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PHOTOGRAPHING MINERALS

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For art or technical photographing minerals in non-professional conditions, high quality of medium magnifications can be ensured by means of miniature single lens reflex (SLR) cameras of general use and ordinary photographic materials. To apply long-focus macro lenses and avoid diaphragm excessive closing is recommended. To reproduce morphological features of a mineral, flexible and multi-functional artificial lighting is necessary. For negatives, daylight film in combination with light-conversion filter is recommended. Adequate reproducing of mineral complicated color involves accurate matching of color temperatures and selection of light sources, preferably halogen low-power cold-light lamps, corresponding the given combination of photographic material and color-conversion filter.
7 color photos, 2 references.

Photography expands appreciably our notion of the mineral kingdom. In skillful hands, even a plain shatter may be lifted, in its information and esthetic value, from the waste bin up to the level of museum specimen. An experienced photographer would never disregard those fragments, miniatures, and unpretentious petty crystals that are usually ignored by museums and collectors. At the same time, a large specimen attracting general admiration and exposed in its own separate showcase would hardly look equally spectacular on its small or medium size photo. Photography also gives full scope for any kind of interesting art-experiments with minerals.

Provided a well tooled-up professional studio is available, the technique of photographing minerals differs little from the ordinary close-up photography (Scovil, 1996). However, mineralogist and photographer professions combine only seldom in the same person. More often, a mineralogist — specialist or hobbyist — has no access to the expensive special cameras as well as studio lamps and other professional equipment. To illustrate a book or a paper or simply to picture minerals occasionally for his own pleasure, he is obliged to accommodate to the homely schedule of the so-called pop photography: picturing with a general use camera with succeeding processing and printing in a minilab.

Setting aside purely pictorial problems, whose solving depends entirely on the photographer's taste, competence, and mineralogical interests, let us define technical preconditions of mineral successful photography under these «amateur» conditions.

A mineral photo should be sufficiently sharp. Viewing, from the usual reading distance (25—30 cm), a picture up to 15 or 20 cm in size, a person with normal eyesight discerns not more than 8 or 10 lines per mm (400—500 dpi). Accordingly demanded resolution of a miniature (24 x 36 mm) negative is 50—60 lines per mm (2500—3000 dpi) maximum. This is fairly achievable with the present-time photographic lenses and medium speed films (ISO 100—200). Technically perfect pictures can be made, so, with an ordinary miniature SLR camera, including any one of the amateur class, and ordinary photographic materials of general use.

A medium format camera even enables creating a «reserve» of resolution for an occasion of manufacturing larger magnification. However, popular roll-film cameras (e.g., *Pentacon-Six* or *Exacta-66*) have comparably massive mirrors which entails harmful vibrations during the process of exposure. As a result, the resolution is appreciably diminished and so the medium format advantage reduces to nothing. A good tripod diminishes vibration but cannot eliminate it entirely. It is less noticeable on condition of short enough (not more than 1/100—1/180 s) or long enough (not

less than 2–3 s) shutter speed, which is, however, not always accessible. Another way is to expose by switching the light on for the metered time after the shutter has been previously opened in darkness. The latter may entail, however, a shift of color in the red side because of the light source thermal lag.

So the balance of advantage should be lain with miniature cameras. On condition of using a tripod, the vibration in this case is inconspicuous. In addition, some miniature cameras are provided with the option of shutter release delay after the mirror has been lifted, which gives additional assurance.

At the same time, the larger format is preferable for slides, as they need, in this case, no magnification to be viewed.

Minerals are mostly photographed in close-up regime, i.e. with magnifications up to 1:1, sometimes greater. As the camera standard lens cannot be focused from the demanded short distances, one lengthens it with an extension tube or bellows or provides with a close-up lens. However, both mentioned entail deterioration in the image quality, since the camera standard lens is corrected for «infinite» distance and does not, in the mentioned case, answer its purpose. Essentially better images can be produced with a macro lens as its optical system is specially corrected for close-up distances. In particular, not too expensive lenses of the *Sigma EX macro* series are noteworthy; they are put out for all the basic SLR cameras of modern generation (*Canon, Nikon, Minolta,* and *Pentax*) and produce high quality images.

For mineral photography, a macro lens with focal length about 100 mm is the best. It facilitates well the illusion of third dimension and perspective, is accommodative in operation, and, compared with short-focus lens, less liable to light diffraction in the diaphragm hole.

Despite of the common opinion, the use of a long-focus lens does not entail diminishing of the depth of field. According to calculations, the depth of field at close-up photography is proportionate to

$$f(M+1)/M^2,$$

where f is diaphragm number and M is image magnification. Therefore the depth of field does not depend on the focal length.

The possibility of the lens aperture to be closed down at least to $f=32$ is advisable. However, closing down should not be overused. Sometimes, it contradicts the pictorial task; in addition, it affects adversely image quality. According to our data, the resolution of *Canon EF* as well as *Sigma EX* macro lenses is maximal at $f=8$ and drops by 20–25 per cent at $f=22$, and even by 40 per cent for the *Sigma EX 2,8/50 macro* lens.

To choose the type of light sources is a primary task. In photographic sense, minerals are fairly complicated objects. This implies the use of not less than three or four autonomous light sources supplemented with reflecting cards of white paper and aluminium foil. The gleams of faces and the whole light pattern are very much sensitive to the illuminator positions. This implies a literally precision setup of light. It can be achieved on condition the illuminators are enough mobile.

By this reason, the «non-controlled» sunlight only finds a limited use, and so electronic flash without pilot light. The tungsten low-powered lamps are mostly used, as they do not provoke photographer's weariness of too intensive light and heat radiation that is also ruinous for some minerals like native sulfur or realgar. Mounted on miniature stands, the lamps may be easily moved along the surface of the table, an improvised shooting stage. A miniature remote-control station with individual toggle switches for illuminators would enable photographer to set up lighting not drawing away from the camera viewfinder.

Adequate reproducing of mineral complicated and whimsical colors is a most urgent problem.

In the process of minilab printing, color rendition errors of a negative can be corrected to a small degree only; besides, this is only possible after the draft copies have been made and studied. As to color slides, they cannot be corrected at all. To correct color completely is not always possible even by means of editing files obtained by scanning original photographs. So it is very important to avoid errors when taking pictures or, at least, to minimize them. The pledge of success is the proper choice of film, light filter, and light source types with matched color parameters:

$$10^5/T_l - M_{lf} = 10^5/T_f,$$

where T_l, T_f — color temperatures, Kelvin (K), of light sources and film, M_{lf} — filter conversion degree, decamired.

The film choice is only confined to two types balanced either for day (sun) light or tungsten light with color temperatures, accordingly, 5500 K and 3400 K. The choice of light-conversion filters is also limited. Purplish-blue filters are usually used with conversion degree either 12 or 15 decamired (marked as B12, B15 or Wratten 80B, Wratten 80A). On the other hand, the market assortment of lamps is fairly rich, and, furthermore, they are much cheaper than light-conversion filters. So it is reasonable to select lamp type matching one or two film — filter type fixed combinations.

Slides are usually taken on a reversible film for the light of incandescent lamps (tungsten light). As to negative films for tungsten light, they belong to the category of relatively expensive materials of narrow assortment and are intended mainly for portrait studio photography. At the same time, color correct rendition can be also achieved with daylight film on condition that the lamps are selected correctly and the light is conversed with the proper filter.

Unfortunately, lamp manufacturers do not indicate, as a rule, their color temperatures. According to our data, they are diverse within fairly wide bounds. The light temperatures of the majority of miniature halogen lamps are at the level of 2700—2800 K, like domestic low-powered lamps. More promising are the halogen lamps of «cold light». In particular, «Radium» Company (Germany) produces miniature halogen lamps for 12 V and 50 W that can be matched satisfactorily with daylight film and 12B or 15B conversion filter. So do, as well, home-produced mirror photolamps of the ZK 220—250 type for 220 V and 250 W. To diminish fatiguing radiation, the latter's voltage can be reduced for the period of light setup (which is inadmissible for halogen lamps).

For the lack of a special light-colorimeter, color temperature of a light source may be estimated even in domestic conditions (Kantor, 1999). Of course, obtained data should be verified by means of control picturing of chromatic scale and colored and color-free objects (malachite, crocoite, quartz, etc.).

The background — a sheet of paper, cardboard, cloth — should be even, of subdued color, congruous with that of the specimen, with no pattern, spot, and texture. A neutral gray background is universal. A highlight spot on the background behind the photographed object would «lift» it and intensify volume illusion. A photo-printer file printout of gradual passage from white to dark gray color, with the dark side up, is a successful solution. The background should be placed at a sufficient distance to avoid shadow falling from the specimen.

All the modern miniature SLR cameras are provided with automatic exposure metering. Having chosen the aperture priority function and set up the proper diaphragm number, one lets the camera to set up the proper shutter speed. On the condition of light-shadow contrast being sufficiently evened, the option of integral (polysegment) metering should be selected.

When viewing a specimen, one turns it absent-mindedly with various sides to himself, lingering at some details of especial interest, and thereby a cumulative three-dimensional visual image is being formed in one's consciousness. The photographer's task is to imitate this image on the picture plane emphasizing, at the same time, either detail important for the given object, e.g., etching form, twinning seam, or face striation. For all this, only two pictorial means are actually available: specimen orientation and lighting setup. It is useful to study the specimen previously under the desk lamp in order to outline pictorial solution and select the object pole position and directions of main and accessory lighting. In the process of this procedure, it is better to view the specimen by single eye only, likewise camera does. On the shooting stage, the illuminators and reflecting screens should be set up one after another to light up, successively, the entire shape, brilliance and sculpture of faces etc. A reflecting screen of sufficiently large size can partly imitate the source of diffused light, which may be problematic for the home studio. At the final stage, the general light—shadow contrast should be regulated. A powerful tubular halogen lamp directed a sufficient distance from the front would do for this aim.

It is very important to check the specimen cleanness. Being left on its surface, dirt, dust, fingerprints will inevitably be visible on the picture.

All the illustrations have been taken with Canon EOS 50E camera with Sigma EX

2.8/105 mm macro lens and light-conversion filter Schneider 80B, using the mirror two-second blocking option, on Kodak ProFoto 100 and Fuji Superia 200 films; the lighting with «Radium» miniature halogen lamps 12 V 50 W.

Author's specimens and photos.

References

1. *Scovil, J.A.*Photographing Minerals, Fossils, and Lapidary Materials. **1996**. Tucson: Geoscience Press.
2. *Kantor, B.Z.* What is the Color of Your Light? *//Khimiya i zhizn' — XXI vek*, July, **1999.** pp. 62—63.