

Technique for Solids Thermal Property Measurements at Elevated Pressure and Temperature and Measurement Results

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A theoretical base and instruments for measurements of thermal conductivity (TC) and thermal diffusivity (TD) of anisotropic inhomogeneous porous solid's with simultaneous influence of temperature (up to 250°C), pore pressure, and two components of lithostatic pressure (up to 200 MPa for each component) have been developed. A new version of the line-source method has been developed to provide simultaneous measurements of TC and TD tensor components within one pressure and temperature cycle. Metrological testing of the instruments has been performed on reference samples with TC and TD values within ranges of respectively 0.71...10.7 W/(m·K) and $(0.557...5.42) \times 10^{-6}$ m²/s. According to the test results, accuracy and precision of TC and TD has been established to be correspondingly 4 and 7 % at a confidence probability of 0.95. Variations of TC and TD tensor components of mineral crystals have been registered within similar temperature (up to 220°C) and confining pressure (up to 200 MPa) conditions. Application of the technique for sedimentary and crystalline rocks allowed us to obtain new important information for basic and applied studies of the Earth's crust. An instrument for measurement of the coefficient of linear thermal expansion (CLTE) has been developed. Metrological tests of the instruments performed on the set of four reference samples with CLTE values within range of $(0.5...24.6) \times 10^{-6}$ has shown that accuracy and precision of CLTE measurements do not exceed 4 % at a confidence probability of 0.95.

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