CONTROLLING AND MEASURING DEVICE SUITE FOR THE MICROSCOPIC INVESTIGATIONS OF PHASE BEHAVIOR OF INCLUSIONS IN MINERALS UNDER DIFFERENT TEMPERATURES

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A new controlling and measuring device suite for the microscopic investigations of phase behavior of inclusions in minerals under different temperatures (up to 800 ºC) is designed. It ensures a possibility in situ of optical and PC observations under the phase transition processes in minerals. The technique makes it possible to determine homogenization temperature of different phases in the inclusions, to control melting and crystallization, and to correct experimental parameters. In temperature parameters it belongs to the middle - temperature class of installations. The maximal working temperature is first of all limited by the material of a metal thermo smoothing insert, where the researched sample is located. Authors used a silver insert (m. p. 960.5ºC). This allows making long experiments at temperature up to 800ºC. Besides high-quality heating micro stage this installation is supplied with the original device of automatic control and temperature regulation to specify and control temperature – kinetic parameters during the experiment. The initial information is recorded on rigid disk and represents both a film and a simultaneous file with thermocouple data. Digital video camera, allows observation of changes in inclusion directly on the screen of the computer monitor. This device makes it possible not to keep the inclusions under steady microscopic observation.

Different constructions of heating micro stages are used for investigations of physicochemical conditions of formation of igneous rocks and minerals. The design variety is caused by a need for recording of various phase transformations and the estimation of P-T parameters of crystallizing phases and also thermometric studies of melt inclusions in minerals with direct observation of the processes occurring inside the inclusions during their heating and cooling. A good review of industrially made and currently used designs of heat micro stages is presented in [1]. A design, described in [2, 3] which allows for out nucleation, growth and crystal dissolution investigations directly during the experiment is of chief interest. Hermetic micro stages with controlled gaseous atmosphere have recently gained wide acceptance, making it possible not only to prevent the oxidizing action of air oxygen on minerals but also to preset various oxygen fugacity during high-temperature experiments [4].

The scheme of controlling and measuring complex is submitted on the block diagram (fig. 1). The setup consists of the heating micro stage with an operating temperature of up to 800 ºC (2, fig. 1); the electronic equipment units, regulating and controlling temperature in the heating micro stage (4, fig. 1); the objective water cooling systems of microscope (7, fig. 1), illumination optics and two monitors. The heating micro stage may be located on the object stage of a “Biolam” microscope or other microscopes long-focus objectives and water cooling (1, fig. 1). The digital video camera (3, fig. 1), attached to an ocular of a microscope, transfers the image to the computer monitor (5, fig. 1). It allows recording and reproducing of behavior peculiarities of the fluid inclusions for the subsequent study.

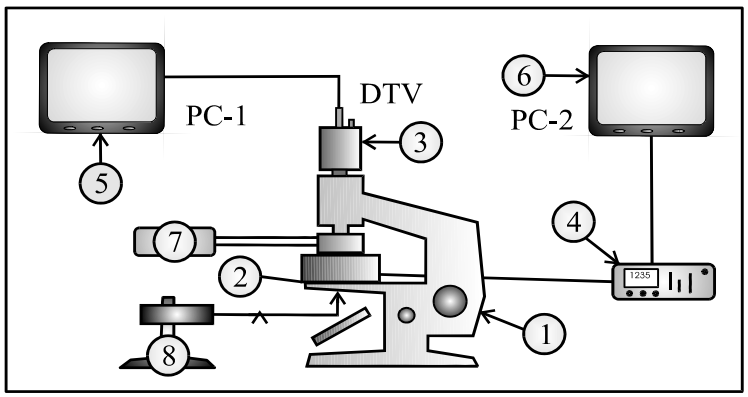

Fig.1. Block diagram of the controlling and measuring device suite.

The heating micro stage of 25 mm. in height (fig. 2) consists of the cylindrical titanium case of 60 mm. in diameter (2, fig. 2). The block of a heater (8, fig. 2), is a vertical ceramic bush with nichrome heater (0.4 - mm-diameter wire) wound over the external surface. The spiral of a heater is isolated by kaolin wool (4, fig. 2). A metal, thermo smoothing insert is located inside the block of the heater (7, fig. 2). The heat flow is uniformly distributed from the heater along the upper end of the insert, where the sample is mounted (10, fig. 2). The heating block is isolated from the case by super light chamotte (3, fig. 2). The power connectors of the heater are placed in ceramic straw, passing through the heat insulation and the metal case (6, fig. 2).

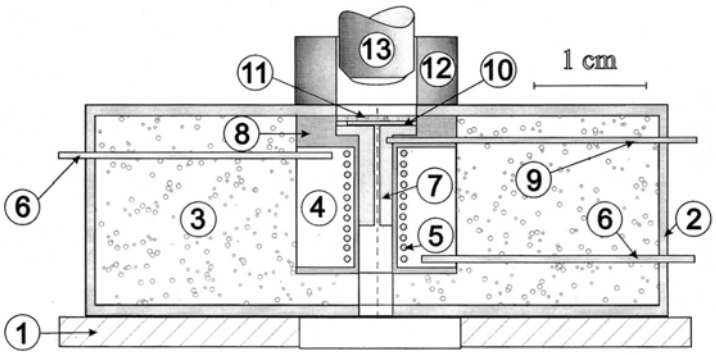

Fig.2. Scheme of the heating micro stage

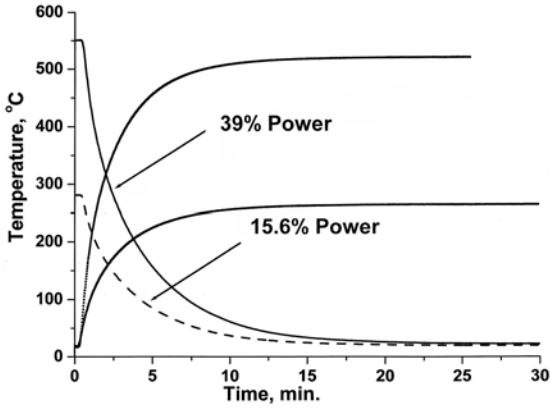

Fig.3. Heating and cooling kinetics of the heating micro stage

The controlling - regulating thermocouple (Pt-PtRh10 wire of 0, 2 mm. in diameter) is brought sideways heating micro stage through ceramic 2 - channel straw (9, fig. 2). Its contact is inside the metallic insert allowing the sample temperature to be controlled with required accuracy (±0.5°C). The thermocouple on melting point of $K_2Cr_2O_7$ (398°C) and NaCl (800,4°C) was calibrated. The visual calibration of thermocouples on pure compounds allows a precise registration of the temperature in the operating section of the heating stage. E.m.f. indications of the thermocouple during the experiments were registered by an electronic controlling - regulating system. Doubly-polished, 50-100 μm thickness, parallel-sided specimens are used for investigations.

The setup can be used in fluid inclusion geochemistry, experimental petrography and in the study of the phase transition processes.

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