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Development of a Differential Thermosensor for Extra Precise Temperature Measurements

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For the study fine structure of temperature fields in the rock strata, we designed extra precision temperature sensors with possibility to measure temperature with an accuracy of at least 0.001°C. As thermosensitive element, we are used platinum thermoresistors, which have an almost linear temperature dependence of the change in internal resistance on the external temperature and an excellent long-term stability of their basic characteristics. To reduce the level of self-noise, special technical solutions were applied including low-frequency filtering of output signals and all supply voltages. The main methods for calibrating and setting the necessary operating temperature range of thermosensors were considered. The first experimental measurements with the help of the developed sensors were carried out in the adit of the North Caucasus Geophysical Observatory, Institute of Physics of the Earth RAS, in the Baksan Gorge. They provided unique data on the structure and dynamics of the thermal field near the Elbrus volcano. Corresponding continuous monitoring is a particularly important task both for obtaining new fundamental knowledge about the structure of magmatic structures and for assessing volcanic hazard from the presence of a fluid magmatic melt in the volcano's interior. In addition, such temperature sensors can be used for temperature monitoring of critical components of seismic devices. Well known that one of the main noise-causing factors in precise long-period seismometry is temperature fluctuations of mechanical elements of devices and sensitive sensors, as well as temperature oscillations in their interior space. To reduce such noise it is possible to apply adaptive filtering of seismic signal based on elements of temperature registration. However, to date, this way it was not possible to achieve significant results since there were no systems capable of recording temperature changes with sufficient accuracy and resolution. The work was carried out with the financial support of the grant of the President of the Russian Federation to support scientific schools No. SS-5545.2018.5.