

Tectonic context of the Black Sea Earthquake from the 5th of August 2009 ($M_L=4.8$)

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Abstract

“At 10:49 local time an earthquake of Richter magnitude about 5 was felt in Eastern and Central Bulgaria”. This was the first information for the earthquake of 5th of August 2009 emitted by the media based on the information from Department of Seismology, Geophysical Institute, Bulgarian Academy of Sciences. The EMSC has reported soon after for m_b magnitude 4,8 and 10 km hypocentral depth of the earthquake located at about 15 km eastern from the Cap Kaliakra, in the Black Sea (07:49:03.1 UT; coordinates: 43.3949⁰ N, 28.6579⁰ E). The collected data show the sequence of 2 foreshocks and 4 aftershocks in the same area for the period of 3 to 8 of August 2009. The last information from the Geophysical Institute of BAS is for magnitude $M_L = 4.8$ and $I_{max} = 6$ EMS for the main shock (coordinates: 43.4⁰ N 28.7⁰ E). It affected mostly the village of Kamen Briag and the town of Shabla where limited numbers of poor built houses were damaged. Information about rock falls from unstable coastal scarps was also reported.

The events followed the line of the Kaliakra Fault Zone in Western Black Sea, the most active structure of the Shabla Seismic Zone. This zone is situated in the southeastern part of the Moesian Platform, and it is characterised by very strong earthquakes with a relatively well-known frequency of occurrence. According to historical data, one strong earthquake with magnitude of the range of 7.0 affected the coastal territories every 400-500 years. The last one, with a magnitude evaluated at 7.2 provoked considerable damages in 1901. Recently published data for the active faults in this area, according to onshore drilling and offshore acoustic and seismic profiles, have identified a number of activated fault segments.

Kaliakra Fault Zone is related to significant faulting and deformations of Mesozoic and Palaeozoic sediments. The width of the zone is evaluated by different authors from 1-3 km to 6-8 km. Some of the peripheral associated faults are mapped onshore, along the coastal area. The offshore investigations give about 100 m amplitude of displacement in Palaeogene sediments and tens of meters in the Neogene sediments.

The published data for the Quaternary and today tectonic stress field indicate the general direction ENE-WSW of the tectonic compression. This result is supported by the fault plane solution of the 30 of June 1956 Earthquake ($M_s = 5.4$) in the same area, as well as by the solution presented by the Institute of Geophysics at ETH, Zurich, Switzerland (ETHZ) for the earthquake from the 5 of August 2009. These two solutions are practically coinciding. The resulting movement is right lateral strike slip along the activated fault segments of Kaliakra Fault Zone.

The other two on-line published solutions for the mechanism of the main earthquake give or different nodal planes without possibility to be recognised as really existing faults (Dogan KALAFAT, KOERI-NEMC, Turkey), or an opposite orientations of P and T axes (Seismology Department of DDA, Turkey). The solution of ETHZ gives more acceptable result, taking into account the regional tectonic stress field and the characteristics of the activated fault segment striking NE-SW.