ISSN 1533-9211

DOI 10.5281/zenodo.7322970

GENERAL GEOPHYSICAL AND REMOTE CHARACTERIZATION OF THE DEEP STRUCTURE OF CONCENTRIC STRUCTURES OF EASTERN UZBEKISTAN

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Abstract

Relevance of the topic is determined by development of spatial distribution of earthquake sources in different morphogenetic types of concentric structures (CS) and caused by necessity to study structure of Earth crust and upper mantle on the territory of Uzbekistan. Our republic is one of the highly seismic regions of Central Asia characterized by complex geological and tectonic structure. To date, the seismicity and seismic activity of the territory of Uzbekistan have been studied using geological-geomorphological, geophysical and seismological methods.

Keywords: magneto-metric methods, gravimetric survey, concentric structures, seismological methods, isometric form.

INTRODUCTION

The proposed work corresponds to a new scientific direction in revealing the nature of seismic activity, revealing its links with concentric structures - one of the fundamental questions of seism-genesis. The work is carried out within the framework of the problem: "Complex research of the Earth's crust and upper mantle".

ISSN 1533-9211
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Based on the geological and geophysical results obtained, seismic zoning and forecasting of earthquake sites have been carried out. At the same time, the links of earthquake focuses with concentric structures (CS) and geodynamic characteristics of the latter were not considered. Space-photo-geological information for identification of lineaments and concentric structures, their analysis and connection with seismic activity of the territory of Uzbekistan was not widely used. Therefore, there was a need for a more detailed study of concentric structures and their relationship with seismicity. The geological-tectonic structure of the regions is studied using various geological-geophysical methods. Recently, the remote sensing method has been introduced into the practice of studying the structure and geodynamics of the earth's crust.

The aim of the work is to analyse concentric structures. To clarify their geological and geophysical nature and their relation to seismicity. The research objectives are:

- Determination of geological nature of the objects forming circular, semicircular contours in the landscape. Identified on the remote sensing data as concentric structures.
- Determine the frequency of occurrence of morphological-genetic types of concentric structures.
- Determining the extent of concentric structures in geophysical anomaly distributions.
- Characterization of the geodynamic activity of the Earth's crust within the reference concentric structures.
- Identification of the relationship between reference concentric structures and seismicity depending on their geological and tectonic position.

MATERIALS AND METHODS

When studying the geological nature of concentric structures, in addition to traditional geological materials, geophysical survey methods are widely used. The use of geophysical materials to determine the deep structural elements of the investigated areas is important. The determination of concentric structures in geophysical fields is of great importance. Choice of method of geophysical investigations and form of resulting material is of great importance [11, 12].

At present, the study of the deep structure of the earth's crust is based on a set of seismological methods involving extensive geological information. Another approach is to study the composition and structure of the earth's crust using magneto metric and gravimetric methods. Their interpretation is based on geological data and information on the physical properties of rocks. In the region under study, researchers have identified the following structural-material partition boundaries.

Mokhorovich (M) boundary. Based on survey results, this boundary in the region is characterized by a fairly wide range of depths of occurrence. The surface topography is smooth, with an average vertical gradient of 1 km per 10 km lateral distance [1, 2]. The shallowest depth of occurrence of the M-boundary is in regions of Mogoltau, south-west of Karamazar and west

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ISSN 1533-9211
DOI 10.5281/zenodo.7322970

of Chatkal and Karzhantau ridges (40-45 km). The general trend of boundary dip is from west to east with north-east direction of the main structural landforms.

If we refer to the scheme of tectonic zoning of Chatkal-Kurama region, it should be noted that Angren structural-formation subzone is characterized by insignificant depths of surface occurrence. Pskem-Saidalash and Talas-Ugam subzones have north-eastern extension of the horizon at depths of 45-55 km.

The Kassan, Namangan blocks of the Earth's crust are characterized by the greatest depths of occurrence of the M boundary (55-60 km), and are characterized by a complex built-up topography.

The Conrad surfaces. According to V.A. Chernovsky and S.O. Borisov, the horizon in question lies at depths of 25 to 40 km. The general structural plan of the isohypses strike has predominantly north-western direction and is characterized by very smooth landforms. The smoothest, undisturbed by tectonic and magmatic processes, is the western part of Kurama, Chatkal and Karzhantau ridges. Here the vertical drops in depth are insignificant (about 1 km per 20 km of horizontal strike). This calm relief pattern is observed up to the Kumbel-Arshan fault zone, where there is a sharp surface discontinuity to depths of 35-37 km [1].

The morphologically described surface area is a terraced scarp, gently sloping from west to east. Further to the east, another meridional scarp is traced, gently descending to the Charkasar-Kurama and Aktash fault zone. The Conrad surface slopes downwards for another 3-4 km. At the intersection of the Angren-Chatkal and Koksarek-Chavatinsk faults, the considered terraced scarp is complicated by a meridionally extended depression structure where the relative dip of its central part reaches 2.5-3 km [1, 2].

The surface of the dioritic layer in the Chatkal-Kurama model of deep crustal structure is characterized by different elevations, which is associated with both magmatic processes and tectonic movements of the main activation stages. The dioritic layer relief is morphologically distinguished by a zone of uplift and a zone of sharply pronounced depression structures. In general, it has isometric shape. Thus, the Chatkal Structural Formation zone has a large depression in the relief of the dioritic layer, 80-90 km in diameter and 14-16 km in depth from the average surface relief at the periphery to 30-32 km in the central part of the structure. Thus, the elevation gradient is about 15 km. The average elevation gradient is 1 km per 5 km horizontal distance. The maximum elevation gradient occurs in the peripheral parts of the depression, while the central areas represent a flattened surface of the bottom of the structure.

The Angren Depression area on the diorite layer map is a "cluster" of isometric structures of positive and negative landforms. Consider concentric that the average depth of the top of the dioritic layer is 16-18km, the relative level of the structures of positive relief forms is 6-8 km, while negative relief forms sink to a depth of 10-12km. The Kurama structural-formational zone, as a more magmatic ally saturated and tectonically reworked zone, has the most complex dioritic layer topography.

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Basalt layer. The average thickness of the basalt layer, which is ubiquitous in the region, is 16-18 km. In contrast to the overlying layers, the layer does not have a sharply dissected thickness and areas of depressions and swells. The Kurama zone is the area where the Earth's crust has the highest thickness of the basalt layer in the region (18-20 km). The swells are isometric, with a maximum diorite thickness of 20-22 km.

In the Chatkal zone, the range of thickness changes is 12-16 km. The zone itself also has structures with increased thickness up to 17 km, extending in latitudinal direction, and isometric areas of reduced thickness [3, 4].

The granite layer is ubiquitous in the region, with average thickness ranging from 16-18 km to 28-30 km. The lowest thicknesses are in Kurama zone blocks ranging from 8 to 12km. It is interesting to note that the zones of spreading of concentric structures coincides both with zones of low values of thickness of granite layer, and with areas of maximum gradients of its change.

Relief of the Early Proterozoic crystalline basement.

Based on known geological and geophysical materials, V.A.Chernovskiy and S.O.Vorisov [2] have mapped the surface of the pre-Rhistocene crystalline basement in the Chatkal-Kurama region at a scale of 1:200000. According to their data, crystalline basement in the region in question lies at a depth of 2 to 10-12 km. Their separate outcrops are exposed on the surface within Kassan and in south-western part of Chatkal ridge. The map identifies both the most submerged areas (up to 8-10 km) of undisturbed crystalline basement surface relief and areas that have passed the stage of magmatic substitution of granite granodiorite and diorite compositions.

Tectonic intensification of the later stage has greatly complicated the geological and tectonic structure of the region in question. In addition, active magmatic melts "sediment" the host rocks contributed to the complication of the crystalline basement surface topography. Crystalline basement, which has undergone changes as a result of the injection of magmatic melts, lies at different depths ranging from 0 to 12 km within the Chatkal-Kurama region. The smooth, relatively soft surface topography indicates that the synclinorium was formed on an undisturbed sagging basement.

In the western part of the region under consideration, intermountain depressions are characterized by elevated depths of individual blocks of the concentric strukture. A narrow strip located along the Chirchik River valley is shaped as an elongated block of crystalline basement and morphologically looks like the bottom of a graben-like structure lowered relative to the sides by 8-10 km. At Karzhantau and Chatkal Ridge, it lies at a depth of up to 2 km from the geoid level.

The material presented above shows the effectiveness of geophysical methods in studying the deep structure of the earth's crust, especially it is very important for the study of embedding depth, tectonic activity and other parameters of concentric structures.

ISSN 1533-9211
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RESULTS AND DISCUSSION

As is known, the main method of revealing the geophysical essence of concentric structures is the drawing (mechanical) of the structure contour, including within the synclinorrhea, on the corresponding geophysical map (on the map of gravity in this case) and visual analysis of the reflection of the structure borders in the anomalous fields. Such an approach, according to most researchers, is the only method so far capable of giving a general idea of the depth of concentrations in the Earth's crust and of their real existence in nature. Therefore, the contours of all reference objects, including their daughter satellites, were plotted on the map of local gravity anomalies of the study region, with a preliminary reduction of space-photo structural and geophysical maps to a single scale (1:500000). Analysis of the relationship between the concentric structures boundaries with anomalous lines of different intensities allowed establishing the following features [5, 6,].

Namangan concentric structure. In the gravity field the structure is expressed mainly (92%0) by straight negative local anomalies of high intensity - from -150 to -246 units. It is typical that intensity unambiguously decreases from north (from -140, -150 units) to south (to -246 units), thus in the southern part of the concentric structures linear form of is anomalies sharply passes into isometric.

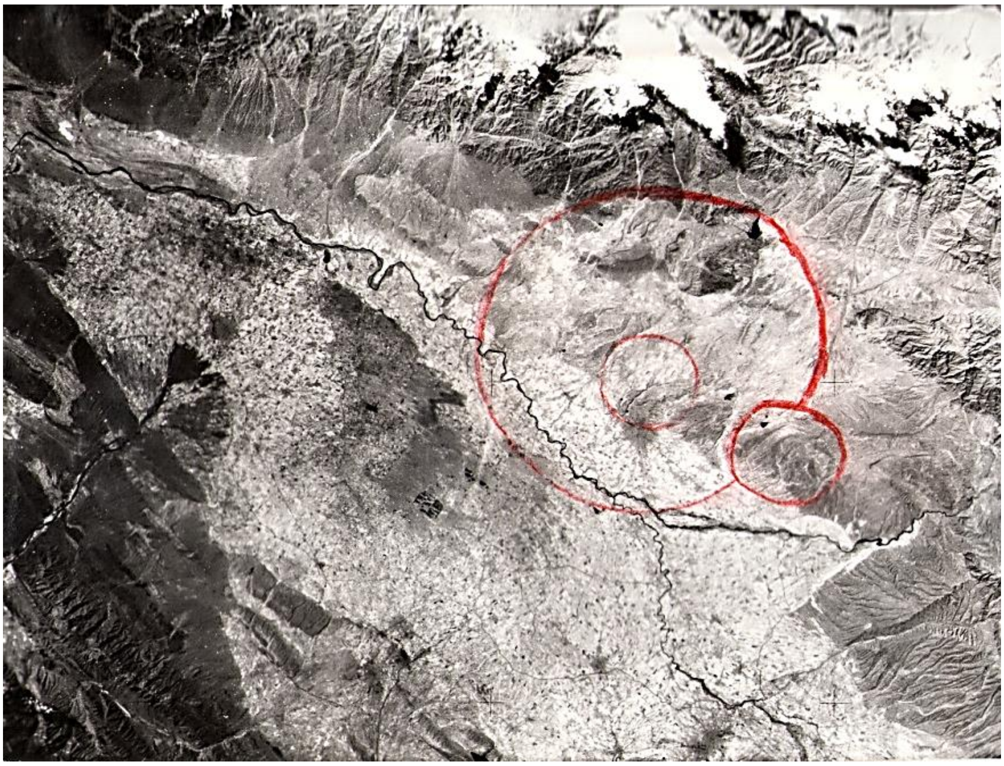

Fig. 1: Namangan concentric structure

DOI 10.5281/zenodo.7322970

The external contour of Namangan concentric structure in northern, eastern and southern sectors is almost certainly confirmed (or limited) by local bends of different intensity is anomalies. The exception is its western sector, which is represented by elevated blocks-chains of watersheds on the left bank of the Syrdarya River, stretching from south-west to north-east-subparallel to the contour lines. Here the boundary of the concentric structure comes exclusively in the zone of insignificant bend of anomalous lines. It should be said that on large-scale (e.g. 1:200000) maps [11].

Sharp isograds of gravity anomalies with characteristic bends well delineate the contour of the structure in question. Outside the Namangan concentric structure, linearly expressed isogranes of anomalies lose linearity rather sharply and curve away from the structure. In the eastern sector they are directed to the southeast-northeast, in the northern sector to the northwest, in the southern sector strictly linear form of is anomaly is preserved, in the form of well-defined bands of high intensity from 180 units to 220 units.

In the southern sector of the considered concentric structure, isograds of very high intensity anomalies from 235 units to 246 units form ellipsoidal closed lines, crossing from west to east the contour of the concentric structures, almost without affecting the integrity of its borders. Probably, this section of the structure represents the most buried geoblock, formed by the complex of rocks with initial composition less affected by the modern tectonic movements. Probably, this is the reason why the southern sector is less affected by earthquake sources than other parts of the concentric structures. [3]

Similar to the parent structure, the pattern of isogranes of anomalies with similar 180 to 230 intensity within the daughter concentric structures is found that linear form of is anomalies is typical only for the territory of daughter concentric structure. Located in western sectors of Namangan concentric structure, located in western sectors of Namangan concentric structure, and for subsidiary structures formed in eastern sectors - isometric - arc-shaped. At the same time, arc-shaped bends are formed in places in linearly - extended isolines, sub-parallel boundaries of daughter structures. These facts indicate the real existence of subsidiary structures of Namangan concentric structure where their seismic activity is manifested at present.

Tashkent concentric structure. The use of remote sensing materials for the purpose of detecting structural and material objects of a buried foundation opens up wide opportunities for researchers involved in the study of valleys, as well as other closed areas. However, in order to be specific: in what cases the deep interpretation of images is difficult or not possible, and in what cases, it is necessary for specialists to first establish the technical and optical parameters of the remote images used. Obtained by Sh.E. Ergashev in the process of experimental work carried out within the Chirchik Valley in 1992-1993, for the first time, the author, together with Sh.E. Ergashev, made it possible to fix on photographic materials the Tashkent concentric structure with clear images of intrastructural frame components. The main amount of information about the decipheconcentric features of the considered geostructure was obtained using space images of the color positive of the early summer survey, scale 1:200000. The materials of another zonal survey turned out to be uninformative in this respect. This is

ISSN 1533-9211
DOI 10.5281/zenodo.7322970

probably due to the similarity of the composition of the upper horizons of the cover-Quaternary formations, the comparative evenness of the relief, the territory of the Tashkent region, as well as the diversity of exposure of the relief components in relation to the sun in different areas. Morphometric background. The Tashkent buried concentric structure, 17 km in diameter, is located approximately in the middle of the Chirchik valley, near the city of Tashkent (it is located almost in the center of the concentric structure). In general, the structure under consideration in the modern relief is poorly expressed, although its outer contour can be traced in places by characteristic alternations of positive (hills, hills) and negative (depressions, ledges) relief forms. This is especially noticeable in the northern, northern, northwestern sectors (located on the territory of Kazakhstan) of the concentric structure: small (up to 20-50 m high) hills, hills and depressions between them, having elongated shapes, arcuately frame the outline of the structure from the outside. In the southwestern and eastern sectors, the location of individual hills (5-20m high and 30-50m long) in the form of chains along the contour of the structure is noted. The inner arcuate and linear framework on the daylight surface is almost not captured, they are obscured by objects of human activity: natural depressions are leveled, hills are destroyed - the main signs of concentric structure decipheconcentric.

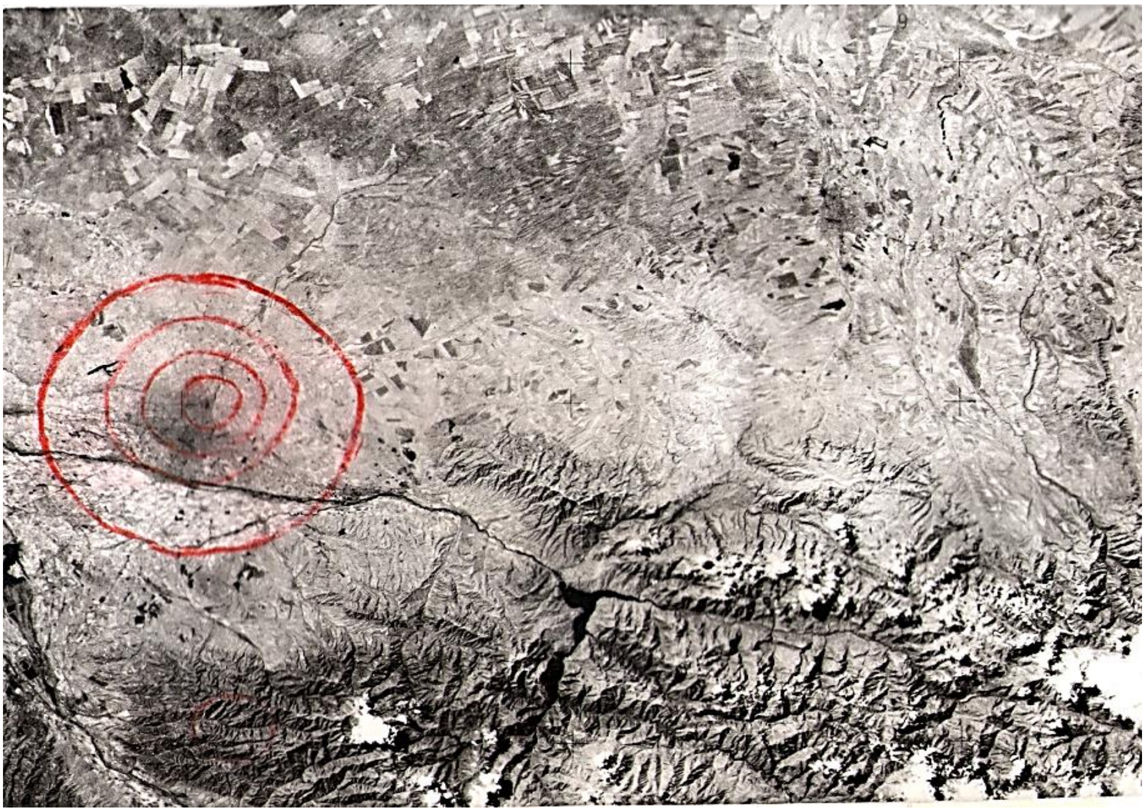

Fig. 2: Tashkent concentric structure

ISSN 1533-9211

DOI 10.5281/zenodo.7322970

Remote background. The Tashkent concentric structure can be seen in full only on the prints of the color positive obtained in early summer. On other photographic materials - multizonal, spectrozonal, etc. it is almost non-existent. Its clear image, including frame components (on prints from a color positive) and its real reflection in geodynamic and geophysical fields, convinces us of the reliability of the existence of the Tashkent concentric structure.

On the used remote sensing materials, the described concentric structure is fixed in the form of an almost perfect circle, composed of arcuate and linear discontinuities in the eastern segment. The arched frame, in turn, forms an independent multi-zoned daughter concentric structure with a complex structure.

The outer contour of the concentric structure in the images is clearly seen in the form of a narrow (0.5-1.0 mm) intermittent strip: dark lines on a white photo tone or light gray lines on a dark photo tone. An arcuate and linear-radial frame usually marks the photo borders of dark and light gray stripes, corresponding in nature to relatively low elevations (dark spots) and plains (lightened area). The photo tone of the structure is characterized by the alternation of dark, dark gray tones with light gray. In the northern, northwestern and partly in the western segments, light (almost white) areas of various configurations are fixed, reflecting agricultural land.

The alternation of light and dark tones contributes to the formation of a spotty, pea-like pattern of the photographic image. At the same time, it was established that a fine-grained pattern is typical for the eastern half of the Tashkent concentric structure, and a large-sized pattern is typical for the border zones (western, northern and northwestern sectors) of the concentric structure. This is explained by the fact that within these sectors there are the largest in height and width types of relief: long hills, individual hills, small chains of watersheds, etc.

Subsidiary concentric structures. 9 km in diameter, has the shape of a clearly defined circle, located almost in the middle of the parent structure, closer to its western sectors. The western part is complicated by arcuate ruptures with the formation of 4 zones. The latter are recorded in the form of arched photo anomalies, limited along the edges by linear discontinuities located fan-shaped with respect to the middle of the concentric structure. It is characteristic that the geoenergetic center of the structure is shifted to the south from its geometric center. The photo tone inside the small concentric structure is light grey, the photo pattern is mottled, pea-like. Geological background. Within the Tashkent concentric structure, there are mainly Quaternary deposits of the Tashkent complex, which cover more than 95% of the surface of the structure. Younger formations of the Syrdarya complex (02-03) were recorded in the southeastern segment (southeastern outskirts of Tashkent). at dawn, on the slopes of the hill, red-colored terrigenous formations of the Paleogene-Neogene (P3-N) are exposed. On the photographic materials, the deposits of the Syrdarya complex differ from the Tashkent one mainly in the fine-grained pattern of the image and a barely noticeable darkish tone. A clear boundary between the complexes is not visible. The area where Paleogene-Neogene rocks are exposed is characterized by a lighter photo tone and a large-sized, spotted pattern.

ISSN 1533-9211
DOI 10.5281/zenodo.7322970

On the concentric structure obtained in the near IR range, the entire territory of the Tashkent concentric structure, regardless of the composition and age of the terrigenous complexes, is characterized by a smooth gray photo tone and a fine-grained image pattern. Lightened spots correspond to farmland areas. The outer contour of the concentric structure is very clearly embarrassed in sections by the contacts of cutting age deposits. A similar contouconcentric with sections is also characteristic of its daughter structures.

An unimportant aspect in the study of concentric structures is the development of general principles for the mechanism of connection between concentric structure and seismicity. Based on the spacing of the spatial distribution of the concentric structure of individual regions with earthquake sources of different depths, the following geometric forms of connection are outlined. "Prismatic" form of connection. The source of concentric structures formation are foci located evenly on oval shaped or concentric-shaped areas. Concentric structures parameters depend on the area of distribution of foci. In cross section, it has the shape of a prism. Funnel-shaped connection. This source is seismic centers concentrated on a small area. It is located at a depth of at least 50 km. The depth distribution of different-magnitude earthquake sources determines the concentric structures parameters. In the context, they have a funnel-shaped pattern. Conical form of connection. It is the most complex, where at least three to five crowded foci are involved. Each of them, according to the funnel-shaped pattern, creates its own concentric structure on the surface. The outer fragments of these concentric, uniting in plan, form new concentric, arched or arched structures. In the section, under the influence of newly discovered Cosmo elements, the outer funnel-shaped contours acquire a conical shape. The non-traditional outlines and contours of the Cosmo structures of "funnel-shaped" and "cone-shaped" origin of the pattern give the impression that the concentric structure is unsystematic for studying modern movements of the earth's crust. But knowledge of the decoding of these mechanisms opens up new possibilities for the remote method in determining the deformation of focal regions and the earth's crust as a whole

On the example of concentric structures in general, reference concentric structures of Eastern Uzbekistan in particular, testing a new direction for using the results of interpretation of remote survey materials to study the seismic activity of the territory. For the first time in Uzbekistan, an attempt was made to use concentric photo anomalies to identify the spatial distribution of earthquake sources. The results obtained showed that concentric structures can be favorable areas for the accumulation of end kinetic energy, which contributes to the occurrence of earthquakes.

The research methodology is based on a comprehensive analysis of materials from aerial and space surveys of various scales, spectral range, survey time, and geological and geophysical studies. The facts presented in the dissertation allow us to draw the following conclusions and practical recommendations.On the territory of Uzbekistan, the most widespread font structures are located mainly in folded structures. Many spectral structures are also confined to cconcentric structures, although they are also revealed in the alignment of frequent territories. Depression structures, found mainly in western Uzbekistan, received the least distribution.

ISSN 1533-9211

DOI 10.5281/zenodo.7322970

The geodynamic activity of concentric structures located in orogenic platform areas is different. Concentric structures located in the orogen are geodynamically more active on the platform. A relatively good correlation between the contours of reference concentric structures and is anomalies of the gravitational and magnetic fields is revealed.

The external contours of the reference structures to magnetic fields are clearly correlated in the form of arched shapes and knee-shaped turns of isogammas. Positive signs and a closed, isometric shape of the isogamma inside the concentres are characteristic. The increased activity of the manifestation of the anomaly inside the concentres compared to their outer zone indicates potential geodynamic activity in the inner zones. Concentric structures selected as reference objects, located at the junction of mountains with foothills, are the most optimal for identifying the relationship between earthquake sources and concentric photoanomalies. A comprehensive interpretation of remote photographic information and the results of experimental surveys, together with the materials of geological, geographical, geodesic and morphostructural studies, contributed to the determination of the reliability of the above reference geostructures. Increased tectonic activity in most concentric structures is concentrated inside them, where contrasting anomalies of geophysical fields, gradients of recent movements of the earth's crust, recent movements and heat flux density are manifested. The indicated trend of tectonic activity in the concentric structures is confirmed by modern and recent movements, and seismically active areas generally coincide with active blocks of the earth's crust.

The speed of modern vertical movements within the reference concentric structures has the following parameters. Inside - burial structures (Tashkent and Namangan concentric structure) - 2-2.5 mm / per year (uplift and loweconcentric), inside exposed structures (Lashkerek and Karabashsay concentric structures) 3-3.5 mm / per year (only uplifts) . The given quantitative values of movements can be one of the proofs that seismic activity within concentric photoanomalies is determined by their geodynamic activity.

A detailed study of the spatial relationship of reference concentric structures with sources of instrumentally characterized earthquakes made it possible to identify the following trends. - Morphological and genetic types of concentric structures of Uzbekistan ranked by size have different frequency of occurrence.

- The geological bodies identified by the photo image, related to the concentric structures, are characterized by landscape features, geological and geophysical structure and distribution of anomalies of magnetic and gravitational fields.
- The relationship of the reference concentric structures of Eastern Uzbekistan with seismicity lies in the active manifestation of seismicity in the concentric structures, located in the transition zone of the earth's crust blocks with different tendencies of movement.
- The existing map of the concentric structures of Uzbekistan was refined and supplemented.
- on the basis of this map, the frequency of occurrence of morphological and genetic types of concentric structures ranked by size was determined
- Substantiated the geological and geophysical structure of the identified reference concentric structures in Eastern Uzbekistan.

ISSN 1533-9211
DOI 10.5281/zenodo.7322970

- The tendency of reference concentric structures connection with seismicity was revealed.

The monograph is based on the material collected over 10 years in the laboratory of geodynamics of the Institute of Geodynamics of the Academy of Sciences of the Republic of Uzbekistan. More than 200 images of the daytime surface of the studied region were analyzed in the course of experimental and selective work. Used photographic materials. Space image obtained from the Salyut orbital station, high-altitude aerial photographs, as well as American scanner images from artificial Earth satellites of the ERTS system. Pictures are black-and-white, color synthesized, obtained at different times of the year and day. Aerial visual observations were made with the MI-4 helicopter, the AN-2 aircraft, together with the employees of the Central Cosmogeological Party of the State Committee of Geology of Uzbekistan. Ground control field work was carried out by the author independently in the Chatkal-Kurama region and the Ferghana Valley.

CONCLUSION

The methodological basis of the research is modern ideas about seism geology and the use of aerospace information in the study of seism geology, methods of systemic static mathematical analysis of concentric structures parameters, spatial comparison of geophysical, seismological and geodynamic parameters. In the work uses materials from aerospace sounding of the Earth, data from ground-based geological, as well as experimental and analytical studies of the territory of Eastern Uzbekistan.

The practical significance of the work is as follows:

- Data on the morphogenetic types of concentric structures were summarized and their relationship in the structure of the earth's crust was determined.
- Adjustments were made to the assessment of seismic activity in Eastern Uzbekistan.
- The results can be used in detailed geological, seismotectonic studies for the purpose of seismic zoning and search for mineral deposits.
- The methodological foundations for studying the reference concentric structures of Eastern Uzbekistan can also be applied in other similar regions to solve the above problems.
- Burial concentric structures confidently control earthquake sites and have a connection with a deep energy-generating site. They are modern geodynamically active structures compared to expose CLs.
- Accumulation of energy, leading to an earthquake, in most cases occur in the western and southeastern sectors of the reference objects.

The seismic passivity of concentric structures located in folded structures indicates a weakening of energy storage processes in the earth's crust. A systematic study of the connection between concentric structures and earthquake sources can reveal new seismo-dynamic aspects of concentric structures, and the results obtained can have not only practical (for example, in earthquake prediction), but also theoretical significance in understanding the theory of seism genesis. In eastern Uzbekistan, the most seismically active are the western and southwestern sectors and zones of arcuate frameworks of buried concentric structures, as well as exposed

ISSN 1533-9211

DOI 10.5281/zenodo.7322970

concentric structures in general, where the process of mountain building is manifested. Therefore, when predicting the locations and strengths of future earthquakes, special attention should be paid to these features of the concentric structures. At the same time, it is necessary to take into account the role of through transverse and edge lineaments in seismotectonics.

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