



Dickinson College Department of Geology

Title:	HOW TO MAKE A THIN SECTION
Equipment:	MK TRIM SAW, LAP WHEEL, AND BUEHLER PETRO-THIN, ROLL GRINDER AND MINI-MET POLISHER
Revision:	3.0
Effective Date:	9/17/2003
Author(s):	J.ROTH & G.YOGODZINSKI

Do **nothing** until you've had an introduction to the use of the thin sectioning room by a qualified person.

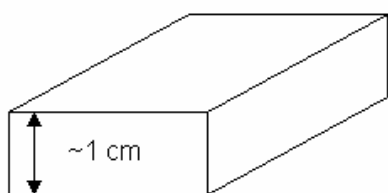
SUMMARY INSTRUCTIONS

1. Cut a slab from your sample.
2. Mark the slab and cut the billet.
3. Label one side of the billet.
4. Hand grind the billet with #120 SiC grit on lap wheel.
5. Hand grind the billet on the #240 and then #320 grit paper on the roll grinder.
6. Frost the glass slide.
7. Wash and dry the billet and slide.
8. Epoxy the billet to the slide.
9. Clean off excess epoxy and label the section.
10. Trim off the billet using the thin sectioning cut-off saw.
11. Grind the section on the thin sectioning machine.
12. Wash the section.
13. Hand grind the section on a glass plate using #600 grit.
14. Finish hand grinding the section on a glass plate using #1000 grit.
15. (Optional) If doing SEM analysis, polish the section on the Mini-Met polisher using 15, 9, 3, and 1 micron diamond-suspension polishing solutions.

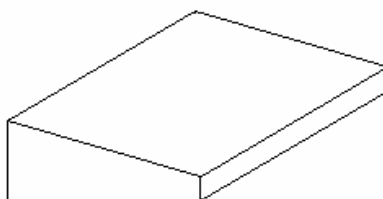
DETAILED INSTRUCTIONS

I. Cutting the Rock Billet:

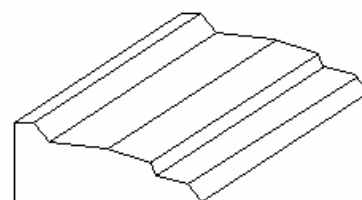
1. Use the trim saw to cut a slab from your sample ~1 cm thick. (If the sample is too big for the trim saw, you will have to slab it on the slab saw in room 11A – see Jeff Roth if this is the case). Be certain that there are two flat (and parallel) surfaces on the sample when you are done cutting it. One will be glued to the slide, the other will carry the sample label.
2. Mark your slab where you want to cut it (tracing around a slide is helpful - it is best if your sample fills the slide completely, but does not extend beyond the edge of the glass).
3. Put your slab flat on the saw table. Align one side of your marked area with the blade, and slowly push the slab into the blade to make your cut. Hold the slab firmly, and try to make the cut as straight as possible. Let the saw cut at its own pace, and don't force it. When finished, make the other three cuts to complete the billet (see diagram).



like this



not like this...



...or this

4. Wash the billet with water, and dry it. Label the back with the sample number. You can mark on the billet with an indelible marker (a 'Sharpie') or put a sticky paper label on the billet with a sample name. Be careful though, because the sticky labels may come off as you move the billet through the grinding process described below.

II. Grinding the Rock Billet:

1. The surface of your billet will have coarse saw marks on it that must be ground smooth before you glue the slide to it. You may be able to feel the saw marks with your finger, and if you look closely you will see them. Take the billet to room 11A in the basement. Squirt some water on the steel lap wheel there, and sprinkle a liberal quantity of #120 silicon carbide (SiC) grit on the wet wheel. Before you start the wheel, use your billet to spread the grit and water around so that it makes wet, gritty mud on the wheel.
2. Turn on the wheel and grind the surface of your sample for about 5 seconds. Do this by applying pressure to the billet and moving it back-and-forth across the surface of the wheel. Try to keep an even pressure on the billet, and don't let it slip off the edge of the wheel. Flip the billet around 180° and grind the same surface for another 5 seconds. Repeat the process for a total grinding time of about 20 seconds or so. Wash the billet clean of grit and dry it off. Feel it with your fingers and look at it closely (blowing it dry with compressed air helps)—all of the coarse saw marks should be gone, though you may be able to see scratches created by the grinding grit.

The idea is to remove the saw marks while doing as little grinding as possible so that you retain as flat a surface on the billet as you possibly can.

3. When you are done with the lap wheel, clean it thoroughly. I find it is easiest to simply unscrew the wheel from the shaft, and rinse it in the sink. Be sure to dry it thoroughly with paper towels and compressed air. If left wet, it will rust. Remember to screw it back onto the shaft.
4. Now bring the billet upstairs to the roll-grinder in Room 233. Turn on the water on the roll-grinder and get the surfaces of the grinding papers wet. Once they are wet you can probably turn the water off or turn it down low. If you start splashing a lot as you grind, you've got too much water.

5. Start on the #240 grit paper. Grasp the sample firmly in the finger tips. Apply a uniform but firm pressure to the billet against the abrasive surface. Draw the specimen over the paper, from back to front in a straight, even motion. (A back and forth motion usually leads to an undesirable curved surface). Perform as many strokes as required to remove all visible scratches (~20), then continue on for several additional strokes to be certain that the previous scratches have been removed.
6. Rinse the billet to remove abrasive particles, flip the billet 90°, and repeat the process on the #320 grit paper.
7. Clean the billet thoroughly and blow the surface dry with compressed air. If you look at it closely, you will see the beginnings of a shiny polish on the billet's surface. If you failed to flatten the surface in the previous grinding step, you will notice that some parts of the billet surface are shiny and others are not. If you see this, you probably need to go back downstairs and repeat the grinding with #120 grit. Once you are finished with the roll-grinder, use the steel ruler to check the ground surface of the billet for flatness – as long as you haven't done an excessive amount of grinding, it should be OK.
8. Put the billet on the hot plate, ground side up, at 100-150° for at least 10 minutes to dry it out. If the rock is cracked or porous, you may want to dry it for 30-60 minutes.

III. Grinding the Slide

1. Obtain a glass slide. Label one side of your slide with the electric engraver or etching pen.
2. Turn on the motor, vacuum, and water for the thin sectioning machine. Wet the surface of the glass slide, making sure that it is free of grit and/or epoxy. Wet the steel chuck that holds the slide and stick the slide onto the surface of the chuck. Make sure the side with your label is against the steel chuck, and that your label is at the top of the slide.
3. Before you begin grinding, be sure that your slide will swing well clear of the grinding wheel at the beginning. On the right-hand side of the thin section machine there is a steely-gray knob with a circular scale inscribed on it. If you turn the knob toward you, it will move across a horizontal scale that begins with a '0' (zero) on the left. Play around with this knob so that you see how it moves and controls the position of the sample relative to the grinding wheel.
4. Once you've got the idea, be sure to leave the knob so that it completely covers the '1' which is located to the right of the '0' on the horizontal scale. This will keep you from grinding your slide into oblivion on your first pass across the grinding wheel. Bring the arm down and note the distance between the slide and

grinding wheel. Slowly turn the micrometer towards you while moving the sample arm in a back-and-forth motion to close the gap between the slide and grinding wheel. Soon you will hear the slide begin to grind.

5. When the slide is completely frosted, it has been ground to an even thickness and may be removed.
6. If you are making several thin sections, it may be advantageous to grind all of your slides to the same thickness. Write down the micrometer setting to facilitate doing this.

IV. Gluing the Slide to the Billet

1. Obtain one of your ground glass slides. Wash it thoroughly in warm soapy water and rinse. Dry it with compressed air, and wash it again thoroughly in acetone with a kimwipe. Use compressed air to remove dust from both the clean glass slide and the dry billet.
2. Put your billet on the white part of the wooden holder that slides beneath the ultraviolet light. Squirt a liberal quantity of Loctite UV Epoxy on the surface of the billet. Put the glass slide on the billet (frosted side down!) and move it around just enough to coat the surface of the billet. Don't press on it or move it around too much. It's OK if some epoxy spills over the edge of the billet, as long as it's not a huge amount that will run everywhere and create a mess.

NOTE: If you are gluing more than one section at a time, make sure that you match the slide sample number to the proper billet!

3. If the ground surface of the billet is not perfectly horizontal, the glass may shift down-hill. To keep this from happening, slide some broken pieces of the large flat toothpicks under the bottom of the billet to level the surface. It is important that you keep the edges of the billet entirely within the edges of the glass slide.
4. Let the slide-epoxy-billet sit undisturbed for about 2 minutes – then put it under the ultraviolet lamp for 5 minutes. After 5 minutes the epoxy should be well cured.
5. Any excess epoxy that spilled over the edge of the billet will not cure due to the presence of air. Use kimwipe +/- acetone to clean the excess epoxy from the billet and from the shelf.

V. Cutting the Slide Away From the Billet

1. Turn on the motor, vacuum, and water for the thin sectioning machine. The water should be on just enough so that a light spray is created around the opening to the saw. Wet the surface of the glass slide, making sure that it is free of grit and/or

epoxy. Wet the steel chuck that holds the slide and stick the slide onto the surface of the chuck. Make sure the side with your label is against the steel chuck, and that your label is at the top of the slide.

2. Bring the arm of the thin section machine to the full-up-and-back position, slide the whole arm to the left (along the axle that it rotates on) and bring the arm down and forward.
3. The arm (and chuck holding your slide) should now be aligned so that when you lower the arm, the saw blade is aligned between the billet and the glass slide. Do this slowly at first by letting the weight of the arm press the billet into the saw. Once the cutting has begun, apply gentle pressure to the arm until you've cut through the billet – this should take less than 30 seconds.
4. When you raise the arm back up, **be careful!** The arm is spring-loaded so that when it is in the cutting position with the arm fully up and back, it will jump to the right and smack into a stop. This may shift the adjustment of the arm relative to the grinding wheel (not good) and/or it may cause your sample to go flying. So, using both hands, raise the arm and move it gently to the right-hand position.
5. Be sure to retrieve your cut-off billet from the sample chamber. Do this by turning the machine off and opening the door on the right side of the machine. Be sure to close the door securely, or a switch will keep you from turning the machine back on again.

VI. Course-Grinding the Slide to Near 30 Micron Thickness

1. Remove your slide from the chuck and rinse it in water. Be sure that the chuck is also free of grit, and put your slide back on the chuck. Before you begin grinding, be sure that your sample will swing well clear of the grinding wheel at the beginning.
2. Set the micrometer knob so that it completely covers the '1' which is located to the right of the '0' on the horizontal scale. This will keep you from grinding your billet into oblivion on your first pass across the grinding wheel.
3. Lower the arm slowly toward the grinding wheel – it should be positioned so that your billet passes in front of the grinding wheel without touching it. If necessary, turn the gray knob away from you a few turns - this will push the arm and chuck to the left so that the sample won't hit the grinding wheel.
4. Now you are ready to grind. Slowly turn the gray knob toward you, allowing the chuck and your sample to move to the right (toward the grinding wheel). Do this slowly so you don't take out a big chunk on your first pass across the wheel.

5. Once the sample hits the wheel, turn the arm up-and-down so that the sample passes across the grinding wheel several times – one or two passes across the grinding wheel is not enough to produce a flat surface. Avoid over-grinding the edges of your thin section by grinding in short strokes, back-and-forth across the center of the section (if you swing the chuck fully forward and back, you will over-grind the edges relative to the center). When you have thoroughly ground the sample at one position, turn the gray knob toward you and repeat the process. The more you turn the gray knob toward you, the further the sample moves to the right, and the thinner the billet becomes.
6. You can move the sample into the grinding wheel quickly at first (3-4 units on the circular scale). After some grinding, pull the sample off and look at it under the polarizing lamp. At first, the grains will be opaque, then higher-order white, then high-order pastel colors. Once you start seeing 3rd-order interference colors, you should slow down the rate at which you move the sample into the wheel (1 unit on the circular scale). Be sure to grind thoroughly after each turn of the gray knob. At this point it is critical that you avoid over-grinding the edges of your thin section, so be sure to grind in short strokes, back-and-forth across the center of the section.
7. Once you begin to see mostly 2nd-order interference colors, you should slow way down (0.25 units on the scale), and be extra careful to grind very thoroughly at each step. The more patient you are at this point, the better your thin section will turn out. Once you begin to see pale yellow and the low-order gray interference colors in your slide, it's time to stop grinding.

NOTE: It is NOT recommended that sections be ground to the final desired 30 micron thickness on the PETRO-THIN machine. Sections should be finish ground on the glass plates.

VII. Finish Grinding the Thin Section to 30 Micron Thickness

1. Finish the slide by grinding by hand on a glass plate in a slurry of water and #600 SiC grit. Check the interference colors of the thin section frequently, and apply pressure to different parts of the slide until all of the low birefringence minerals (generally feldspars and quartz) show no higher than pale-yellow interference colors.
2. Repeat this process on a separate glass plate with #1000 SiC grit. This will significantly improve the effects of the subsequent polishing steps (see below).

POLISHING THE THIN SECTION

I. The Polishing Containers:

1. Locate the thin section holders and plastic polishing containers for the Min-Met Polisher. Each container is labeled with the dimension (in microns) of the diamonds in the polishing solution that is used the container.
2. There should be containers for 15, 9, 3, and 1 micron polishing solutions. The polishing cloth used with these polishing solutions is the Buehler Texmet 1000 non-nap cloth (with adhesive backing).
3. There are also containers for 0.3 and 0.05 micron aluminum-oxide polishing powders. The polishing cloth used with these fine, white, polishing powders is the low-nap Microcloth by Buehler.
4. Check all of the cloths that you will be using - if any seem excessively worn, remove the cloth, clean and dry the glass platen, and replace the cloth.

II. Setting Up the Polisher

1. Put the 15 micron polishing pot on the polisher.
2. Dampen the surface of the cloth with distilled water.
3. Squirt a liberal, 1-inch diameter puddle of 15 micron polishing solution onto the center of the cloth.
4. Wet the back of your thin section and place it in the holder. Be sure that the rock face of the thin section is facing out. Also, be sure that the surface of the holder that is in contact with the back of your thin section is coated with the clear plastic tape. Failure to keep the holder coated with tape will result in the frosting of the back of your thin sections as you polish them.
5. Place the holder and thin section face down on the puddle of polishing solution. Be sure that the thin section rests flush on the flat surface of the holder.
6. Slide the holder and thin section around on the polishing surface. Be sure that the polishing cloth is completely wet and that the thin section and holder slide easily around on its surface.

III. Basic Polishing

1. Adjust the 'Load' on the polisher by pushing the knob slightly 'in', and turning it all the way clockwise to the 'MAX' position.
2. Turn the speed control to 8 or 9 - this is full speed.
3. Adjust the 'Time' knob to 0 (zero) and turn the black timer on top of the polisher to the desired polishing time.

4. Push the 'Start' button to begin polishing.
6. Repeat with finer polishing as-needed (see below). Be sure to clean your thin section and holder thoroughly when you switch to a new polishing solution.
7. How Long to for a Basic Polish?

Rocks that are made of common anhydrous silicate minerals (quartz, feldspar, olivine, pyroxene) seem to require 5-10 minutes of polishing with the 15, 9, and 3 micron polishing solutions. Check the quality of your polish with the reflecting-light microscope as you proceed, You may discover that you need either more or less polish time, depending on your samples.

Rocks that are non-silicates (e.g., carbonates) will require significantly lower polishing times-perhaps only 1-3 minutes on each polishing size. Experiment to figure out what works.

8. If your samples contain significant quantities of amphibole and/or mica, and if polishing these minerals is important, additional Fine Polishing will be required. Follow the procedure for fine polishing below.

IV. Fine Polishing

1. Fine polishing is done on with the 0.3 and 0.05 micron aluminum-oxide polishing powders.
2. Proceed as under 'Basic Polishing' for the 0.3 and 0.05 micron polishing, except that the polishing speed should be set at about 3-4 (not 8-9), and the 'Load' should be set at about 25% ('Load' dial set at about 3-4 o'clock).

Be sure that the napped polishing cloth is thoroughly wet and that your thin section sides smoothly across its surface. If the polishing speed or load are too high, the edge of the thin sections holder will catch on the napped cloth, resulting in possible damage to your thin-section. When this happens the edges of the thin section may become chipped, and the polishing cloth may become contaminated with coarse pieces of glass. Under these circumstances be sure to replace the polishing cloth.

V. Cleaning Up

1. Rinse the thin sections holders thoroughly.
2. No need to rinse the polishing pots. Leave them out to air dry on the shelves.

3. Wipe down the polishing machine and area thoroughly, leaving it cleaner than when you arrived.

VI. Final Note

The foregoing procedures were developed on the basis of relatively limited experience and experimentation. There is no doubt that the optimal polishing procedure will vary significantly from sample-to-sample. The user is encouraged to proceed slowly and observe their samples carefully, and to make notes that can be incorporated into these procedures in the future.