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Institute of Oceanology – BAS, Varna, P.O.Box 152

ANCIENT COASTLINES OF THE BLACK SEA AND CONDITIONS FOR HUMAN PRESENCE – BLACK SEA EXPEDITION 2011

Project DO 02-337, an expedition on the RV Akademik, took place during June 2011 with financial support from the Bulgarian Science Fund. The location for this expedition was the Western Black Sea. 17 core and 8 grapple organic seabed samples were taken. The initial core samples were extracted from the submerged shorelines with subsequent ones taken from deeper water. So submerged shoreline was mapped, samples for dating, isotope analysis and pollen sampling were taken.

Introduction. Two abrupt flood scenarios have been proposed for the Black Sea. The first, or Late Pleistocene 'Great Flood' of Chepalyga (2003, 2007) – the CH hypothesis – states that the brackish Neoeuxinian Lake in the Black Sea basin filled rapidly with the overflow of the Caspian Sea via the Manych Spillway shortly after the Late Glacial Maximum, 17–14 ka BP. The second, or Early Holocene 'Noah's Flood' of Ryan *et al.* (1997) and Ryan and Pitman (1998) describes a catastrophic flood of the Neoeuxinian Lake by the inflow of Mediterranean sea water at either 7.2 ka BP (RP1 hypothesis) or 8.4 ka BP (RP2 hypothesis: Ryan *et al.* 2003; Ryan 2007; Dimitrov and Dimitrov, 2003; Dimitrov, 2010). Turney and Brown (2007) suggest that a jump in sea level was triggered by the Laurentide Ice Sheet collapse (TB hypothesis). These hypotheses propose that the massive inundations of the Black Sea basin and ensuing environmental changes profoundly impacted prehistoric humans inhabiting in the surrounding areas and formed the basis for the 'Great Flood' legends (Yanko-Hombach V. *et al,* 2011).

The flood hypothesis suggests there was a decrease in water level, creating shorelines (now submerged) that can be dated to 8.5 ka BP (Ryan *et al.,* 2003). However, the outflow hypothesis maintains that there was no drawdown and that the Black Sea remained high after the drawdown 11 ka BP, continuing to outflow through the Bosphorus into the Marmara Sea (Hiscott *et al*, 2007)

In this expedition with the collected data, we hope to prove either an abrupt Holocene flood scenario, or a gradual, fluctuating Holocene sea-level rise.

Materials and Methods. We embarked on the R/V *Akademik* from Varna, Bulgaria on June 27th. The *Akademik* is operated by the Institute of Oceanology, Bulgarian Academy of Sciences. There were approximately 30 people on board which included the crew, the scientific party and journalists from the magazine "Spisanie 8". The head scientist of the expedition was Prof. Petko Dimitrov and Prof. William Ryan was the assistant head scientist. The *Akademik* (Fig. 1) is a 55.5m ship with a breadth of 9.8m. The ship was equipped with a 4.3m high A-frame from which the core sample drill was attached and which was also used

to tow the sonar equipment. There are two labs on the R/V *Akademik* – the sonar lab and the core lab.

Fig. 1. The R/V Akademik

Echo and navigation. Two echosounders, made in Norway by the company SIMRAD, were used onboard the *Akademik*. The frequencies used were 12kHz and 38 kHz with the software systems Open CPN 2.3.1 (Fig.2). Two independent GPSs were used– Magellan FX 324 with precision +/- 3m and Garmin GPSMAP-76 with precision +/- 5m. The navigation software was GPS Win Pro 3.0. The Magellan antenna and SIMRAD EK 60 transducers were located close to each other so no distance correction was necessary. All navigation and echo data were entered into the navigation computer.

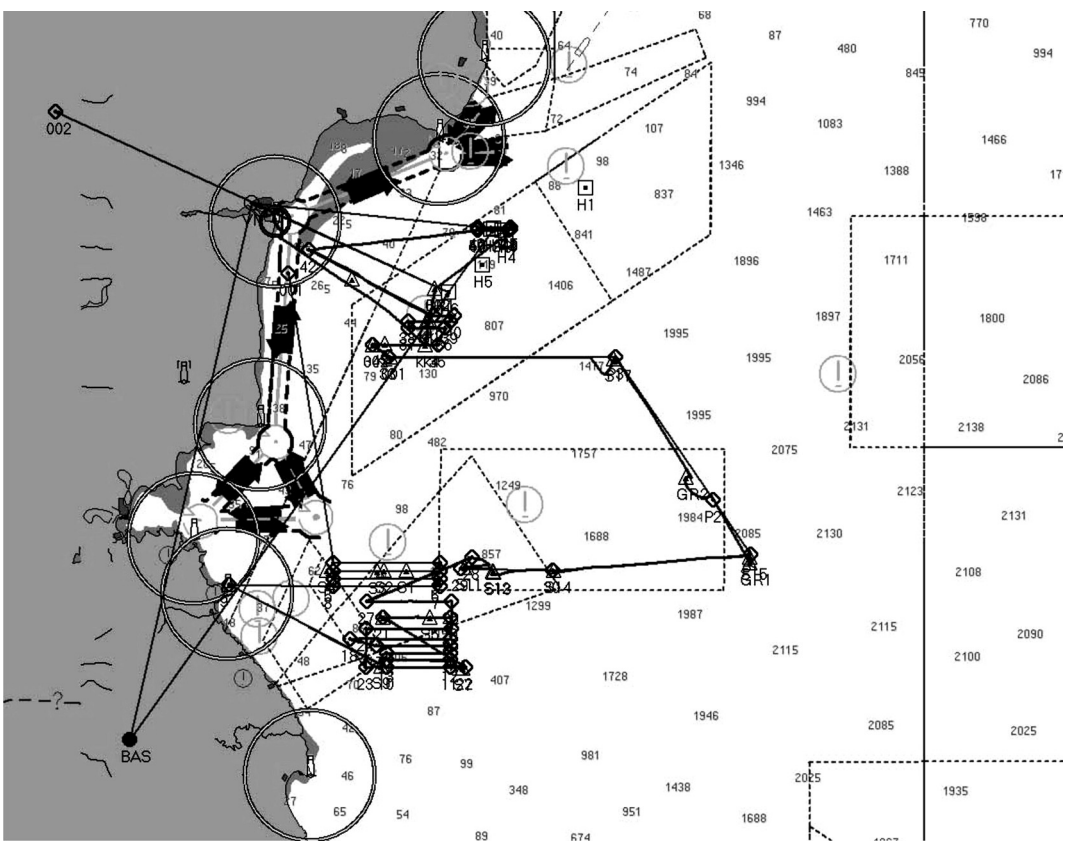

Fig. 2. Navigation map of the expedition, Open CPN 2.3.1

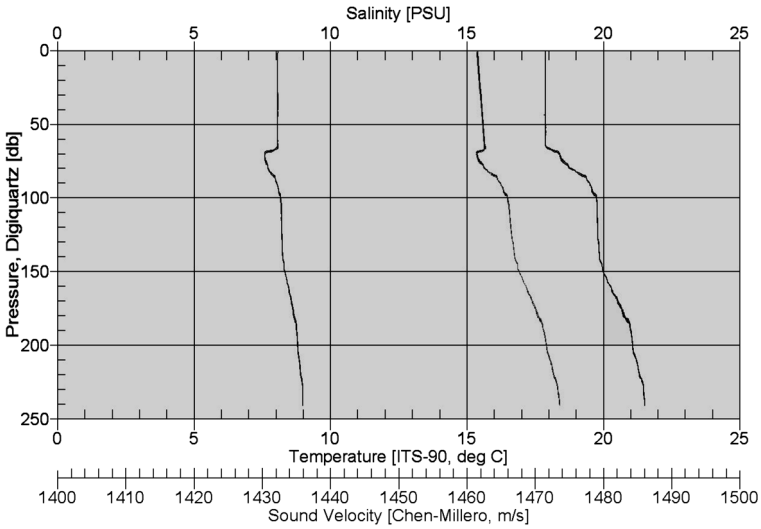

Fig. 3. CTD profiles

The echosounders' calibration in each polygon was made by measuring the water's mean temperature and salinity. The speed of sound was calculated using Delgrosso and Chen-Millero equations, again taking the mean value. A calculated value of 1472 m/s was entered in the echos and was used for depth calculations, taking into account the ships draft of 4.8m (Fig.3).

Batimetric precision was estimated at about 1m, taking into account an average depth of 100m and the waves (Fig.4).

These dunes and shorelines were created by a Black Sea drawdown that brought the water level down to -90 to -120 m below the current water level.

Core Sampling. The location for this expedition was the Western Black Sea (Fig. 2, 5) and 17 core and 8 grapple organic seabed samples were taken.

In order to sample the coastal dunes we would have to core them. To take samples for dating, isotope analysis and pollen sampling we had to core the deep water seabed. On board the R/V *Akademik* we used a 12cm gravity coring device and a grapple device. The gravity coring device had a 280 kg head on the end of a 4-meter metal tube and was 12cm in diameter (Fig.6.). At the bottom end of the corer shaft there is a core catcher.

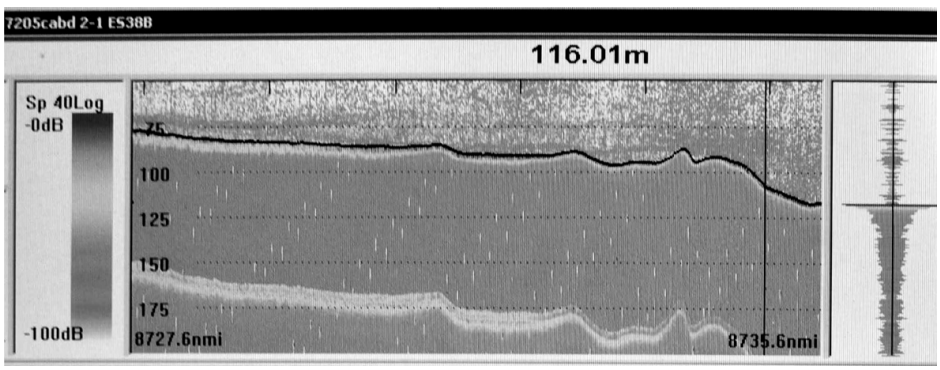

Fig. 4. Submerged coastal dunes

Table showing depth on the cores taken during the cruise on the RV Akademik in 2011

Core №	Station №	Water Depth	Core Length	Core Type
Akad 11-01	1	125 m	350 cm	12cm Gravity
Akad 11-02	2	90 m	134 cm	12cm Gravity
Akad 11-03	3	90 m	196 cm	12cm Gravity
Akad 11-04	4	70 m	330 cm	12cm Gravity
Akad 11-05	5	70.8 m	370 cm	12cm Gravity
Akad 11-06	6	96.7 m	412 cm	12cm Gravity
Akad 11-07	7	125 m	325 cm	12cm Gravity
Akad 11-08	8	95 m	99 cm	12cm Gravity
Akad 11-09	9	91 m	372 cm	12cm Gravity
Akad 11-10	10	80.5 m	416 cm	12cm Gravity
Akad 11-11	11	510 m	356 cm	12cm Gravity
Akad 11-12	12	1000 m	121 cm	12cm Gravity
Akad 11-13	13	860 m	340 cm	12cm Gravity
Akad 11-14	14	1500 m	343 cm	12cm Gravity
Akad 11-15	15	2200 m	305 cm	12cm Gravity
Akad 11-16B	16	2112m		Grapple
Akad 11-17	17	1805 m	389 cm	12cm Gravity
Akad 11-18B	18	1605 m		Grapple
Akad 11-19	19	85 m	120 cm	12cm Gravity
Akad 11-20B	20	1610 m		Grapple
Akad 11-21B	21	1604 m		Grapple
Akad 11-22B	22	92.2 m		Grapple
Akad 11-23B	23	92 m		Grapple
Akad 11-24B	24	96 m		Grapple
Akad 11-25B	25	95 m		Grapple

The corer was hoisted up onto the A-frame on the stern and dropped in the water. The main hydraulic winch controlled the descent of the coring device until it was about 20m above the seafloor. The mechanic would then stop the winch and allow the device to free-fall into the seafloor. Once the corer hit the seafloor and the cable went slack the hydraulic winch would then be reattached and the device would be raised on board. Once on deck, the top of the corer was opened and the plastic sleeve full of sediment was taken to the core lab in 1-meter sections. We were very fortunate as we managed to penetrate 120 cm into the hardened shelly gravel of the submerged shoreline without a vibracorer. (Fig. 4, & table).

Sampling. There are submerged cliffs, beaches, coastal dunes, and evidence of shorelines at depths between -70 m and -120 m these indicate that the Black Sea surface was somewhere in this depth range prior to the proposed time of the flood. The flood hypothesis suggests there was a decrease in the water level, creating shorelines (now submerged) that can be dated to 8.5 ka BP (Ryan, W. B. F. et al., 2003). Because of this, the majority of cores were taken from the depths of the submerged shorelines (table 1). In order to core into this shoreline we used a gravity coring device with a 280 kg head on the end.

Fig. 5. 17 core and 8 grapple samples were extracted during the Black Sea expedition 2011

Thankfully this apparatus was able to penetrate into the coarser sediment. Once the cores were recovered they were cut into approximately 1-meter sections on the fantail and immediately taken to the wet lab that is situated mid ship. The sections were then cut open and observed. Nearly all the cores were sampled every 10 cm for pollen analyses from Mariana Filipova. William Ryan and the scientific team would sample for mollusks using sieves for isotope analyses and ^{14}C dating. Radiocarbon dating is a commonly used dating method.

During the expedition we took 10 samples for ^{14}C dating from Core Akademik 11-17 (tabl.1.). The first sample is from Unit 1. Coccolithic ooze is matter containing the first appearance of *Emiliana huxleyi*. The next two samples are from Unit 2 – sapropel dark green grey – finely laminated at 1 mm. The next sample will date the beginning of protosapropel. We decided that is

Fig. 6. Core Akademik 11-19

more important to determine the different periods in the history of the red-brown clay and because of this we took six ^{14}C data from Unit 3.

The last core taken during the expedition was Core Akademik 11-19 (tabl.1, Fig.7). This was a successful attempt to penetrate the submerged coastal dunes. The core was remarkable, containing some special features. The first one is that we found wood at 80cm and this has been sent for ^{14}C dating. At 58cm we found articulated *Dreissena* and at 50cm to 51cm we have whole *Dreissena,* not polished. The second one is the appearance of *Cardium* found at 43 cm, at the boundary between the Old Black Sea and Neoeuxinian sediments. This has also been sent for ^{14}C dating. *Cardium* is a mollusk species that only live in salty water. At 42cm we found mineral sand and one *Dreissena* but no more after. After that from 43cm to 36cm the sediments were mostly clay.

Conclusions. Despite there being no dates as yet, a few conclusions can be drawn from our 2011 expedition on the RV *Akademik*.

The submerged shoreline where we cored consisted of shell gravel. This leads us to believe that the Black Sea once had a water level above these shorelines that allowed the mollusks to thrive. Then there was a drawdown leaving these mollusks exposed. Their shells were then weathered forming the shell gravel observed in the core.

Also a series of reddish-brown clay layers were deposited and found within the deep water cores (tabl. 1). The occurrence of the red layers may be linked to high latitude climate variations.

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Проект ДО 02-337, експедиція у східну частину Чорного моря на н/с «Академік» відбулася в червні 2011 року за фінансової підтримки Болгарського наукового фонду. Відібрано 17 проб трубкою і 8 проб драгою. Зразки відбиралися із затопленої берегової лінії, відібрано зразки для датування, ізотопного і пилкового аналізів.

Проект ДО 02-337, экспедиция в восточную часть Черного моря на н/с «Академик» состоялась в июне 2011 г. при финансовой поддержке Болгарского научного фонда. Отобраны 17 проб трубкой и 8 проб драгой. Образцы отбирались из затопленной береговой линии, отобраны образцы для датирования, изотопного и пыльцевого анализов.

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