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Determining seismic hazard in slowly deforming region: Can we gather enough information from karst caves?

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Methods to determine seismic hazard in any region vary depending on the regional seismicity, but can be roughly grouped into two main groups: one based on probabilistic methods that use data about known seismicity in the region, and another, which is based on data related to the faulting processes and determination of seismically active faults. Both groups of methods are relatively good for seismically active regions. However, in regions of low seismic activity and slow deformations, there is neither enough data for proper probabilistic determination of seismic hazard, nor enough data about deformation that can indicate possibly active faults. Because of that, all sets of data have to be combined in order to gather necessary information needed to determine seismic hazard for a given area.

One of such regions of low seismicity and very slow deformation is the region of Carpatho-Balkan orogen, situated in Eastern Serbia. This orogen represents the western part of the Carpatho-Balkan orogenic chain, extending in the north to the Romanian Southern Carpathians and in its southeastern part to the Balkan massif in Bulgaria. In its central part, in Eastern Serbia, Carpatho-Balkanides are made up of a system of east-vergent nappes, that have been formed in Early Cretaceous and were multiply activated during their geological history. This activity led to the formation of faults that are favorably oriented in respect to the main thrust system. It is suspected that some of these fault systems are also active in recent times.

Relatively complex geological structure and existence of a large number of rock discontinuities, as well as relatively long time during which these geological units have been exposed on the surface, led to intensive karst process and formation of both surface and underground karst forms. Therefore, investigations of faults and deformations on the field surface are very difficult, but investigations of neotectonically active faults inside the karst caves can give a lot more information.

In this abstract, we present evidence about the youngest and recently active faults in the region of interest, based on data from karst caves. Age of activity of faults mapped inside the caves was determined based on indicators of faults cutting speleothems, forming fault breccias that incorporate cave sediments (broken speleothems), and based on speleogenetic considerations.

Samples for radiometric dating have been collected, that will help to quantify fault activity rate.

Preliminary results show that the research area is characterized by strike-slip tectonics, most likely resulting from far-field stress generated by the collision of the Adriatic microplate, the Moesian indenter and the tectonic units in-between. Such stress field is shown to be highly heterogeneous even in this relatively small research area, so local areas of transtension and transpression have also been very important in controlling the recent fault kinematics in this part of the Carpatho-Balkanides. These preliminary conclusions are also of high importance for seismic hazard characterization.