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SELECTIVE STAINING OF K-FELDSPAR AND PLAGIOCLASE ON ROCK SLABS AND THIN SECTIONS*

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ABSTRACT

This note describes a new method of selectively staining plagioclase in which a surface etched with hydrofluoric acid is dipped into a solution of barium chloride, rinsed, and treated with a solution of potassium rhodizonate. Plagioclase feldspars other than pure sodium feldspar are thus stained a brick red by barium rhodizonate. This procedure is combined with the cobaltinitrite staining of K-feldspar to stain K-feldspar yellow and plagioclase red on polished rock surfaces and uncovered thin sections.

This paper describes a method for differentially staining K-feldspar yellow and plagioclase red on slab surfaces or uncovered thin sections. Figure 1 shows a specimen of granitic rock that has been stained using the method.

The new method of staining plagioclase feldspar consists of etching the specimen with hydrofluoric acid vapor, dipping it in barium chloride solution, rinsing, and treating the surface with a solution of potassium rhodizonate. Plagioclase is thus stained brick red. This method of staining plagioclase is combined with the cobaltinitrite staining of K-feldspar to stain K-feldspar yellow and plagioclase red. Staining of K-feldspar with cobaltinitrite was proposed by Gabriel and Cox (1929) and further developed in studies by Keith (1939A and B), Chayes (1952) and Rosenblum (1956).

It seems apparent that the etch-residues left after the hydrofluoric acid treatment are stained, and not the feldspars themselves. Unetched feldspars are not visibly stained. In etching the specimen with hydrofluoric acid vapor, silicon is removed as the volatile fluoride, leaving the other elements on the feldspar surface.

Residual potassium from the K-feldspar reacts with cobaltinitrite to form yellow potassium cobaltinitrite. The staining of the plagioclase is accomplished by replacing the calcium ion in the etched feldspar with barium, which reacts with the rhodizonate reagent to form red insoluble barium rhodizonate. Rhodizonic acid or its soluble salts produce insoluble dark red precipitates with barium (see Yoe and Sarver, 1941).

Pure albite did not become stained by the treatment with barium ion and rhodizonate, but albite with calcium corresponding to only 3 per cent of anorthite was stained red. Apparently sodium in the etch-residue from albite is not readily replaced by barium; however, it may be replaced by

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potassium. After immersing etched albite in a solution of potassium chloride, it may be stained yellow with cobaltinitrite, showing that potassium ion has substituted for sodium in the etch-residue. By this method plagioclase, except perhaps for nearly pure anorthite, as well as the K-feldspar, can be stained yellow with cobaltinitrite.

On surfaces stained by the two-color method, the yellow K-feldspar and red plagioclase are sharply defined. Textures not readily seen when only K-feldspar is stained become clearly visible, and small particles of one feldspar within the other can be seen. In some specimens zoning is brought out by minor differences in color.

Many practical applications of the two-color staining are apparent. For example, rapid and accurate modal analyses can be made on thin sections as the grain boundaries are clearly defined. On stained hand specimens modal analyses can be made, by the methods of Jackson and Ross (1956), by assistants with little or no mineralogical training. Paul C. Bateman, of the U. S. Geological Survey, is successfully using 35 mm. color transparencies of hand specimens stained two colors in making modal analyses of granitic rocks under the microscope (personal communication). Stained slabs should prove particularly effective in demonstrating to students the interrelations of the K-feldspar, plagioclase, quartz, and dark ferromagnesian minerals because of their brilliant color contrasts.

Elimination of Porosity in the Hand Specimens

Porosity causes difficulty in staining plagioclase in some hand specimens. Fluoride absorbed by the porous surface may prevent staining of the plagioclase or cause the red color to bleach on drying. Also barium chloride solution may be absorbed and later come to the surface, causing the yellow-stained K-feldspar to be discolored with red barium rhodizonate.

Porosity can be eliminated by soaking the rock specimen, on which a flat surface has been sawed and roughly polished, in molten paraffin for about 15 minutes. Excess paraffin is then wiped off, and the flat surface is polished with #400 abrasive and dried. Care should be taken not to touch the polished surface and thus transfer paraffin to the surface and prevent its being evenly etched. Other materials, such as plastics which may be sprayed on the specimen, may also be effective in eliminating porosity.

Reagents and Apparatus

Hydrofluoric acid, concentrated, 52% HF. *Caution:* HF can cause painful burns.
Barium chloride solution, 5%.
Sodium cobaltinitrite solution, saturated.

Rhodizonate reagent. Dissolve 0.05 g of rhodizonic acid potassium salt in 20 ml of distilled water. Make fresh in a small dropping bottle, as the reagent solution is unstable.

Etching vessels. Plastic vessels of about 3/4″ depth and various diameters slightly less than those of the specimens to be etched.

Plastic cover vessels, large enough to cover the etching vessels and specimens placed on them for etching.

Plastic or paraffin etching vessel to fit thin sections.

Ribbed vessel to hold the cobaltinitrite solution.

PROCEDURE FOR POLISHED SURFACES OF HAND SPECIMENS

1. In a well-ventilated hood, pour the concentrated hydrofluoric acid into an etching vessel to about $\frac{1}{4}''$ of the top.
2. Place the rock specimen across the top of the etching vessel, polished surface down.
3. Cover the etching vessel and specimen with an inverted plastic cover vessel to prevent drafts, and let stand 3 minutes.
4. Remove the specimen from the etching vessel, dip in water, and dip twice quickly in and out of the barium chloride solution.
5. Rinse the specimen briefly in water and immerse it face down for 1 minute in the sodium cobaltinitrite solution.
6. Rinse the specimen by gently tilting it back and forth in tap water until the excess of cobaltinitrite reagent is removed from the surface. The K-feldspar is stained bright yellow if the specimen has been adequately etched. If the K-feldspar is not bright yellow, remove the etch residue by rubbing the surface under water, dry, etch again for a longer period, and continue from step 4.
7. Rinse briefly with distilled water, and cover the surface with rhodizonate reagent. Within a few seconds the plagioclase feldspar becomes brick red. When the red is of satisfactory intensity, rinse the specimen in tap water to remove excess rhodizonate.

The procedure for polished surfaces of hand specimens needs to be modified to suit different needs. The procedure above gives brilliant colors which appear grainy under magnification. The brilliant colors are best for demonstrating coarse features in the rock structure and for counting grains with the naked eye. When fine details of structure are to be studied under the microscope a short period of etching is desirable as it gives a thin, tightly adhering etch-residue and smooth, less highly colored stains. The time of etching will also have to be shortened or lengthened somewhat for different rocks, but it should be kept to a minimum as thick etch-residues tend to flake off of the surface and leave areas of unstained feldspar.

The red color on hand specimens may fade on some of the grains of plagioclase when dry, presumably due to the bleaching action of fluorides left in the pores of the specimens.

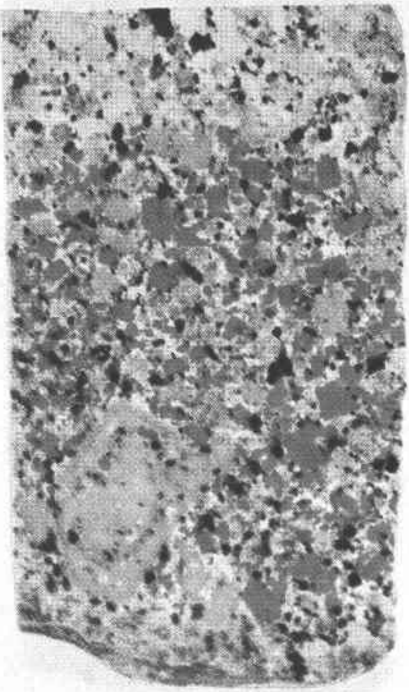

FIG. 1. Granitic rock with K-feldspar stained yellow by cobaltinitrite, and plagioclase stained red by barium rhodizonate. Actual size.

PROCEDURE FOR UNCOVERED THIN SECTIONS

1. Etch the rock surface by leaving it face down for only 10 seconds over hydrofluoric acid at room temperature. *Note:* Rinsing the slide after etching causes the stains to be uneven.
2. Immerse the slide in the saturated sodium cobaltinitrite solution for 15 seconds. The K-feldspar is evenly stained light yellow.
3. Rinse the slide briefly in tap water to remove all of the cobaltinitrite.
4. Dip the slide quickly in and out of the barium chloride solution.
5. Rinse the slide briefly with tap water and then with distilled water.
6. Cover the rock surface with the rhodizonate reagent from the dropping bottle. When the plagioclase feldspar has become pink, rinse the slide in tap water.
7. Allow the slide to dry and cover it in the usual way.

In the stained thin sections under the microscope, the K-feldspar can be seen to be evenly stained a pale yellow and the plagioclase pink. The mineral borders may be outlined by tiny spots of amber red, which seem to be a reaction product of rhodizonate with residual barium chloride left in the cracks between the mineral grains. This defect is not sufficient to interfere with study of the thin section. It was thought that longer washing after the barium chloride treatment would eliminate these amber spots, but after 3 minutes in tap water the K-feldspar also was stained red by the rhodizonate.

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