



Scientific report for ECORD MagellanPlus Workshop Series Program

Black Sea history of the past 15 Ma (BLACKSINK)

Utrecht (The Netherlands), February 27-28, 2014

Report to ESSAC

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1. SUMMARY

BLACKSINK held in Utrecht in February 2014 was envisaged as a workshop to bring together researchers in academia and industry to identify the most suitable drill sites in the Black Sea to tackle the **time control on recurring restriction events**, their **impact on regional paleoclimate and paleoenvironment** and the intricate **hydro-interactions with Mediterranean Sea and the World Ocean** during the past 15 Myr. For scientific purposes, the only quasi-continuous rock records of the Black Sea geological past are now provided by the DSDP42B Sites 379, 380 & 381 drilled back in 1975. At that time it was recognized that, *‘despite the fact that the coring was almost continuous it was nearly impossible to reconstruct the overall late Neogene-Pleistocene history of the Black Sea, particularly with regard to stratigraphy and dating’*. With the latest advances in the integrated stratigraphy (magnetostratigraphy, radiometric dating and isotope chemistry) we can overcome the biggest issues in the Black Sea geological history: **the time control on its stratigraphy**. A drilling in the Black Sea would interest people and society around it because of the remarkable knowledge that can be generated. Additionally, Black Sea is an underexploited region on the IODP map. The scientific community can better understand isolation events, their inception, evolution and demise since the Black Sea is and was the archetype of intracontinental basin, immediately affected and responding to **glaciations, eustasy, sea level changes and active tectonics**. The responds are now well recorded in the thick sedimentary pile of the Black Sea basin, making its drilling a too long awaited action. In Utrecht we worked on identifying the scientific purpose of the drilling in relation to the general IODP goals. We formulated the fundamental scientific questions that will be addressed ideally in two pre-proposals. The first day of the workshop was dedicating to summing up the scientific reasons to drill in the Black Sea and defining the problems expected to be solved by an international effort of such caliber. At the end of the day we already started to line the most probable successful outcome. The second day was used entirely to sketch the (sub)proposal and decide the teams working on different subdivisions of the proposal. It was also decided that the Black Sea related efforts will be correlated to the parallel running proposal to drill in the Mediterranean Sea (DREAM).

2. OBJECTIVES OF THE BLACKSINK WORKSHOP

The main objective of the BLACKSINK workshop was reached by the nucleation of group of scientist directly interested and committed to Black Sea special (paleo)environmental oddities and its geological history. The participants were covering various expertises (e.g. stratigraphy, geochemistry, biogeochemistry, tectonics, paleontology) (See table 1). They pose different questions from the recent Black Sea environmental problems to those occurring during Cretaceous, at the time of the opening of the Black Sea.

The goal of the BLACKSINK workshop held in Utrecht was to initialize international effort and awareness about the lack and acute need of deep sea drilling related knowledge on one of the most fascinating marine domains known since antiquity: Pontus EUXINUS.

3. LIST OF CONFIRMED PARTICIPANTS

No.	Given name	Name	Workshop related expertise	Institution	Country	Remarks
1	Günay	Çifçi	Seismics/Turkey Black Sea side	DEU	TK	
2	Corneliu	Dinu	Seismics & tectonics Black Sea	BuU	ROU	
3	Rachel	Flecker	Mediterranean/Paratethys relation	BrU	UK	
4	Liviu	Giosan	Black Sea Quaternary	WHOI	USA	Canceled
5	Arjen	Grothe	Palynology	UU	NL	PhD
6	Wout	Krijgsman	Stratigraphy & time control	UU	NL	
7	Cor	Langereis	Black Sea Paleomagnetism	UU	NL	
8	Mark	Lever	Deep Biosphere	AaU	DK	
9	Luc	Lourens	IODP/ECORD & Cyclostratigraphy	UU	NL	
10	Timothy	Lyons	Biogeochemistry /Anoxic Basins	UC	USA	
11	Liviu	Matenco	Tectonics/seismics of Black Sea	UU	NL	
12	Jack	Midelburg	Biogeochemistry of Black Sea	UU	NL	
13	Seda	Okay	Seismics/Turkey, Black Sea side	DEU	TK	
14	Werner	Piller	ECORD & Paratethys stratigraphy	UG	AT	
15	Gert-Jan	Reichart	Marine Geology	UU/NIOZ	NL	
16	Francesca	Sangiorgi	Palynology	UU	NL	
17	Jaap	Sinnighe-Daamstee	Organic Geochemistry	UU/NIOZ	NL	
18	Caroline	Slomp	Phosphorous/ Anoxic Basins	UU	NL	
19	Appy	Sluijs	Palynology	UU	NL	
20	Gabor	Tari	Oil industry activating in Black Sea	OMV	AT	Canceled
21	Christian	van Baak	Paleomagnetism of Black Sea	UU	NL	PhD
22	Marcel	van der Meer	Organic Geochemistry	NIOZ	NL	
23	Iuliana	Vasiliev	Stratigraphy of the Black Sea	UU	NL	
24	Frank	Wesseling	Paleontology in restricted basin	NB	NL	

Table 1. Participants to BLACKSINK. DEU (Dokuz Eylül University), BuU (Bucharest University), BrU (Bristol University), WHOI (Woods Hole Oceanographic Institution), UU (Utrecht University), AaU (Aarhus University), UC (University of California), UG (University of Graz), NIOZ (Netherlands Institute for Marine Research), OMV (OMV group), NB (Naturalis Biodiversity Center of Leiden).

From the entire list of the confirmed participants there were two that had to cancel some days before the workshop: Liviu Giosan (WHOI) because of illness and Gabor Tari (OMV) because of urgent business related changes.

Bill Ryan (WHOI) and Bo Barker Jørgensen (AaU) could not attend the workshop but they were ensuring their full support during the future proposal writing.

4. WORKSHOP PROGRAM

The workshop took place in the Academy Building, Domplein 29 in Utrecht.

DAY 1: 27th of February 2014

09:00 - 09:30 Introduction & coffee

09:30 - 09:40 Welcome by Cor Langereis

09:40 - 09:50 Wout Krijgsman *Integrated stratigraphy of the Miocene Black Sea Basin*

09:50 - 10:00 Jaap Sinninghe Damsté *Why would an organic geochemist be interested in drilling in the Black Sea?*

10:00 - 10:10 Timothy Lyons *Proxy Development, Atmospheric O₂ through time*

10:10 - 10:20 Mark Lever *Anaerobic Microbial Carbon Cycling in Sediments and Crustal Environments*

10:20 - 10:30 Iuliana Vasiliev *The role of the Black Sea in the desiccation of the Mediterranean during the Messinian Salinity Crisis*

10:30 - 12:30 Plenary discussions

12:30 - 13:30 Lunch

13:30 - 13:40 Caroline Slomp *Phosphorus cycle in anoxic basins*

13:40 - 13:50 Jack Middelburg *Black Sea alternation of salt/freshwater and non-steady state diagenesis with consequences for authigenic mineral formation, ion-exchange, preservation*

13:50 - 14:00 Gert-Jan Reichert *Anoxic basins geochemistry and foraminifera based proxies*

14:00 - 14:10 Rachel Flecker, *Paratethys-Mediterranean interactions*

14:10 - 14:20 Liviu Giosan (canceled)

14:20 - 14:50 Coffee break

14:50 - 17:00 Plenary discussions

17:00 - 17:10 Luc Lourens and Werner Piller, presentation on *ECORD activities*

17:30 - 22:00 Reception & Dinner

DAY 2: 28th of February 2014

09:00 - 09:30 Coffee

09:30 - 09:50 Corneliu Dinu *Seismics on the Black Sea (Romanian Shelf)*

09:50 - 10:10 Liviu Mațenco *Seismics on the Black Sea (Romanian Shelf)*

10:10 - 10:30 Gunay Çifçi *Seismics on the Black Sea (Turkish Black Sea coast)*

10:30 - 12:00 Plenary discussions

12:00 - 13:00 Lunch

13:00 - 14:30 Break-up teams

14:30 - 15:00 Coffee brake

15:00 - 16:50 Plenary discussions

16:50 - 17:00 Concluding remarks

The initial program was modified. However, all participants had been presenting their announced contributions. We devoted the first day to presentation and plenary discussions. At the end of the day we already started to line the most probable successful outcome. The second day was used entirely to sketch the (sub)proposal and decide the teams working on different subdivisions of the proposal.

5. OUTCOME OF THE WORKSHOP

WHY THE BLACK SEA AND WHY NOW?

- The Black Sea is a recorder of high frequency climate change because of its anoxic deep water. However, due to the endemism of the flora and fauna reading this record requires local proxies to be developed or existing proxies to be recalibrated.
- Due to its latitude it provides an essential link between high and low latitude climate. Long term evolution of global climate is influenced by the gradual increased restriction of the basin. Development of Himalayas, role of monsoon.
- Unraveling the record of past environmental change in the Mediterranean is hindered by a lack of knowledge of Black Sea influence.
- Due to its restricted nature the Black Sea is and was highly susceptible for sea level change.
- The restricted nature of the Black Sea resulted in highly endemic biota. This offers the opportunity to study evolutionary pathways in many different organismal groups?
- *Never* drilled for microbiology, although clearly of great interest. Unique setting because of layer cake structure.

- Moreover pore-water data is needed to constrain ongoing processes.
- In contrast to the Baltic there are a series of transitions and there is a deep-sea setting.
- In comparison to Cariaco this is a mid-latitude setting in contrast to Tropical (i.e. salinity stratification compared to thermal stratification).
- Now we have the time scale available allowing connecting the Black Sea record with global change.
- We cannot work with the old cores because of oxidation/desiccation affecting the original material.
- Recent interest for Black Sea from oil companies
- Black Sea is subject of recent major programs
 - i. International EU/UN funded Black Sea program
 - ii. Danube international program

During this workshop an important aspect was the identification of the links to the IODP Science plan:

- Regional patterns of precipitation
- Resilience of the BS/Paratethys to chemical perturbation
- What are the patterns and processes of Carbon cycling in the Black Sea over range of climatic timescales?

6. FUTURE ACTION

Anoxia – climate – connectivity –the core of the Black Sea research

Parathethyan anoxia – today the Black Sea is the largest anoxic basin in the world. Its history of large-scale anoxia including world-class oil source rocks, spans ~40 million years reflects the sensitivity of this mid-latitude basin to subtle climate, tectonic, and basin connectivity.

Because of the large number of scientific aspects of interest for the community it was decided to write two pre-proposals. The participants at the workshop agreed that in this way the changes would increase in finding solutions to some of the logistic problems like the clearance of Bosphorus Bridge, the presence of gas hydrates, geopolitical situation.

Pre Proposal 1 (BLACK SEA SINCE QUATERNARY)

1. What are the patterns and processes that govern carbon cycling in the Black Sea over a range of climatic time scales?

- Do microbes/microbial communities move? Microbial community versus environmental conditions. Taking advance of ancient sapropels. “Everything is everywhere, but the environment selects” Does this also hold for the deep biosphere.

- New inorganic and organic proxies now allow much better constraining past environmental conditions.
- Does ancient DNA reflect past environmental conditions (inherited primary signal?)
- Do we know all pathways involved in diagenesis? The unique geochemical gradients in the Black Sea allow unraveling geochemical processes (i.e. link to microbiology). Relative importance of anaerobic re-oxidation processes (e.g. methane, ammonia).

2. How resilient is the ocean to chemical perturbations?

- Past changes in Black Sea chemistry. Drivers of change?
- Dynamics of change?
- Productivity versus preservation?

3. How to use the Black Sea as a recorder of past hydrology? Is the relation between sea level and Black Sea hydrology maintained over longer time scales than the last glacial-interglacial cycle? **Evaporation-precipitation vs. connectivity (climate-tectonics)**

- Local versus global sea level changes
- Relation to sea level changes, glacial-interglacial (Milankovitch).
- Sub-Milankovitch changes: High resolution studies (varves), millennial, centennial to decadal change.
- What has been the nature of the connection between the Black sea and the global ocean

4. The Black Sea: connecting marine and terrestrial records of past environmental change.

- How did the continental interior change compared to the changes in the open ocean?
- Different rivers provide information on different parts of the continental interior. Tools that might be applied are Sr and O isotopes. Organic geochemistry: branched GDGT's.

Pre Proposal 2 (DEEP TIME – DEEP BIOSPHERE BLACK SEA)

Rapid changes in sedimentary and basin evolution patterns are driven by connectivity events.

1. How was Paratethyan-wide anoxia triggered and sustained for millions of years?

Initial phase – relation to restriction of a major seaway – global implications – Maykop – millions of years timescale – the dating of a major source rock which is not possible on land.

2. What is the Black Sea's response to global cooling and is this a control on anoxia?

Does connectivity with an adjacent saline basin influence stratification in the Black Sea? Middle Miocene – big climate change moment (Miocene optimum to transition therefore a cooling). How does the Black Sea respond particularly considering that we

have evaporites = salt basin in the western basin – the issue is where is the source of the water for this area of the Carpathians/Poland coming from e.g. is this from Black Sea – do we see evidence of exchange. This section on the margins of Black Sea is also evaporitic, we need a deep basin section to see what the hydrology of the basin is doing.

- 3. What are the sub-precessional scale drivers of palaeoenvironmental change including alternations from marine to lacustrine conditions?** Marine-lacustrine-marine transition – Messinian (connection driven) – same idea as for the Middle Miocene, but now the saline basin is the tectonically driven Mediterranean MSC – this is a major regional extreme climate event – relates strongly the DREAM-II proposal to drill the Mediterranean. All aspects of MSC need to be linked to what is going on in BS e.g. Lago Mare. We have the shallow margin setting at Taman. High resolution cyclicity in both Med and BS mean that we can do sub-precessional scale correlation and comparison – this is remarkable.
- 4. Can we reconstruct the onset of Northern Hemisphere glaciation from the Black Sea record?** Akchagyl – when did the modern anoxic system start? Need to look at the onset of northern hemisphere glaciation (climate e.g. glacial driven; 2.6-3.1Ma). New evidence suggests there is a hiatus and then an increase in sedimentation rate e.g. possible new source of sediment. – Thousands year timescale – major climate shift.
- 5. Can we understand the processes that drive rapid connectivity events and gateway evolution (Oligocene-Quaternary).**
- 6. PETM** on one side for the moment – it could be a separate drilling proposal under the same umbrella

PROPOSING PRIMARY SITES

At the end of the meeting it was decided that we should focus on finding 2 primary sites.

1 located in the Deep Basin: Oligocene-recent

1 located on the shelf: Cretaceous to Oligocene (next to Danube)

Finding the best primary sites was attributed to Iuliana Vasiliev, Corneliu Dinu and Günay Çifçi. In the past year I (Iuliana Vasiliev) had three meetings with Corneliu Dinu in Bucharest where we discussed the best possibilities. Corneliu Dinu had discussions with OMV-Petrom, Oil Company operating in the region about sharing the knowledge on this type of planning. I (Iuliana Vasiliev) also had a meeting with Gabor Tari (OMV Austria) during EGU 2014. The conclusion was that the oil industry is very interested in cooperating for an international deep sea drilling of the Black Sea succession.

Alternate sites could be also proposed.

- 1) Slope (still next to Danube, alternate for shallow site)

- 2) Deep eastern Black Sea
- 3) Turkish western Black Sea

7. DIFICULTIES

This workshop had some long delays in its way, from initiation to this reporting. Part of it is related to the fact that these are the first international efforts (after almost 40 years) to nucleate a group to work on a proposal to drill the deep part and the deep time of the Black Sea. At the beginning of an unknown road no one knows how many curves will have. However, the international community started to talk (good and ‘bad’s) about drilling in the Black Sea. Some colleagues even felt offended to not be invited to participate. We actually would be very happy to have the opinion of most of them. This 7th part of this report is only the opinion of Iuliana Vasiliev. I feel that is something that has to be said not hidden.

8. NEW RESEARCH RELATED TO DRILLING THE BLACK SEA

In the past year some new work was performed on the old DSDP cores from the Black Sea. The research included stratigraphy, magnetostratigraphy and isotope data on organic components. These are:

Grothe, G., Sangiorgi, F., Mulders, Y.R., Vasiliev, I., Reichart, G.J., Brinkhuis, H., Stoica, M., Krijgsman, W. (2014) Black Sea desiccation during the Messinian Salinity Crisis: fact or fiction? *Geology*, 42, 563-566. doi:10.1130/G35503.1

Vasiliev, I., Reichart, G.J., Grothe, A., Sinninghe-Damsté, J., Krijgsman, W., Sangiorgi, F., van Røij, L. Recurrent phases of drought in the Miocene of the Black Sea region, submitted to *Palaeogeogr. Palaeoclimatol. Palaeoecol.*, Doi10.1016/j.palaeo.2015.01.020

Van Baak, C. G.C., Radionova, E. P., Golovina, L.A., Raffi, I., Kuiper, K. F., Vasiliev, I., Krijgsman, W. Messinian events in the Black Sea, to be submitted to *Terra Nova*.

9. SPENDING OF MAGELLAN PLUS GRANT

The allocated budget was 15.000 Euro. Large part of this budget (6,553.36 Euro) was not spent because two of the participants (coming from USA and Austria) canceled their trip in the last moment. Additionally, expenses for the Magellan watchdog (Werner Piller) were refunded from the ECORD directly and not from the BLACKSINK as initially thought.

Costs	Amount (euro)
Renting of meeting rooms & projector	400.00
Travel and hotel costs	4,700.09
Lunches, dinner, coffee breaks	3,280.55
Printing costs	66.00
Total spent	8,446.64
Unspent	6,553.36