



Preliminary assessment of the tsunami hazard for the Romanian Black Sea area: historical and paleotsunami data

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Scientific studies referring to natural hazards, such as earthquakes, hurricanes, tsunamis, are not to be limited within state borders, as the affected areas usually extend at regional or global scales.

As a half-open marine basin, limited by active fault systems and showing a high regional seismicity, the Black Sea basin represents a suitable area for occurrence of the tsunami-type natural hazards. The characteristic features of the Romanian seashore (very large shelf, low water depths and low seashore topography) make it highly vulnerable to such phenomena. Informations related to historical recordings of such events is almost lacking in Romania, while other countries sharing the Black Sea shoreline (Turkey, Bulgaria, Ukraine) benefit of a large amount of historical evidences and results of older and recent scientific studies, some of them within European projects.

The first historical information related to tsunami type anomalous waves in the Black Sea belong to the Byzantine historian Theophanes — in 544/545 the sea advanced inland in Thracia with 6 km, covering large territories around the cities of Odessus, Dionysopolis and Aphrodisium. The Armenian historian Moses Khorenatsi (410-491 AD) has mentioned a similar event on the Black Sea southern shore (Altinok, 2000). For Romanian Black Sea coast the oldest tsunami mention is from the year 104, when the Callatis citadel was affected by high sea waves (Marmureanu, 2006).

The latest tsunami event in the Black Sea is mentioned in December 4, 1970 (01.59 GMT), close to Soci town (Russia). Significant sea level oscillations (80 cm high) were registered in the area. The event was produced by an earthquake with a magnitude of 4.8, 7 km deep, the epicenter being located at 43.84° latitude N and 39.34° longitude E.

Geological studies that support the occurrence of tsunami type waves in the Black Sea describe

“sapropelic breccia” on the Bulgarian seashore and “tsunamites” (Ranguelov, 2003).

The existence of a clear facies repeatability in the sediment column can help the tsunami zoning of the Black Sea coasts and the justification of the existing tsunami catalogue of the sea (Ranguelov, 2003). Oaie et al. (2005) observed within the cores performed in the Black Sea basin particular intercalations that could represent effects of tsunami waves.

A preliminary documentation intends to initiate a multidisciplinary study, by means of a partnership between research-education and applied geosciences domains, of a dangerous natural phenomenon, already observed in the region of the Black Sea.

In Romania, the tsunami natural hazard is poorly documented by scarce information. Along the Romanian Black Sea coast occurred anomalous hydrodynamic events, usually mentioned by witnesses and rarely measured by instruments of hydrologic stations located on the shoreline. Even if these natural phenomena occurred from time to time, usually they have not been mentioned in written documents or in scientific publications. Rarely, such observations are documented by visual or instrumental measurements on hydro-meteorological stations along the seashore. A summary of these observations is presented in the following:

In all the above mentioned situations, the uprising of water level occurred as solitary waves propagating from south toward north, with heights varying between 1.50 — 8.66 (?) m. The water level increased rapidly and decreased much slower, during several hours.

The lithofacies of sediment intercalations deposited by tsunami type waves is characterized by: irregular boundaries of the deposited strata looking much alike a sedimentary breccia, mixture of fossils originating from different environments (marine,

Year	Month	Type of observation	Zone	Effects
1957		Instrumental	Sulina south jetty	8,66 m (?) high waves to the entrance in the Sulina canal from south to north
1958	May	Visual	Sulina canal	Floods on jetties situated along the Sulina canal and in the eastern part of the town
1960	December	Visual	Sulina canal and harbour	Complete flooding of the canal jetties and of the meteorological station platform; displacements of rock blocks that are fixing the jetties; sudden and violent displacement of ships located within the harbour.
1993	August	Instrumental	Sulina canal	Floods on the Sulina canal jetties
1995	March	Visual	Sahalin Island	Total flooding of the island
1995	May	Visual	Sulina canal	Floods on the Sulina canal jetties and of the nearby beach

brackish, lacustrine) and different geological ages (Pleistocene, Pliocene, Holocene).

The seismological studies identified active hypocenters in the vicinity of the Black Sea basin, high magnitude seismic events being considered as triggering the tsunami type waves. Since 1826, based on historical written evidence on the Black Sea seismicity, a number of 1435 earthquakes have been recorded. Starting with 1945 the earthquakes were instrumentally recorded, the interpreted hypocenters depths ranging between 10 and 60 km. Most of these events occurred in the northern and northeastern parts of the sea basin.

The study of the tsunami type hazard is approached by specialised Romanian research institutions through the integrated analysis of the existing information and new information obtained within the project. The application of monitoring and protection activities may be done together with the central and local authorities or companies involved in research and environment problems.

The users of the project results are both national and international. Users from abroad are institutions and scientists from countries located around the Black Sea basin: Turkey, Bulgaria, Ukraine, Russia, Georgia, and researchers involved in monitoring European networks for natural hazards (ESPON). An agreement between countries situated around the Black Sea would enlarge the exchange of scientific information and would create a warning system for natural disasters such as high tsunami waves.

The results of this research will be disseminated in a national and international frame as well as to the local authorities.

The complexity of the subject and lack of systematic data at national level impose gathering and updating the information, increasing the data base with related information obtained in the countries adjacent to the Black Sea, their processing, elabo-

rating documentations for application and information (guides, catalogues) and implementation of an automated monitoring system. All these are necessary because tsunami-type natural hazard does not occur at national, but at regional scale. The appearance of such an event *anywhere in the Black Sea basin* will have significant effects on the coastal area. The importance of the phenomenon for southeast Europe, and especially for a semi-enclosed basin as the Black Sea, is strongly emphasized by the fact that several countries (Turkey, Bulgaria, Ukraine) have performed studies strictly focused on the tsunami-type natural hazard.

The main targets of the project are:

- Getting evidences of the tsunami type natural hazards on the Romanian Black Sea coast based on two sorts of evidences: historical and actual ones. Using historical evidences, tsunami-type events and their effects, commented by various historical sources, will be integrated in the new data obtained as results of project activities. Such information, corroborated with those, will document the occurrence of this natural hazard in the region of Romanian Black Sea shore.

- Forecasts. Based on data offered by the geological, geophysical and sedimentological studies on marine and brackish cores sampled from drillings performed on the Black Sea, the time intervals between occurrences of significant tsunami-type events.

- Protection. The newly acquired data will be utilised to elaborate a plan for prevention and protection of the coastal population and the marine infrastructures.

- Data dissemination will be performed toward the national authorities and international institutions and partners.

- Implementation of an automated system for monitoring this natural hazard, including warning possibilities in real time.

— Integration of the project in ERA-Net and enlargement of partnership at the international scale. The solution can be approached successfully only if a network, formal and informal, of collaboration will be established among various research groups, and if experience and data can be freely exchanged.

— Involvement of research institutions of Romania in international associations and boards deal-

ing with natural hazards, including the tsunami-type hazard.

Considering the importance of the subject, the attention it has received in the other Black Sea riparian countries and the scarcity of data for the Romanian shore, the initiation of such a project in Romania has become a too long awaited necessity, finally answered.

References

Altinok, Y., S. Ersoy. 2000. Tsunamis observed on and near the Turkish coast. — *Natural Hazards*, 21 (2-3), 185–203.

Marmureanu, Gh. 2006. Romania, tsunami danger! *Libertatea newspaper*, Mars 29, 2006.

Oaie, Gh., D. Secieru, K. Shimkus. 2005. Black Sea basin: sediment types diastribution and sedimentation processes. — *GEOECOMARINA*, 9/10, 21–30.

Rangelov, K. B. 2003. Possible deposits discovered on the Bulgarian Black Sea coast and some applications. Submarine landslides and tsunamis. — *NATO Science Series*, vol. 21, 237–242.