Felt earthquake on March 4, 2024, Mw=5.0, in the Kyungey–Ala–Too ridge

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Abstract The paper presents the results of the analysis of instrumental and macroseismic data of the strong Kungey earthquake on March 4, 2024, on the border of Kyrgyzstan and Kazakhstan in the Kemin-Chilik fault area. The hypocenter of the earthquake is confined to the focal zone of the catastrophic Kemin earthquake of 1911 with Mw=8.2. The earthquake of March 4, 2024 occurred under the action of submeridional near-horizontal compression, which is typical for the sources of the Northern Tien Shan. The type of motion in the source along the steeply dipping plane NP1 of southwestern strike is a reverse type of motion with a left-sided strike-slip component, along the plane of an eastern strike is a thrust with a right-sided strike-slip component. Before the Kungey earthquake, a ring-shaped seismicity structures formed by earthquakes with depths of up to 33 km, which is a prediction's factor for strong crustal earthquakes. The earthquake was felt in Almaty (Kazakhstan) and its suburbs with an intensity of 5 points on the MSK-64 scale and had the most significant impact on the megapolis after the Baysorun earthquake of 1990. Data on the macroseismic impact of the Kungey earthquake in Kazakhstan and Kyrgyzstan were collected. An analysis of the records of strong motion instruments based on data from Central Asian stations was carried out.

Keywords Strong earthquake, Northern Tien Shan, focal mechanism, strong motions, intensity.

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References

Abdrakhmatov, K.E., Berezina, A.V., Walker, R., Frolova, A.G., Gryutsner, K., Grebennikova, V.V., Pershina, E.V., Sokolova, N.P., & Moldobekova, S. (2022). *Zemletriaseniia Kyrgyzstana* [Earthquakes of Kyrgyzstan]. Bishkek, Kyrgyzstan: Publ. House of Scientific Journals and Children's Fiction, 205 p. (In Russ.).

Bogdanovich, K.I. (1911). [Earthquake on December 22, 1910 (January 4, 1911) in the northern Tien Shan chains between Verniy and Issyk-Kul]. *Izvestiia Geologicheskogo komiteta* [News of the Geological Committee], *30*(189). (In Russ.).

GFZ Data Services. Other/Seismic Network. (2024). *ACROSS Strong Motion Network in Central Asia*. DOI: *10.14470/NQ293785*

Global CMT Web Page. (2024). *Global CMT Catalog Search*. Columbia, SC, USA: Lamont-Doherty Earth Observatory (LDEO) of Columbia University. Retrieved from *https://www.globalcmt.org/CMTsearch.html*

International Federation of Digital Seismograph Networks. (2024). *Kyrgyz Digital Network*. – DOI: *10.7914/SN/KR*

International Federation of Digital Seismograph Networks. (2024). *Global Seismograph Network – IRIS/IDA*. – DOI: *10.7914/SN/II*

International Federation of Digital Seismograph Networks. (2024). *Kazakhstan Network*. DOI: *10.7914/SN/KZ*

ISC. (2024). *Search Earthquake Bulletin*. Retrieved from *http://www.isc.ac.uk/iscbulletin/search/bulletin/*

Kashima, T. (2007). *ViewWave*. IISEE. Retrieved from *https://iisee.kenken.go.jp/staff/kashima/viewwave.html*

Kondorskaya, N.V., & Shebalin, N.V. (Eds.). (1977). *Novyj katalog sil'nyh zemletryasenij na territorii SSSR s drevnejshih vremyon do 1975 g*. [New catalogue of strong earthquakes on the territory of the USSR from ancient times to 1975]. Moscow, Russia: Nauka Publ., 536 p. (In Russ).

Kopnichev, Y.F., & Sokolova, I.N. (2010). On the correlation between seismicity characteristics and S-wave attenuation in the ring structures that appear before large earthquakes. *Journal of Volcanology and Seismology*, *4*(6), 396-411. DOI: *10.1134/S0742046310060047*. EDN: OHMPQF

Kopnichev, Y.F., & Sokolova, I.N. (2013). [Ring-shaped seismicity structures, being formed prior to large earthquakes with different mechanisms within intracontinental regions]. *Geofizicheskie issledovaniia* [Geophysical Research], *14*(1), 5-15. (In Russ.). EDN: RAGHLD

Kopnichev, Y.F., & Sokolova, I.N. (2019). Mapping S-wave attenuation field of the North Tien Shan region using seismogram coda for local earthquakes and quarry

blasts. *Izvestiya*, *Atmospheric and Oceanic Physics*, *55*(11), 1803-1813. DOI: *10.1134/S0001433819110215*. EDN: MGVBTW

Kulikova, G., & Krüger, F. (2015). Source process of the 1911 M8.0 Chon-Kemin earthquake: Investigation results by analogue seismic records. *Geophysical Journal International*, *201*(3), 1891-1911. DOI: *10.1093/gji/ggv091*. EDN: USXTNB

Lahr, J.C. (1999). *HYPOELLIPSE*: *A computer program for determining local earthquakes hypocentral parameters*, *magnitude*, *and first motion pattern*. *Open-File Report 99-23*. Reston, Virginia: US Geological Survey. Revised: 2012, 119 p. Available at: *https://pubs.usgs.gov/of/1999/ofr-99-0023/HYPOELLIPSE_Full_Manual.pdf*

LTD Seismological Experience and Methodology Expedition of the Committee of Science of the Ministry of Education and Science of the Republic of Kazakhstan. (2003). *Seismic network of the Seismological Experience and Methodology Expedition CS MES RK* [Data set]. International Federation of Digital Seismograph Networks. DOI: *10.7914/SN/QZ*

Medvedev, S.V., Sponheuer, W., & Karnik, V. (1965). *Shkala seismicheskoi intensivnosti MSK-64* [Seismic Intensity Scale MSK-64]. Moscow, Russia: Interdepartmental Geophysical Commission of the USSR Acad. Sci. Publ., 11 p. (In Russ.).

Mikhailova, N.N., & Neverova, N.P. (1986). [Calibration function d( ) for determining the MPVA of earthquakes in the Northern Tien Shan]. In *Kompleksnye issledovaniia na Alma-Atinskom prognosticheskom poligone* [Complex studies at the Alma-Ata prognostic polygon] (pp. 41-47). Alma-Ata, Kazakhstan: Nauka publ. (In Russ.).

Mikhailova, N.N., & Poleshko, N.N. (2005). [On the focal mechanisms of earthquake in East Kazakhstan]. *Vestnik NIaTs RK* [NNC RK Bulletin], *2*(22), 142-146. (In Russ.).

Mukambaev, A.S., & Mikhailova, N.N. (2014). [100 years of the Kemin disaster: new data on the earthquake source]. *Vestnik NIaTs RK* [NNC RK Bulletin], *1*, 104-111. (In Russ.).

Nurmagambetov, A. (1999). [Kemin earthquake on January 4, 1911 (December 23, 1910)]. In *Seismicheskaia istoriia Almaty* [Seismic history of Almaty]. Almaty: LEM Publ. House, 68 p. (In Russ).

Nurmagambetov, A., Mikhailova, N.N., Sydykov, A., Gapich, V.A., Vlasova, A.A., Sabitov, M.M., & Khaidarov, M.S. (1996). [Baysorun earthquake on November 12, 1990]. In *Zemletriaseniia v SSSR v 1990 godu* [Earthquakes in the USSR in 1990] (pp. 46-52). Moscow, Russia: Nauka Publ. (In Russ).

Przhiyalgovskii, E.S., Rybin, A.K., Morozov, Yu.A., Lavrushina, E.V., Leonov, M.G., & Bataleva, E.A. (2022). [Geological and geophysical transect of the Middle Tien Shan across the Naryn and Atbashi depressions]. *Geodinamika i tektonofizika* [Geodynamics & Tectonophysics], *13*(1), 0568. (In Russ.). DOI: *10.5800/GT-2022-13-1-0568*. EDN: BWRWFM

Quinlan, D. (1998). *A tutorial for Datascope*: *The ASIS relational database system*. Boulder, Colorado, USA: Boulder Real Time Technologies.

Rautian, T.G. (1964). [On the determination of the energy of earthquakes at a distance of 3000 km]. In *Eksperimental'naia seismika*. *Trudy IFZ ANSSSR N 32*(*199*) [Experimental seismic. Proceedings of the IPE AS USSR N 32(199)] (pp. 88-93). Moscow, Russia: Nauka Publ. (In Russ.).

Sabitova, T.M. et al. (2006). *Zemnaia kora i verkhniaia mantiia Tian'-Shania v sviazi s geodinamikoi i seismichnost'iu*. *Pod red*. *A.B. Bakirova* [The Earth's crust and the upper mantle of the Tien Shan in connection with geodynamics and seismicity. Ed. A.B. Bakirov]. Bishkek, Kyrgyzstan: Ilim Publ., 114 p. (In Russ.).

Sobolev, G.A., Anosov, G.I., Aptikaev, F.F., Arefyev, S.S., Fearless, V.M., et al. (2000). *Prirodnye opasnosti Rossii*. *V 6 tomakh*. *T. 2. Seismicheskie opasnosti*. *Red*. *G.A. Sobolev* [Natural hazards of Russia. In 6 vol. Vol. 2. Seismic hazards. Ed. G.A. Sobolev]. Moscow, Russia: KRUK Publishing Company, 296 p. (In Russ.). EDN: VDJOMZ

Sokolova, I.N., Gabsatarova, I.P., Beryozina, A.V., & Aristova, I.L. (2024). [Large earthquake on January 22, 2024 with Mw=7.0 in the south of Tien Shan]. *Rossiiskii seismologicheskii zhurnal* [Russian Journal of Seismology], *6*(1), 42-64. (In Russ.). DOI: *10.35540/2686-7907.2024.1.03*. EDN: KHSGBI

USGS. (2024). *Search Earthquake Catalog*. *Earthquakes*. Retrieved from *https://earthquake.usgs.gov/earthquakes/search/*

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