ACKNOWLEDGEMENT

The author acknowledges his indebtedness to Sri Dhrubajyoti Mukherjee and Sri Subimal Sinha Roy for their helpful suggestions and criticisms.

REFERENCES

DANA, E. S. (1868) *The System of Mineralogy*, John Wiley & Sons, N. Y.

GILBERT, C. M. (1949) Cementation of some California Tertiary reservoir sands, *Jour. Geol.* **57,** 1–17.

PETTIJOHN, F. S. (1957) *Sedimentary Rocks*. Harper & Brothers, N. Y.

PYE, W. D. (1944) Petrology of the Bethel Sandstone of the south central Illinois; Bull. Am. Assoc. Petrol. Geol., **28,** 63–122.

TURNER, F. J. AND C. M. GILBERT (1949) Use of universal stage in sedimentary petrography. *Am. Jour. Sci.* **247,** 1–26.

THE AMERICAN MINERALOGIST, VOL. 47, NOVEMBER-DECEMBER, 1962

EPOXY RESIN FOR OIL IMMERSION AND HEAVY MINERAL STUDIES

FRED F. LANGFORD, *Department of Geology, The University of Kansas, Lawrence, Kansas*[1]

Anyone working with loose mineral grains (especially when using the universal stage) has at some time felt the need of a method of fixing grains on the microscope slide which would permit him to use index oils and retrieve single grains for further studies. Hess (1960, p. 9) has used glycol phthalate, but it is limited to low indexes and at present hard to obtain. Epoxy resin cement appears to be a satisfactory solution to the problem, because it holds the grains, is inert towards standard index oils, isotropic, and easily obtainable. The epoxy resin has a refraction index of 1.55.

The epoxy resin generally comes in two tubes, one containing the resin, and the other a hardner. To use the cement, two drops of about equal size are squeezed on a piece of glass or paper and mixed together. At this stage, the cement is a viscous sticky liquid (with a working life of about an hour), which can be removed with common solvents such as xylene. The cement requires about 12 hours to set at room temperature, but this time can be shortened by heating.

The work cited (below) used Borden's transparent epoxy resin. Some contain opaque fillers and are unsuitable for optical work. The resin and hardner were mixed in about equal parts, the grains were mounted and the cement was cured for at least two hours in an oven at 80° C. Leaving

[1] Present address: Dept. of Geological Sciences, Univ. of Saskatchewan, Saskatoon, Sask.

the mounts in the oven for longer periods (such as overnight) has no apparent effect, good or bad.

The main factor in making a satisfactory mount is to keep the grains from being immersed in the epoxy. This is accomplished by spreading the epoxy on the microscope slide in a *very thin film* (*i.e.*, as thin as possible) so that only a small part of the grain becomes embedded. When index oils are then placed on slides with grains so mounted, the grains will be immersed in the index oil and the refractive indices can then be de-

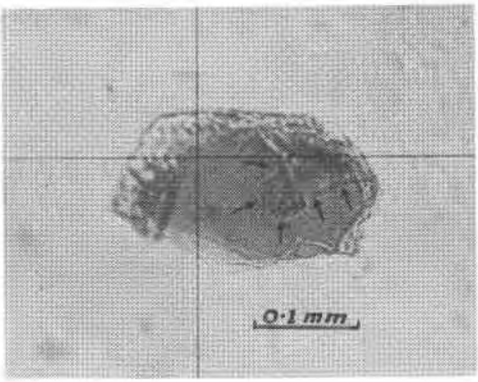

FIG. 1. Grain of biolite on an epoxy mount. The "internal" Becke line indicated by the arrows, delineates the portion of the grain cemented by the epoxy.

termined. The simplest technique to obtain a thin films is to take a small mass of epoxy on a partially straightened paper clip, and using heavy pressure smear it across the glass. With a little practice a fairly uniform thin film can be applied. The mineral grains are then sprinkled on the slide, which is then put in the oven to cure for 2 hours or more at 80° C.

In the best mounts, the epoxy is spread thinly enough so that only part of the lower surface of the grain is cemented. The cemented portion of a grain can often be recognized by the presence of an "internal" Becke line as shown in Fig. 1.

The epoxy cement when cured is physically, and as far as refractive index is concerned, inert towards the common index oils; mineral oil, monochloro-naphthalene, and methylene iodide. The above liquids were mixed with epoxy shavings, and their refractive indexes measured with an Abbe refractometer at intervals over a period of 10 hours. The indices remained constant ± 0.001. Xylene, methyl alcohol and carbon tetrachloride appear to have no deleterious effect on the mount, even after two hours immersion, and thus are suitable as cleaning agents to remove index oils.

A satisfactory technique for changing index oils is to hold the slide tilted, with one corner down, and by applying xylene with a dropper to the upper edges wash the index oil to the lower corner, where it can be wiped off. Patting the mount with tissue usually knocks off grains and leaves bits of fiber. Blowing strongly upon the amount removes most of the xylene and the remainder will evaporate within a few seconds. When first using this technique it is wise to examine the mount at this point with a binocular microscope to insure that all the index oil and xylene have been removed. Mounts with biotite and feldspar have had the index oils changed by this method as many as 25 times without noticeable deterioration of the mount.

Provided the slides are protected from physical damage, they will serve as permanent mounts. They are particularly handy for heavy mineral suites, because they enable the suite to be preserved, and yet all the minerals can be accurately identified by their refractive indices.

These mounts also permit accurate indentification of the opaque minerals, because it is extremely easy to take a needle and pry off a single opaque grain which can then be identified by the *x*-ray techniques commonly used for ore minerals (Berry and Thompson, 1962).

When moderately strained, the epoxy becomes anisotropic, and consequently it is unsuitable as a mounting media for thin sections, except perhaps to cement on the cover slip.

References

Berry, L. G., and R. M. Thompson (1962) *X*-ray powder data for ore minerals, the Peacock Atlas. *Geol. Soc. Mem.* **85.**

Hess, H. H. (1960) Stillwater Igneous Complex, Montana. *Geol. Soc. Am. Mem.* **80.**

THE AMERICAN MINERALOGIST, VOL. 47, NOVEMBER–DECEMBER, 1962

ADDENDUM NOTE TO "REACTION SERIES FOR SUBALKALINE IGNEOUS ROCKS BASED ON DIFFERENT OXYGEN PRESSURE CONDITIONS"

E. F. Osborn, *The Pennsylvania State University, University Park, Pennsylvania.*

In Fig. 4 of the paper, "Reaction Series for Subalkaline Igneous Rocks Based on Different Oxygen Pressure Conditions" (Osborn 1962), I indicated by dashed lines some simple, inferred phase relations for the right face, $CaSiO_3$-Fe_3O_4-SiO_2, of the tetrahedron, $CaSiO_3$-Mg_2SiO_4-Fe_3O_4-SiO_2 in air. The precise relations on this face are not important as far as the argument of the paper is concerned. There was no intention however of omitting available data. The data published by Phillips and Muan (1959) and plotted as the diagram for CaO-Fe_2O_3-SiO_2 were obtained in an air