

THE AMERICAN MINERALOGIST, VOL. 45, SEPTEMBER-OCTOBER, 1960

## THE PREPARATION AND USE OF POLISHED THIN SECTIONS

G. C. AMSTUTZ,

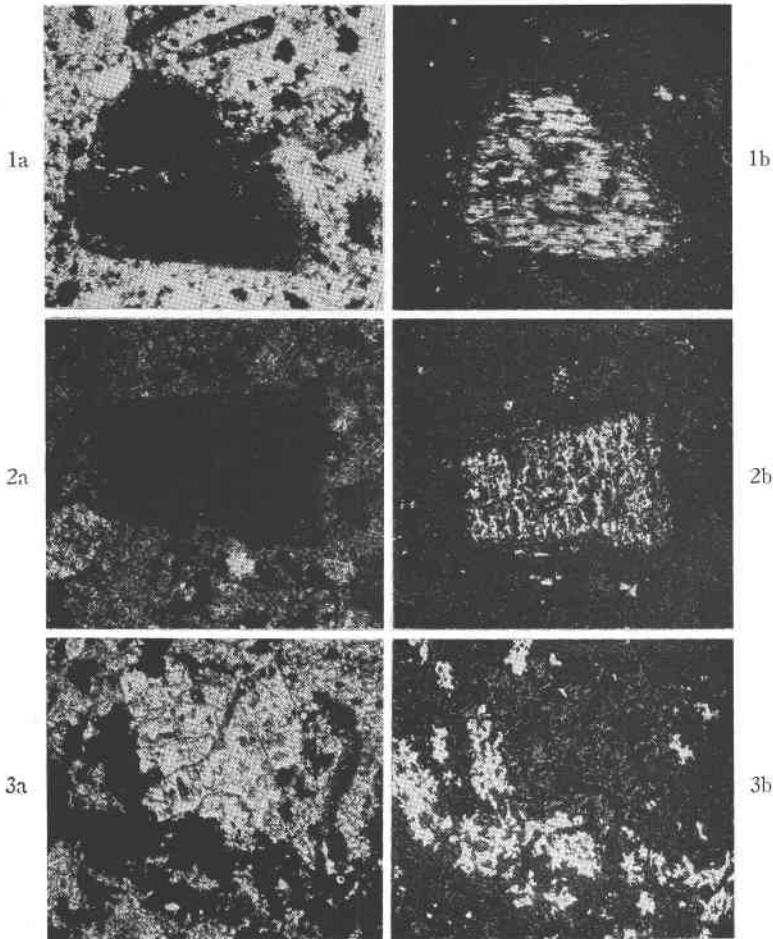
*Missouri School of Mines and Metallurgy, Rolla, Missouri.*

The literature on the preparation of polished thin sections known to the present author describes only complicated procedures. This may be the main reason why polished thin sections are not widely used, although they can provide the geologist with many detailed criteria for ore genesis, many of which are not available from separate thin and polished sections. These criteria may, in turn, act as guides in exploration. The present paper describes a simpler and faster method for preparing polished thin sections of rocks and ores.

The preparation of the polished thin sections from which the photographs of Figs. 1 to 3 were taken, is simple. It requires only 25 to 35 minutes per section. First a thin section is prepared in the conventional way with Lakeside plastic cement and ground to almost normal thickness with any conventional powder. Quartz may still show yellowish to orange interference colors. The slide is then washed carefully and dried, in order to remove the grinding powder. The next and last step is the polishing on a lead, a lead-bismuth, a silk, or a Trojer (linden-wood) lap with abrasives of 1 or 0.5 micron size. The rotation speed should be rather slow (30-60 rpm.). The slide is placed with only about 50-100 g. pressure on the lap and held there for 5-20 minutes, depending on the nature of the ore and country rock. Frequent checking under the microscope will help to determine the point at which the surface is polished to a satisfactory degree. The powder and the oil is then removed and the section labeled. No further mounting is needed. The polished thin section is of course not covered.

The usefulness of a combined observation with transmitted and reflected light does not have to be pointed out. A combination of thin and polished sections is most needed when alteration is present, or when the exact metallurgical properties of ores are sought.

The frequent association of hydrothermal, deuteric, or supergene alterations with ore minerals is a well known fact. A divergence in geological opinion often takes place, when the discussion centers on the time and the origin of such alterations. Polished thin sections are a refined tool for the determination of the type and nature of these mineral changes. Limonite haloes can be readily recognized (Figs. 1 and 2). True replacements can be distinguished from apparent replacements; congruent and non-congruent features can be differentiated (1), and syngenetic and epigenetic criteria may be observed in more detail (2).



FIGS. 1-3. Pairs of photomicrographs taken of polished thin sections, with transmitted light on left and reflected light on right, all under oil immersion. Enlargement 175 $\times$ . All three samples from small copper deposits in Carlos Francisco porphyry near Casapalca, Peru. (Geological details, given in (1).)

FIGS. 1, 2. Two examples of pseudomorphically replaced mafic phenocrysts (biotite) are shown. The sulphides also occur as disseminated specks in the matrix of this volcanic rock. During deuteric alteration the early phenocrysts became unstable and were replaced largely by sulphides which now show lamellar orientation in the direction of the original  $\text{Si}_2\text{O}_5$ -lattice sheets. These pseudomorphs are surrounded by a halo of limonite. Note the size difference of the reflected and the opaque areas. The haloes are broad in the elongation of the silicate sheets, but almost absent adjacent to the cleavage plane of biotite. This might indicate the "permeability" of the lattice for the replacement migrations. The sulphides consist of chalcopyrite and bornite, and in Fig. 1 possibly also of some idaite.

FIG. 3. An irregular mass of chalcopyrite in the matrix of the andesite irregularly surrounds a feld-spar phenocryst. Geometrically this is a transition between a true dissemination and an irregular tiny veinlet. Note that all opaque material under transmitted light is not necessarily sulphide mineral. About 25-35% of the visible opaques consist of limonite. This is very fine grained and intermixed with some non-opaques, and therefore, did not take on any polish.

In summary, polished thin sections afford a small but valuable enhancement of the quality and objectivity of observation and help to reduce the quantity of interpretation in ore genesis. These improvements will be welcome when it is recognized that a complete theory needs to be built on a careful combination of geochemical and geometric (fabric, structural) evidence.

Polished thin sections also provide more complete information for ore dressing microscopy, where metallurgical properties of minerals are sought. Coatings, alterations (clay, sericite, etc.), intergrowths or locking types and locking sizes can be seen in more detail and in less time.

Typical examples are discussed in detail by the present author (3).

#### ACKNOWLEDGMENT

The polished sections reproduced in Figs. 1 to 3 were prepared in the Petrology Laboratory of the Cerro de Pasco Corporation in La Oroya, Peru, where the simple method described in this paper was first tried out. Permission for publication of this note is herewith acknowledged with thanks. The author wishes also to thank Dr. P. D. Proctor for the critical reading and valuable suggestions in connection with the content and form of this note.

#### REFERENCES

1. AMSTUTZ, G. C. (1959a) Syngenetic zoning in ore deposits: *Trans. Geol. Assoc. Canada* **11**, 95-113.
2. ——— (1959b) Syngene und Epigene in Petrographie und Lagerstättenkunde: *Schweiz. Min. Petr. Mitt.* **39**, 1-84.
3. ——— (1960) The copper deposits Caprichosa and Antachajra in Central Peru (with notes on ore genesis in general): *N. Jb. Min., Ramdohr Festschrift*, 45 p.

THE AMERICAN MINERALOGIST, VOL. 45, SEPTEMBER-OCTOBER, 1960

#### VARIATIONS IN INTERFERENCE FIGURES IN SINGLE CRYSTALS OF ZONED SMOKY QUARTZ

L. F. DELLWIG AND W. E. HILL, JR.

*The University of Kansas, Lawrence, Kansas.*

#### INTRODUCTION

Much attention has been directed to the problem of coloration of smoky quartz and to the related problem of zonation of smoky and colorless quartz in a single crystal. Phillips (1908) recognized a relationship between irradiation and coloration in quartz crystals, noting that color-