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Morphotectonics Causes for the Seismic Hazard in South-West Bulgaria

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Abstract: Югозападна България се отличава с подчертано мозаечен релеф. Той включва средно и високо планинските масиви, изграждащи отделни части от източната периферия на Брегалнишката (Източнодарданската), Рило-Пиринската и западните окрайнини на Родопската морфоструктурна зона. Между тях са разположени дългите и сравнително тесни Среднострумски, Средноместенски и Струмешнишки комплексни морфоструктурни коридори. Повишената, неравномерно площно разпределена сеизмична опасност се дължи на локални и регионални причини. Към първите се отнасят коровите геодинамични процеси, свързани с протичащата колизия между Неоевропа и Гондвана. Те причиняват бързото издигане на планинските масиви спрямо оградните комплексни морфоструктурни коридори. Това поражда средно силни и силни земетръсни явления в граничните зони между тези коренно различни морфоструктури. Регионалните причини за земетръсната опасност в Югозападна България се дължат на кватернерните компресионни тектонски процеси в Егейската област. Част от освободената там сеизмична енергия се насочва на север по Среднострумския и Средноместенския морфоструктурни коридори и там поражда сериозна сеизмична опасност.

Key words: seismic hazard, mosaic Earth's crust pattern, complex morphostructural passages

Introduction

The study is an attempt for a comparative morphostructural-seismic analysis of the seismic hazard in South-West Bulgaria in the light of Plate tectonics theory. This is an interpretation of the regional Quaternary morphotectonics evolution. So far all attempts to explain the regional seismic hazard was based on already outdated and currently lost weight geosynclinal scientific hypothesis. According to her the seismic effects in the region are product of a long-lived and stable over time "depth" faults (Яранов, 1960). Accumulated in recent years scientific evidence proved the fallacy of such claims.

Seismic hazard in South-Western Bulgaria is due to the local and regional reasons. At first concern crustal geodynamic processes related to the ongoing collision between Neo Europe and Gondwana (Tzankov, 2008). They cause rapid rise of mountain massifs to the surrounding complex morphostructural passages. This raises moderate and strong seismic events in the border areas between these disparate morphostructures. Regional causes of the earthquake hazard in South-West Bulgaria due to compression Quaternary tectonic processes in the Aegean area. Part of the seismic energy released there headed north on Middle Struma and Middle Mesta morphostructural passages and there was a major seismic hazard.

Morphotectonics evolution of the South-West Bulgaria as a precondition for the emergence of the regional seismic hazard

The geomorphology of the South-Western Bulgaria is distinguished by very intensive segmented topography. It is composed by high mountains, middle high mountains, kettles and different by size river valleys (Цанков, 2013). The following morphoelements belong to the southwest parts of the Bulgarian continental microplate (Tzankov, Iliev, 2015): the east margin of the Bregalnitsa (East Dardanian) morphostructural zone (in Western Macedonia and South-West Bulgaria), the Rila-Pirin morphostructural zone (in South-West Bulgaria and North-East Greece) and the west margin of the Rhodopean morphostructural zone (in South-West Bulgaria and North-East Greece) (Fig.1). The investigated part of the Bregalnitsa (East Dardanian) morphostructural zone includes the regional Late Pleistocene-Holocene dome-like morphounits of the Razmetanitsa Mountain, Piyanets Mountain, Vlahina Mountain, Maleshevska Mountain, Lebnitsa Mountain, Ograzhden Mountain and Belasitsa Mountain massifs. The majority of the Rila-Pirin morphostructural zone is composed by the regional Late Pleistocene-Holocene dome-like morphounits of the Rila Mountain, Pirin Mountain, Slavyanka (Ali Botush) Mountain, Chengelitsa (Angistro) Mountain, Strangats Mountain, Mavro vouno Mountain, Vrontous Mountain, Menoikio Mountain, Pangeo Mountain and Elehorion Mountain massifs. The internal pattern of the Rila-Pirin morphostructural zone includes the relics from the Post Late Pleistocene orthoplain in the eastern part of Balkan Peninsula: the Middle Struma complex morphostructural passage (between the East Dardanian and the Rila-Pirin Mountains Range) and Middle Mesta complex morphostructural passage (between the Rila-Pirin Mountains Range and the west margin of the Rhodopean morphostructural zone) (Fig.1). The Strumeshnitsa complex morphostructural passage divides the Bregalnitsa morphostructural area from the Gradesh-Belasitsa morphostructural area in the East Dardanian morphostructural zone (Fig.1).

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Fig. 1 Survey map of the eastern part of Balkan Peninsula

The rock basement of the observed territory is build by Precambrian metamorphosed rocks, Phanerozoic magmatic rocks, Late Eocene-Lower Oligocene volcanic and sedimentary-volcanogenic deposits. They are showing similar indices for the specific gravity, density and chemical composition and they have identical reactions toward the seismic influence.

The Late Neogene and Quaternary epicontinental deposits show different physical-mechanical indices in comparison with the rock basement. They have a different reaction toward the seismic effects.

The survey of the regional seismic activity during the last 50 years (Fig. 2) in the eastern part of the Balkan Peninsula shows that the investigated territory is with the highest earthquake density within the Bulgarian continental microplate.

The most part of the seismic effects are disposed on the borders between the Late Pleistocene-Holocene dome-like morphostructures and the relicts of the Post Late Pleistocene orthoplain– the complex morphostructural passages. Some of the seismic effects are connected with the fault bundles between the morphostructural areas and regions (Gochev et all., 1989).

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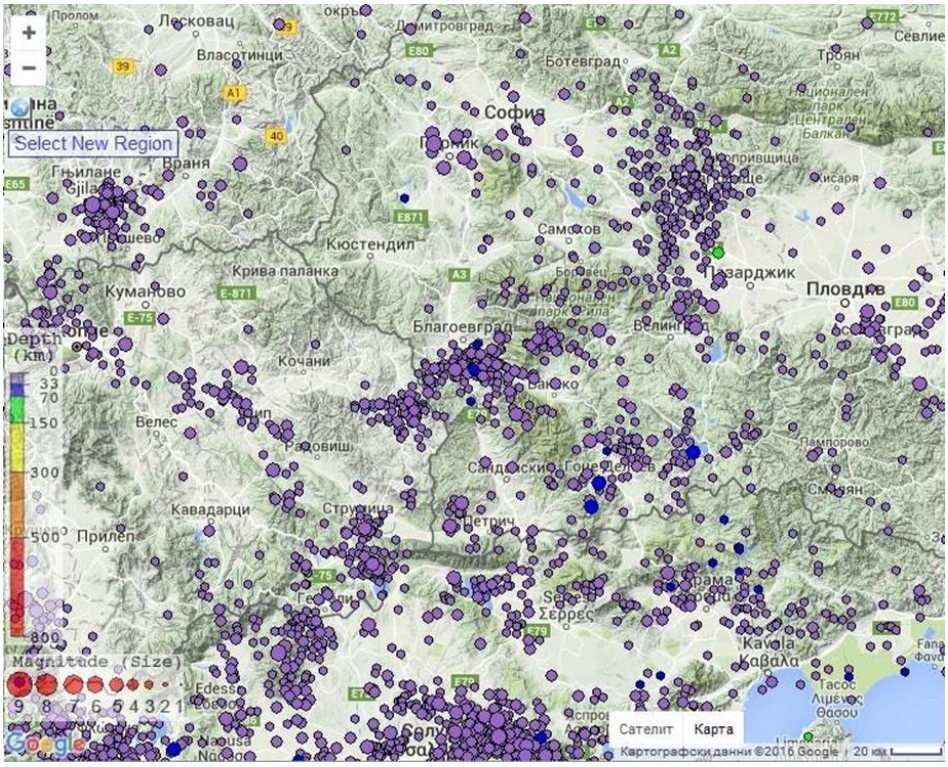

Fig. 2 Survey map of the 50 years seismic activity in the investigated area
(Iris Earthquake Browser- http://ds.iris.edu/ds/)

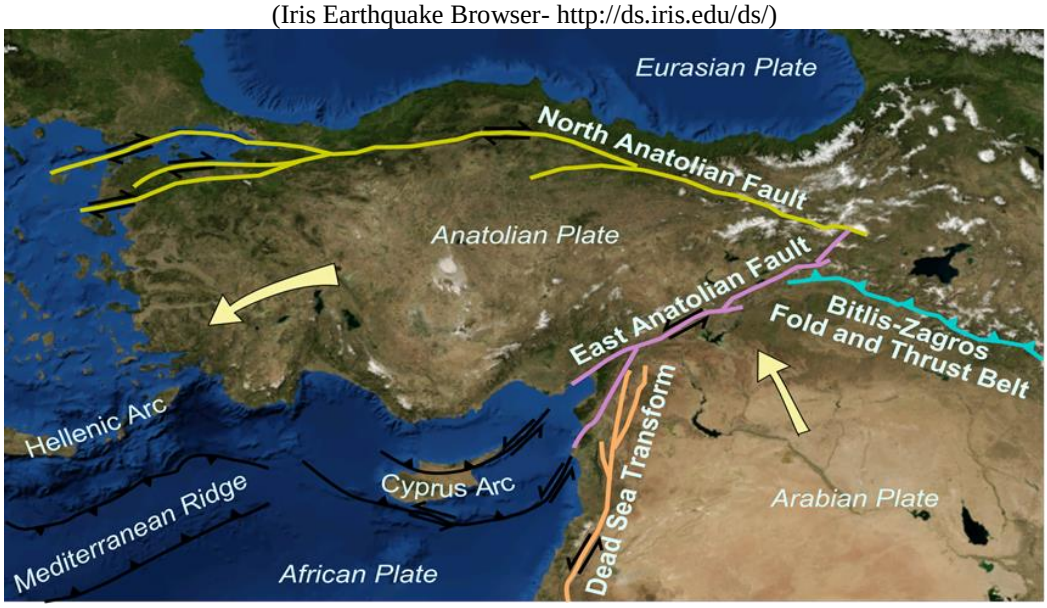

Fig. 3 Contemporary movements along the North Anatolian transform fault (Source: https://en.wikipedia.org/wiki/Anatolian_Plate)

Conclusions

Key role in the formation of seismic hazard in South-West Bulgaria have:
1/ the transcontinental collision between Gondwana and Neo Europe landmasses in this sector of the Mediterranean region. This contemporary tectonic process provoked the very intensive mountain building in South Bulgaria and North-East Greece. The rapid relief rising in the Rila-Pirin and Rhodope areas provokes different intensive displacement between the different blocks.
2/ the contemporary very active movement of the Anadola continental microplatte to the west in connection with the right-side strike-slip movements on the zone of the North Anatolian transform fault (Fig.3). This process breed submeridional oriented zone of compression in the Aegean Sea. The seismic activity in this zone produces increasing of the seismic hazard along the Middle Struma and Middle Mesta River valleys – the areas of the both complex morphostructural passages.

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