GC2024-SG003

On the possibilities and problems of using creepex as a characteristic of the seismogenic environment stress-strain state

Anna V. Mikheeva[1] , Igor I. Kalinnikov[2]

[1] Institute of Computational Mathematics and Mathematical Geophysics, Siberian Branch of the Russian Academy of Sciences
[2] O.Yu. Schmidt Institute of Physics of the Earth, Russian Academy of Sciences

anna@omzg.sscc.ru

This paper highlights the development of the conceptual provisions and solutions set out in [1-4] on the creepex-analysis of seismicity in the tasks of geodynamic research of the major earthquakes preparation areas: 1) by the change in the creepex value around their foci [1] or in the accompanying seismic swarms [2], 2) by the correlation of the creepex with magnitude and depth during the major shock preparation [3]. The influence of the medium-depth seismicity of regional and global deep faults on the processes of focus preparation was also studied [4].

In this paper the dynamics of the correlation coefficient K_{KOR} (of the pair correlation of the magnitude M_S(t) and the creepex Cr(t)) is considered on a global scale according to the Harvard CMT catalog by deep (H≥50 km) seismicity extended along two strictly orthogonal to each other "main" seismic belts of the Earth [4], that are detecting by GIS-ENDDB seismolineamentic algorithm [5] and covering all earthquakes of the Globe with M_S≥7.5.

The K_{KOR} graphs demonstrate the four earthquakes having the most extensive K_{KOR} anomalies with approximately the same time intervals between them: 27.12.2003, 18.01.2011, 8.9.2017 and 9.01.2023.

This is two earthquakes: New Caledonian 27.12.2003 (M_S=7.0) and Mexican 8.9.2017 (M_S=8.3) corresponding to positive anomalies and the maximum of the trend growing before and decreasing after these events. Similar display can be associated with endogenous processes that increase the medium decompression, i.e. with episodes of global geotectonic stretching.

The Pakistani 18.01.2011 (M_S=7.0 and 7.0) and Indonesian 8-9.01.2023 (M_S =7.0 and 7.7) events have the largest negative anomalies, starting 49 and 15 days before them. It is logical to associate them with the consolidation of the environment along global seismic belts, presumably due to episodes of the most intense geotectonic compression of modern times. Such episodes may be connecting with the registered now fluctuation of the Earth's rotation [6].

Thus, the analysis results confirm the validity of the previously obtained conclusions [5] on the classical parameter creepex Cr_0~M_S-m_b according to the IDC catalog. The need to verify these results arose in connection with the observed cases of mass recalculation of the M_S values of this catalog. The lack of sufficient stability of the paired definitions of M_S and m_b forced us to involve other pairs of magnitudes in the creepex-analysis, in particular, the surface M_S and the moment one M_W (available in the CMT catalog). The resulting modified kind of the creepex Cr ~M_S-M_W has a clear physical meaning of estimating the degree of enriching the rupture in the focus by seismic energy E_S per unit of seismic moment [7] and therefore, just like the classical creepex, reflecting the relationship between creeping and explosive shift component [8].

The possibility of confirming the conclusions of the creepex-analysis with data from other catalogs (including with the involvement of other magnitude pairs), greater reliability of the definitions of M_S and m_b magnitudes and their completeness would increase the reliability of the results of retrospective geodynamic analysis.

The work was carried out within the framework of state project № 0251-2021-0004.

[1] A. V. Mikheeva, I. I. Kalinnikov, Russ. Seism. J. 4 (2021) 7.

[2] A. V. Mikheeva, Bull. of Novosib. Comp. C., Ser.: Math. Model. in Geoph. 23 (2021) 11.

[3] A. V. Mikheeva, Russ. Seism. J. 2 (2023) 51.

[4] A. V. Mikheeva, Bull. of Novosib. Comp. C., Ser.: Math. Model. in Geoph. 25 (2023) 12.

[5] A. V. Mikheeva, I. I. Kalinnikov, Mach. Learn. and Data Analysis. 3 (2017) 36.

[6] F. R. Stephenson, L. V. Morrison, C. Y. Hohenkerk, Royal Society A. 472 (2016) 1.

[7] R. E. Tatevosyan, Physics of the Earth, 4 (2016) 157.

[8] A. G. Prozorov, D. Hudson, Dependence Magnitude and energy classification of earthquakes, V. 2, IFZ AN SSSR, Moscow, 1974, p.208.