

Polygon “Simeiz–Katsively” – study of changes in the geodynamic, heliogeophysical and climatic characteristics of Crimea

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Abstract. The solution to the problem of forecasting catastrophic natural and technological phenomena in Crimea is associated with the organization of complex observations in a network of local geodynamic polygons. Currently conducted on-site observations involved in the solution of problems of geodynamic and environmental monitoring in international cooperation. To study lithospheric deformation, the reasons for their cause, the search for prognostic indicators, preparing regional seismic events of natural and anthropogenic origin in the Crimean region, in 2018, geodynamic testing area “Simeiz–Katsively” have been expanded tiltmeter and magnetovariational stations, included in the national observation network.

1 Introduction

To explore emerging and developing deformation processes, movements of lithospheric plates are created geodynamic polygons, experimental equipment, which implements the comprehensive observational techniques of radio interferometry with very long baseline (VLBI), the laser ranging to artificial satellites (LRS) and the satellite systems GPS/GLONASS.

In Crimea, established and partially equipped with necessary equipment for the integrated monitoring of geodynamic polygon “Simeiz–Katsively”. Currently conducted on-site observations involved in the solution of problems of geodynamic and environmental monitoring in international cooperation.

To study lithospheric deformation, the reasons for their cause, the search for prognostic indicators, preparing regional seismic events of natural and anthropogenic origin in the Crimean region, in 2018, geodynamic testing area «Simeiz–Katsively” have been expanded tiltmeter and magnetovariational stations, included in the national observation network.

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2 Experimental base for geodynamic observations

Created in Crimea geodynamic site “Simeiz–Katsively” have formed the basis of ground and space-based time series of observations of climatic and geophysical characteristics of the Crimea, especially the Mountainous parts (Fig. 1).

Applied a fundamentally new approach - geodynamic site «Simeiz–Katsively» consists of three mutually supportive of each other technology observations: VLBI, laser ranging satellites and global navigation satellite system [1, 2]. According geodynamic observation stations of the polygon is defined with an accuracy of few millimeters in the horizontal and vertical component of speed of movement of the Crimean Peninsula and the Eurasian tectonic plates. To ensure monitoring of large-scale tectonic processes and control of “fast” deformations in local seismic and landslide hazardous zones of the Crimean peninsula, the local speed and direction of movement of the coast of the Southern Crimean coast near the settlements of Simeiz-Katsively were determined by geodynamic measurements [3].

The analysis of climatic characteristics of the Peninsula of Crimea held on average daily and average annual satellite measurements of climatic parameters gave the possibility to obtain information on insolation and warming of the earth's surface in the Crimea, the surface temperature on the Peninsula as a whole, and the abnormal lowering of the temperature of the earth's surface in the extreme Eastern point of the Peninsula [4].



Fig. 1. The “Simeiz-Katsively” test area.

The positions of the points in the “Simeiz-Katsively” test area have been determined by special GPS survey campaign. Results are presented in Table 1 and 2.

Table 1. Final solution for coordinates of points in the Simeiz-Katsively area.

Station	X, m	Y, m	Z, m
RT22G	3785230.904	2551207.524	4439796.448
RT22	3785223.388	2551202.451	4439787.574
KATS-SLR	3785944.414	2550780.660	4439461.335
SIMI-SLR	3783902.266	2551405.032	4441257.506
GPS-CRAO	3783897.116	2551404.411	4441264.266

Table 2. Offsets for 10 years of the coordinates of points in the Simeiz-Katsively area.

Station	dX	dY	dZ
RT22G	-0.216	0.126	0.077
KATS-SLR	-0.200	0.137	0.032
SIMI-SLR	-0.230	0.134	0.069

Tiltmeter station, installed in Katsively on the territory of the Crimean astrophysical observatory, designed and manufactured by D.G. Gridnev in collaboration with employees of IZMIRAN. It is composed of two identical quartz tiltmeter, which are located on the plane with mutually perpendicular arrangement of the axes of rotation of pendulums. The design of the tiltmeter shown in Fig. 2.

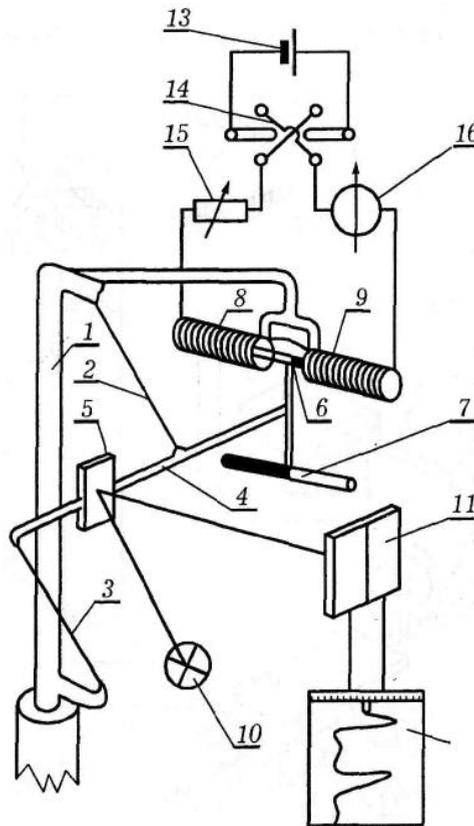


Fig. 2. Tiltmeter with control device and calibration using electromagnetic force.

In the mounting frame 1, a horizontal pendulum 4 is suspended on elastic threads 2, 3 with a mirror 5 and two identical rod, antiparallel permanent magnets 6, 7, rigidly fixed horizontally at the end of the pendulum 4 perpendicular to its axis in one vertical plane at a distance of no more than 10 mm from each other from friend. The ends of the magnet 6 are placed in the solenoids 8, 9, rigidly fastened to the mounting frame 1 so that when the circuit is open, they coincide with the centers of the solenoids, and the axis of the magnet coincides with the axis of the solenoids. The tiltmeter contains a photoelectric converter, consisting of a illuminator 10, a mirror 5 and a differential photocell 11 connected to the recorder 12. Solenoids 8, 9 are connected to a control unit consisting of a power source 13, a polarity switch 14, a resistance store 15, and a mirror calcareous microammeter 16.

The tiltmeter does not contain current leads to the sensitive system; therefore, the possibility of drift of the null point is excluded and linearity of the instrument readings is ensured. The distance between the magnets does not exceed 10 mm, which allows to eliminate not only the effects of changes in the external magnetic field, but also changes the gradients of the external magnetic field. The placement of the ends of the magnet in the middle of the solenoids provides a linear relationship between the magnitude of the deviation of the pendulum and the magnitude of the current in the circuit of the solenoids. These tiltmeters have found wide application in our country, and also operated in Belgium and Luxembourg.

3 Conclusion

To study lithospheric deformation, the reasons for their cause, the search for prognostic indicators, preparing regional seismic events of natural and anthropogenic origin in the Crimean region, in 2018, geodynamic testing area «Simeiz–Katsively» have been expanded tiltmeter and magnetovariational stations, included in the national observation network.

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