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IMPROVEMENTS OF THE MICROSCOPE TECHNIQUES OF INVESTIGATIONS OF FLUID INCLUSIONS IN SMALL CRYSTALS WITH HIGH REFRACTIVE INDICES

INTRODUCTION

Fluid inclusions in minerals of high refractive indices are very difficult to investigation, because the inclusions are dark due to large difference in the refractive indices of the host mineral and inclusion filling. Very bright illumination does not help, because most of the light either is reflected from the faces of vacuole back to the crystal, or, after penetrating into the vacuole, remains inside it due to the total internal reflection. Moreover, if the host crystals are small (≤1 mm), the preparations are commonly made from the whole rock, yielding non-oriented slices of the crystals, which host inclusions that should be investigated. In many observations of fluid inclusions the birefringence of the host mineral precludes good recognition of the fluid inclusion fillings. On the other hand, sometimes random orientation of the host mineral gives unfavourable position of the elongated fluid inclusions, *e.g.* almost perpendicular to the surfaces of the preparation; this makes the observations of the fluid inclusion filling impossible. Also, if secondary inclusion planes are highly inclined to the light beam in microscope, the observations of the inclusion contents may be impossible. The present paper outlines the methods, elaborated during the 20-years-long practice, which eliminate the inconveniencies described above. The proposed improvements allow to obtain valuable data from studies of fluid inclusions in small grains of zircon, sphene and other minerals of high refractive indices.

SAMPLES

The studies were performed on 8 zircon grains (0.9–0.5 mm in size) from quartz-microcline-albite vein occurring in the granitoids of the Variscan Karkonosze massif (Borkowska 1966) at the place called Złoty Widok (Golden Viewpoint) near Szklarska Poręba. Moreover, inclusions were studied in zircon (5 grains 0.8–0.6 mm long) and sphene (6 grains 1.2–0.5 mm long) from the hydrothermal quartz-chlorite metasomatic zones in Variscan Strzelin granitoids (Oberc-Dziedzic 1999). Very interesting assemblage of fluid inclusions was found in zircon (5 grains 1.1–0.7 mm in size) from the chlorite blackwall of a rodingite boudine

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from Nasławice in the Jordanów-Gogołów serpentinite massif (Dubińska 1995); the latter sample was submitted by Professor E. Dubińska from the Faculty of Geology of the Warsaw University, what is graciously acknowledged.

PREPARATIONS

The mineral grain is glued with epoxy to the end of a thin glass thread and next covered with multiple layers of a transparent acetone-soluble glue, *e.g.* Uhu® Universal, to form a sphere with the crystal inside (Fig. 1). Each new layer of the glue should be thoroughly dried at room temperature, and the final drying should last till the solvent completely evaporates. Next the sphere is glued under binocular to a preparation glass in oriented position and its upper part is carefully ground and polished to obtain the upper surface of the preparation. Afterwards, this surface is glued to another preparation glass, and the lower glass plate and the unnecessary part of the grain is ground. The new surface of the mineral is polished and finally the glue is dissolved in acetone and the preparation is removed from the glass.

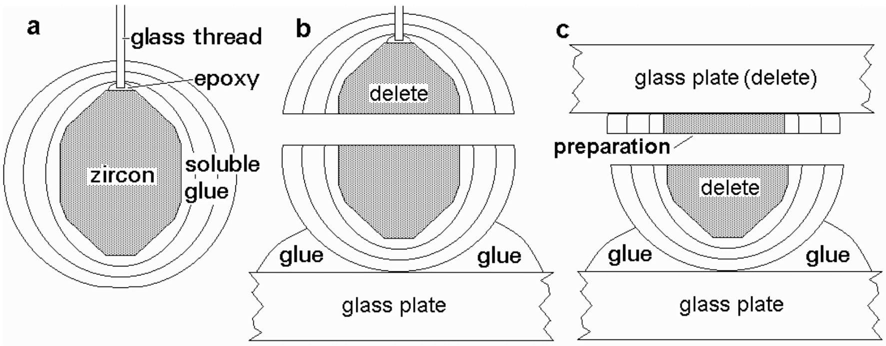

Fig. 1. Making oriented preparation from small grain of zircon.

ILLUMINATION

The correct illumination is crucial to the proper observations of the inclusion contents. For this purpose the fibreglass illuminator was developed, consisting of three thin (0.6–1 mm dia.) fibreglasses,

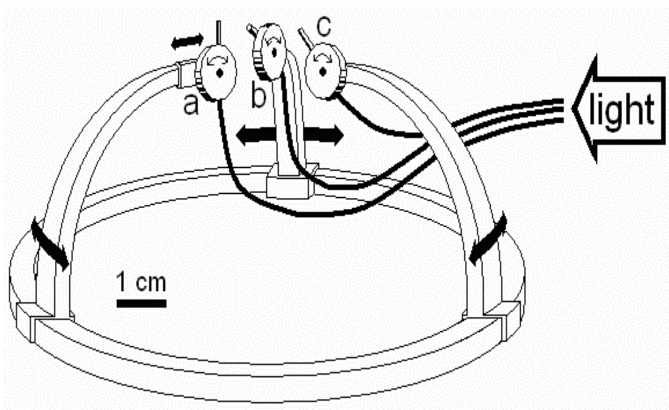

Fig. 2. Microscope fibreglass illuminator.

each of different diameter (*a*, *b* and *c* in Fig. 2). The fibreglasses are mounted on separate supports, which may move on a ring base. Each fibreglass may be inclined independently and moved forth and back in the support, what makes possible to locate the light spot in various positions. Moreover, one fibreglass (*a* in Fig. 2) may be located vertically in the optic axis of the microscope, yielding the perpendicular illumination of the preparation, if necessary. Each fibreglass may have independent source of light of variable intensity. The joint application of the differently and properly oriented light beams yields good images of the inclusions with their details well visible. The illuminator is mounted on the microscope base with use of two-side self-adhesive tape.

RESULTS

The improvements described above resulted in determination of temperature and pressure of crystallisation of hydrothermal zircon from Złoty Widok as 370–360°C and 0.92–0.89 kbar. Zircon from the Strzelin granitoids formed at 450–420°C and under 1.4 kbar, while sphene from the same massif at 440–400°C and under 1.4 kbar. Zircon from Nasławice contained interesting set of primary and secondary fluid inclusions (Fig. 3). Some of them had the size from 3 to 11 μm (inclusions Nos. 1–4 and 9–20); they contained aqueous solution with the dominant Ca^{2+} cations, as determined by the freezing method (Roedder 1984). The obtained parameters of the zircon crystallization are as follows: temperature 270–300 °C, pressure 1±0.1 kbar, density of the aqueous fluid ~0.90 ±0.01 g/cm^3, and density of CO_2 phase 0.70 ±0.02 g/cm^3.

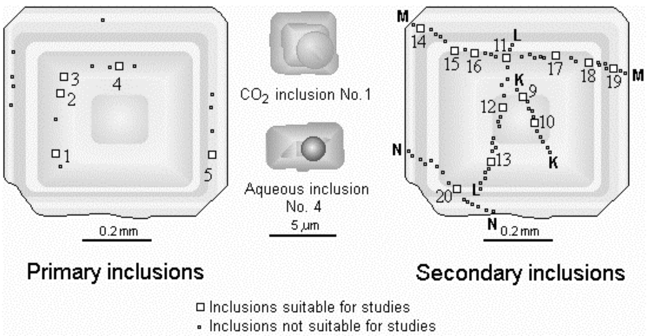

Fig. 3. Fluid inclusions in zircon from Nasławice.

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