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THIN SECTIONS OF PALEOSOLS

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INTRODUCTION

Many paleosols present problems for preparation of thin sections because they are clayey and fractured, and few commercial or university laboratories are prepared to take them. Here we outline practical and inexpensive ways of preparing high-quality thin sections from these difficult materials. The general procedure for making thin sections is well known (Martin et al. 1979; Socci 1980; Fitzpatrick 1984; Murphy 1986). Here we detail the main problems encountered in making thin sections of friable and fractured claystones.

PROBLEM 1: LABELING

Some clayey wet or friable samples do not take ink from marker pens, but cutting half the felt tip off allows ink to flow more readily. Soft lead pencils work well on most kaolinite samples. Some samples may need to be wrapped in paper tape, which is then labeled. A more time-consuming method is to paint the specimen with white paint, then label with ink. If the sample is too moist to label, wrap it in labeled paper and allow it to dry slowly. Rapid drying, which occurs under direct sunlight, can cause cracking and crumbling.

PROBLEM 2: CRUMBLING SAMPLES

Many paleosols have a complex system of cracks, clay skins, and altered surfaces remaining from former soil structure. These natural planes of weakness in paleosol samples tend to fracture. This problem can be overcome by using two-part epoxy systems to impregnate the material. However, epoxy does not readily penetrate cracks of clayey specimens. Heating the epoxy on a hot plate lowers its viscosity and allows better penetration. Although laboratories have had success with nitrogen-pressurized impregnation (Ginsburg et al. 1966), it is expensive and cumbersome. Similar results can be obtained without use of vacuum or pressurized equipment. An easier technique is to place the sample in a small well of epoxy. Egg cartons and disposable cups provide easily available inexpensive wells. An envelope of epoxy may add sufficient structural support for the sample to withstand cutting and polishing. Safety gloves should be worn when breaking and cutting hardened epoxy.

PROBLEM 3: CLAY SWELLING

Some paleosol samples contain materials such as smectite clay, which are easily disaggregated in water. Some samples contain water-soluble minerals. Machines that use water as lubricant and coolant dissolve and destroy such minerals. Water-soluble minerals are little affected by petroleum products. Kerosene is best because it is cheaper and less flammable than other products. This entails many changes to cutting machines. If the cutting system used is self contained, replace the internal plumbing with vinyl and PVC, because latex is dissolved by kerosene. Fill the reservoir tank with kerosene instead of water. The use of hand-held plastic bottles filled with kerosene also works but is cumbersome. Kerosene fumes can be noxious, so installation of the entire operation in fume hoods is recommended. Kerosene also can be a skin irritant. Surgical vinyl gloves and hand lotions are helpful. Proper procedures for handling petroleum products in the laboratory have been discussed in detail by the National Research Council (1981).

PROBLEM 4: GRAIN PLUCKING

Paleosol samples are commonly a mixture of hard grains such as quartz in a softer clay matrix. The hard grains plucked during grinding scratch the section. Such scratches are not in all cases easy to distinguish from some kinds of soil microstructure (such as clinobimasepic structure of Brewer 1976). Added epoxy can hold the surface intact during polishing.

Both epoxy and the sawn rock sample should be warmed on a hot plate, to make the epoxy less viscous. The samples should be face down on the hot plate prior to impregnation. This heats the surface and allows better penetration and curing of the epoxy. Too much epoxy on the surface will harden and must be polished off by hand; if there is too little, the surface will not hold together during polishing and grains may begin to pluck. To ensure the proper amount, spread liberal amounts of epoxy across the face of the sample. After a few seconds for the sample to absorb epoxy, wipe the surface until it has a dry matte finish. Wipe a little bit of epoxy back on to produce a glossy finish. Porous material such as tuffs may need a second coat. Most plucking occurs after coarse grit is used, and fine grit makes the little defects noticeable. It may be easiest to leave especially difficult samples finished at 400 grit. The difference is not great under most microscopes.

PROBLEM 5: SCRATCHES ON THE GLASS

Plucked grains and coarse grit can leave scratches on the glass. This can be prevented by using a strong clear plastic packaging tape. Roll out a long section of tape on the work table and place the smooth back side of the glass plates down on the tape, one after the other. With a razor blade, cut between each glass, press the air bubbles out, and smooth the tape. This cover protects the glass surface from excess epoxy and scratches. When using this technique, remember that the tape adds one order of interference color to the thin section, like a gypsum plate.

PROBLEM 6: CRACKING OF GLASS

Fracturing of glass slides associated with clay minerals can occur due to cooling, contraction, and warping. Dehydration of clay minerals on the hot plate may also be a cause. Samples most likely to fracture the glass are red to brown clay samples with clayey matrix supporting larger minerals altered to clay. Leave the sawn rock samples on the hot plate during the entire process until cover slips are mounted. Electric frying pans are inexpensive and adequate hot plates.

PROBLEM 7: AIR BUBBLES

Hydrous minerals such as smectite are a notable source of water that forms bubbles after the cover slip is added. Although the bubbles do not destroy the sample, they hinder mineralogical analysis and photomicrography. Samples with hydrous minerals should be given longer drying times, at least three days. The epoxy also should be cured of potential volatiles by mixing it in a small tinfoil-formed crucible on the hot plate for 10–20 minutes before use. This starts the initial reaction, and much of the gas escapes the epoxy before it is applied to the mounted sample. Applying liberal amounts of epoxy to the sample surface allows some gas to escape after the cover slip is added. The cover slip need not have any epoxy added to it.

CONCLUSIONS

Making thin sections of paleosols can be difficult. These low-cost methods developed from long experience with these materials should improve both quality and quantity of thin sections of these friable and clayey materials. With practice, high-quality thin sections have been made with less than thirty minutes per sample.

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