ROUTINE PREPARATION OF POLISHED THIN-SECTIONS

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The colour plate which appears in this number of the Canadian Mineralogist illustrates the advantage of microscopic observation of mineralized rocks in polished thin-section by incident and transmitted cross-polarized light simultaneously: the identities and relationships of opaque and translucent minerals in contact are immediately evident.

The principle is not new; more than a hundred years ago Sorby ground rock chips smooth and thin enough to see through; and dozens of publications have since recounted a variety of more or less successful techniques for polished thin-section preparation and examination. Cameron (1961) gives an excellent summary and bibliography of the more recent efforts in his authoritative work "Ore Microscopy."

One characteristic is common to all: the methods require skilled hand craft of a high order. Further, microscopes equipped for the simultaneous illumination conditions necessary to take full advantage of the sections, while not particularly complicated or expensive, are not generally available. These real disadvantages have hindered the development and acceptance of this elegant method; in contrast, the thin-section and polished section techniques, as separate entities, are in common use.

Nevertheless, the obvious advantages of the polished thin-section technique prompted the independent trial over a period of years of various methods of preparation, in co-operation with D. H. Monteith. To be practical, the method had to provide a routine output of at least four or five finished sections per man/day. Therefore, it had to be simple, easily taught, amenable to automatic operation in at least some stages, not subject to excessive rejection wastage of irreplaceable specimens, and finally, universally applicable without radical modification to the wide range of rocks, ores, mill- and smelter-products passing through the laboratory.

Polishing optically flat surfaces on brittle materials of variable hardness after grinding to thicknesses of three or four hundredths of a millimetre adds further extreme delicacy to the highly-skilled thin-section procedure. Two key operations added to normal thin-section practice provided a satisfactory answer to the problem, and polished thin-section examinations have been carried out in the Falconbridge laboratory for over a year, as a routine method.

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The first operation added to the sequence of thin-section preparation, is use of 10–15 micron and 6–8 micron diamond-impregnated plastic laps for rough-polishing. Sliced specimens (rock slices or impregnated grain-mounts 1/4″ thick) are cleared of saw-shattered grains by grinding on one side with progressively finer abrasives in the normal way, then finished for a minute or two on the fixed-diamond laps at about 75–100 r.p.m. The laps are simultaneously cleaned of debris, and the correct amount of water for lubrication added, by holding a wet tissue pad against the surface in one hand while the section is held in the other. The rough-polished surface obtained by this procedure is planed flat, with no relief and few tear-outs; the only scratches are those of uniform depth produced by the diamond abrasive protruding from the lap. This surface is then mounted against the glass slide in the normal way. The slice is ground down to about 0.035 mm. with the usual sequence of abrasives, then surfaced carefully with the 6–8 micron diamond lap until the standard thickness of 0.030 mm. is approached.

The second key operation involves the use of an unattended vibratory polisher for one or two stages of final polishing. The sections are mounted in shallow slots in the bases of cylindrical aluminum jigs which fit the standard one-inch or one and one-quarter inch holders used for polished sections. They are placed in the pan of the polisher and left to polish themselves for one-half hour up to three or four hours, depending on the properties of the minerals in the sections and the degree of polish demanded. Nylon taffeta cloth covers the pan of the polisher, while 0.3 micron and 0.05 micron alumina in water-slurry are the polishing media. Up to ten or twelve independently moving sections can be polished simultaneously, and individually examined without affecting the others.

Apparently the rapid vibratory action, without excessive "drag," does not tear away the edges of the specimen, yet provides adequate polishing action. If the section has been rough-polished using light finishing-pressure on the 6–8 diamond lap, the scratches in any hard minerals present will be shallow, and can be cut down quickly on the vibratory polisher without yielding excessive "orange-peel" relief among hard and soft minerals. It is here that handcraft remains—knowing by experience the technique to employ on the diamond-lap for the particular assemblage of minerals present. If the section is properly rough-polished, the vibratory polisher will do the rest, without attention.

More than one hundred and fifty sections have been prepared over the past few months with very few rejections, and excellent uniformity of quality. Polished thin-sections on assemblages such as pyrite-pyrrhotite-pentlandite-violarite-chlorite-quartz-feldspar; pyrite-millerite-chalcopyrite-

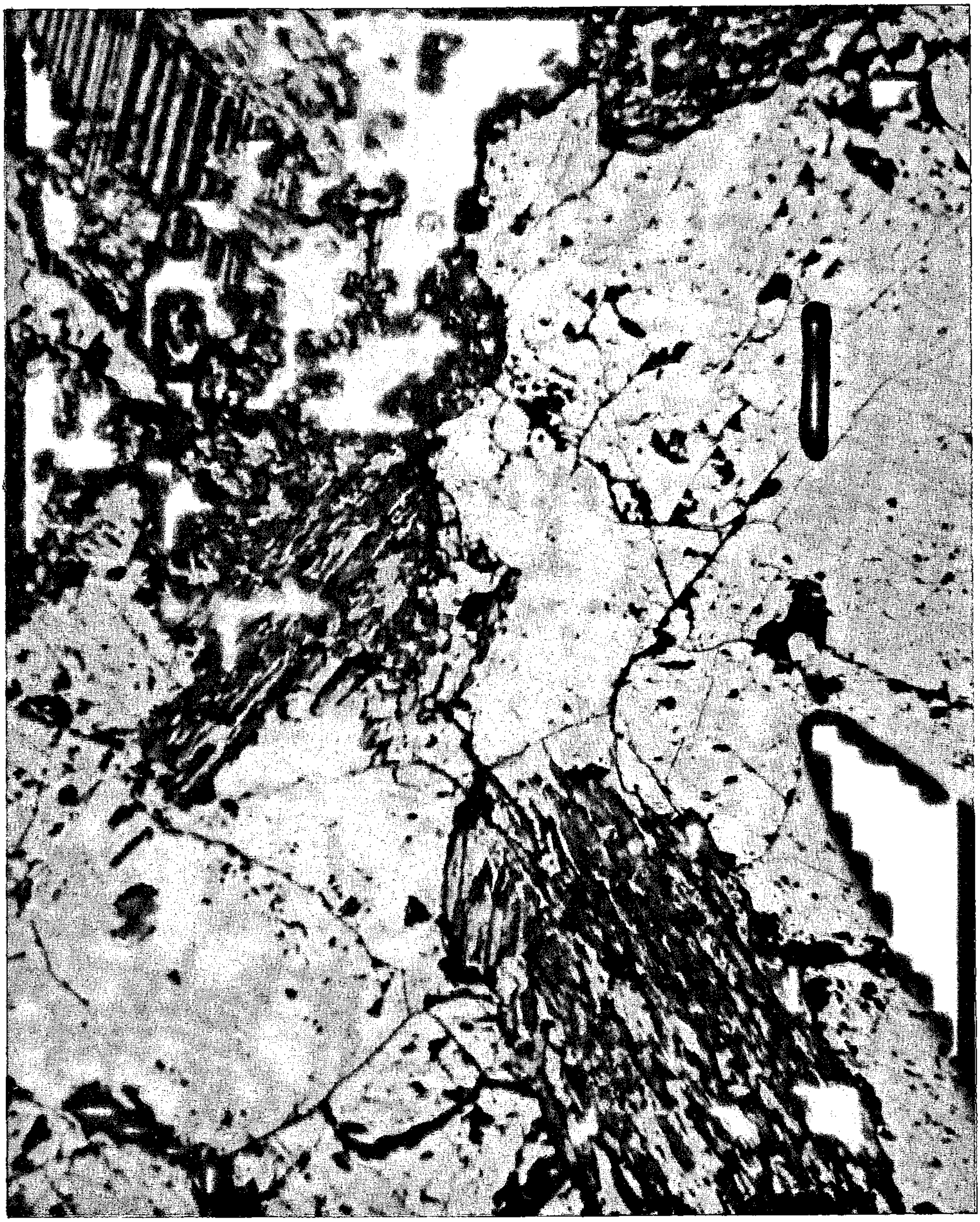

PLATE 2. Polished thin-section of mineralized norite, Blezard Twp., Sudbury Basin, Ontario; enlarged from 35 mm. photograph taken by simultaneously incident and transmitted cross-polarized light; incident polarizer rotated ~30°. Final magnification ×67; bar represents 300 microns on section.

Pentlandite (yellowish white, with parting), chalcopyrite (greenish yellow), and pyrrhotite (light lavender) replace partly amphibolitized and chloritized pyroxene (iridescent gray, blue, green, yellow, and red) and twinned plagioclase feldspar (barred light and dark gray). A sampling needle is silhouetted in the right foreground.

antigorite-talc-carbonate; pyrite-sphalerite-chalcopyrite-gold-chlorite-amphibole-quartz; magnetite-pyrrhotite-biotite-amphibole-quartz have yielded fine results, and much information which might not have been available by standard procedures.

Acknowledgments

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The special plastic-coated laps were invented and supplied by H. J. Lougheed, 83 Hopedale, Toronto.

Thanks are also due to Professor J. E. Hawley, who first demonstrated to the writer the wealth of information available from polished sections, using the Sudbury Basin ores as examples. His advice over the years on this subject, on optical spectrographic analysis of ores and concentrates, and on other facets of the geological sciences, has been sincerely appreciated by his many students at the laboratories, and others on the staff of Falconbridge Nickel Mines Limited.

Reference

Cameron, E. N. (1961): *Ore Microscopy*, John Wiley and Sons, New York.

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