

Seismotectonic danger for medieval Dragalevtsi monastery (Sofia, Bulgaria)

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ABSTRACT: The Dragalevtsi monastery is of high significance for the history of the country. It is created at the end of the Second Bulgarian Kingdom. The monastery is an important educational and cultural center of the country. The 15th and the 17th centuries wall decorations of the church show elements of the Bulgarian national revival. The monastery helps numerous patriotic manifestations during the long period of Turkish domination.

The monastery is constructed on the northern slope of the Vitosha mountain-horst and near its contact with the Sofia graben. The Vitosha fault zone is developed on the horst-graben contact. The Vitosha faults are included in vertical and horizontal movements. The weak and moderate earthquakes are often related to the Vitosha fault zone. The monastery is placed on seismotectonically mobile territory. Its periodical reconstructions give information for the naturally- and technogenically-induced problems.

1 INTRODUCTION

The Dragalevtsi monastery (14th century) is a part of the natural cultural heritage. It is a Residency of the Bulgarian Patriarch. Now the monastery is in reconstruction. It is situated in a mobile territory where the seismic manifestations are frequent. The last ones are among the causes for the monastery reconstruction works.

2 NOTES FOR DRAGALEVTSI MONASTERY

2.1 *Position*

The Dragalevtsi monastery is 10 km to S of the center of Sofia city. The investigated monastery is built over precedent ancient settlement, also in the surrounding of two other old settlements. The monastery is outside of the city in the period of its appearance and during a long time of its evolution. Now it is in the Dragalevtsi quarter of Sofia city.

The monastery is placed in the lower part of the northern strongly inclined slope of the Vitosha mountain-horst. It is in a close vicinity with the southern boundary of the Sofia graben. The cited blocks are recently seismically active structures.

2.2 *Development of the monastery*

The monastery is created in 1345 by the King Ivan Alexander (1331-1371). It has a special charter for his development (1378) by the King Ivan Shishman (1371-1396). The King's attention is the

reason to receive the name of royal monastery (Fig. 1). The royal charter represents also the first official document where the name Sofia for the city in which surrounding is situated the Dragalevtsi monastery is mentioned in the first time.



Figure 1: The Dragalevtsi monastery (14th century) and its old church (15th century) in the right section of the recent church.

The monastery is enlarged in the last tens years of the Second Bulgarian Kingdom (1187-1396). The church wall painting is accomplished mainly in the 15th and the 17th centuries. The first one (Fig. 2) is financially supported by the rich boyar (local feudal) Radoslav Mavur, but the name of the painter is not known.

The second one is supported by rich Bulgarians. The wall painting is related to the activities of Pimen Zographsky and his art school (Chavrakov, 1978). Pimen Zographsky is a famous artist which works in more than 300 monasteries of the country, mainly of the Western Bulgaria, are very highly appreciated.

The monastery is among the significant educational and cultural center of Western Bulgaria and Sofia town during the Turkish domination. Its importance was considerable mainly in the 15th - 18th centuries. The children of the town of Sofia visit the monastery school. A lot of books was prepared and distributed by the monastery. Many people show interest in the rich monastery library.

Some of the servants of Good take part in the national movement for the country liberation. They ensure the temporal accommodation of the greatest organizer of the national activities Vasil Levski during 1870-1872. They help also the formation of Sofia clandestine committees for the national liberation from the five centuries Turkish domination.

The last extension of the monastery church is doing in 1932. The monastery was chosen for Patriarch Residency in the fist half of the 20th century.

Now the church and the monastery are in reconstruction period. The traces of the 15th (Fig. 2) and the 17th centuries wall decoration are saved generally in inner part of the church and locally on its frontal side.

The church is well visited up to recent days by Christians, also by national and foreign tourists. It is one of the lovely place for walks in Sofia region.



Figure 2: The detail of the church decoration (15th century) where numerous highly educated persons are the subject of the wall painting.

3 SEISMOTECTONIC CONDITIONS

3.1 Tectonic and geodetic data

The Dragalevtsi monastery is situated in the Srednogorie structural zone. The Sofia graben and the horsts of its southern periphery are included in the Western Srednogorie blocks.

The Sofia graben is developed mainly in the Neogene and Quaternary. The graben sediments are generally of the indicated age and of continental origin. There are conglomerates, sands, clay, rarely coal.

The rocks of the surrounding southern horsts are of Upper Cretaceous age and of sediment, volcanic and plutonic origin. There are mainly marl, limestone, andesite, tuffs, monzonite, leucosyenite, gabbro etc.

The monastery is placed in the lower part of the northern margin of the Vitosha horst (Fig. 3). It is near the contact zone between the Vitosha horst and the Sofia graben. That is very mobile territory from the tectonic point of view.

The Vitosha fault zone (NW-SE direction) is developed in the cited contact zone (Fig. 3). Recent vertical and horizontal block movements take place in the contact zone

The geodetic information proposes correct values of the most recent geological movements, including the tectonic ones. This information is only for the small contemporary period of the development of the structures in the investigated region.

The rates of the vertical block displacements are moderate. There are geodetic data for their values. It is measured 1.3 ± 0.2 mm/a relative uplift of the horsts in the southern periphery of the Sofia graben and 0.6 ± 0.2 mm/a relative subsidence of the Sofia graben (Dimitrov et al., 2001). The geodetic information shows the not stopped now uplift of the Vitosha horst, on one hand, and the subsidence of the Sofia graben, on the other hand.

The two GPS measurements during 1996-2000 show the active tectonic and strain accumulation in the central western (including the Sofia region) and the southwestern Bulgaria. The data are

analyzed to determine horizontal velocities of the block movements in comparison with Eurasia. The general tendency is of slow extension. The horsts of the southern periphery of the Sofia graben are moving to the S. The values of these movements are of about 1 mm/a (Kotzev et al., 2001).

There is considerable quantity of thermal springs along sectors of the Vitosha fault zone (Fig. 3). Some of them are not far away from the monastery.

The block fragmentation and displacements, the geodetic data for the horizontal and vertical movements, also the spatial distribution of the thermal springs represents indications for the recent activity of the Vitosha faults and of the blocks in the studied territory (Fig. 3).

3.2 Seismotectonic characteristics

The seismic movements represent only a part of the tectonic processes. The epicenters of tens epicenters of moderate earthquakes and of only one strong earthquake are concentrated in the southern periphery of the Sofia graben and in the northern periphery of the Vitosha horst (Fig. 3).

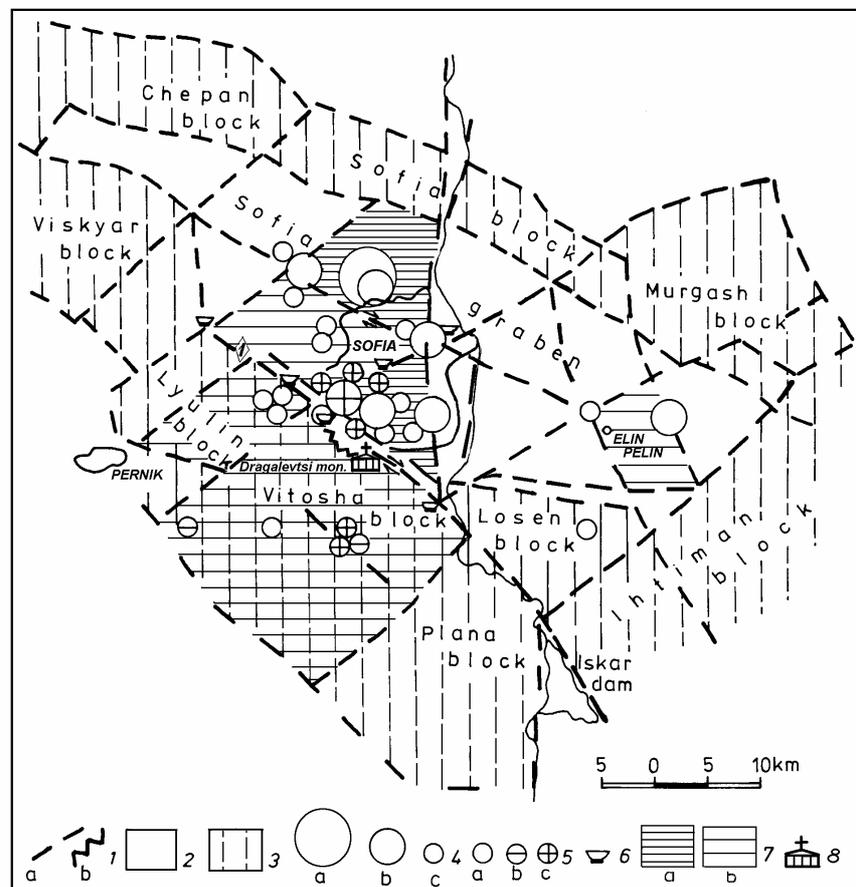


Figure 3: Seismotectonic activity of the Sofia graben and the surrounding horsts.

1 - block boundary: a - without seismic faulting, b - with seismic faulting (1 - Vitosha fault zone); 2 - graben block, 3 - horst block, 4 - earthquake epicenters with magnitudes: a - $M=7.0$, b - $M=5.0-6.9$, c - $M=4.0-4.9$; 5 - hypocenter depths: a - up to 10 km, b - 11-20 km, c - 21-30 km; 6 - thermal spring, 7 - blocks of frequent mobility: a - relatively very frequent, b - relatively frequent; 8 - Dragalevtsi monastery.

The localization of the moderate local earthquake phenomena is very characteristic for the Vitosha fault zone (Matova, 2001). The epicenter localization is the most considerable in the investigated sector of the contact zone between the Vitosha horst and the Sofia graben. The

earthquakes are mainly or very shallow, with seismic focus situated on the depth up to 10 km, or relatively deep, with focus on depths of 21-30 km (Fig. 3).

The Dragalevtsi monastery is situated in a relatively frequently activated block. Its position is very close to the southern margin of the relatively very frequently activated block of the SW part of Sofia city. The monastery support the direct influence of the moderate seismic mobility of the Vitoshka horst and the indirect influence of the high seismic mobility of the neighbour graben block situated in SW Sofia (Fig. 3).

The strong regional earthquakes could cause dangerous situation as well. The shallow 1904 Krupnik earthquake ($M=7.8$) provoke VII degrees effects in Sofia city. The intermediate 1977 Vrancea earthquake ($M=7.2$) is related to locally manifested VII degrees damages in the buildings.

The seismic effects increase in the territories of intensive slope processes and of shallow water. The Dragalevtsi monastery is situated in region where the above cited particularities are well presented.

The seismotectonic conditions in the region of the Dragalevtsi monastery are not favorable for the long-term conservation of the cultural monument. The block displacements, the local and regional earthquakes of different magnitude, depth and frequency create possibilities for the manifestation of real damages or for the accumulation of potential ones. The seismotectonic danger for the monastery is considerable.

4 POSSIBILITIES FOR SEISMICALLY-INDUCED MONASTERY RECONSTRUCTIONS

There are possibilities of related a part of the monastery reconstruction works to considerable earthquakes. The reconstructions that followed the moderate and strong earthquakes will be included in the recent study.

A limited destruction of the monastery in the middle of the 15th century could be provoked by the 1450 Sofia earthquake ($M=6$) or by Turkish acts. The Turkish respect to the royal monastery permit to suppose that the destruction could be seismically-induced.

The following reconstruction in the 17th century is possible to be caused by the significant 1553-1558 Sofia earthquakes. In the Balkan seismological catalog of UNESCO there are notes about the destruction of 12 churches in Sofia and its vicinity during the cited seismic events (Shebalin et al., 1974).

The next destruction in the middle of 19th century could be related to the strong 1858 Sofia earthquake ($M=6.5-7.0$) (Solakov et al., 2001). The epicenter of the earthquake was near the central part of Sofia city and the hypocenter - in the depth up to 10 km..

Some other destruction is provoked by the 1904 Krupnik ($M=7.8$) and by the 1917 Sofia ($M=5.1$) earthquakes. The destruction was followed by the reconstruction of the monastery in 1927.

5 CONCLUSIONS

The Dragalevtsi monastery is named royal one. The monastery plays important role for the protection of the Bulgarian historical and cultural traditions, for the education and the book distribution, for the art development. The wall decoration of the church in the 15th and the 17th centuries has elements of the Bulgarian revival period. The 17th century murals are related to the famous Bulgarian painter-master Pimen Zographsky and his school. The monastery is a cultural heritage of national significance.

The monastery is in unfavorable seismotectonic conditions - near the recent active Vitoshka fault zone, in vicinity of the Sofia graben-Vitoshka horst contact and in a frequently seismically activated sector of the Vitoshka fault zone. The influence of the strong regional earthquakes is taken in account as well. The 1904 Krupnik ($M=7.8$) and the 1977 Vrancea (1977) earthquakes had provoked

considerable destabilization of the mountain slope and of the monastery construction. The local slope processes, also the shallow groundwater and the superficial water contribute to the increase of the seismic effects.

The complicated geological conditions are among the significant causes for the numerous monastery reconstructions.

The Dragalevtsi monastery needs regular conservation activities and periodical restoration works. The national heritage asks special protection cares.

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