

Revealing the seismicity increase in interrelationships in various seismic zones in Uzbekistan as a case study

Artikov T.U. *, Ibragimov R.S., Ibragimova T.L., Mirzaev M.A., Artikov M.T.

Institute of Seismology, Tashkent 100128, Uzbekistan

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ABSTRACT

A new research method was developed to investigate the influence of an increase in seismicity from one zone on the increase in other zones nearby. By applying the developed method to each main seismic zone in Uzbekistan, we specify the external seismic zone activation, which has the greatest impact on activation within the research zone. We also identify each external seismic zone characterized by high seismic activity and large seismic potential that has the greatest impact on each seismic zone in Uzbekistan.

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1. Introduction

The overwhelming majority of strong earthquakes in Central Asia particularly occur in narrow spreading zones along deep crustal faults. Block dimensions, surrounded by faults, minimize the magnitude of earthquakes occurring within the regions of seismic activity. In parts of Uzbekistan, there are several seismically active zones; their directions coincide with large tectonic deformation strike lines, capable

of generating earthquakes with a magnitude of $M \geq 5$, called internal zones. Within Central Asia, higher-energy seismic areas are possible, where earthquakes with a magnitude of $M \geq 7$ occur more often. These areas include the Pamir–Hindu Kush seismic zone, the North and South Tien Shan zones, and others. These zones are external to Uzbekistan.

Questions about which external seismic zones cause the activation in each internal seismic zone and how significant their activation is important and practical.

* Corresponding author.

E-mail address: artikovtu@mail.ru (Artikov T.U.).

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2. Methodology

2.1. Data

Several seismic zones in Eastern Uzbekistan have been identified [1]: (1) Tashkent, (2) South Fergana, and (3) East Fergana. The first of these zones are dynamically influenced by the northeastern part of the Karjantau fault and southwestern part of the Pskem–Tashkent flexure-fault zone. The South Fergana seismic zone includes the South Fergana fault system, eastern part of the South Fergana flexure-fault zone, and western part of the Besapan fault. Expert opinions differ considerably regarding the existence of the East Fergana seismic zone [1–3]. Its existence was recognized by noticing that according to geophysical data, it is characterized by a sharp differential in seismic wave speeds [1,3]. Evidence in favor of its existence relates to the elongation of an epicenter's cloud of both strong and moderate earthquakes and isoseist orientation of all strong earthquakes occurring within it and along its direction (e.g. isoseistes of an Izbaskent earthquake of 15.05.1992, $M = 5.6$). Besides the three mentioned regions, we will consider two more zones in Eastern Uzbekistan: Nurekatin–Angren (4) [2], comprising two seismogenic zones, as shown in R.N. Ibragimov [2], and the North Fergana (5) seismic zone, caused by dynamically influenced zones of the North Fergana fault.

In southern Uzbekistan, we will consider the South Uzbekistan (6) and Amudarya (7) seismic zones. The South Uzbekistan seismic zones in the southwest direction exhibit both strong and moderate earthquakes [1]. According to the seismotectonic data, the southwest of the South Uzbekistan

zones correspond to the Kyzyl-darya–Lyangar–Karail seismogenic zone [2]. Its northeast end crosses the South Tien Shan and the Besapan-South Fergana seismic zones, essentially adjoining it to the Pritashkent'sky (near Tashkent) seismic zone. The position of the Amudarya's seismic zone coincides with the eastern end of the Amudarya deep fault.

In western Uzbekistan, we consider two more seismic regions: Bukhara–Gazli (8) and North Tamdynsky (9). The Bukhara–Gazli seismic zone links the sources of the strongest Karatag and Gazli earthquakes with $M \geq 7$ in a straight line and coincides with the Bukhara fault and the western part of the South Tien Shan fault. The course of the North Tamdynsky seismic zone corresponds to the position of the same named the seismogenic zone, as highlighted in the works of R.N. Ibragimov [2].

A historical map of earthquake epicenters that have occurred in Uzbekistan and surrounding areas are presented in Fig. 1. The internal seismic zones in Uzbekistan are also shown on this map, which will be reviewed later.

As the external seismic zones may influence the seismicity of the research area, we considered the following seismic zones: a deep-focus earthquake zone, Hindu Kush (I), Pamir zone (II), Talas–Fergana (III) seismic zone, North Tien Shan (IV) seismic zone, South Tien Shan (V) seismic zone, and Kopet Dagh (VI) seismic zone and its front fault.

The map of seismogenesis zones in Central Asia are presented in Fig. 2. It was created in 2012 within the framework of the international project Earthquake Model Central Asia (EMCA) on the basis of seismogenesis zone maps of Central Asia designed in 1995. The historical map shows epicenters of strong earthquakes that have occurred in Central Asia. The aforementioned external seismic zones are highlighted in the map.

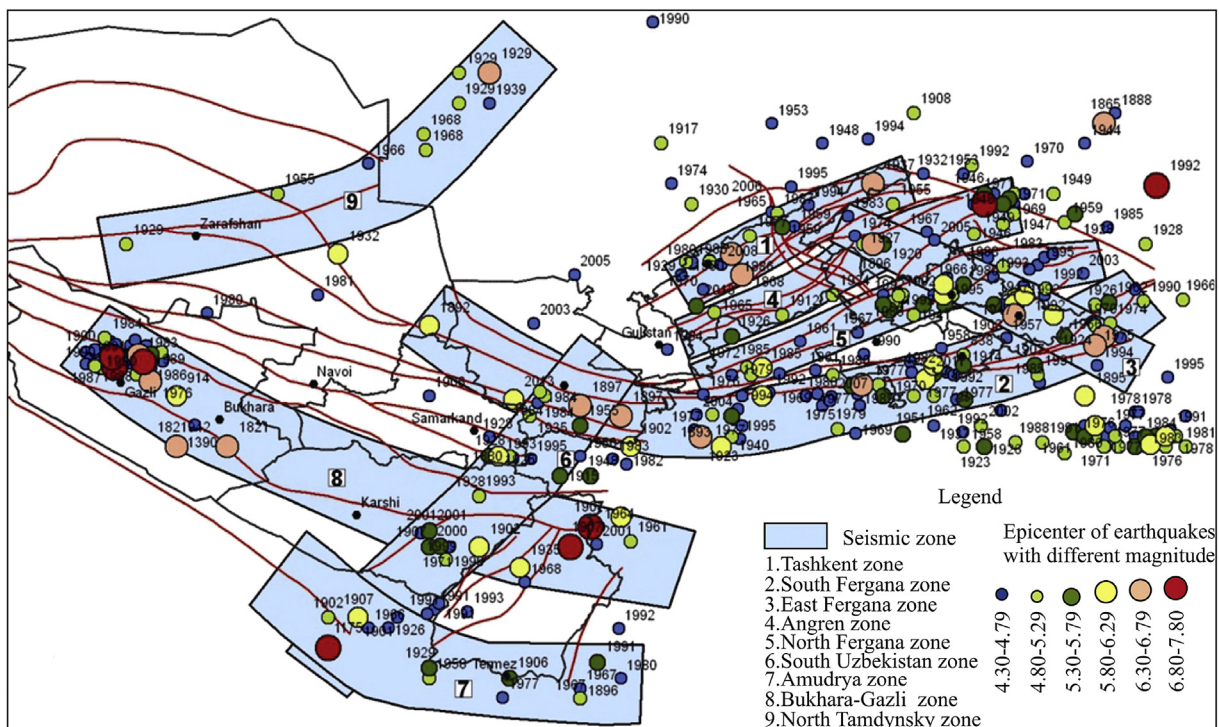


Fig. 1 – Map of epicenters of earthquakes on the territory of Uzbekistan and neighboring areas since historical times.

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