

Thin Sections of Mineral Grains

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The author describes
the development of
a simple technique

Synopsis

Examination of samples of grains of transparent minerals is often facilitated by preparing thin sections of them. A simple means of doing this is described which involves embedding the sample in plastic and then making a thin section of the product by a method similar to that used when dealing with rocks.

Introduction

Although considerable information concerning the components of a sample of grains can be obtained by observing them in air, or immersed in refractive index liquids by means of a microscope in the natural state, or after some of the species have been stained, such tests often fail to reveal details of individual grains which may be of considerable importance to the fragmental petrologist, economic geologist, or mineral-dresser.

If the sample consists mainly of species which are opaque in thin section, a detailed knowledge of these can best be obtained by embedding the sample in plastic, preparing a polished section of the resulting briquette (as described, for example, by Cadwell, 1959)¹ and then examining it microscopically under reflected light. If important amounts of both transparent and opaque minerals are present, the investigation will be most revealing if it includes the examination of polished transparent sections, which can be prepared either in the manner suggested by Barringer (1953-54) or by Amstutz (1960). However, when the sample is a coarse sand and consists essentially of transparent species, or when the grains of major interest are transparent, the preparation of thin sections of the material, and their subsequent examination, provide the most rapid and easiest means of establishing the nature of the light-transmitting grains precisely.

The technique of making such sections, which is described later, has proved of particular value to the writer when studying the

coarse sand-fractions of stanniferous alluvials and when investigating certain problems connected with the beneficiation of "hard-rock" tin-ore. It has a much wider application of course, and it is pertinent to remark that, on occasion, having prepared the thin section, certain species may be stained to facilitate identification. Thus, for example, white supergene lead minerals in, say, a mill product, may be stained yellow by flooding the section with fresh strong potassium iodide solution, then, after a few seconds, adding 1 : 7 nitric acid, and finally washing the slide gently in water before drying it and covering the preparation with a cover slip.

The Necessary Equipment

The equipment necessary to handle samples in batches of 12 is as follows:—

Two glass plates, 7 in. by 7 in.

Twelve cylindrical steel moulds. These should be 1 in. in height and each should have an external diameter of 2 in. and an internal one of $\frac{3}{4}$ in. The internal surface should have a mirror finish.

One 6 in. by 6 in. glass plate for grinding. If a grinding machine is not available a further plate will be needed.

One combined section-cutting and grinding machine. (This is not absolutely necessary, but when available it enables sections to be prepared much more quickly than by hand alone.) In its absence a hack-saw is needed.

One copper hot-plate and a tripod to support it. (The plate is a rectangular piece of copper, of dimensions 7 in. by 5 in. by $\frac{1}{4}$ in., to which a short length of copper tubing has been welded near the middle of one of the longer sides to support a thermometer. Such a plate will accommodate six slides—a convenient number.)

A means of heating the hot-plate. (Heating is best done by means of a bunsen burner with the gas supply controlled by a gate-clip attached to the rubber, or plastic, inlet tube. In an emergency a methylated spirit lamp can be used.)

One thermometer capable of measuring up to

¹ References are given at the end of this article.

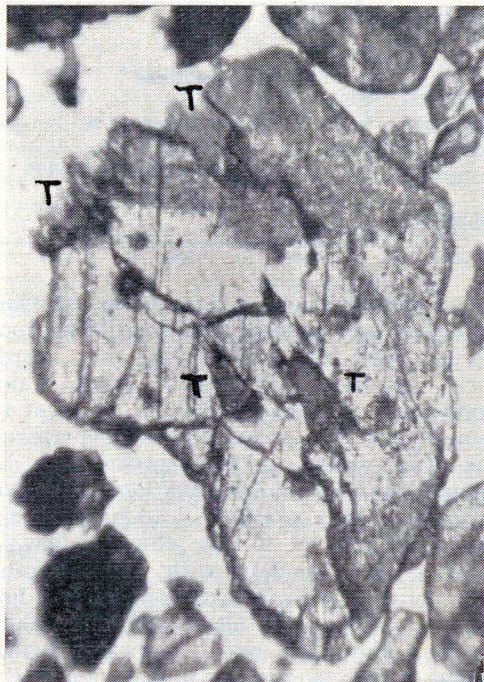


Fig. 1.—Cassiterite Grain with Tourmaline Inclusions (c. 1400μ in length), Phuket, Thailand.

120°C . (A layer, or two, of thin copper sheet placed around the mercury reservoir ensures that good contact is made between the thermometer and the supporting tube of the hot-plate.)

One thermostatically controlled electric laboratory-oven.

Microscope slides, cover slips, a diamond "marking-pencil," slide labels, glass rods (for applying Canada Balsam), "single-edged" razor blades, a no. 6 paint brush from which all but a $\frac{1}{4}$ in. of each hair has been removed, a mapping pen, a bottle of Indian ink, an asbestos paper plate (about 12 in. by 12 in.), and a box of tissues.

"600" carborundum powder. (If a grinding machine is not available the 220 grade will also be required.)

Lakeside 70 cement. (Manufactured by Lakeside Chemical Corporation, 7,600, Greenwood Avenue, Chicago, Illinois.)

Canada Balsam.

Xylol.

Durofix/amyl acetate. A 1 : 1 v/v mixture.

Ambersil Silicone spray. (Obtainable from Amber Oils, Ltd., 11a, Albemarle Street, London, W.1.)

Marco Resin, SB 28/C, accelerator paste H

and catalyst E. (All obtainable from Scott Bader and Co., Ltd., Wollaston, Wellingborough, Northants.)

Water-soluble oil. (If a cutting/grinding machine is used a mixture composed of one part oil to 19 parts water is used as a coolant.)

Procedure

(1) Write, with Indian ink, small sample identification labels (c. $\frac{1}{2}$ in. by $\frac{1}{4}$ in.).

(2) Lightly spray two glass plates and the interiors of 12 metal moulds with silicone, and remove any droplets with a tissue.

(3) Arrange six moulds on each plate.

(4) Into each mould place a few grams of the appropriate sample.

(5) Prepare the briquetting "plastic" by adding first four parts (by weight) of accelerator paste H to 100 parts of resin SB 28/C and stirring for 2 min.; then four parts of catalyst F and stirring for a further 2 min. (100 g. is ample for 12 briquettes.)

(6) Pour "plastic" into each mould until it is one-third full, then stir, with a glass rod, to ensure that the grains are completely wetted.

(7) After a few minutes complete the filling of the moulds with plastic, and insert the identification labels in such a way that they lie along the moulds' walls. (The labels are easily inserted in their correct positions if each is transferred by means of a glass rod whose end has been dipped into plastic.)

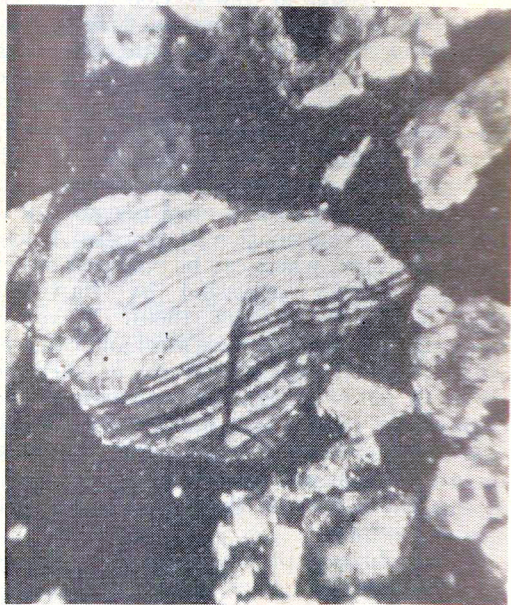


Fig. 2.—Cassiterite Grains (c. 925μ in length): Between crossed nicols, showing zoning.

(8) Place the glass plates with their filled moulds in an electric oven, and cure for *c.* 45 min. at a little over 20° C.

(9) Having extruded the briquettes, grind each with a thin paste of 600 carborundum and water on a glass plate until the plastic veneer covering the grains has been removed. (This operation will also develop flat surfaces on the exposed grains.)

(10) If a cutting machine is available use it to remove a slice, about $\frac{1}{8}$ in. thick, from the grain-loaded end of each briquette. Otherwise, cut off the slice with a hacksaw.

(11) Mount each slice on a microscope slide as follows (having first scratched, with a diamond "pencil," identification data on the face of the slide opposite to that on which the slice is to be attached) :—

(a) Having adjusted the flame of the burner so that the temperature of the hot-plate will increase from 50° C. to 120° C. in *c.* 18 min., allow the plate to heat up.

(b) At 50° C. place the slice, ground surface uppermost, on the plate by the side of the slide on which it is to be mounted. (About six slices can be conveniently mounted at a time.)

(c) At *c.* 90° C. rub the "face" of the slice, and also the middle third of the slide, with a stick of Lakeside cement, then transfer the slice to the slide and remove the preparation to an asbestos plate.

(d) In order to effect a good bond apply pressure to the slice, by pressing it with the blunt end of a pencil, until the cement has hardened.

(e) If air bubbles are entrapped in the cement the slice may become detached during subsequent operations. Therefore, examine the preparation for their presence by looking through the slide at the slice as the former is rotated. Any bubbles present will appear as silvery areas, and if these are excessive the preparation should be returned to the hot-plate when the temperature of the latter is *c.* 90° C. The slice should then be detached and the mounting repeated, after adding more cement to both components.

(12) After the slice has been mounted satisfactorily and the preparation has cooled, remove extraneous cement from its back and sides by means of a razor blade.

(13) If a grinding machine is available, use it to grind the slice until it is *c.* $\frac{1}{32}$ -in. thick. (The degree of thinness to which a given slice can be safely ground by the machine depends to some extent on the size and nature of

the grains: however, an operator quickly acquires the experience necessary to prevent the destruction of slices caused by over-grinding.)

(14) Complete the grinding of the slice, to the acceptable degree of thinness, by hand, with a 600 carborundum/water paste on a glass plate.

If a grinding machine is not available, first grind the slice by hand with a thin 220 carborundum/water paste on a glass plate until it is *c.* $\frac{1}{32}$ -in. thick, and then, having washed both the preparation and one's hands thoroughly, to remove all the coarser abrasive, complete the grinding with 600 carborundum as already indicated. (During the grinding by hand, rotate the preparation through 180° after each 25 revolutions in order that the two faces of the slice shall remain parallel. When the slice is approaching the required degree of thinness, control the operation by examining the wet slice frequently under the microscope, between crossed nicols. In addition, use the whole of the glass plate when grinding as this will tend to keep its surface flat, and this is essential if good thin sections are to be made.)

(15) When grinding has been completed wash the preparation thoroughly with soap

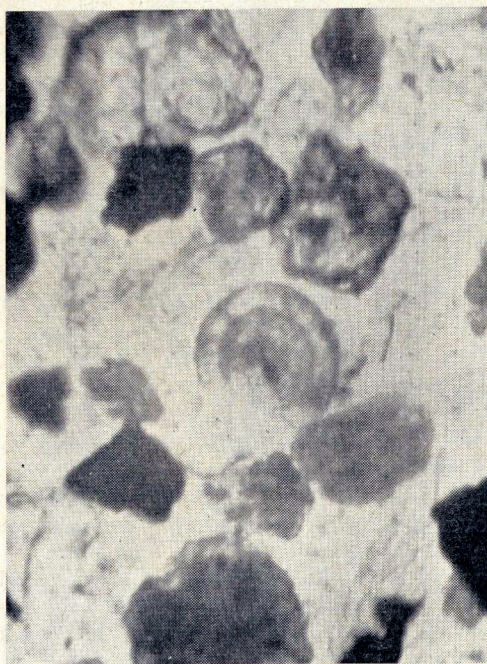


Fig. 3.—Sand Sample from Gwithian, N. Cornwall : Showing a sphere of siderite *c.* 100 μ in diameter and probably biogenic.