AN IMPROVED METHOD OF ETCHING IRON METEORITES*

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There have been many descriptions of the technic by which the structural patterns of the different components in iron meteorites can be developed. The oldest method was by heating a thin section of the meteorite over a burner and a contrasting pattern would result because the various components oxidized differently. This method is seldom if ever used today. Liquid etching agents give better patterns and can be more easily controlled to bring out the desired degree of etching. Most of the iron meteorites in the past 25 years have been etched with dilute nitric acid. It was also recommended that any nodules of troilite, etc., should be lacquered before the application of the etching solution. This precaution is not necessary in the method for etching iron meteorites that is now employed at the U. S. National Museum, and the etched surface obtained by following the method here described gives a much more attractive surface than was obtainable from all the other etching methods tried in our laboratories.

Preparation of the surface to be etched

If a satisfactory macro-etch is to be obtained, the surface must be carefully prepared. It is important that the following preliminary steps be taken to properly prepare the surface. The surface of the meteorite to be etched is ground down with 100 mesh carborundum until it is perfectly flat. The grinding should be continued until the area is as smooth as it can be made with the 100 mesh carborundum.

The meteorite is then washed with water and brushed to completely remove the abrasive. This must be done thoroughly otherwise there is the possibility that some of this coarse material will free itself from some of the cracks in the meteorite and scratch the finish during the subsequent grinding and polishing operations. Between each of the three stages in the grinding of the surface this washing operation must be done with great care.

After the 100 mesh carborundum is removed, the grinding is continued using 320 mesh or FF carborundum until the surface is as smooth as this abrasive can make it. After washing, the slice of meteorite is ready for the third and final grinding with 600 mesh carborundum. This must be

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carried to a point where no scratches remain on the surface. It is desirable to examine the face with a low power magnifying glass to make certain that it is smooth.

Occasionally this process must be carried one step further, and that is to polish it with tin oxide on a felt buffer. The surface of the meteorite after the final grinding with 600 mesh carborundum, or the polishing operation, if it was necessary, is now ready for etching provided it is perfectly clean and free from all scratches.

Preparation of the etching solution

This solution should be freshly prepared for each application and with a little experience the operator will soon learn to estimate the quantity needed.[1] Concentrated nitric acid is mixed with grain alcohol in the following proportions: 2 parts of nitric acid and 5 parts of alcohol. To this solution some carpenter's glue is added by permitting about one drop of the glue to fall upon a glass stirring rod near the end of the rod and then plunging the rod into the solution and stirring immediately.

A swab is prepared by attaching a clean piece of soft white cloth to the end of a glass stirring rod, in such a fashion that about 1 inch of the cloth overhangs the end of the rod making a wide swab.

Etching procedure

The etching is then most conveniently done at a sink where water is available for immediate removal of the etchant after the desired etching effect is attained. Place the iron on a board so the surface to be etched is flat. Then pour the etchant on the meteorite so that the entire surface is quickly covered with the solution and start at once to scrub the etching solution over the entire surface with the swab. The entire area should receive equal amounts of the etchant and also get about the same degree of scrubbing. It is important for the operator to move the swab rapidly over the complete surface to prevent any excessive accumulation of the acid in any one spot. Some of the etchant may run down the side of the meteorite, but this has no serious effects as the outside usually is coated with an oxide film that will retard any appreciable chemical action. The swabbing is continued without interruption until the proper structure has been developed, or until the operator sees that the corrosive action of the etchant has stopped. Usually it is necessary to apply a second and sometimes a third application of the etchant.

Meteorites vary considerably in their reaction to the etching solution. Some etch much slower than others so it is not possible to predict the time

[1] A surface with an area of 10 sq. inches will require 5 ml. HNO_3 (conc.) and 12 ml. of grain alcohol. To this mixture add one drop of carpenter's glue.

required to produce the desired effect. Rarely is it possible to etch a surface in less than 15 minutes and sometimes 45 minutes will be needed.

When the operator thinks that the etching is deep enough, the etchant is washed off with alcohol and the application of alcohol repeated a second time. This washing is followed by two or three minutes of washing in a stream of running water with continued brushing. The etched face is then rewashed with alcohol at least twice to remove the water, and then dried before an electric fan.

It occasionally happens that a spot will appear which has a slight tarnish. Sometimes this can be effectively removed with a clean rubber eraser, but if the spot does not yield to light rubbing it will be necessary to reetch the meteorite with a freshly prepared etching solution made up to contain one half the quantity of nitric acid used in the first solution.

This method gives an etched surface on a meteorite which is more lustrous than can be obtained by using nitric acid or nital (5% nitric acid and alcohol). If the meteorite is free from lawrencite, the etched surface will remain bright and in perfect condition as long as it is not touched with the fingers. This surface does not require protection of lacquers. Prior to the development of this method by Mr. B. O. Reberholt, the meteorites in the display cases in this Museum required refinishing every year or so. The present display of iron meteorites was installed nearly 8 years ago and none have required any refinishing.

BODENBENDERITE, A DISCREDITED SPECIES*

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In 1928 Eberhard Rimann (1) proposed the name bodenbenderite for a supposed new compound of composition given as $(Mn,Ca,Fe,Mg)_4Al[(Al,Y)O][(Si,Ti,U)O_4]_3$. The proposed new species was received with some reserve; thus, J. F. Schairer (2) in 1929 commented that the data were unsatisfactory; in 1932 Dana-Ford (3) listed bodenbenderite in small capitals, signifying a species of doubtful validity; in 1934 Larsen-Berman (4) suggested a possible relationship to beckelite, notwithstanding considerable differences in the formulas ascribed to the two substances. In 1941 Strunz (5) listed it, as probably a variety of garnet, with a question mark as denoting an inadequately defined "mineral."

Recently, Dr. Michael Fleischer of the Geological Survey brought to our attention the unsatisfactory status of bodenbenderite. Through the kindness of Dr. William F. Foshag, of the United States National Museum, a specimen of the original material (U.S.N.M. 95804) was made

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