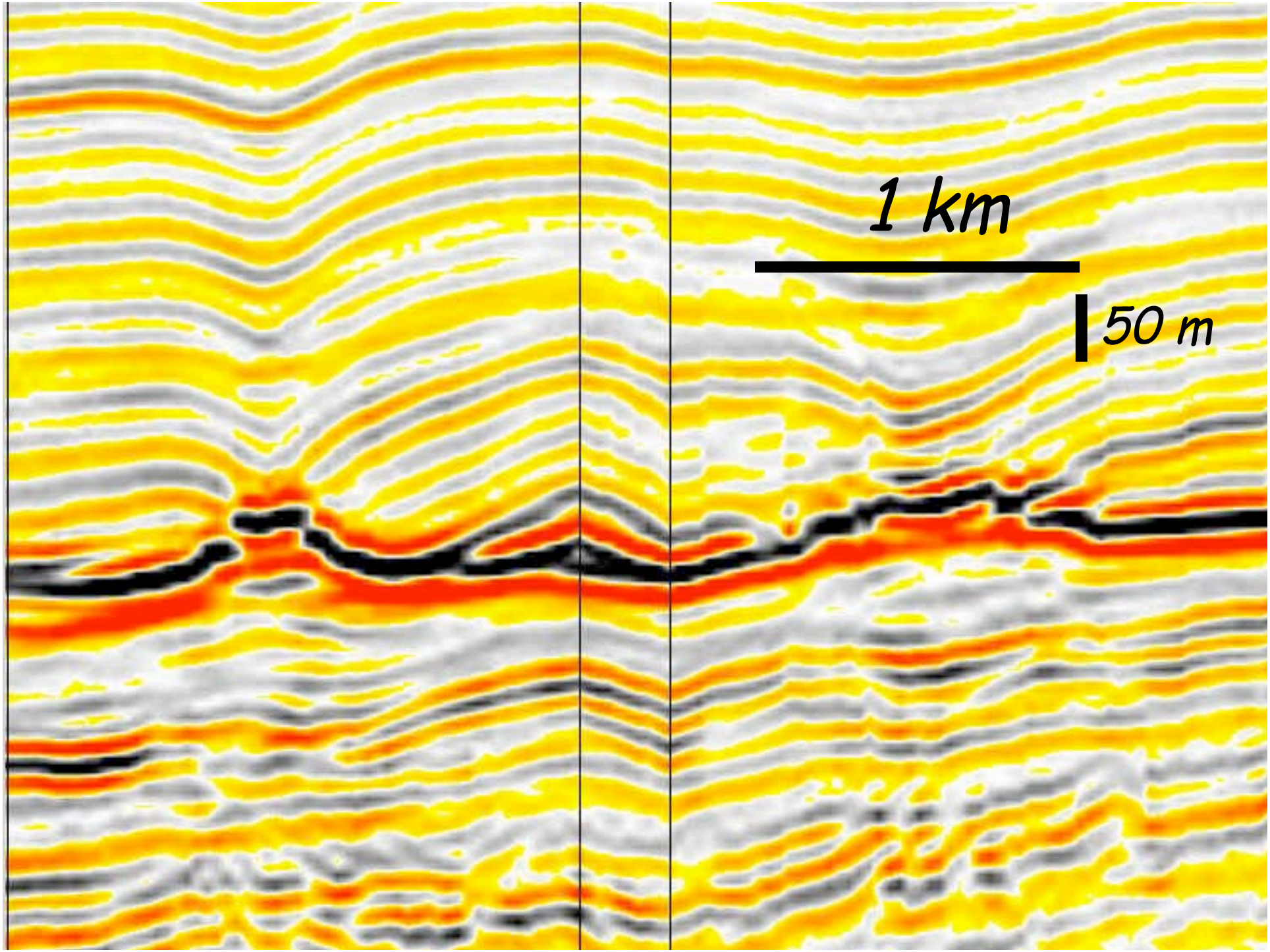
but over large tracts of oceans biogenic silica concentration is moderate to high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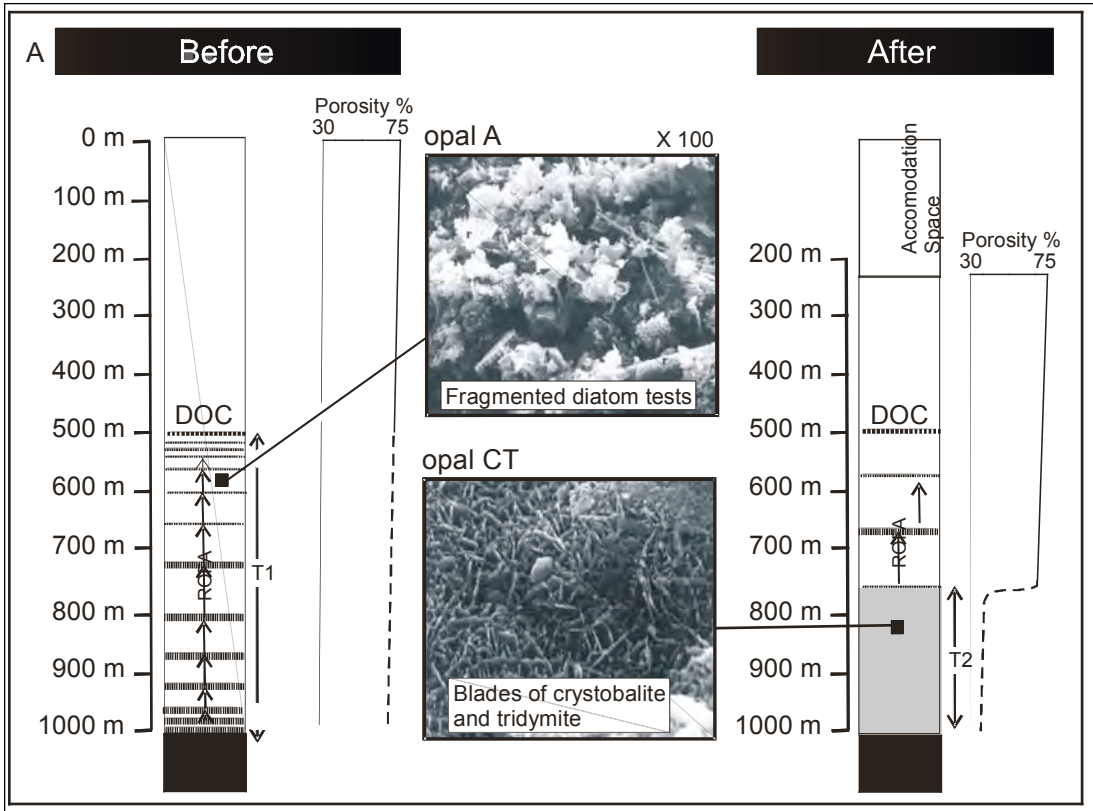
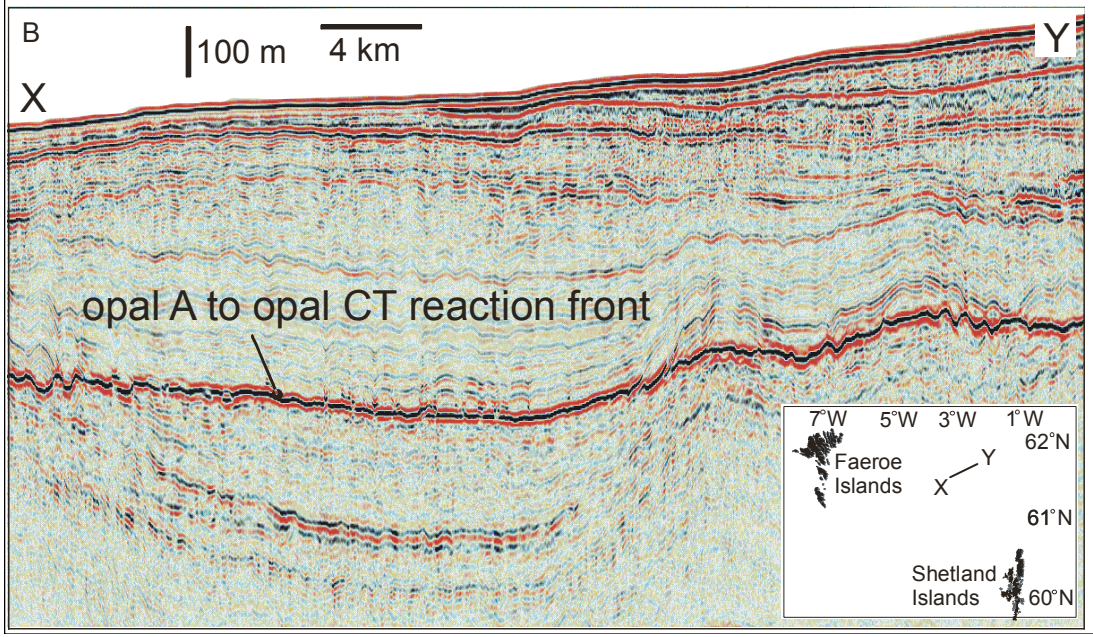
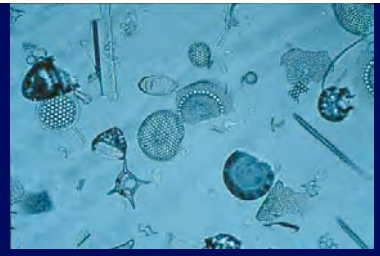
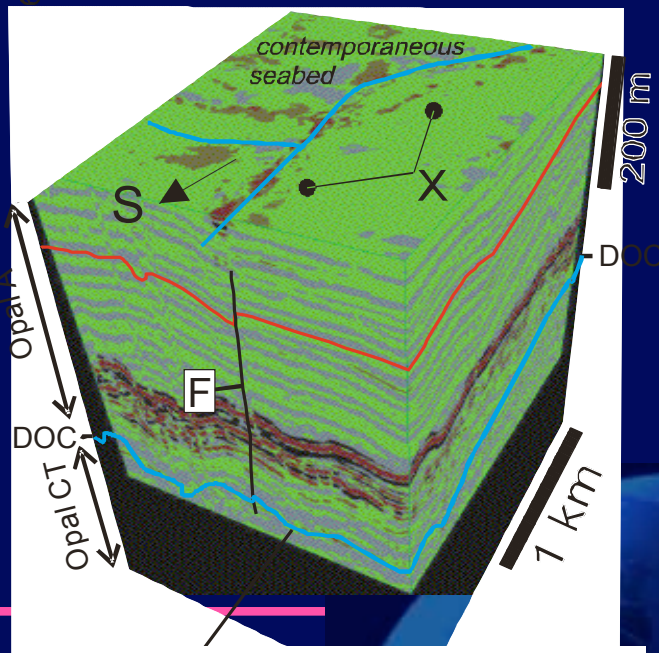
50 m



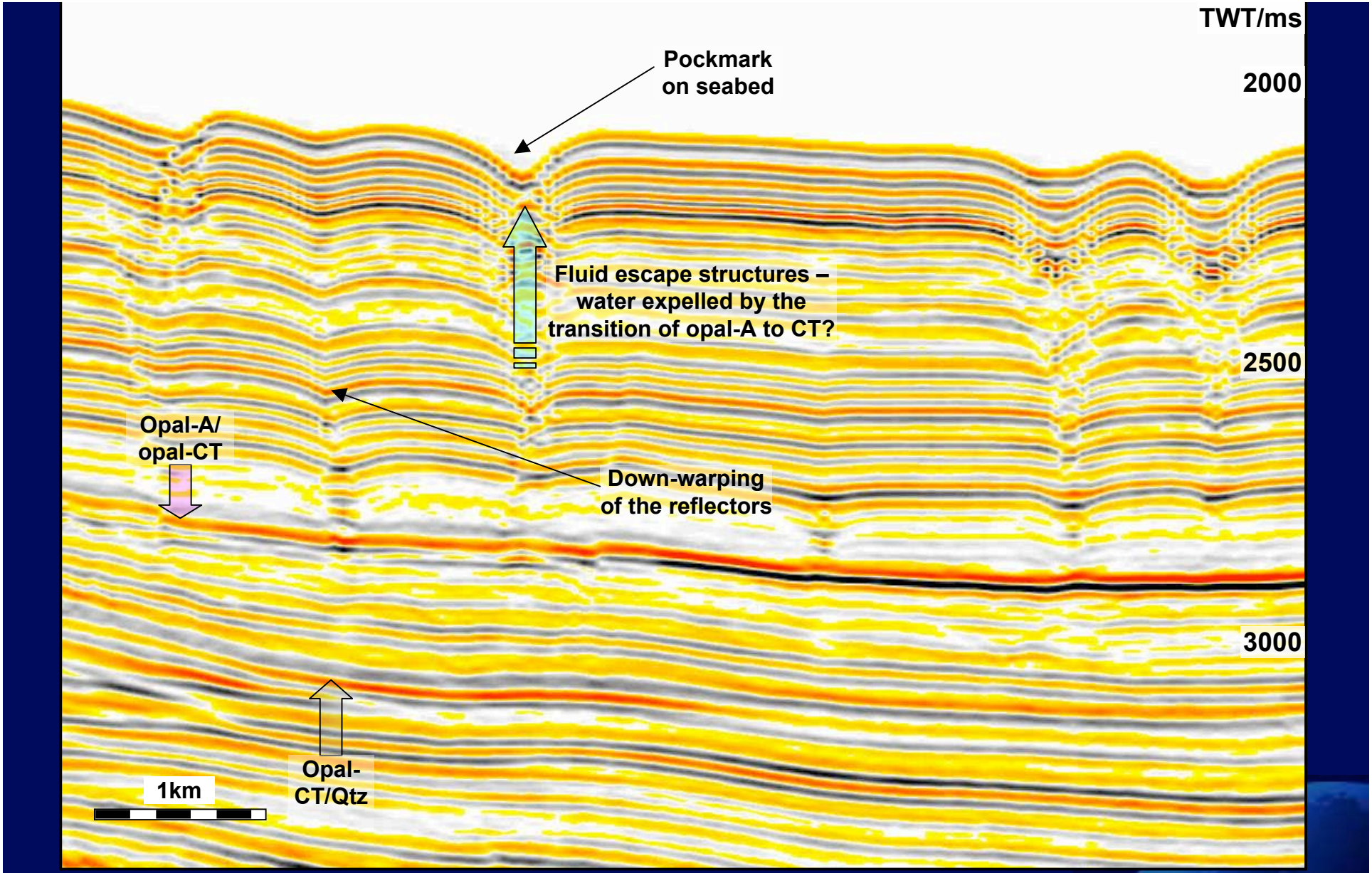




- opal A dissolves and reprecipitates as opal CT
- opal CT dissolves and reprecipitates as quartz
- causes rapid compaction and fluid flow



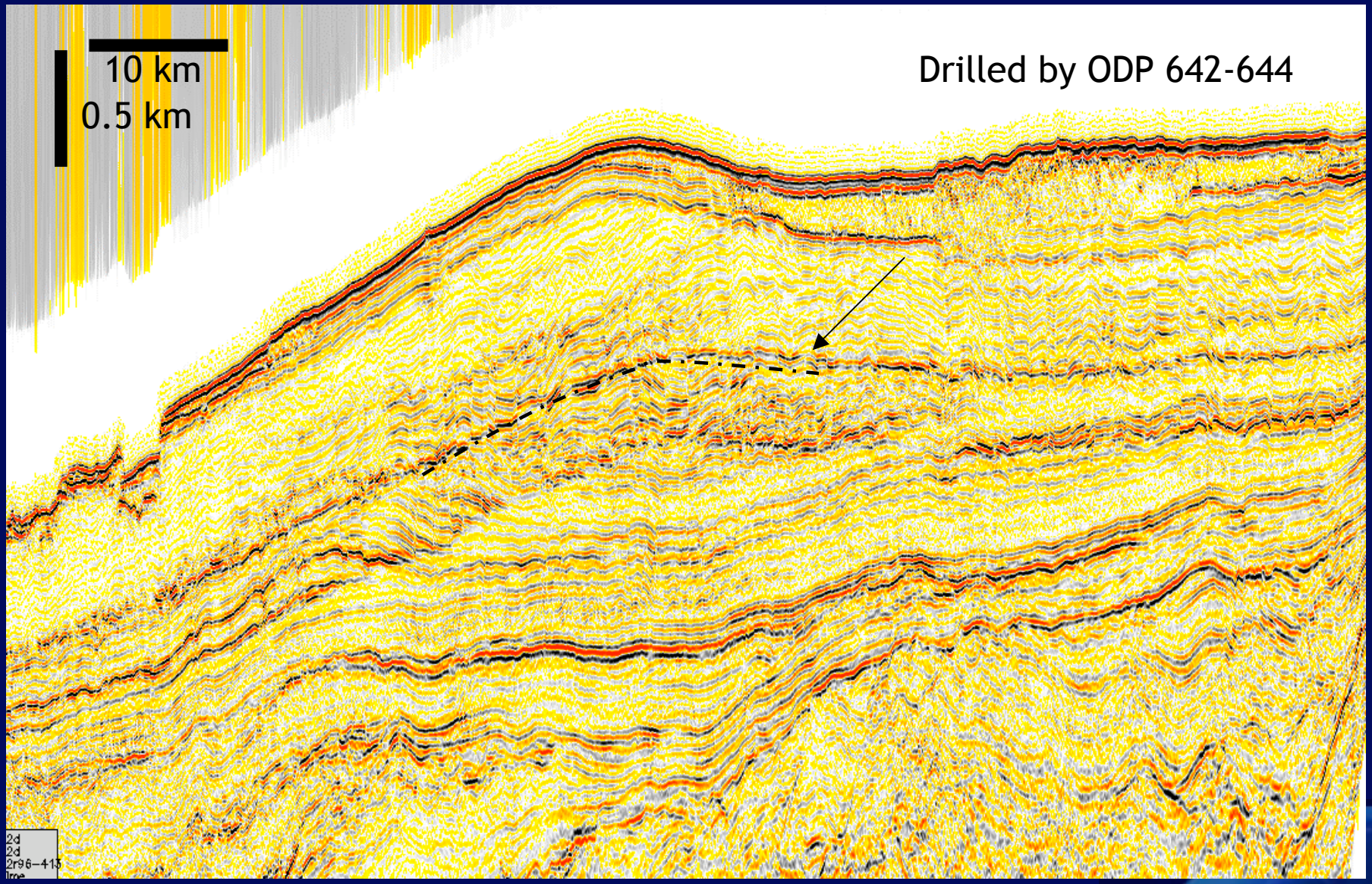
opal A to opal CT reaction front



North Sakhalin Basin

Durham University

CeREES



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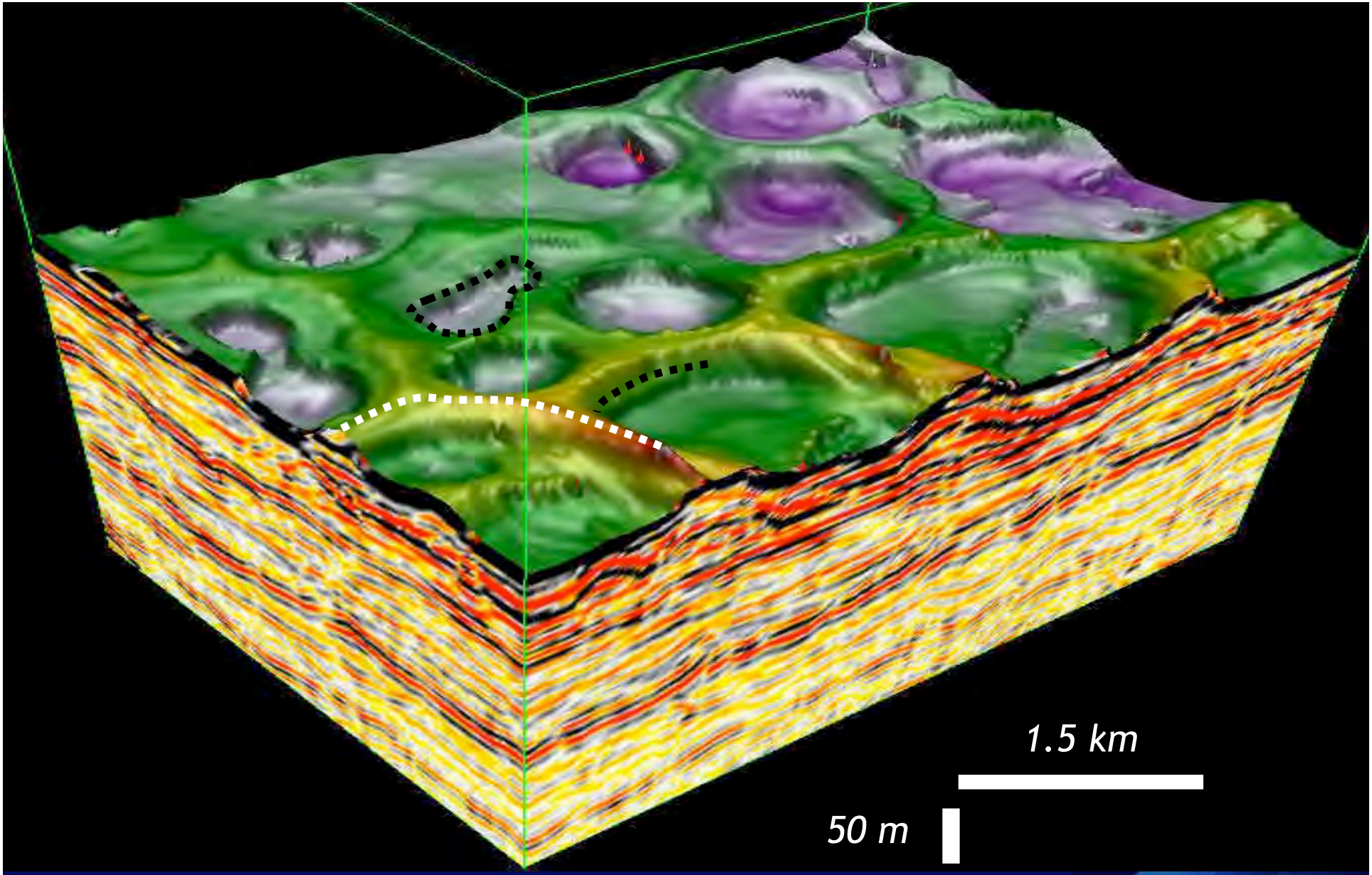
Offshore Norway



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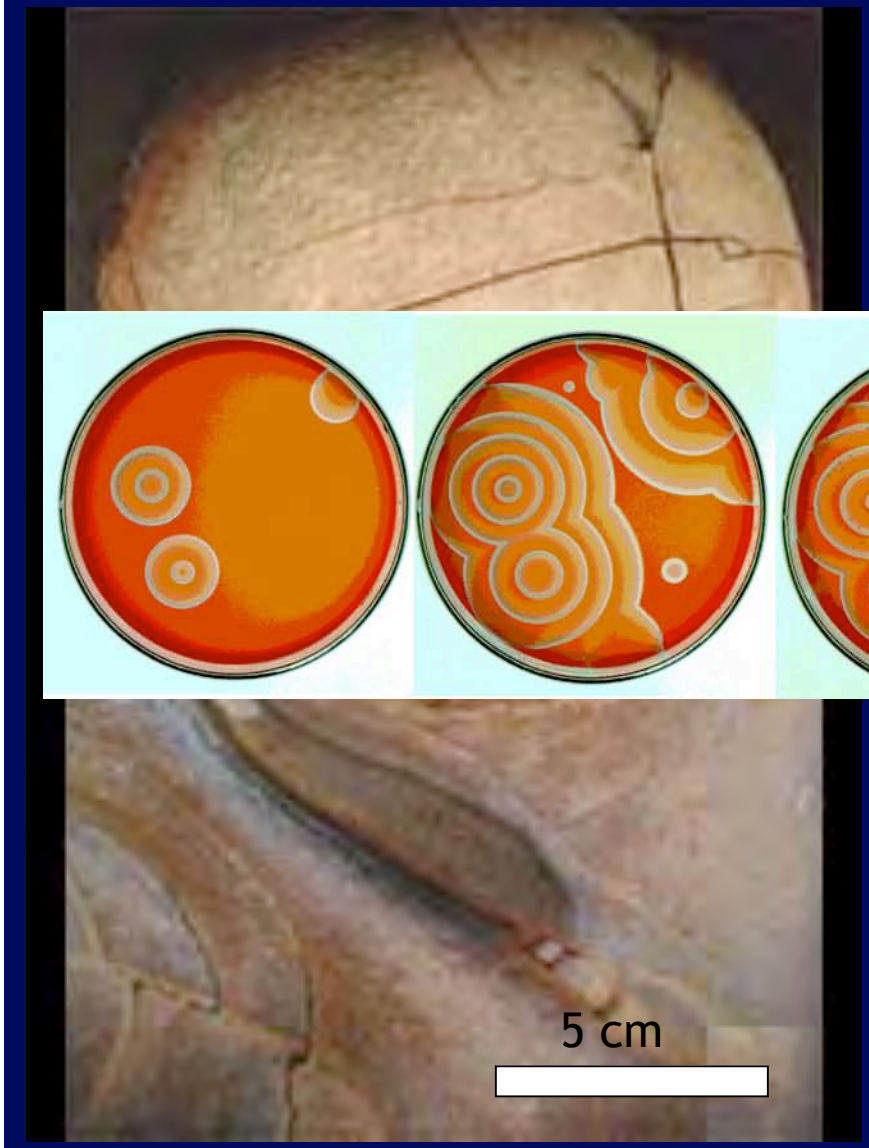
Ridges and Depressions



Chemical diffusion due to concentration gradients

Durham University

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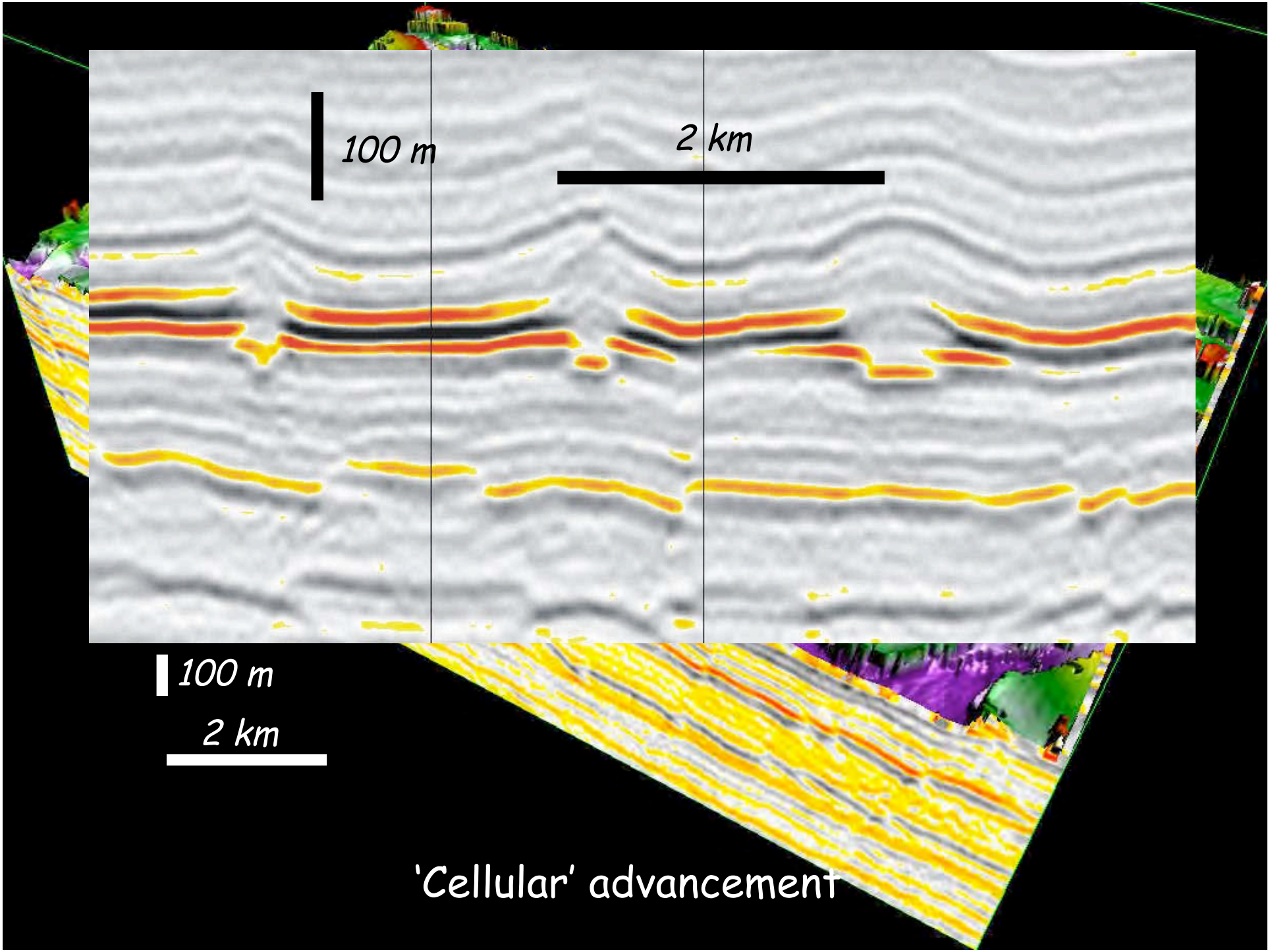
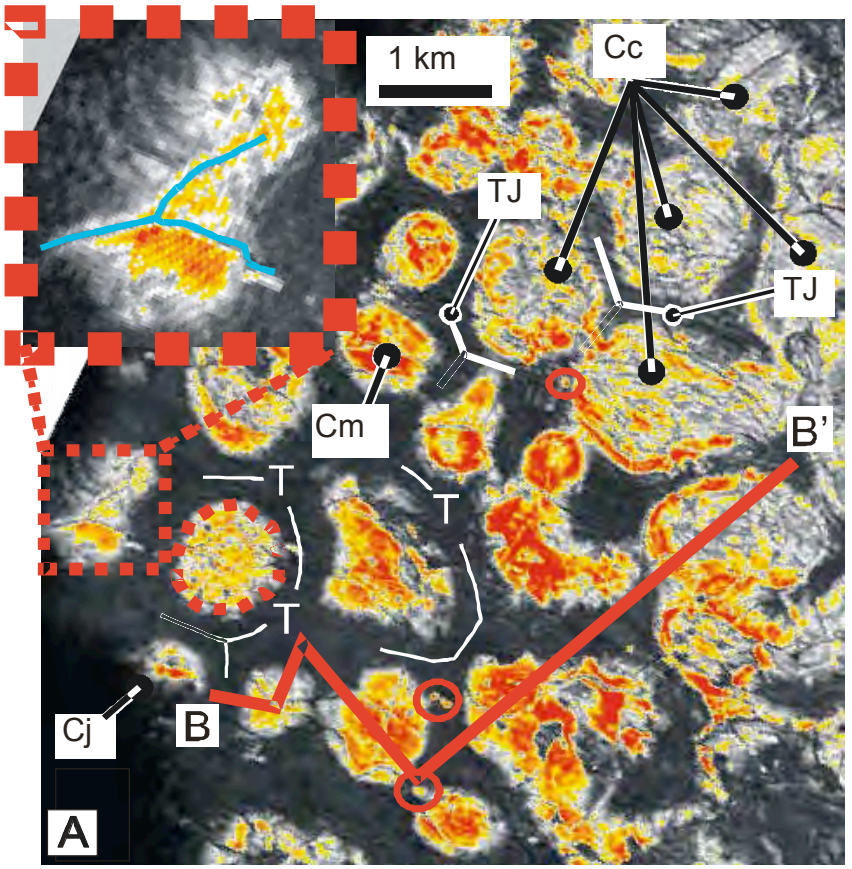
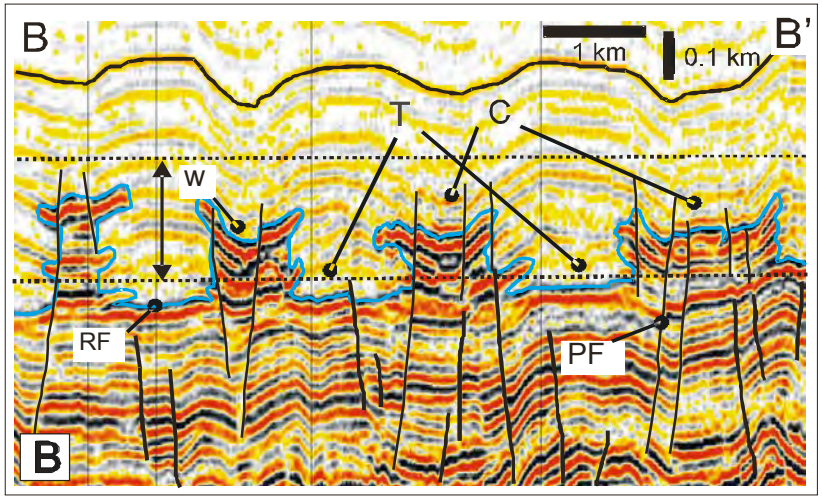
Centimeter to meter scale reaction fronts


100 m
2 km
100 m
2 km
'Cellular' advancement





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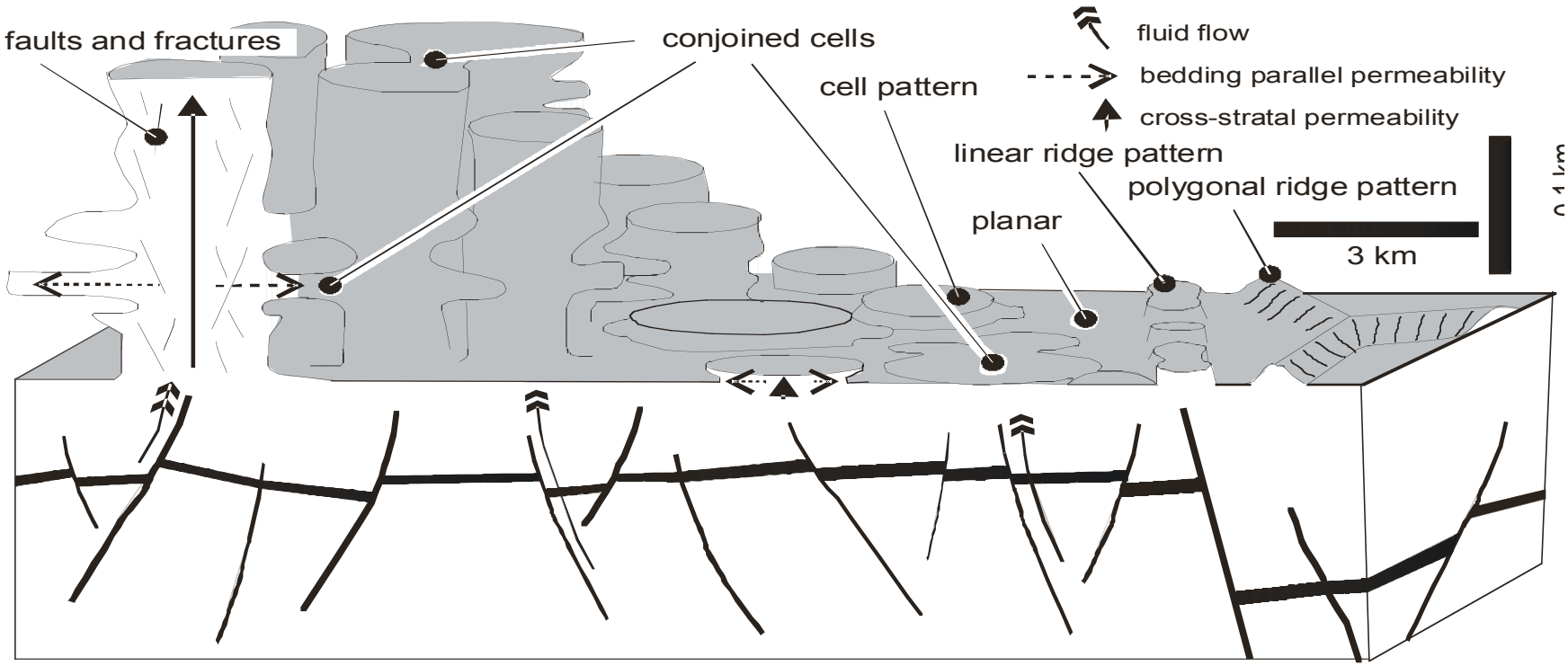
Horizontal and vertical permeability
Fracture and fault growth
Feedback loop (reaction and fracturing) - self organisation



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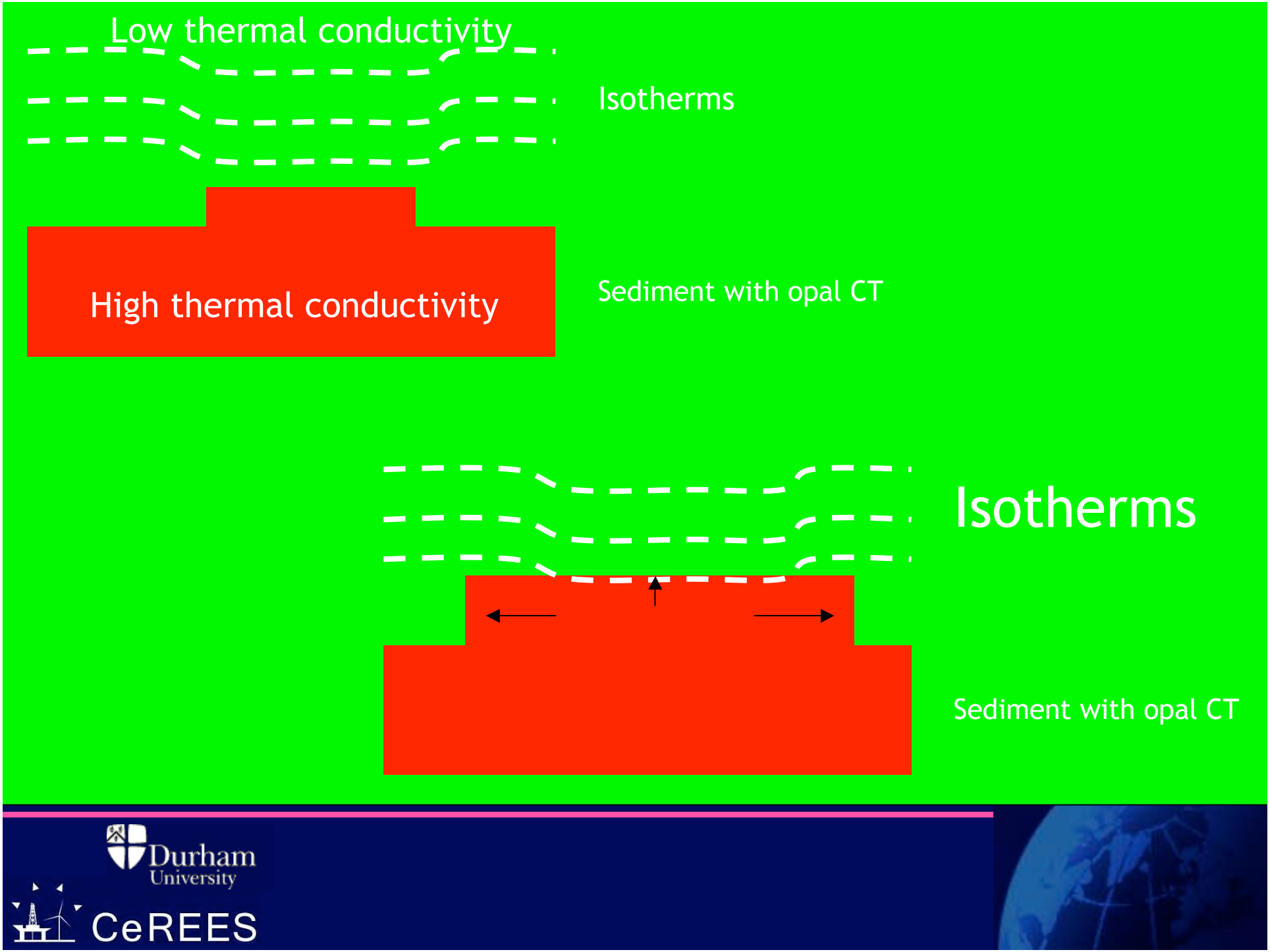
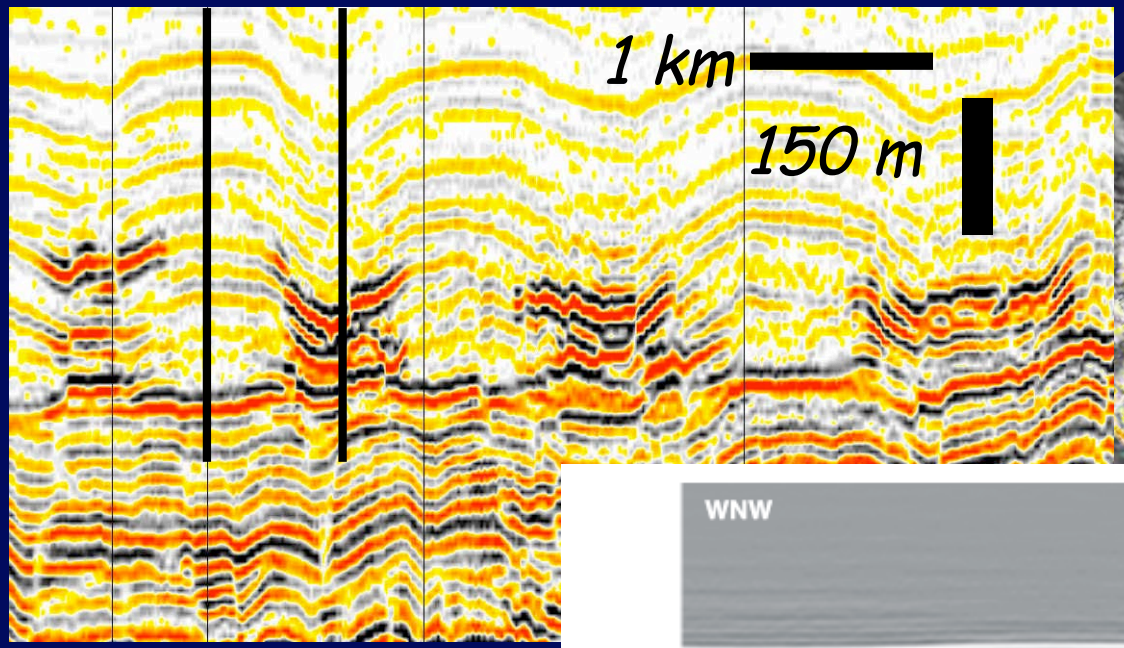
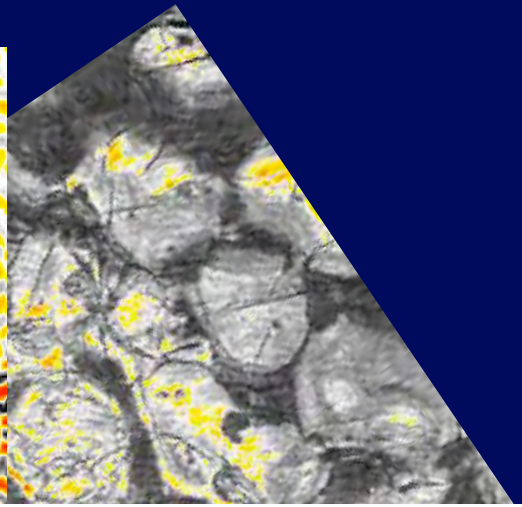
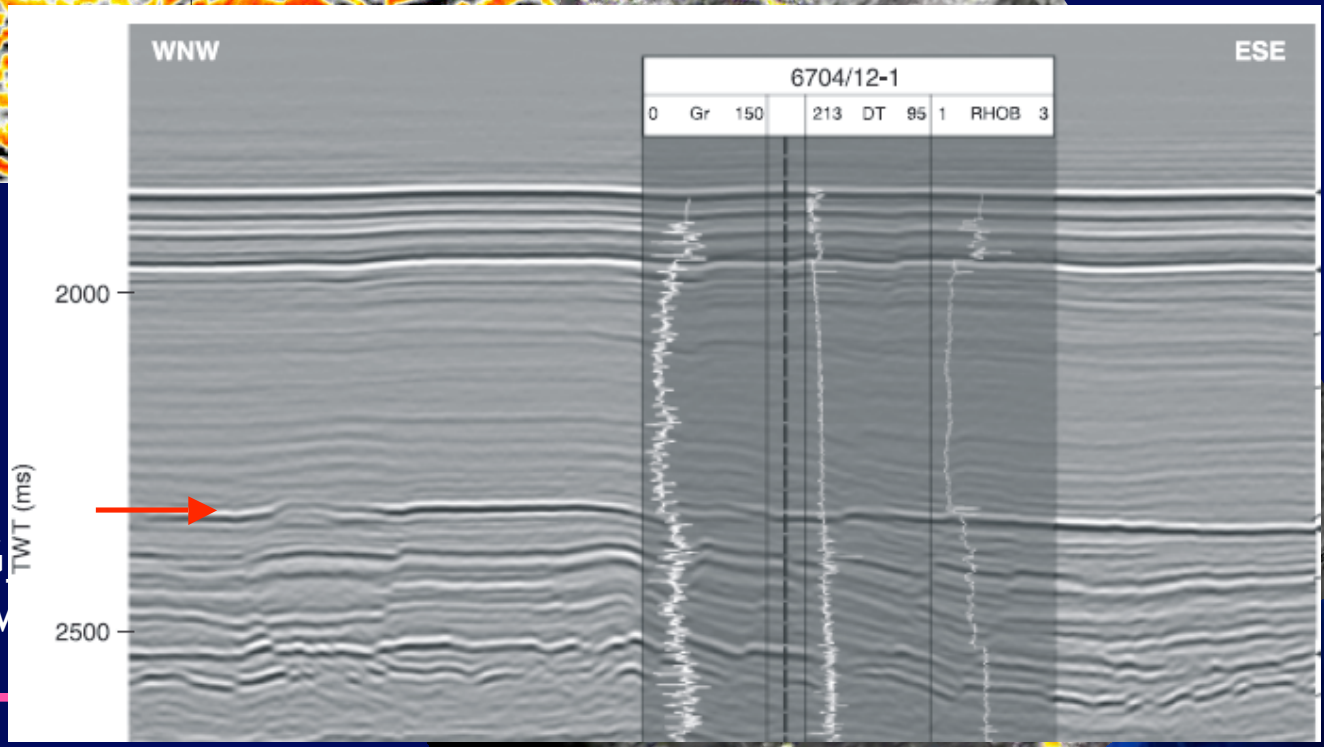
Significant variety of front patterns


Low thermal conductivity
Isotherms
High thermal conductivity
Sediment with opal CT
Isotherms
Sediment with opal CT

Well 1 Well 2







Propose Drilling Cells On G
Voring Basin, offshore Norv

Durham University

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Team and Strategy

- Idea to tag onto a well that drills Paleocene-Eocene hydrothermal mounds (Planke et al proposal in system)
- Drill wells independantly
- Team (Davies, Cartwright, Industry (e.g. Gjallar Ridge))

- Academics now attending the meeting to seek guidance and data for proposals where industry data needed or helpful.
- Has led us to ensure company attendence at meetings.
- We have approximately 4 proposals in some state of development
- Aim to increase the number of individuals that can advise on drilling and logging technology (we already have one driller but want to increase breadth of expertise).
- We have expanded the panel. To insure company representation we now have alternates in each company and new companies represented
- Next meeting in Jan 25th
- Jury out on whether we will be successful in getting ideas completed for April 1st. 'Everyone already has full time day-job....'

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UK ILP Update

Questionare to Japanese Petroleum Geologists on IODP utilization and their replies

Yoshihiro Tsuji

January 19, 2007

In IODP IIS-PPG meeting, Houston

Questionare was sent to Japanese Petroleum Geologists by email

Questions are as follows,

1. Do you know IODP?

2. Do you have experience of utilizing DSDP/ODP/IODP?

3. How the ODP results were used?

4. Why you did not use the IODP result?

5. Do you have any plan to use the ODP results?

6. If you have, where do you want to drill by Chikyu?

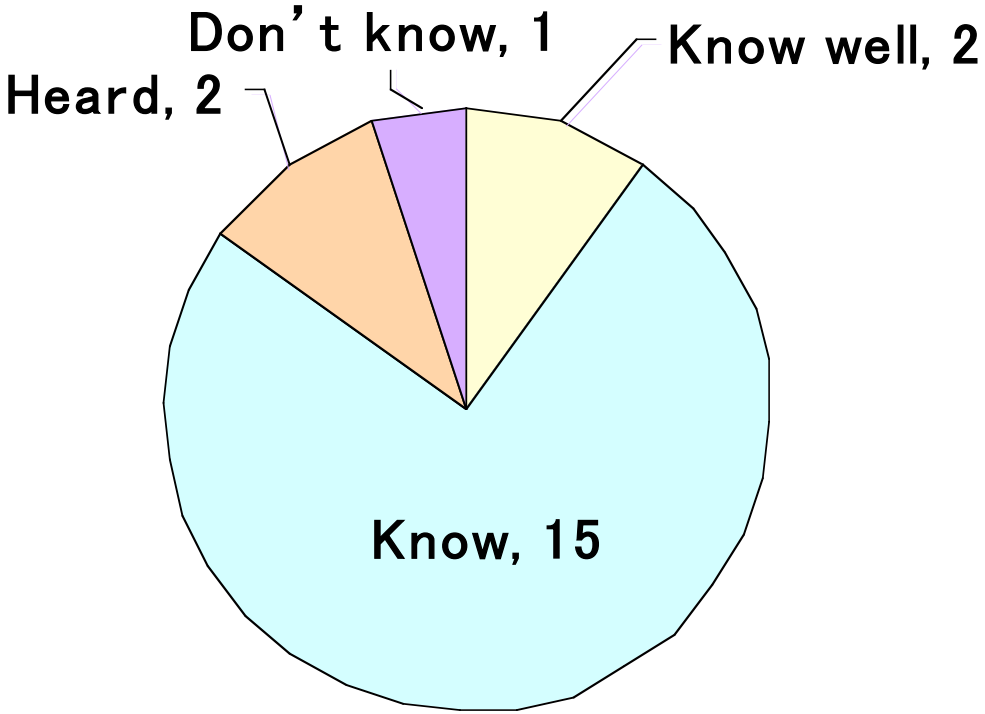
7. If you do not, what is the reason?

8. Will you join a meeting in which candidates or plans of drilling will be reported and discussed?

9. Is there any possibility you propose IODP drilling plans?

Sent to 31 and 20 replies

1. Do you know IODP?

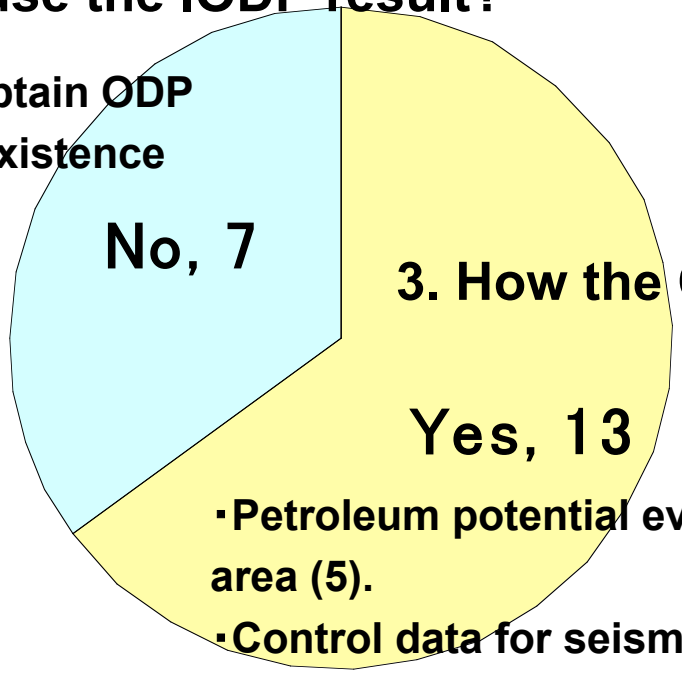


2. Do you have experience utilizing DSDP/ODP/IODP?

4. Why you did not use the IODP result?

・I did not know how to obtain ODP data, although the data existence was known(2)

・No well was in the area of interest (4)



3. How the ODP results were used?

・Petroleum potential evaluation in frontier or deep water area (5).

・Control data for seismic data interpretation.(2)

・To predict character of surface sediment

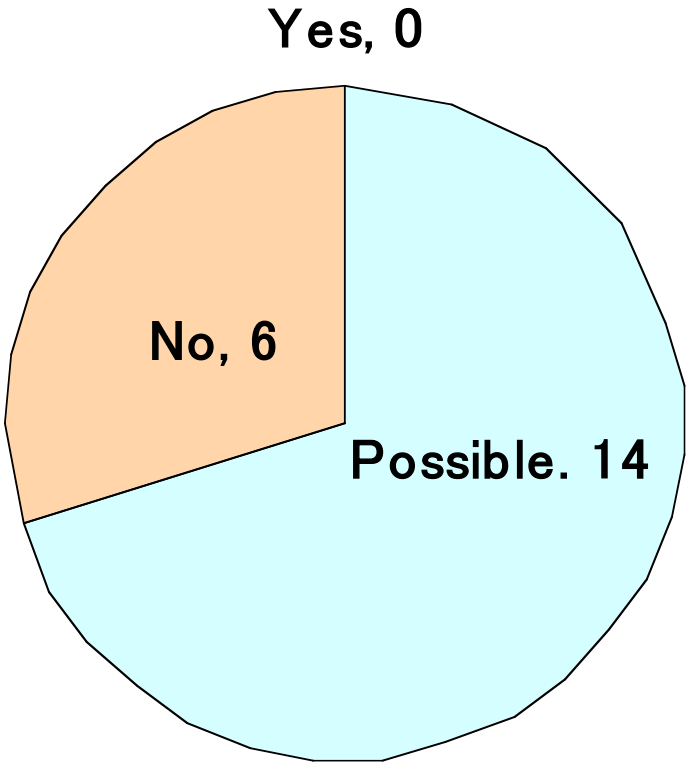
・Sr-isotope stratigraphy and biostratigraphy

・Geological succession, biostratigraphy,. Oxygen-carbon isotope stratigraphy.

・Stratigraphy information in basin evaluation

・To study the origin of Japan Sea

5. Do you have any plan to use the ODP results?



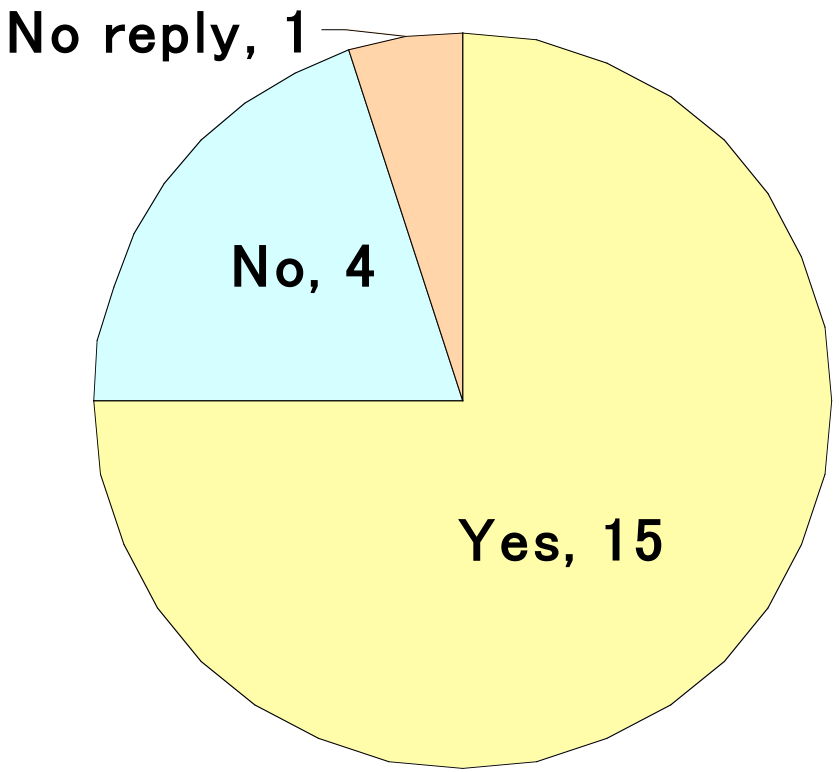
Where and/or what do you want to drill by Chikyu?

- Central area of Black Sea: Petroleum potential and Moho.
- Petroleum potential along Trench from Java, Timor to Papua and Buton Is.
- Source rock distribution and maturation in deep basin where oil wells are not drilled (3).
- To verify seismic geomorphology.
- Basic stratigraphy and reservoir and source rock potential of future high exploration potential area such as Southeast Asia, West Africa, North Africa and East Brazil.
- Frontier area(3).
- Deep sea and deep drilling in basins around Japan.
- Deep sea, offshore Vietnam.
- To know inorganic hydrocarbon generation related to serpentinization of peridotite on submarine ridge, and deep sea biology associated with hydrothermal vent or cold water seepage in relation to source of oil.
- To know paleo-temperature of latitudes in ancient ages which will help to estimate source rock potential of basins.
- To know migration of pore water and its relation to abnormal formation pressure.

7. Why you will not use IODP results?

- No environment in the company
- May need many procedure
- Present position within company
- No information about the volume and quality of data
- No drilling in the area of interest
- Company has no plan in deep sea exploration

Will you join a meeting in which candidates or plans of drilling will be reported and discussed?



Will you join a meeting in which candidates or plans of drilling will be reported and discussed?

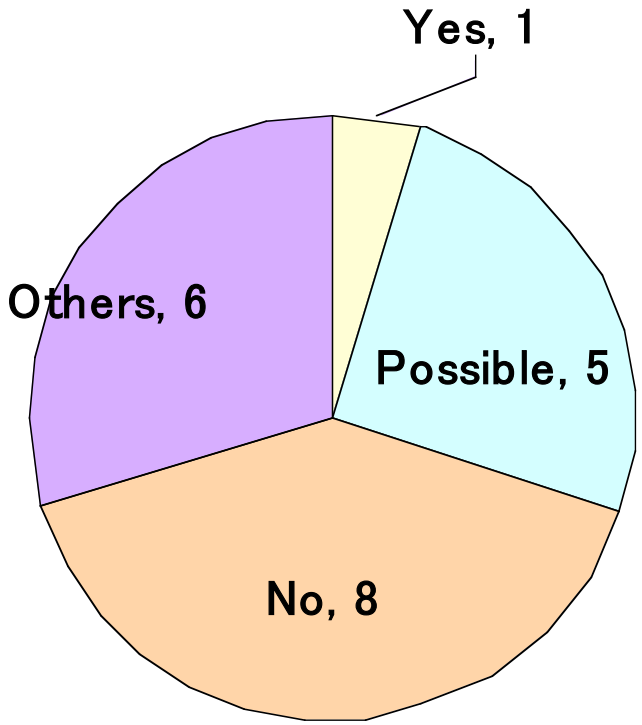
Yes

- **To find possibility to apply the results in oil exploration.**
- **Need to start from knowing**
- **Personal interest**
- **To gather information.**
- **If the agenda is related to oil industry.**
- **If time allows**
- **Expect to obtain new information on geosciences**
- **To use the information from the meeting in the evaluation of petroleum systems and plays**
- **To have a connection with academia and obtain good talent for oil industry**
- **Expect the development or expansion of IODP and believe its value in oil exploration**

No

- **IODP must needs long time for the results and difficult to apply them in projects, although personal interest is there.**
- **Going to stay or presently staying in the abroad**
- **Low possibility to have contact IODP results, or no information on IODP.**

Is there any possibility you propose IODP drilling plans?



Is there any possibility you propose IODP drilling plans?

Yes

- **Drilling of basin center**

Possible

- **There should be many drilling which will help oil exploration and scientifically interesting.**
- **Company may or should have such strategy.**
- **Company has deep sea contract area(2)**

No

- **Neither by the organization nor personal**
- **No time to prepare proposals. If prepared, it takes long time to be adopted and drilled, and it is too long for the study of oil industry.**

Others

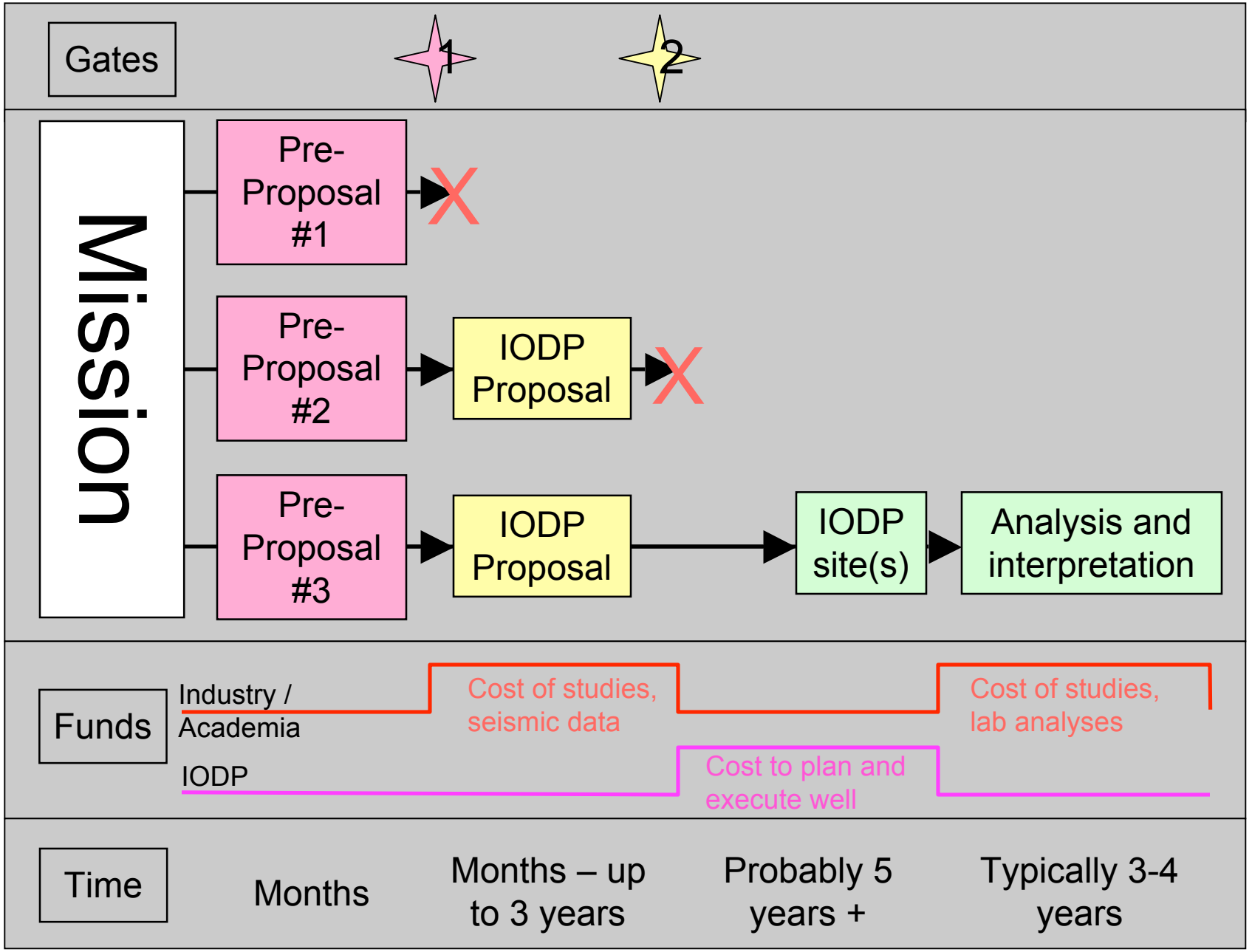
- **Would like to think about from view point of obtaining new data for oil exploration.**
- **Low possibility in short term, but want to think about in middle to long term.**
- **No possibility by one company, but possible by building a consortium or jointly propose with overseas research organization.**
- **No answer.**

Potential IODP-Industry Project Proposal Mechanism

IIS-PPC Meeting

The Hague, July 7-8th 2006

IODP-Industry Project Selection Time-line



Gates

1: Rejection of Pre-Proposal by OIDP panel

and/or

Failure to obtain industry or academic funds and data for full proposal preparation (e.g. M.S., or PhD), if required

2: Rejection of Full Proposal by OIDP panel

and/or

Failure to obtain industry or academic funds for required pre-drill seismic costs (i.e. site survey), and post-well analytical costs