Scientific Collaboration on Past Speciation Conditions in Lake Ohrid - SCOPSCO Workshop Report

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Transboundary Lake Ohrid between Albania and Macedonia (SE Europe, Fig. 1) is considered to be the oldest continuously existing lake in Europe with an age of likely three to five million years. The lake has a surface area of 360 km^2 and is 289 m deep. An extraordinary high degree of endemism, including more than 210 described endemic species (Fig. 2), makes the lake a unique aquatic ecosystem of worldwide importance. Due to its old age, Lake Ohrid is one of the very few lakes in the world representing a hot spot of evolution and a potential evolutionary reservoir enabling the survival of relict species (Albrecht and Wilke 2008). The importance was emphasized, when the lake was declared UNESCO World Heritage Site in 1979.

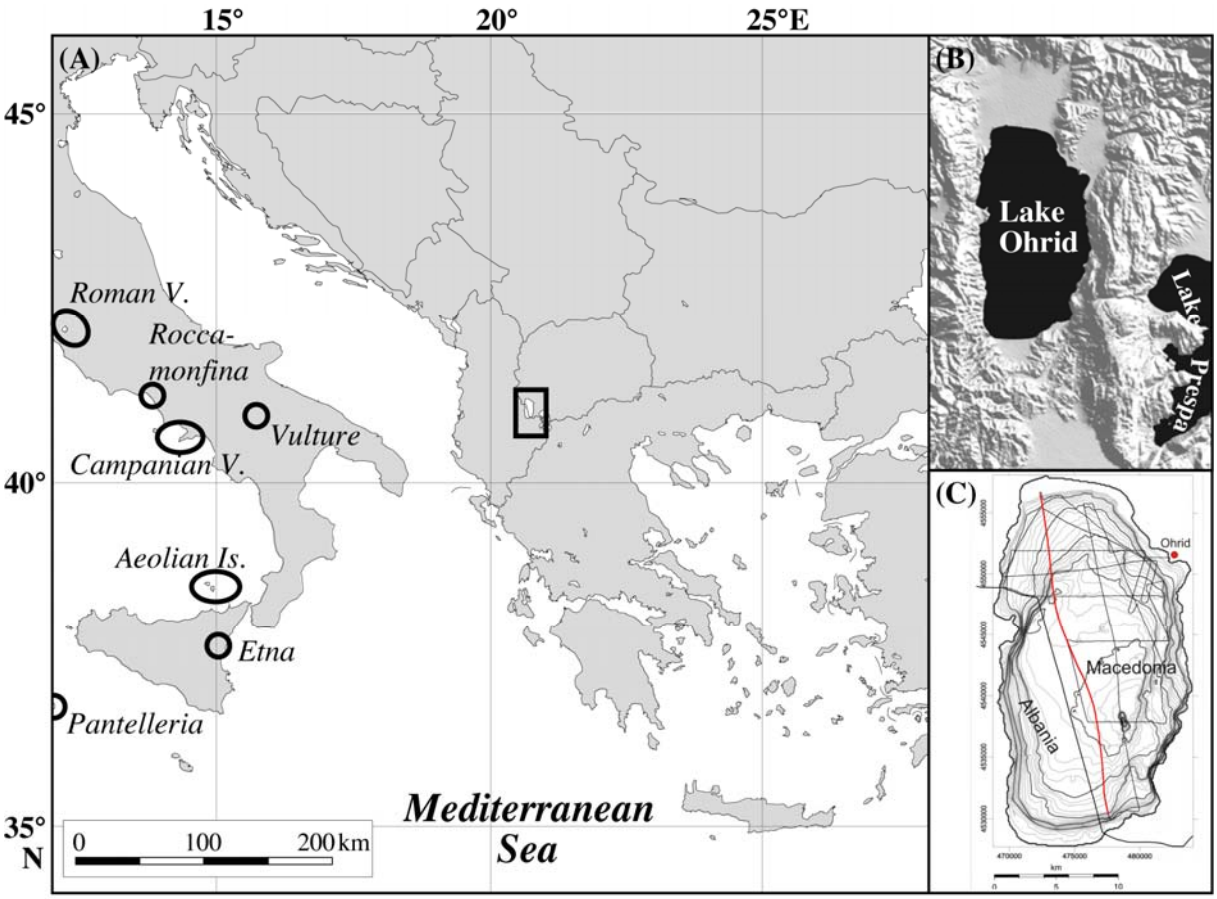

Fig. 1: (A) Map of the northern Mediterranean region showing the study area (rectangle) and Italian volcanic regions (circles). (B) DEM of Lake Ohrid at the Albanian/Macedonian border showing that the lake is part of a NNW to SSE striking graben system. (C) Bathymetry of Lake Ohrid with 25 m contour intervals. The dashed line indicates the border between Albania and Macedonia; the red line shows the position of the seismic profile shown in Fig. 4.

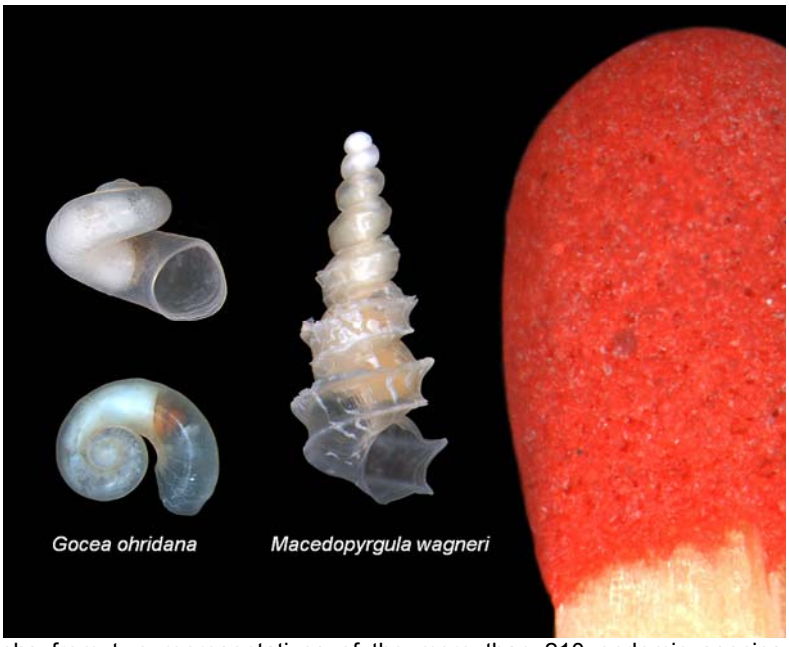

Figure 2: Photographs from two representatives of the more than 210 endemic species of Lake Ohrid. To demonstrate the small size of these gastropods, a head of a matchstick is shown.

The continuous existence since the Tertiary makes Lake Ohrid an excellent archive of environmental changes in the central northern Mediterranean region. Because of its geographic position and its presumed old age, Lake Ohrid represents an important link between climatic and environmental records from the Mediterranean Sea and the adjacent continents. In the eastern Mediterranean Sea, most records focus on the Late Pleistocene and Holocene history (e.g., Geraga et al. 2005) and only few cover several glacial-interglacial cycles (e.g., Schmiedl et al. 1998). Similarly, most terrestrial records from the central northern Mediterranean region are restricted to the Late Pleistocene and Holocene (e.g., Denèfle et al. 2000, Sadori and Narcisi 2001); longer continuous records covering more than the last glacial-interglacial cycle are relatively sparse (e.g., Wijmstra 1969, Tzedakis et al. 1997). Extant sedimentary records from Lake Ohrid were recovered during field campaigns in 1973 (Roelofs and Kilham 1983) and, more recently, between 2001-2007 (Belmecheri et al. 2007, Matzinger et al. 2007, Wagner et al. 2008, in press). These records cover, including some hiati, the past glacial-interglacial cycle and reveal that Lake Ohrid is a valuable archive of volcanic ash dispersal and climate change in the central northern Mediterranean region. However, with respect to the extraordinary high endemism in the lake, these records are too short to provide information about the age and origin of the lake and to unravel the mechanisms controlling the evolutionary development. Molecular clock analyses of mitochondrial DNA genes from several endemic species flocks (i.e., groups of closely related species) indicate that Lake Ohrid is probably two to three million years old (Albrecht et al. 2006). Moreover, concurrent genetic brakes in several invertebrate groups indicate that major geological and/or environmental events must have shaped the evolutionary history of endemic faunal elements in Lake Ohrid (Albrecht and Wilke 2008).

Different site surveys between 2004 and 2008 focused on a detailed seismic investigation of the sedimentological inventory of the lake and on the recovery of sediment sequences spanning the last glacial-interglacial cycle. The results of these site surveys emphasized the potential of Lake Ohrid for a deep drilling. Such a drilling will allow

(i) to understand the impact of major geological/environmental events on general evolutionary patterns and on generating an extraordinary degree of endemic biodiversity as a matter of global significance,
(ii) to obtain a continuous record containing information on tectonic and volcanic activities and climate changes in the central northern Mediterranean region, and
(iii) to obtain more precise information about age and origin of the lake and, thus, meets significantly ICDP key issues.

In order to review the existing datasets and interpretations as well as discussions on objectives and intended achievements, required laboratory analyses and techniques, scientific collaboration and responsibilities, drill sites and operations, logistics and legal issues as well as funding, a workshop on the Scientific Collaboration On Past Speciation Conditions in Lake Ohrid (SCOPSCO) was held in the city of Ohrid, Republic of Macedonia, from October 13 - 17, 2008 under the auspices of the ICDP. Altogether, 34 scientists from eleven nations (MK, AL, D, IT, UK, NL, PL, S, CH, F, USA) participated in the workshop (Fig. 3). In addition, the opening session on 14th October was attended by the State Secretaries of the Ministry of Environment and Physical Planning and the Ministry of Education and Science of the Republic of Macedonia, and by local TV and press.

Figure 3: Participants of the SCOPSCO workshop on Galicica Mountains, which separate Lake Prespa from Lake Ohrid.

After an ice breaker party on the evening of the 13th, the agenda of the workshop included the presentation of posters and talks on the first day, the formation of breakout groups and a half-day excursion on the second day, and the presentation and discussion of the results and goals defined by the breakout groups, as well as a discussion of future steps towards a deep drilling on the third day.

Overall, 19 talks provided a general introduction into the SCOPSCO project, the history of the region and the Hydrobiological Institute in Ohrid, and an overview on existing geological, recent biological, tectonic, and sedimentological datasets. In addition, five posters focusing on tectonic and biological aspects were presented. After the presentation of talks and posters on the first day, three breakout groups were formed in order to define the specific aims and drill sites of a future deep drilling campaign. The three breakout groups focused

(i) on speciation and endemism in Lake Ohrid,
(ii) on seismic and neotectonic issues in Lake Ohrid and its vicinity, and
(iii) on sedimentological and tephrostratigraphical questions to be addressed within the scope of the SCOPSCO project.

The seismic and neotectonic breakout group defined several drill target sites on the basis of more than 500 km of airgun seismic profiles. Drilling less than about 200 m into the sediments in these sites will allow for a better understanding of the sediment input into the lake, the formation and chronology of foresets and slides particularly in the southern part of the lake, and the fault development mainly along the western and eastern sides of the lake. For sedimentological and tephrostratigraphical issues, including the reconstruction of the past environmental conditions at Lake Ohrid throughout its existence, one drill site was defined. This main drill site is located in the central, almost deepest part of the lake, where a sediment fill of about 700 m (Fig. 4) promises to contain the complete history of the lake back to its origin. The breakout group on speciation and endemism in Lake Ohrid defined two to three drill sites close to recent subaquatic springs in the lake where a high degree of endemism can be observed. Possible overlaps, particularly between sites for studying neotectonic activities and those providing information to speciation and endemism around the springs will reduce the number of total target sites to about 7-8. For all sites, downhole logging and core logging issues were discussed and defined.

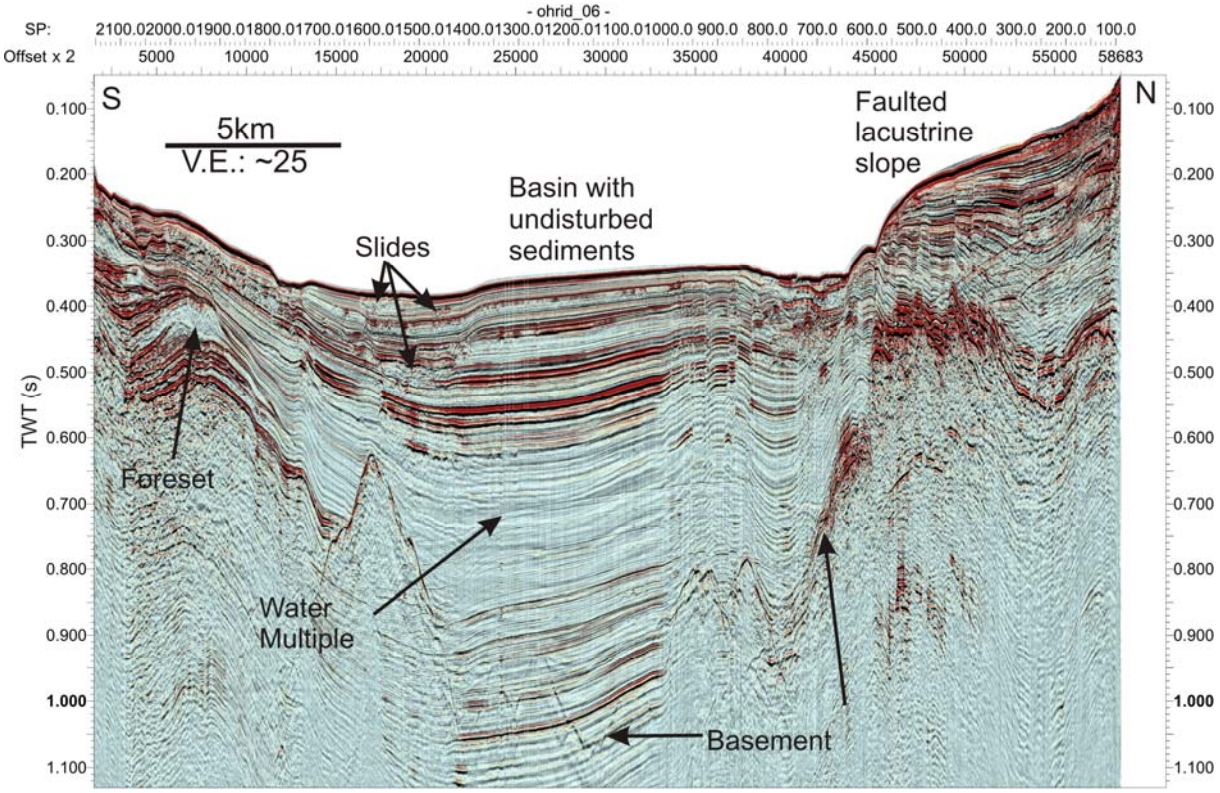

Figure 4: Brutestack of a multichannel seismic profile collected in 2007 (Krastel et al., unpubl. data). The central part of the profile indicates a >700m thick succession of undisturbed sediments.

The excursion in the afternoon of the second day led to the Galicica Mountains, which separate lakes Ohrid and Prespa. The view from the Galicica Mountains allowed all workshop participants an insight into the dimensions and catchment characteristics of Lake Ohrid. Further locations visited were the St. Naum springs at the southeastern part of Lake Ohrid, which form a major part of the water supply to the lake, and the city of Ohrid, which has a long cultural history. The third day of the workshop focused on future steps towards an ICDP deep drilling campaign, with respect to logistic and legal issues, funding within the scope of national and international programs and support by local Ministries and Institutes. Finally, the schedule for submission of a full proposal was established.

In summary, the SCOPSCO workshop provided a reliable platform to discuss the present state of knowledge, and future steps towards a deep drilling campaign. A full proposal for an ICDP drilling campaign shall be submitted in 2009.

Acknowledgements
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