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GEOLOGY

Present-Day Kinematics of the Northern Margin of the Argun Continental Massif (Eastern Part of the Central Asian Belt)

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Abstract—This paper reports the first data on present-day movements in the northern margin of the Argun Continental Massif, obtained on the basis of GPS measurements. The processed GPS data have been obtained to calculate the vector field of displacement velocities in the geodynamic survey site of the Upper Amur Region. The estimated displacement parameters (direction and magnitude) are indicative of the uniform velocity vector field of the points in the northern margin of the Argun Massif and the absence of considerable motions within its range (differences in the vector components do not exceed a few millimeters per year). A conclusion is made on the present-day kinematic integrity of the northern margin of the Argun Massif.

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In tectonic maps, the Eastern Asia Region is a complex collage of variably aged geological structures: the Northern Asian and Northern Chinese cratons, between which the Argun (Kerulen–Argun–Mamyn) and Bureya–Jiamusi continental massifs (superterranes) are clamped. The latter are separated by the Paleozoic and Late Paleozoic–Early Mesozoic fold belts [1, 2].

Table 1. Horizontal displacement velocity of GPS points at the geodynamic survey site in the Upper Amur Region in ITRF2008

Point coordinates, deg		Displacement velocity components, mm/yr		Determination errors of velocity components, mm/yr		Name of point	Observation duration, years
N	E	East	North	East	North		
127.43	53.77	23.45	−16.04	0.89	1.25	PIKA	3
127.28	53.75	22.57	−17.17	0.41	0.50	ZEYA	3
125.80	53.46	24.75	−14.11	0.36	0.46	MAGD	4
124.94	55.51	26.44	−10.54	1.40	1.83	MOGO	3
124.90	54.19	26.55	−11.47	1.81	2.59	SOSN	2
124.89	54.03	16.85	−8.20	1.63	2.16	BUGO	2
124.75	55.15	20.77	−11.79	0.28	0.35	TIND	6
124.64	54.53	20.74	−11.77	0.57	0.71	DJEL	5
124.55	53.75	22.26	−13.42	0.26	0.34	TALD	5
124.46	54.29	28.58	−16.81	0.81	0.97	SOLO	4
124.20	55.21	29.33	−14.36	0.29	0.38	KUVI	5
124.11	53.97	24.14	−16.10	0.27	0.35	SKOR	6
123.80	54.56	28.35	−17.23	3.38	4.91	ANOS	2
123.78	54.26	20.89	−15.91	2.27	2.87	TAHT	2
123.20	55.35	22.74	−7.17	1.08	1.41	URKI	4
122.91	54.03	24.62	−11.96	0.32	0.42	URUH	5
122.73	54.27	17.39	−23.01	3.55	4.82	PUTA	2
122.17	54.59	18.89	−19.81	3.65	5.06	NYUK	2
121.96	53.99	22.19	−13.28	0.65	0.83	EROF	4

Velocity determination errors are given in the 95% confidence interval. The location of points is given in Fig. 1.

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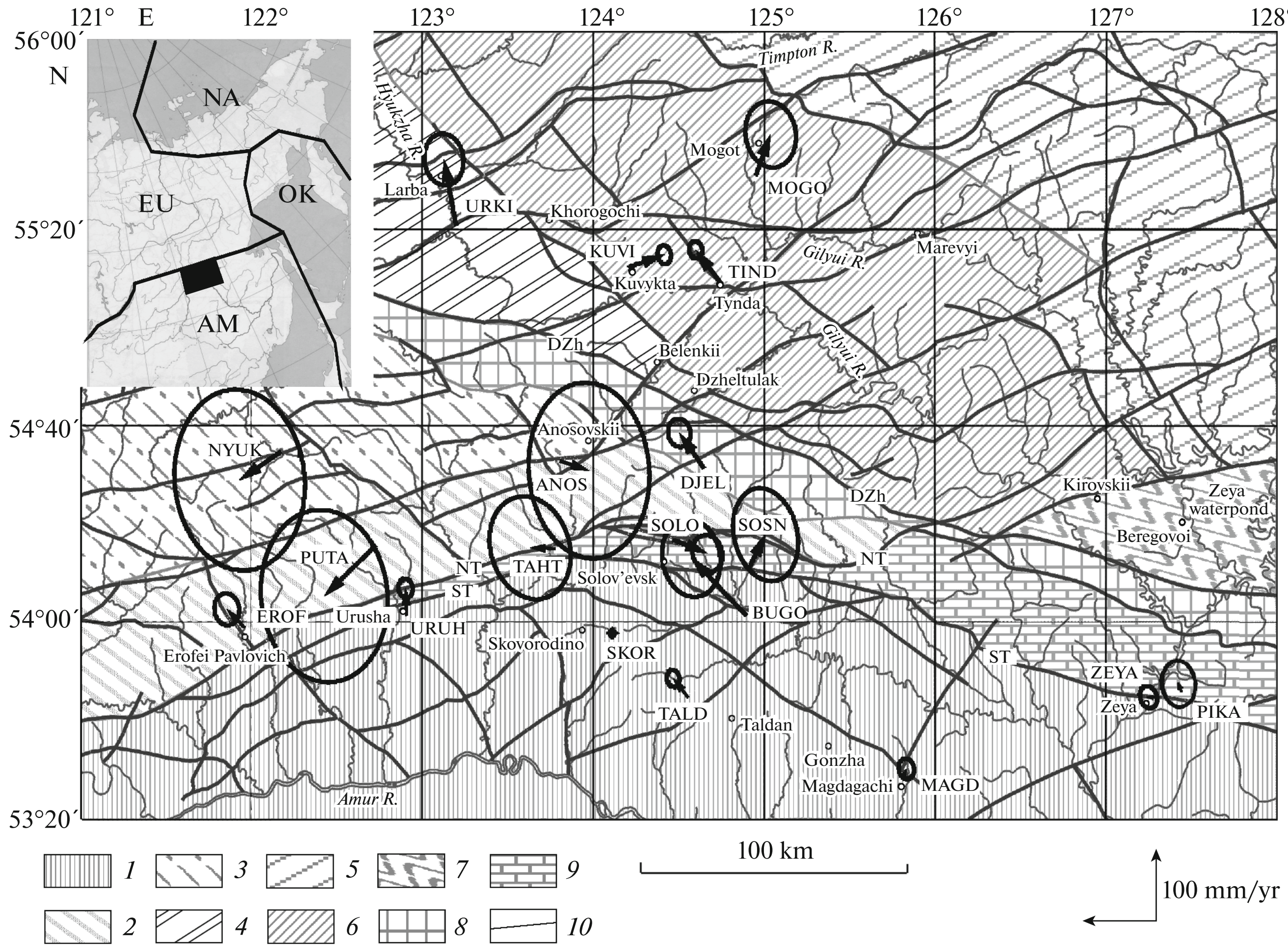

Fig. 1. Major tectonic structures of the Upper Amur Region and horizontal displacements relative to the SKOR point. Major tectonic structures of the Upper Amur Region: (*1*) Argun Continental Massif; (*2*–*3*) Selenga–Stanovoi superterrane, blocks: (*2*) Urkan, (*3*) Mogot; (*4*–*7*) Dzhugdzhur–Stanovoi superterrane, blocks: (*4*) Larba, (*5*) Bryanta, (*6*) Ilikan, (*7*) Dambuki; (*8*–*9*) suture zones: (*8*) Jeltulak suture zone, (*9*) Mongolian–Okhotsk fold belt; (*10*) major faults: (ST) South Tukuringra, (NT) North Tukuringra, (DZh) Dzheltulak. The displacement velocity vectors (arrows) are shown relative to the SKOR point with ellipses of a 95% confidence interval. The major lithospheric plates of the Eastern Asia Region are shown in the inset: (EU) Eurasian, (AM) Amur, (OK) Okhotsk, and (NA) North American. The area studied is shown with a black triangle.

One of the most disputable issues is the present-day regional geodynamics commonly considered in terms of the interaction between the Eurasian and Amur plates. This interaction area [3, 4] is a broad band (up to 400 km) of activated endogenic processes. The northern boundary of this band, stretching from Lake Baikal in the west to Uda Bay of the Sea of Okhotsk in the east, is the Olekma–Stanovoi seismic zone, while the southern boundary is the Tukuringra–Dzhagdy zone. The kinematic characteristics of the interacting Eurasian and Amur plates are almost identical [5]: the displacement velocity of the Amur Plate relative to that of the Eurasian Plate is low, 1–3 mm/year [6], meanwhile, their conjugation zone is well-defined in stress field gradients, fault occurrence frequency, and seismicity [7, 8].

This paper reports the first data on present-day movements in the northern margin of the Argun Continental Massif, obtained on the basis of GPS measurements at the geodynamic survey site in the Upper Amur Region. In the structural zoning maps [3, 6, 8, 9], this continental massif is considered as an integral part of the Amur lithospheric plate.

The present-day kinematics of the northern margin of the Argun Massif was investigated by estimation of displacements of the geodetic observation points located within it. Measurements at the benchmarks, as a rule, were performed once a year; the information was recorded with the help of receivers with a 30-second interval for at least a 36-hour session, which is a sufficient condition to calculate the spatial coordinates of a point with a submillimeter accuracy [10].

The GPS observation data obtained were processed using the GAMIT/GLOBK software package [10]. The processing made it possible to obtain a vector field of displacement velocities of the points at the geodynamic survey site of the Upper Amur Region (Table 1; Fig. 1).

As follows from the estimates given in Table 1, all observation points (except for BUGO, which is still devoid of a long-term observation range) located in the northern margin of the Argun Massif are characterized by similar displacement parameters (direction and magnitude). This fact is indicative of the uniform velocity vector field of the points located within it (differences in the vector components do not exceed a few milliliters per year) and, consequently, the absence of considerable motions within the northern margin of the considered massif. This suggestion can be confirmed by comparison of the estimated displacement velocities of the points in the northern margin of the Argun Massif, given in this work, with those obtained for the Chinese part of this massif [11, 12]. The difference in the vectors of closely spaced points, despite differences in the observation network configuration, in observation duration, and also in data processing techniques, does not exceed a few milliliters per year.

Hence, despite the heterogeneous nature of the geological structure characteristic for the Argun Continental Massif, which is reflected in the complex structure of geophysical fields, its margin is established to be characterized by a uniform vector field of displacement velocities, evidencing its kinematic integrity. Meanwhile, the kinematic parameters of the northern margin of the Argun Massif are considerably different from other geological structures located in the region of interaction between the Eurasian and Amur plates.

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