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LOW MAGNIFICATION THIN SECTION PHOTOGRAPHY

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Introduction

The method whereby photographs of thin sections are made by using a photographic enlarger instead of a microscope is not original, but is not widely known and is seldom used. The method has advantages which warrant further publication, so that its use will become more general.

Crooks (1938), briefly recorded the method, but did not stress its advantages. His account limited its application to plain light photographs and to use of a particular type of enlarger. This paper discusses the method in detail, lists its advantages and limitations, and describes the technique of making photographs with "crossed" polarized light, as well as with plain light.

Method

For plain light photographs no special photographic equipment or attachments are required. Only a dark room, a standard photographic enlarger, and one or more 4″×5″ sheet film holders are needed. The Leitz and other enlargers designed for roll film can be used, but they are not readily adaptable for making crossed nicol photographs. The Omega enlarger which will handle a 4″×5″ negative was found to be ideal. Most enlargers come equipped with 35 mm. negative holders made of metal. But as there is a danger of breaking the thin sections in a metal holder it is best to improvise a slide holder from cardboard, cutting the opening the size of the cover glass.

After the thin section is inserted in the enlarger, the image is projected on a large white cardboard, from a height set to give desired magnification. An image of the entire enlarged section is obtained. An open 4″×5″ sheet film holder, in which a white paper has been inserted, is placed flat upon the cardboard and moved about until the desired feature or texture in the projected image is selected. The area to be photographed is then carefully brought into focus on the white paper in the film holder. The exact position of the film holder is marked, and all lights turned off. A loaded film holder is then substituted for the open film holder and the exposure is made by turning the enlarger light on and off.

Crossed Nicol Photographs

Crossed nicol photographs are made in the same way as plain light photographs, except that the thin section must be inserted between polaroid sheets mounted at 90 degrees. This mounting of the polaroid sheets can be accomplished in several ways depending on the size and type of enlarger to be used. The writer improvised such a mount by using two gunsight lenses, obtained from Government surplus, and mounting them in folded corrugated cardboard with Scotch tape. A slide holder with permanently mounted polaroid sheets and a device for holding and rotating the thin section could be easily designed.

Exposure

Because of varying light conditions the correct exposure for different types of film is attained by trial and error, depending on the relative opacity of the thin section. A trial negative showing five different exposures can be made as follows: The loaded film holder is substituted for the empty film holder, as described. With lights off the film holder cover is opened one inch and an arbitrary time exposure made. The cover is then opened another inch and another exposure made, and so on until five exposures are completed. Each exposure is for the same time interval. For example, if a three second interval is used, the resulting negative will show exposures of 3, 6, 9, 12, and 15 seconds. The exposure producing normal contrast is used in making the final negative. It would be a simple matter to establish a calibration chart of exposure time vs. light meter readings.

Several variables are involved in setting the trial exposure interval. For example, the time required for crossed nicol exposures is usually 6–8 times that for plain light exposures. Film emulsion speed is another important factor. Longer exposures are required for higher magnifications, as with a microscope, although for a different reason. With an enlarger, longer exposures are needed as magnification increases because the distance between the light source and film is increased, causing the light intensity to decrease. Still another factor involved in judging the exposure interval is the aperture opening of the enlarging lens. It is best to open the aperture when viewing and focusing the image, and to stop down the aperture when making negatives.

Film and Developers

Modern film emulsions cover a wide range of latitudes and have been perfected for specific purposes. The applicability of these films to the present technique depends on the subject and objective in mind. However, for general use a high resolution panchromatic film (color sensitive), such a Kodak Panatomic X or Ansco Isopan, will give the best results, particularly for crossed nicols. If the subject is colorless, orthochromatic film is probably best. Emulsion speed is not particularly important, although the slower emulsions generally give a higher degree of resolution.

Any number of standard developing solutions can be used for processing the negatives, but the slower, finer grained developers, such as Kodak D-76, give better results. If strong contrast is desired, Kodak D-11 developer is satisfactory.

Advantages

The method described is ideally suited for illustrating the textures of coarse grained rocks, as low magnification permits a large area of the section to be photographed.

Microscope lenses, unless supplemented by expensive compensating oculars or auxiliary lenses, produce spherical aberration. This inherent feature of microscopes precludes low magnification photographs that are in perfect focus throughout the field of view. The use of a photographic enlarger eliminates this difficulty, for the lens system of enlargers is designed for reproduction of a flat surface. The projected image lies in a plane, and a sharp focus is effected throughout the enlarged area. There is no fuzziness in the resulting photograph and the component features in the thin section are sharply resolved.

The use of a microscope for photomicrographs presents the additional difficulty of obtaining adequate even-field illumination. Unless special equipment is used, photographs taken through a microscope almost invariably are slightly over-exposed in the center and somewhat underexposed on the edges. This trouble is eliminated when using an enlarger; the light source is centered, and the diffusion, condensing, and enlarging system is designed for even illumination.

Petrographic microscopes in common use are not designed for magnification below 16–20×. Moreover, microscope magnification is limited to set combinations of objectives and oculars, while an enlarger makes available a continuous range of magnification from 1:1 to about 20:1, depending on the focal length of the enlarging lens used. Field diameter and exact linear magnification is obtained by placing a plastic scale in the enlarger and measuring its length in the projected image.

In addition to the advantages outlined, greater speed is possible with a photographic enlarger than with a microscope. A projected enlarged image of the entire thin section is viewed at one time and it is an easy matter to select the desired area or feature to be photographed, and since the work is done in a darkroom, an immediate check of the results is possible.

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A STAGE FOR MACRO POINT COUNTING

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Adequate sampling is the major problem in the modal analysis of the coarser-grained (3–20 mm.) and porphyritic rocks. It has been shown by several authors (e.g. Chayes, 1956, p. 93) that a standard thin section is not large enough to represent a rock with a maximum grain size of more than about 3 mm. In order to obtain a large sample area and avoid the added expense of duplicate thin sections, a technique for counting a rock slab cut from a hand specimen has been developed.