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A modified sink-float procedure to measure the density of tiny individual mineral particles

A COMMON procedure for determining the density of a small mineral particle is the heavy-liquid sink-float method. The procedure has been described in the literature, which has been adequately summarized by Muller (1977). The sink-float method is quite straightforward for particles above 0.001 mm^3 (average dimension 0.1 mm), but problems arise when the particles are appreciably smaller than that. These problems include the difficulty of observing the mineral particle, difficulty in recovering the particle, and anomalous particle movement due to convection currents in the heavy liquid. The procedure described here overcomes these difficulties to a large extent.

The density determination is carried out using a small cell filled with heavy liquid and mounted in a temperature-controlled air bath, in the weighing chamber of an analytical balance. Sink-float behaviour of the small particles is observed using a stereomicroscope. Density calibration is achieved by use of a sealed mercury-in-glass plummet.

Because the particles involved are not visible to the unaided eye, a stereomicroscope is mounted horizontally to enable the movement of the particle to be observed. The magnification used should initially be as low as possible so that a large field of view is obtained. To avoid having to shift the microscope up and down in searching for the particle, it is desirable to use as small a container as possible; a standard glass 10 mm spectrophotometric cell, with a volume of about 3 ml, was found to be suitable. An added advantage of a small container is that it reduces thermal convection currents in the contained liquid.

To control temperature, the cell is mounted in a perspex air bath with a thermocouple well next to the cell. The air bath is mounted on an adjustable-height bridge in the weighing chamber of an analytical balance. A mercury-in-glass plummet on a stainless steel hook is used for the determination of the liquid density, when equilibrium has been achieved. The spectrophotometer cell is charged with heavy liquid of greater density than the sample to be determined. The sample is then added by means of a glass rod (*c.* 1 mm diameter), wetted with the liquid to be used in the density determination, and the sample should float. A suitable diluent is then added in small increments (15–20 μl) and the mixture is stirred with the glass rod until it is homogeneous. This is continued until the sample is of neutral density with respect to the solution, i.e. neither rising nor sinking. The plummet is then weighed in the solution at a constant depth from the surface to ensure consistent results. This is accomplished by means of a pointer on the plummet loop, and the adjustable-height bridge.

It is essential to measure the solution density just before the neutral point is judged to have been reached, at the actual neutral point, and also finally just past the neutral point.

The procedure outlined here has been used to determine the density of samples consisting of as few as two or three crystals with a largest dimension of about 0.1 mm. Clerici solution was used as the heavy liquid, although other heavy liquids should work equally well if their densities are greater than that of the sample to be measured. Normal safety precautions should, of course, be maintained in handling the heavy liquids. With skill, and a bit of luck, particles as small as 0.1 mm can be recovered following the density determination by manipulation with the stirring rod. We have achieved an approximately 50% recovery rate with particles of this size.

REFERENCE

Muller (L. D.), 1977. In J. Zussman (ed.), *Physical Methods in Determinative Mineralogy, 2nd edition.* Academic Press.

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