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Newest Tectonics and Modern Geodynamics of Mining Industrial Areas of Central Kazakhstan

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Abstract. The rapidly developing mining industry in the territory of Central Kazakhstan leads to emergence of near the areas of active mining of tangible earthquakes of technogenic genesis, which creates difficulties in their operation. Displays of irreversible changes in the state of rock mass with the development of new structures, active faults. The features of the formation of potentially dangerous areas of the occurrence of seismicity. We have considered one of the major factors the features of modern tectonics and modern geodynamics of ore-industrial facilities in Central Kazakhstan.
The shield of the young platform is a wide area protrusion of the basement of the epigercina platform, adjoining mountain-building area in the southeast, and in all other directions sinking under Mesozoic-Cenozoic deposits. Geomorphologically it is a vault, complicated by increases of a higher order with contrastingly expressed tectonic layers. The seismic events were concentrated on the boundaries of the active of passive blocks of the earth's crust of Neogene-Quaternary tectonic activity of the Kazakh shield.
The active impact on the geological environment of industrial explosions will change the geodynamical activity and as consequence occurring technogenic earthquakes in the fields of central Kazakhstan.

1. Introduction

The Central Kazakhstan is one of the most rapidly developing in the mining industry the territory of Kazakhstan. The maximum number of actively exploited quarries and mine fields of numerous deposits of polymetallic, coal and copper deposits create certain difficulties in their exploration associated with the development of new structures, active faults and relatively rare seismicity of these areas in the comparison with the Southern and Western regions of Kazakhstan. However, the active exploitation of these deposits can lead (and unfortunately has already led) to the appearance near the areas of active production of tangible earthquakes of man-made genesis. (Gatinsky et al., 2014; Nurmagambetov, 2010; Akanova, 2009; Mikhailova, Uzbekov, 2018). To understand the features of the formation of potentially dangerous areas of occurrence of technogenic seismic events in the territory of Central Kazakhstan, we consider the features of the latest tectonics and modern geodynamics of ore-industrial objects of Central Kazakhstan as one of the main factors.

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2. The latest active faults and morpho structures of Central Kazakhstan

The In the middle of 1930s, the expeditions of geologists from Soviet Union of Soviet Academy participated in the large expeditions on the territory of Central Kazakhstan [1].

Since 1955 in the Central Kazakhstan by tectoinsts of the Institute of Geology of Academy of Science SSSR under the guidance of A.B. Peyve made a special study of kinematics of deep fault zones.

They found that the largest sub-latitude and East-North-East direction faults are major overthrust (Uspensky, Spassky). North-West direction faults were right shift (Chingiz, Jalair-Naiman, Junggar, etc.). (reference Trifonov at al., 1987).

The main types of horizontal displacements were shown – overthrust, strike slip, normal, reverse – are paragenetically interrelated and form overthrust dynamopairs, strike-slip fault, etc. Research results published [2] and led to the further study of the problem of horizontal displacement [3]. These features of the structure of Central Kazakhstan obey the patterns of location and earthquakes mechanisms.

The latest tectonic movements in the main types of geomorphology structures.

The stages of Alpine tectogenesis indicates that its main result and feature in Central Kazakhstan, is the emergence of currently existing geomorphic structures (tectonic structures expressed in relief) by deforming the surface of the epigercin platform originating from the beginning of the Mesozoic (Figure 1). The current level of the World Ocean has been taken as the initial level in identifying the total deformations that are reflected in the scheme [4].

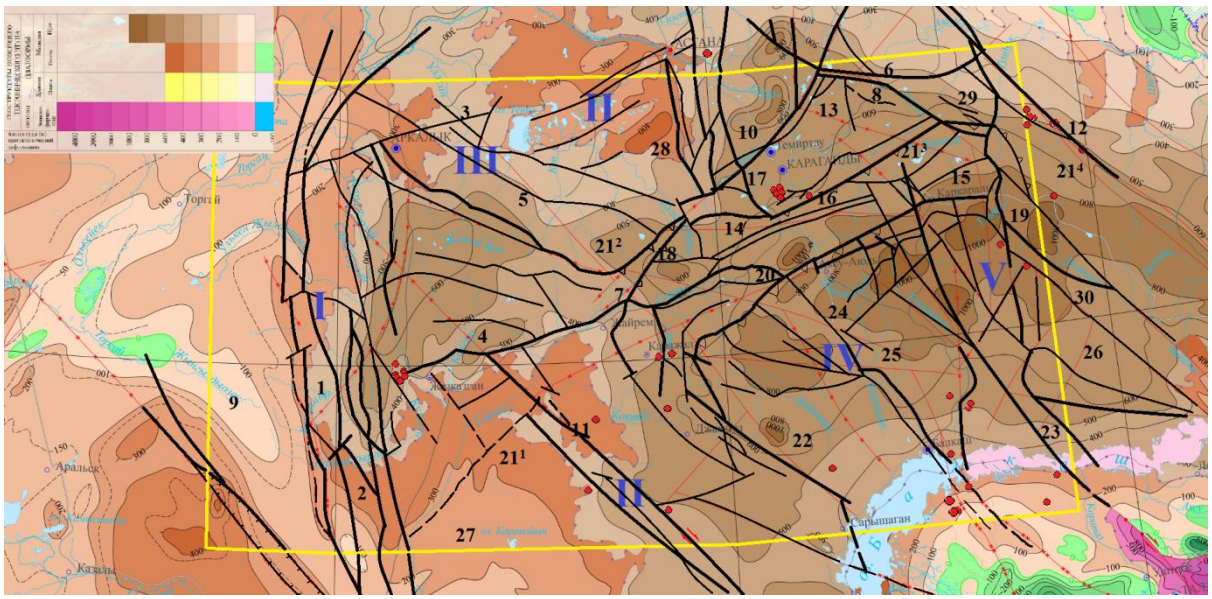


Figure 1. Scheme of the latest tectonics and active faults of Central Kazakhstan [Editor: Nusipov E, (2007 with additions according to Mazarovich A.O. – 2006)].

Convention:

I-Ledges of metamorphic basement; II- the Caledonian fold zones; III-Imposed Hercynian structures in Caledonia; IV-Hercynian, Jungar-Balkhash system; V- Balkhash-Ili volcanic belt of the late Paleozoic.

1-30. Tectonic elements.

I-Protrusions of the metamorphic basement: 1—2 —Ulutau;

II-Caledonian fold zones. Anticlinoria: 6 — Yermentausky, 8 —Boshekulsky, 12 — Chingiz Meganticlinorium, 27-Betpakdalinsky, 28-Maykayn;

Synclinorium: 9— Baykonursky, 10 — Seletinsky, 11 — Jalair-Naimansky, 29-Bayanaulsky;

III-Superimposed hercynian structures in caledonides: 3 — Tengiz depression, 4— Zhezkazgan (Chu- Zhezkazgan) depression, 5 — Sarysu-Teniz zone of block fold, 7 — Karazhalsky trough, 13 — Schidertinsky depression, 17— Karagandinsky trough;

21^1— 21^2 —21^3—21^4 Devonian Volcanic belt.

IV-Hercynian Junggar-Balkhash system. Anticlinors: 14 — Spassky, 16 —Tekturmasky, 18 — Atasuysky, 22 — Aktau-Moyntinsky, 23 — North-Balkhash;

Synclinoria: 15 — Nurinksky, 19 — Karasorsky, 20 — Uspensky (with the same name crumple zone), 24 — Zhaman-Satrysuyky;

V-Balkhash-Ilisky Late Paleozoic volcanic belt: Depressions: 25 — Tokrauskaya, 26 — Kalmakemelskaya, 30-Bakanaskaya.

Red circles – earthquakes source, black lines – active faults.

Deep faults: Ⓐ-Astaninsky, Ⓑ-West-Balkhashsky, Ⓒ-Central-Kazakhstan, Ⓓ-West-Dzhungarian, Ⓔ-Kounrad-Borlinsky, Ⓚ-Kalba-Chingizky, Ⓛ-Chingizky thrust, Ⓝ-Jalair-Naiman, Ⓢ-Spassky, Ⓤ-Uspensky, Ⓨ-West-Ulutau.

2.1. Young platform shield (Kazakh shield)

Kazakh shield is a wide ledge of the basement of the epihercynian platform, adjacent to mountain genesis area in the south east and in all directions plunging under Mesozoic-Cenozoic sediments.

North-Balkhashsky and Betpak-Dalinsky anticlinoria, Sarysu-Teniz zone of the block folds are a higher tectonics steps in the geomorphological vault, and also wide Tengiz depression [5].

Sarysu-Tenizkaya zone of the block folds. The amplitudes of latest movements in bound of Kazakh shield, it should be noted that they increase from northwestern to southeastern from +200 ÷ +300 to +800 ÷ +1000 meters and more.

In the Caledonian folding areas (Yermentausky, Boshekulsky anticlinoria, Schidertinskay depression and Seletinsky synclinoria) the latest uplift of the earth crust had shown with an amplitude of +600 ÷ +1000 meters. Which characterized by polygonal forms with unclear severe focus.

In the Hercynian folding areas (Spassky, Tekturmassky, Atasuysky, Aktau-Mointinsky and North-Balkhashsky anticlinoriums, Nurinsky, Karasorsky, Uspensky and Zhaman-Sarysuysky synclinorium) spatially aggravated to Central-Kazakh Gravitational Minimum, abnormally high values of the latest movements of the earth's crust are revealed +600 ÷ +1000 meters.

In the field of genesis of the Ulutau outthrust metamorphic basement, the amplitudes of newest movements of the earth's crust are increasing from west to east, from +100 to +400 meters.

The most part of junction zone of north-eastern areas of the Ulutau outthrust of metamorphic basement from west part of Sarysu-Teniz zone of block folds, in Zhezkazgan depression in Neogen-Quarternary, tectonic process were more active in newest movement of the earth's crust. The amplitude of elevation +500 ÷ +600 meters.

In areas with superimposed Hersynian folding (Tengiz depression), on Caledon folding areas (Maykayn and Betpakdalinsky anticlinoriums). The amplitudes of earth's crust in south parts of Devonian regional volcanic belt within +200 ÷ +400 meters.

The main earthquakes epicenters are concentrated on the boundaries of blocks of active and passive tectonic faults of earth's crust at the stage of Neogene-Quaternary tectonic activation of the Kazakh shield [15].

Most of the tectonical faults are coincide with stretch maximum values of the newest movements of Central Kazakh gravitational minimum territory (Figure 2).

A seismic event occurred on the border of the newest movements of earth's crust from +300 ÷ +400 meters, a less number of seismic events occurred at heights up to +500 ÷ +800 meters. The most of seismic events occurred in northwestern part of Central Kazakh gravitational minimum and 180 km south of the city of Karaganda [20].

The Ulutau outthrust metamorphic basement areas in the newest movements increase from +200 meters and in the central part of the area the newest movements are stretched to the north-eastern part, where the heights are limited within +400 ÷ +600 meters. Tectonic faults extend from the south-east to

the north-west. The newest movements coincide with the stretch of tectonic faults in the areas of Zhezkazgan depression.

The seismic events occurred in the southwestern part is shown 150 km from the city of Zhezgazgan [16].

The newest movements of earth's crust in the area of the Jalair-Naiman fault from +300 meters and partially reaches +500 meters. Seismic events occurred along the Jalair-Naiman fault.

The newest movements of earth's crust from the North-Balkhash part from +300 to +500 meters. Seismic events occurred in the average of height from +300 ÷ +500 meters. In the South-Balkhash part, an increase in the latest newest movement is observed from the south to the north, here heights are observed within +100 ÷ +300 meters and all seismicity.

In the area of Seletinsky synclinorium the newest movements of earth's crust of heights reaches from +600 to +800 meters. Most of the movements coincide with the stretch of tectonic faults. The capital of Kazakhstan, to the western part of the city Nur-Sultan at a distance of 108 km seismicity occurred.

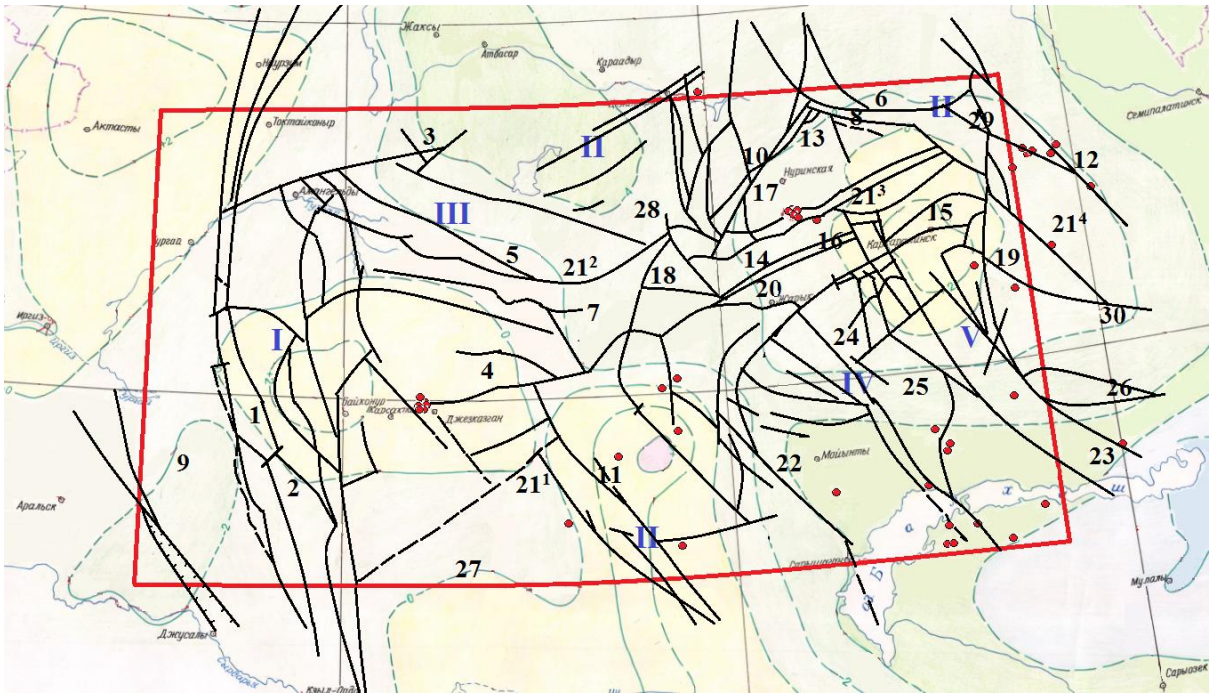


Figure 2. Scheme of modern vertical movements and active faults of Central Kazakhstan in 1988 [Editors: Nusipov E. at al.]

Legend in Fig.1.

Red circles – earthquake epicenters, black lines- active tectonic faults.

3. Modern vertical movements

The latest tectonics is weakened by the inherited mode in the region of Jalai-Naiman synclinorium, and modern tectonic movements of earth's crust [17].

In the southern part of Devonian volcanic belt, Karasorky and Nurinsky anticlinorium and Tekturmansky anticlinoria in the newest movements of earth's crust are activated from +500 to +1000 meters, also activization vertical movements from 0 to +2 mm/year [18].

On the periphery of the Central Kazakh gravitational minimum in the newest movements of earth's crust is the activation from +500 to+1000 meters and modern vertical movements passivity within -2 mm/year.

In the areas of the southeastern Ulutau metamorphic basement, Betpakdalincy anticlinoria, northern part Devonian volcanic belt and north-west parts of Jalai-Naiman fault in the newest movements of earth's crust was passive in average of +200 ÷ +400 meters and in modern vertical movements it is activated within +2 to +4 mm/year.

The northeastern Ulutau metamorphic basement and into Sarysu-Teniz zone which in newest movements is activity from +400 to +600 meters in modern vertical movements from 0 to +2 mm/year. There is and interrelation in the areas.

Observed bending in the areas Tengiz depression and Maykayn anticlinorium which modern vertical movements from -2 to -4 mm/year and newest movements of earth's crust is passive raising in the aisles of +300 ÷ +400 meters.

The modern vertical movements are active sagging from -2 to -4 mm/year in the newest vertical movements of earth's crust is rising from +400 to +1000 meters on the eastern part of Aktau-Moynty and North-Balkhash anticlinorium [19].

The behavior of the Devonian volcanic belt from the south-western part where passively rising from +300 meters and further stretching to the north-eastern part is actively growth from +300 to +500 meters and further stretches to the east where the value varies in the aisles if +500 meters in the newest movements of earth's crust. In modern vertical movements, it is observed that the southern and north-western parts of the Devonian volcanic belt in activation further stretches to the north and north-east where the values decrease and increases again and in the eastern part activation become slower.

4. Conclusion

Studies of the newest movements of earth's crust, active faults in the Central Kazakhstan is shown, that modern tectonic process occurring in Central Asia are sequences of collisional effects which occurring Indian and Eurasia collisions zone and reflect the regularly attenuating phenomena with distance from the collision zone of the main structures (Zonenshain, Savostin, 1979; Gatinsky et al., 2014; Trifonov at al., 1987; Ulomov et al., 1999). The modern geodynamic activity of the area is defined as a moderate, but at the same time, an active impact on the on the geological environment of industrial explosions will definitely change the local geodynamic activity (Satov 1999). Consequence of all is cause an increase in a technogenic earthquakes in Central Kazakhstan, which can create some problems in further exploitation of numerous deposits.

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