

Cleaning the grinding wheel

- Fill a large half-cut jug with water. Clean off a sponge.
- Pour half of it on the spinning wheel.
- Clean the spinning wheel with the sponge. Pour some more water on the wheel.
- Repeat step C until the sponge stops picking up dirt from the wheel.
- Pour the remaining water around the outside of the plastic bucket to make the grit wash away.
- Dry the spinning wheel with a paper towel or two.
- Dry the spinning wheel with the hair dryer until it's totally dry.
- Cover the wheel immediately.
- Clean the bench top that holds the wheels.



Pouring water on the grinding wheel for initial cleaning.





Initial drying of wheel with paper towel.



Final drying of wheel with hair dryer.

Step Two: Mark your rock

- You need to decide where you will cut your rock.
- Mark a line on the rock with the Sharpie.



Rock prior to cutting. Pencil for scale. Note that this rock was not marked before cutting, but normally it would be.

Step Three: Cut the slab

- First clamp the sample in the holder so that the line is parallel to the saw blade, sticking out of the holder. You do not make your first cut along this line!
- Find crank handle and attach to square protrusion on tray. Wind the tray about 11 turns away from the saw blade. There is some hysteresis, or "slop", so don't count crank turns where the tray isn't moving. Remove the crank handle.
- Close the cover, making sure the sides and bottom are tucked inside the lip.
- Make the cut. First turn the switch on to get the blade moving, then turn the knob until the weight begins to fall.
- Once the cut is done (you can hear it), turn the blade off and stop the weight moving by turning the knob away from you.
- Pull the tray back to the beginning, and use the crank to wind the blade back to your line, 11 real turns (where the tray is moving).
- Remove the crank handle, and close the cover.
- Make the next cut as you did the first. These two cuts should be parallel planes about 8-10 mm apart. The slab should fall onto the catch tray behind the blade.



Slab saw. Note location for crank in bottom center.



Slab saw controls. Turn knob to move rock into/through blade, and switch start blade turning (only turn on with cover completely closed!).



Rock ready for first cut. Note that it sticks out extra far to allow for second cut without removing from clamp.



After first cut. Next, close knob, pull tray back from saw, then move tray towards blade about 11 turns of the crank handle.



Ready for second cut.



nafti.ir After second cut: slab complete (piece lying on catch tray at left).

Clean up the slab

- First wash the slab, the leftover rock, and the first cut piece (if there's enough to save) to remove any oil and grit from the slab saw process.
- Next (while the rocks are drying) set the leftover rock and the first cut piece on a paper towel to dry, but mark the sample number on the towel. It's very easy to mix up specimens at this point, because you may have needed to cut through the number previously marked on the rock. Also, the first cut piece likely has no number. Once these are dry, re-mark them with the sample number.



Washing oil and dirt off the rocks after slab cutting.



Step Four: Cut the chip

- You will use a special rock-cutting blade which is made of metal with diamonds embedded in it. Essentially, such blades are narrow grinding tools. You can even safely put your finger on it as it moves (if it is lubricated with water), however you should not put your fingernail on it.
- You should wear eye- and ear-protection gear when using this saw.
- Start the water using the valve above and to the right of the saw, and start the blade using the switch to the right.
- You just put the slab on the platform and move it into the blade. You can use a glass slide to get the size correct (the chip should be slightly smaller than the slide).
- After cutting the chip, the side from which the thin section will be cut must be polished to remove marks from the saw blade. For best results you can grind on each of the four wheels, but a useable section will result from just grinding on the second (240 grit) wheel.
- As above, clean the grinding wheel when you are done with it.



These blades are safe to touch as long as they are lubricated, but don't put your fingernail on it.



The platform moves, so you just push the slab through the blade.



Final cut for the chip.



Grinding the chip will remove any saw marks from the cutting.



Washing the chip.

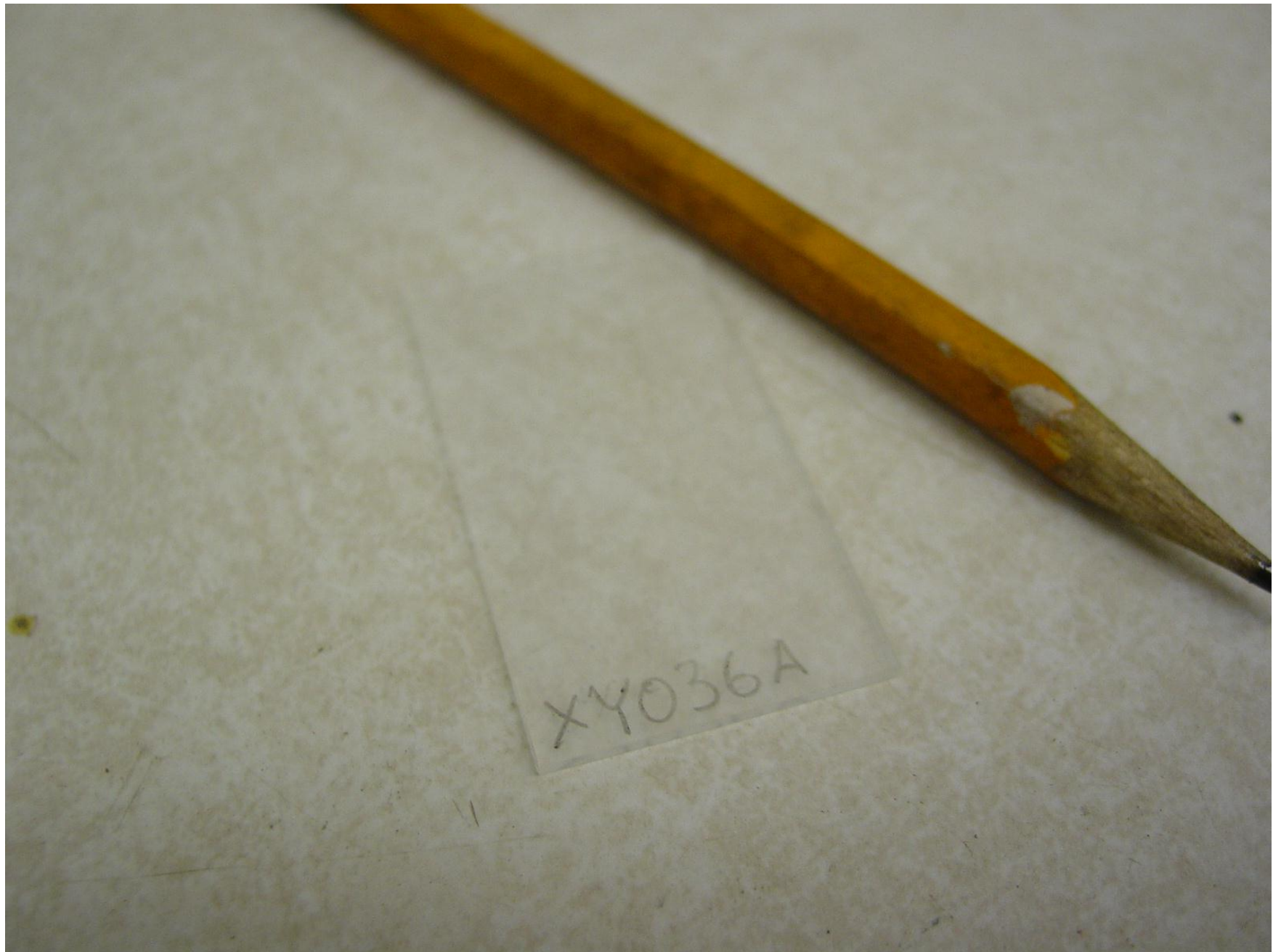
Step Five: Glue the slide to the chip

- Heat up the chip by placing it on one of the hot plates with the polished side up (so it doesn't get dirty). This allows the epoxy to flow more easily and cure faster.
- Write the sample number in pencil on the frosted side of the slide. This number will get covered by epoxy shortly.
- You now need to mix a batch of epoxy.
 - For a single thin section, this will be too much, but it is difficult to accurately mix a small amount.
 - You need to use two parts epoxy (the large bottle) with one part hardener (the small bottle). It's best to use the balance to measure by weight.
 - A small batch would have about 4 grams epoxy and 2 grams of hardener. (Be sure to take into account the weight of the tray!)
 - These materials now must be well-mixed, but while creating as few bubbles as possible. In order to achieve this, I drag the coffee stirrer in a sinuous pattern first in one direction, then in the same pattern rotated 90 degrees.

- Once the epoxy is well-mixed, spread a few drops across the top (polished side) of the warmed chip.
- Many rocks are porous (even some that you might not expect) and you must let the epoxy penetrate fully, or the thin section will not survive. So, spread epoxy, then wait for it to soak in (5 minutes) then spread more epoxy. Repeat until no more epoxy soaks into the chip.
- Place the slide, frosted side down on the epoxy. It's best to put one side down, then let the other side fall to avoid trapping bubbles.
- Move the slide around with your finger or a pencil eraser. This will squeeze out extra epoxy to achieve a constant thickness, and if you work at it, you can remove most bubbles this way as well. While doing this, be sure that the sample number gets coated with epoxy.
- Let this sit to cure. Check it periodically for the first 5-10 minutes to be sure the slide has not slid off the chip.
- The epoxy will cure in about 20-30 minutes. Do not take the next step before that.



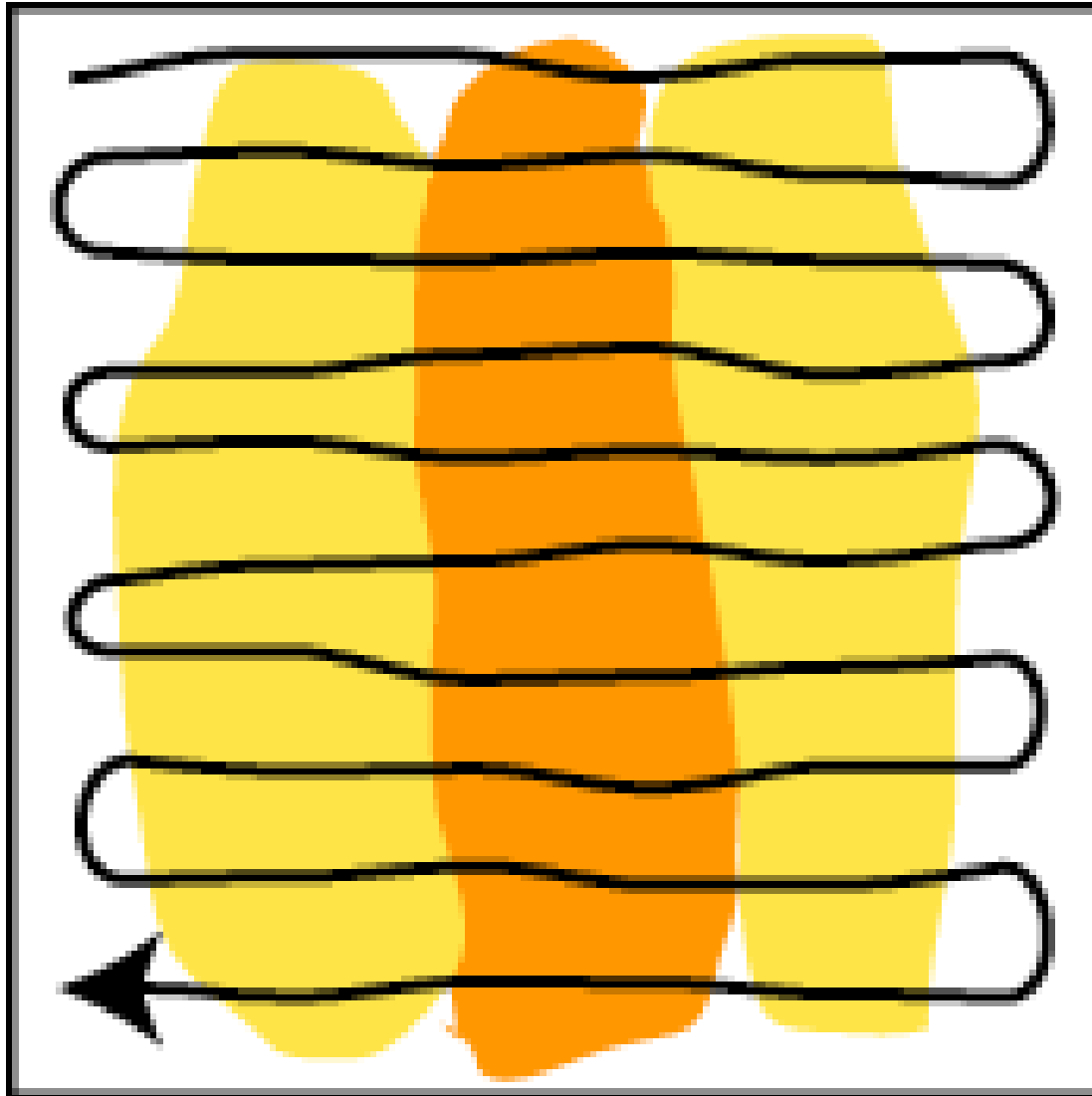
Cut and polished chip warming up on the hot plate.



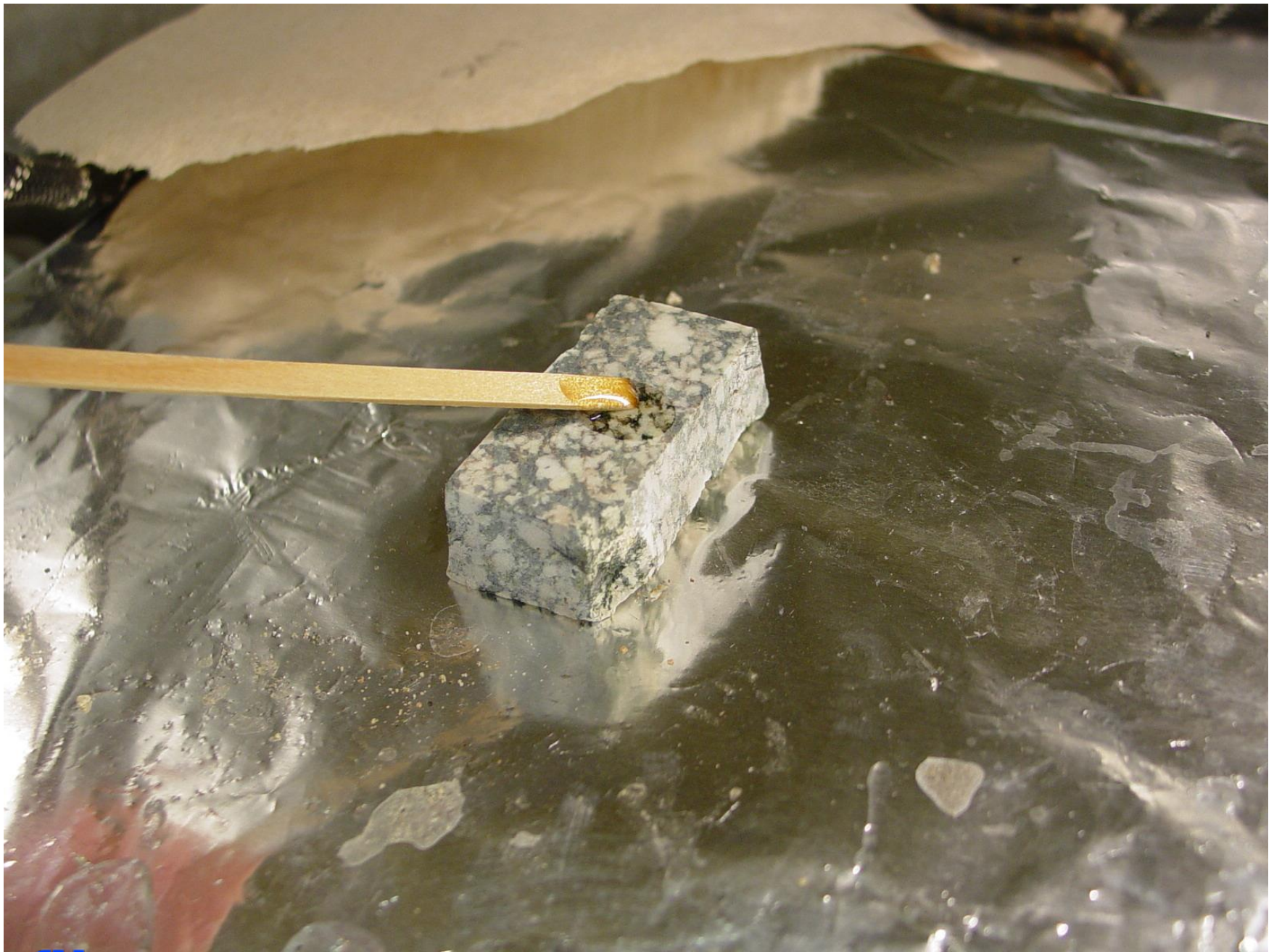
Sample number marked in pencil on frosted side of slide.



Epoxy and hardener prior to mixing.



Pattern for mixing. Should be rotated 90 degrees after each time through pattern.



Spreading epoxy on chip.



Chip coated with epoxy after allowing it to penetrate.

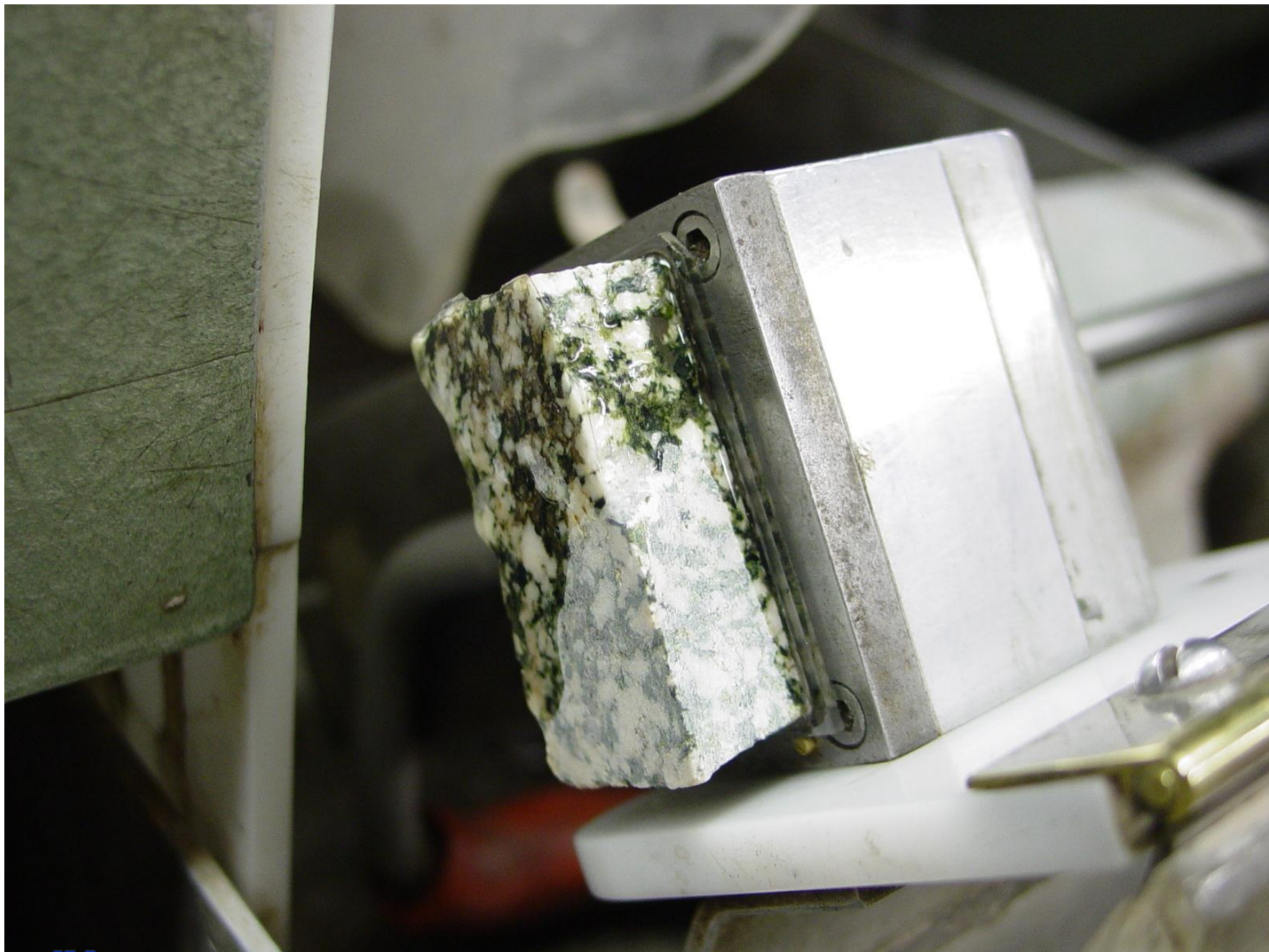


Placing slide on chip, frosted side down.



Step Six: Cut off the chip from the slide

- Place a blank glass slide on the grinder to block the vacuum.
- Turn on the water to the cut-off saw.
- Place the slide on the cut-off saw (note direction of ground corner) and turn on vacuum to hold it. Be sure edges of slide are lodged against pins in holder.
- Turn on saw motor.
- Use the handle to move the chip into the blade. Go very slowly, or you can break your slide and have to start over.
- Once the chip is cut off the slide, retrieve the chip from the water tray and set it aside (it will likely need to be labeled with the sample number).
- Turn off the vacuum, and saw motor.
- Using the button (as with the grinder - see above), break the vacuum. Once the hissing stops, remove your slide from the saw.
- Rinse your slide to remove any particles.



Slide with chip mounted in cut-off saw.



Slowly cutting off the chip from the slide.



Chip nearly cut from slide.



Chip and slide separated.

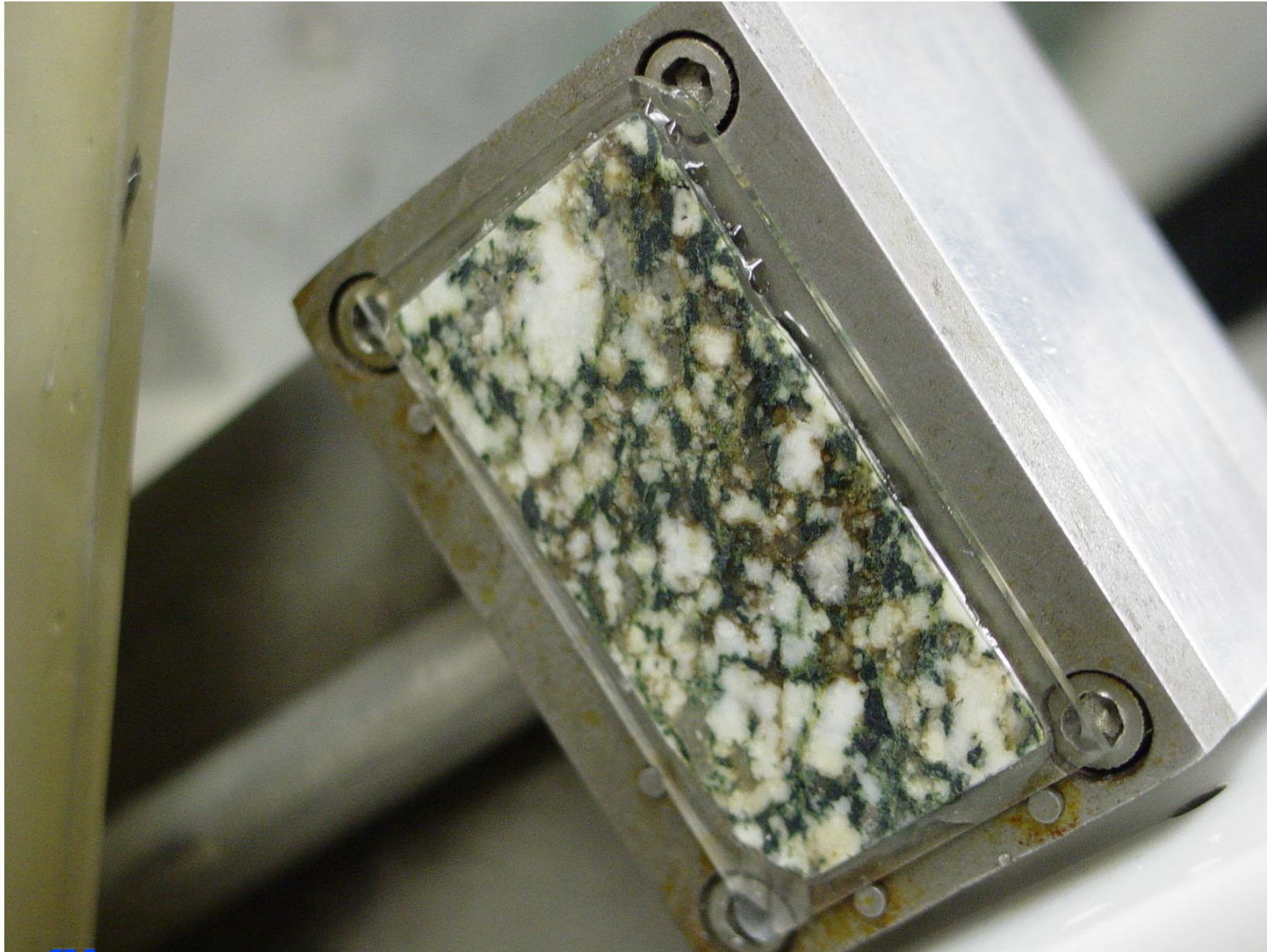
Step Seven: Grind your slide to the correct thickness

- Place a blank glass slide on the cut-off saw to block the vacuum.
- Turn on the water to the grinder.
- Turn the control towards you (counter-clockwise) a full rotation to zero.
- Be sure the slide holder and the slide are clean and free of any grit or particles.
- Place the slide on the grinder (maintaining the same orientation using the corner you notched).
- Turn on the vacuum and grinder motor.
- Moving the slide back and forth with the handle, gradually advance the control until the slide contacts the grinding wheel.
- While moving slide back and forth across the grinding wheel with the black handle, gradually advance the control until you reach a point about 15 ticks below your "zero value" (see step 2).

- Remove the slide (turn off the vacuum, break the vacuum with the button, then remove the slide) and see if you can identify any minerals in the section.
 - If you can, then proceed slowly until those minerals achieve the correct maximum interference color (e.g., quartz should show a maximum interference color of a pale straw yellow)
 - If you cannot, then advance one tick at a time until you can identify a mineral. If you are within 5 ticks of your zero value, and you still can't identify anything, stop and ask someone who knows more than you.
 - Go slow, especially when you are close to the correct thickness! It's quite easy to go from slightly too thick to slightly too thin (or ground completely away), ***even without advancing the position control at all!***

- Troubleshooting

- **Warning:** Most sections fail at this stage because you are grinding too fast! Remember, any time the grinder makes noise against a slide, you are removing rock. You often don't have to advance the wheel at all to just grind a small thickness away.
- If your section comes out with the minerals all cracked: **you were grinding too fast.**
- If your section comes out with the edges thin and the center thick: **you were grinding too fast.**
- If your section comes out thick on one side and thin on the other, you either didn't frost the slide well, or there was an uneven epoxy layer.

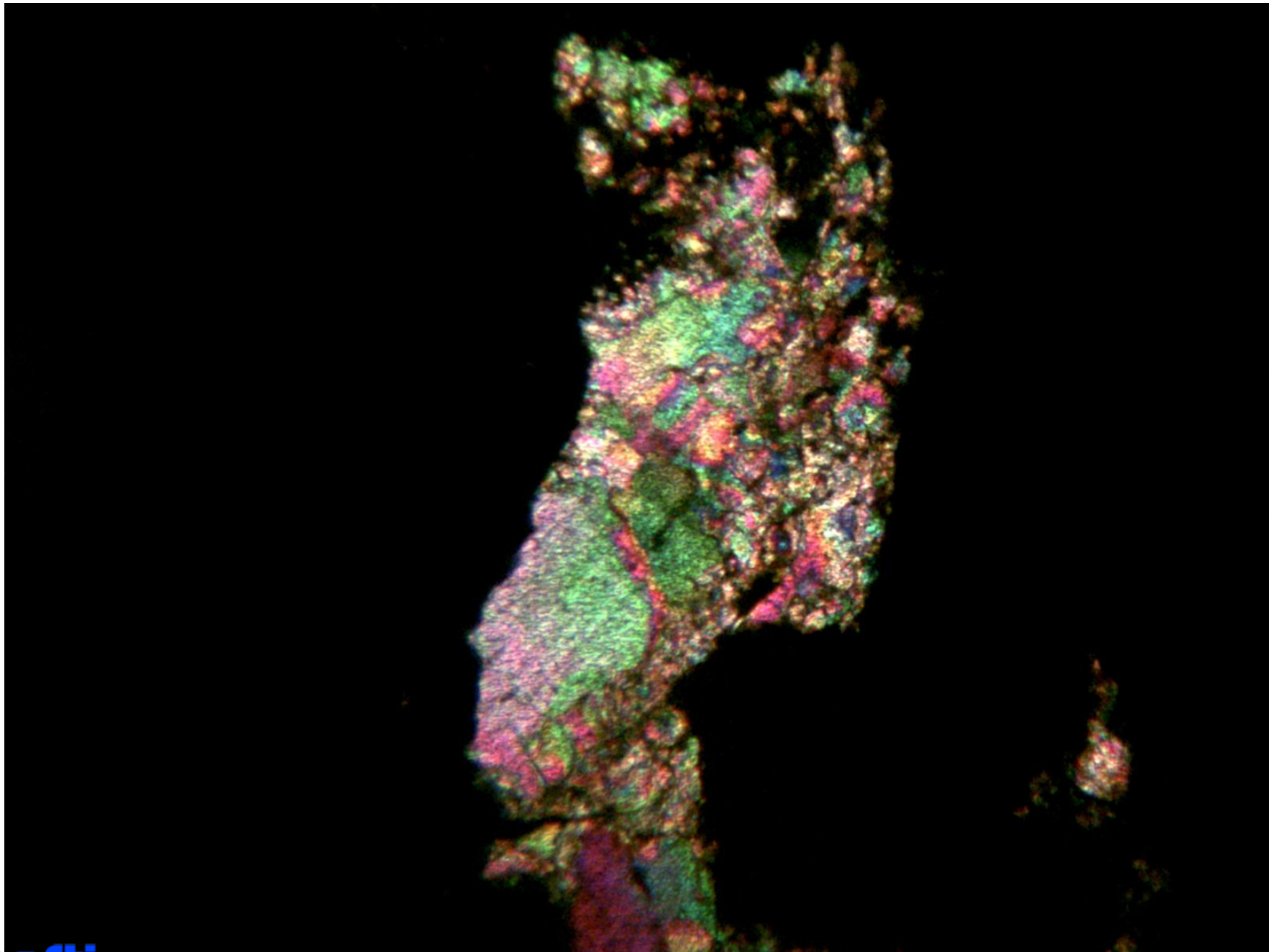


Ungrounded slide mounted in grinder holder.

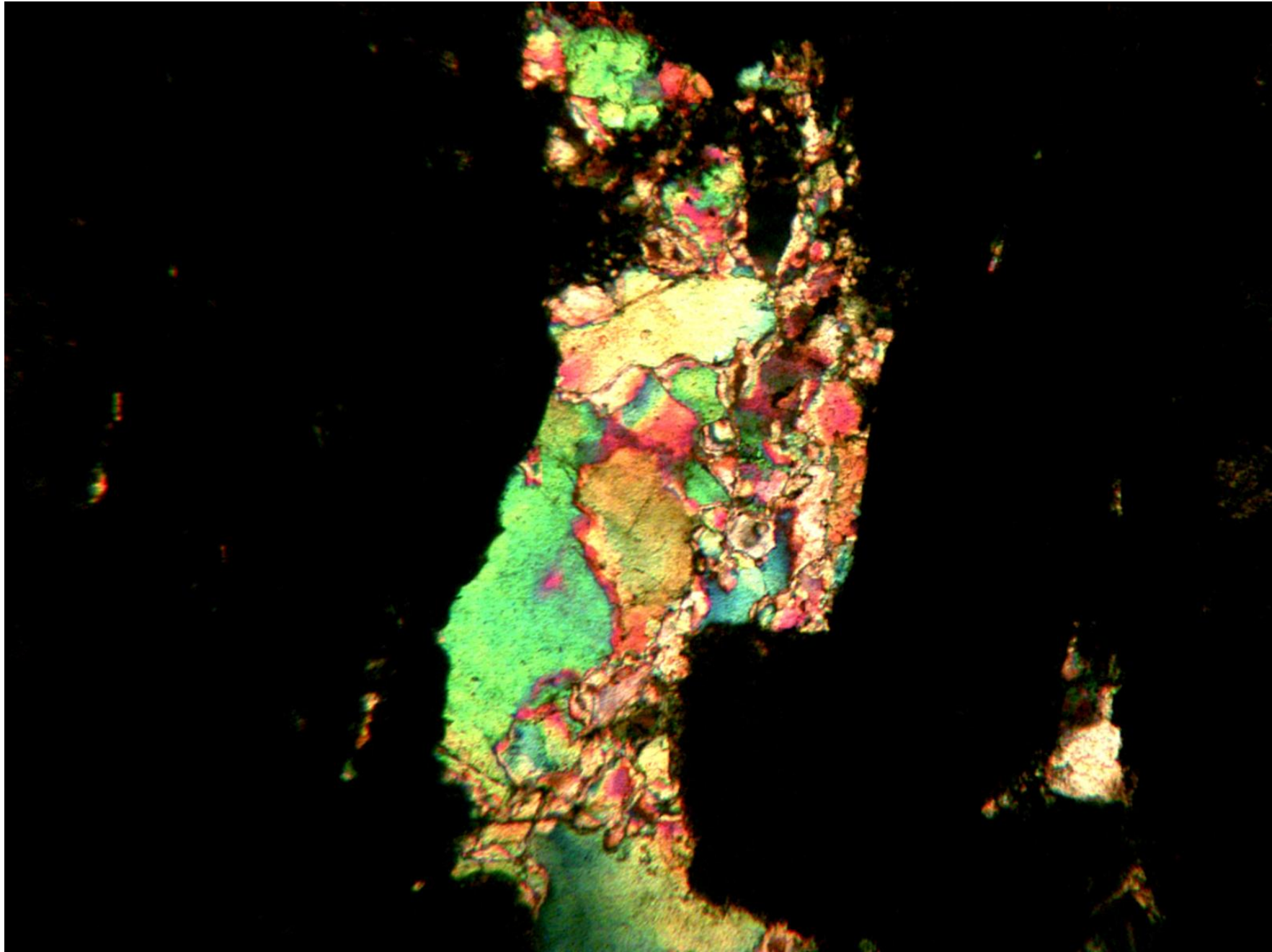




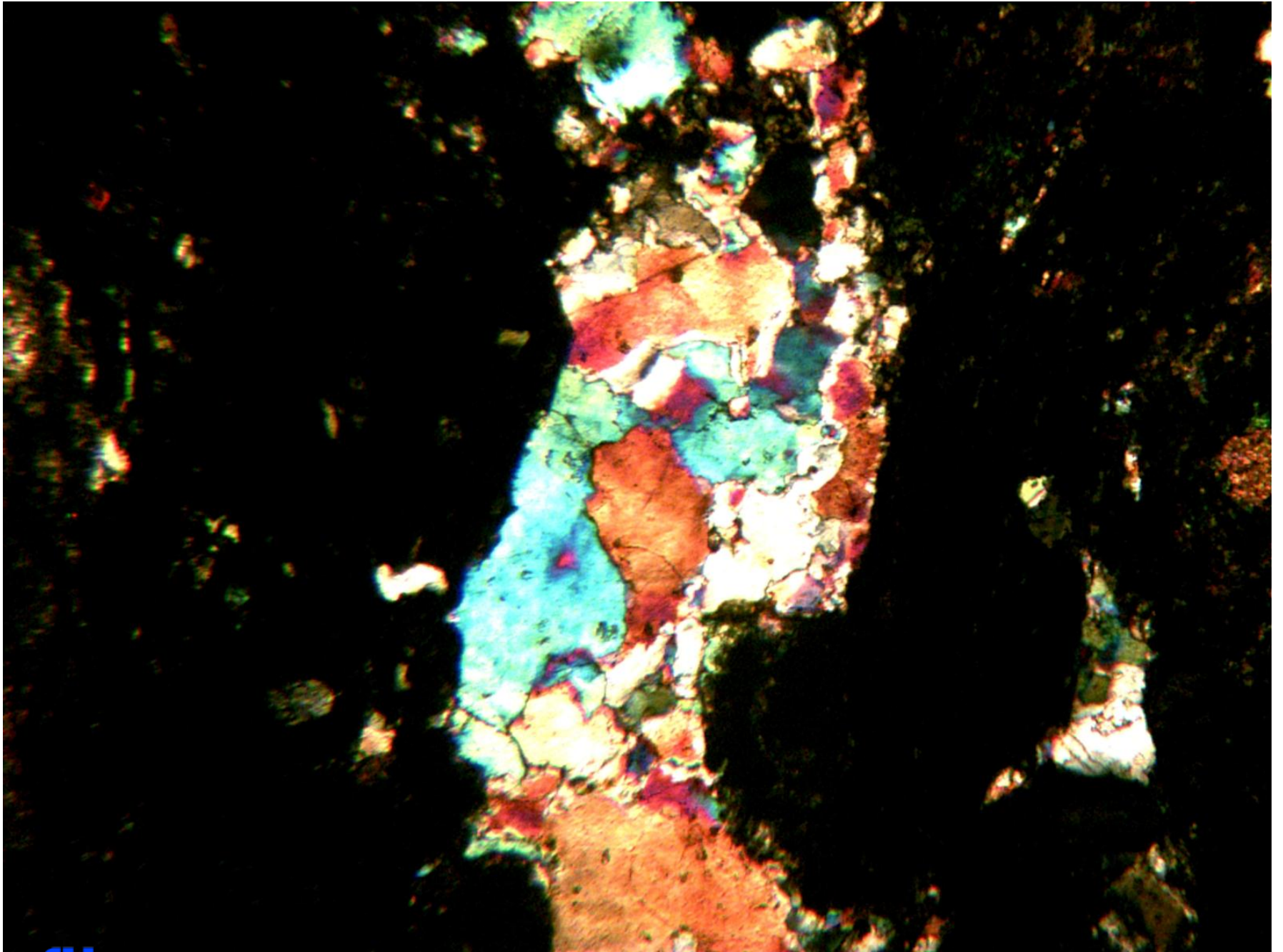
Checking the slide thickness using the microscope.



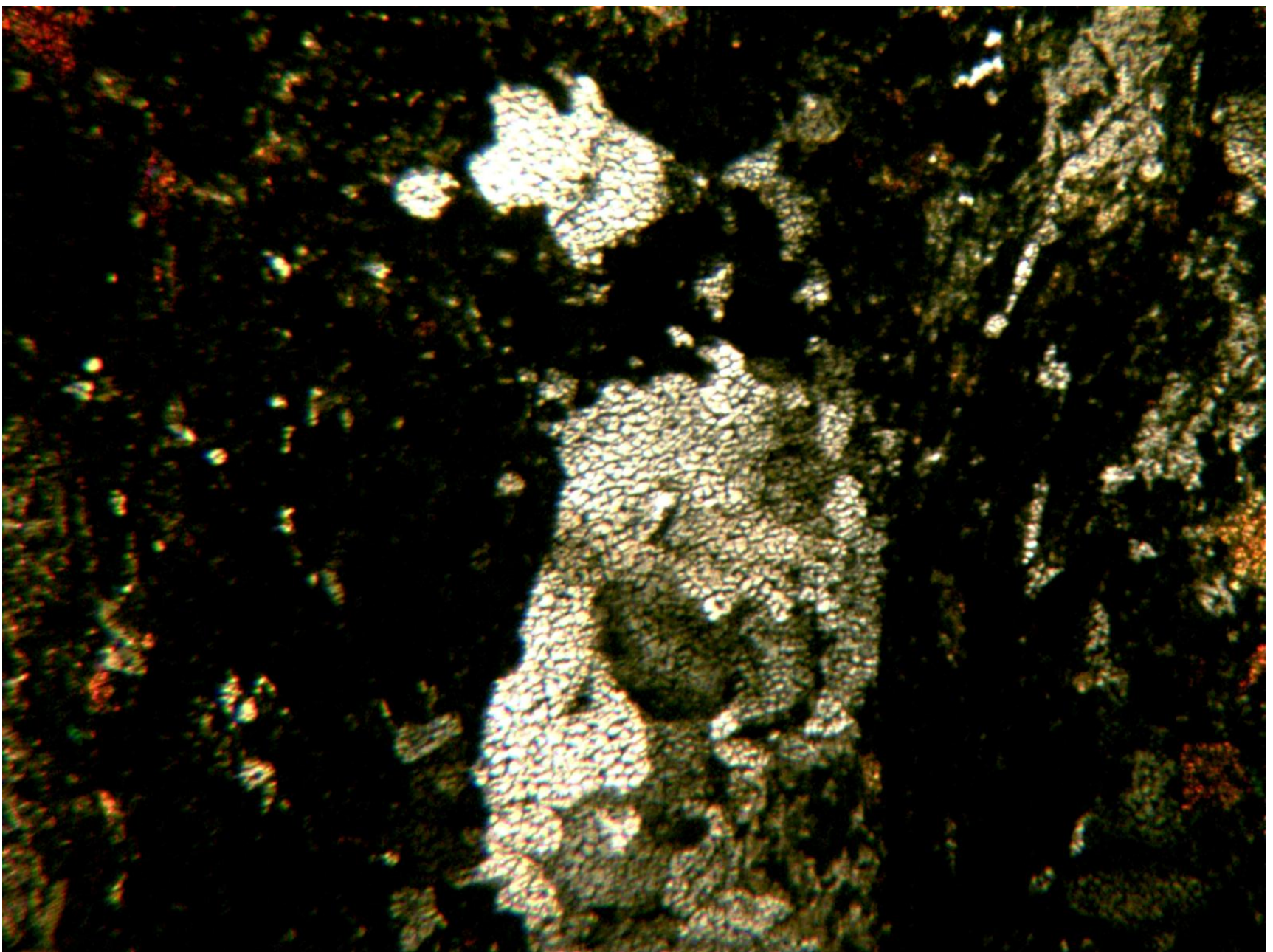
Quartz in a thin section, way too thick.



Quartz in a thin section, still fairly thick.



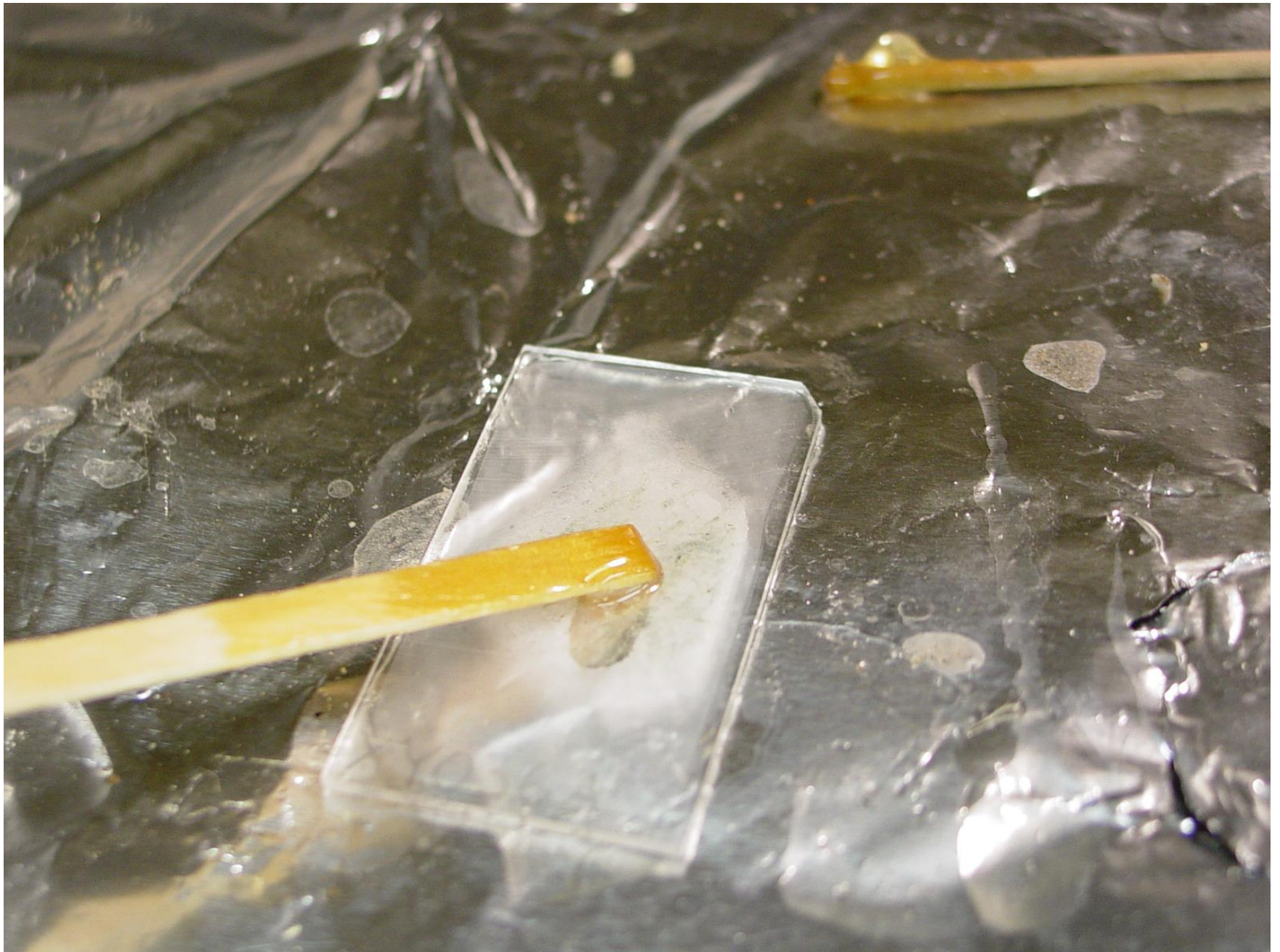
Quartz in a thin section, still a bit thick.



Quartz in a thin section, now too thin. At this point, much of the remaining section has been ground away.

Step Eight (version 1): Add a cover slip

- If you do not expect to perform chemical analysis on your minerals in this thin section, you should add a cover slip to protect the section from damage, and increase the clarity observed in the microscope. This process is a simple one:
 - ❑ Make sure the section is clean and free of grit or dirt.
 - ❑ Place it on the hot plate.
 - ❑ Mix up a small batch of epoxy and hardener.
 - ❑ Place a small drop of epoxy on the section.
 - ❑ Drop a cover slip on the drop.
 - ❑ Move it around to expel bubbles and fully coat the section.
 - ❑ Let it cure.
 - ❑ After it has cured, there may be extra epoxy on the top, sides, or bottom. You can remove this, **very carefully**, with a razor blade.



Putting a drop of epoxy on the ground slide.



Container for cover slips.



Dropping a cover slip on the slide. Put one end down first in order to prevent bubbles.



Moving cover slip to spread epoxy and expel bubbles.



مختصری درباره مراحل تهیه مقطع :

- برای تهیه کردن مقطع از یک سنگ یا کانی قسمتی از آن را توسط دستگاه برش داده سپس جدا می کنیم و باید توجه داشته باشیم که قسمتی را که انتخاب می کنیم باید از نظر فیزیکی دارای ویژگی های مطلوبی باشد سنگ را روی پودرهای مخصوص از درشت تا ریز به ترتیب و با حرکت ویژه دست در همه جهات کاملا سایش می دهند تا سطحی صاف و صیقلی بدست آید.
- بعد یک لام نیز با استفاده از پودر ریز سایش داده تا سطح آن از یک طرف کدر شود. اینکار برای جلوگیری از تشکیل حباب هوا در هنگام چسبانیدن سنگ به لام انجام می شود. سنگ صیقلی شده را روی هیتر گذاشته به صورتی که سطح صیقلی آنها به طرف بالا باشد و در تماس با هیتر نباشد. وقتی به طور کامل داغ شد، لام هم مقداری گرما داده و چسب کانادابالازام را روی سطح صیقلی شده لام و سنگ می مالیم و این دو را به هم می چسبانیم. باید دقت شود که به طور کامل حباب هوای بین لام و سنگ گرفته شود. بعد باید صبر کرد که این دو کاملا به هم متصل و چسب خشک شود.
- در مرحله بعد لام و سنگ همراه آنها روی دستگاه برش قرار داده و و سنگ را نازک می کنند. بعد از این مرحله چون سنگ به طور کامل توسط دستگاه ساب نازک نمی شود باید با دست و پودرهای ساینده اینکار انجام شود و وقتی مقطع به حدی نازک شد که کانی ها به وضوح مشخص بودند باید مقطع را خشک و سپس با چسب کانادابالازام مایع لامل را روی آن قرار داد.

مقطع صیقلی

- برای تهیه این نوع مقاطع نمونه به صورت مربعی در ابعاد (2x2 Cm) برش داده، داخل قالب مخصوصی (مانند قوطی فیلم عکاسی) قرار می‌دهیم و قالب را با چسب اپوکسی پر می‌کنیم. (چسب صمغ کانادا به علت ترک برداشتن مناسب نیست)، نمونه به مدت ۲۴ ساعت به صورت معلق در داخل چسب قرار می‌گیرد. سپس قالب را از بالا و پایین باز کرده و نمونه را همراه چسب از قالب خارج می‌کنیم و سطح آنرا برش می‌دهیم تا سنگ قابل لمس باشد.
- در ادامه کار ابتدا با پودر کروندم و مشهای مختلف پولیش می‌دهیم و بعد از هر مرحله نمونه را شسته و کار را بر همین منوال ادامه می‌دهیم. (به ترتیب از پودر مشهای ۳۲۰ ، ۸۰۰ ، ۱۲۰۰ استفاده می‌کنیم) سپس از خمیر الماسه که خود نیز دارای سایزهای مختلفی است، استفاده می‌شود. برای این کار خمیر الماسه ۶، یا خمیر الماسه ۳ میکرونی این کار را ادامه می‌دهیم. برای کانیهای فلزی تا مرحله ۳ میکرونی کافی می‌باشد، ولی در مواردی از خمیر الماسه‌های ۰.۵ میکرونی نیز استفاده می‌شود. بعد از هر مرحله با میکروسکوپ مقطع را کنترل می‌کنیم.
- هر زمان نور تابشی و بازتابشی به نحوی عمل کنند که کانیها بخوبی قابل شناسایی باشند، کار پولیش دادن را خاتمه می‌دهیم. این مقاطع بوسیله میکروسکوپیهای انعکاسی برای مطالعه کانیهای فلزی و اوپیک که نور از آنها عبور نمی‌کند، مورد مطالعه قرار می‌گیرند.

مقاطع دو کاره

- برای مطالعه همزمان دو کانی در کنار هم که یکی فلزی و دیگری سیلیکاتی می باشد، از این مقاطع استفاده می شود. در این مقاطع لامهای ضخیم بکار می برند، این مقاطع با میکروسکوپیهای انعکاسی که همزمان نور را هم از بالا و هم از پایین می تابانند، مطالعه می شود.

مقاطع فلوئید اینکلوزون

- فقط در موارد خاصی مانند آزمایش حرارت سنجی از این مقطع استفاده می شود. این مقاطع را همانند مقاطع نازک تهیه می کنند، ولی لام نمی چسبانند و مقطع را داخل یک حلال (استونی) قرار می دهند، تا چسب آن حل شود و بعد آن را حرارت می دهند تا کانیها ذوب شود و به این طریق دمای تبلور کانیها مورد بررسی قرار می گیرد.

انواع میکروسکوپ:

■ میکروسکوپ پلاریزان:

□ کاربرد آن در زمین شناسی است و برای مطالعه خواص نوری بلورها، شناسایی کانی ها، مطالعه پترولوژی و پتروگرافی سنگ های آذرین، دگرگونی و رسوبی از آن استفاده می شود.

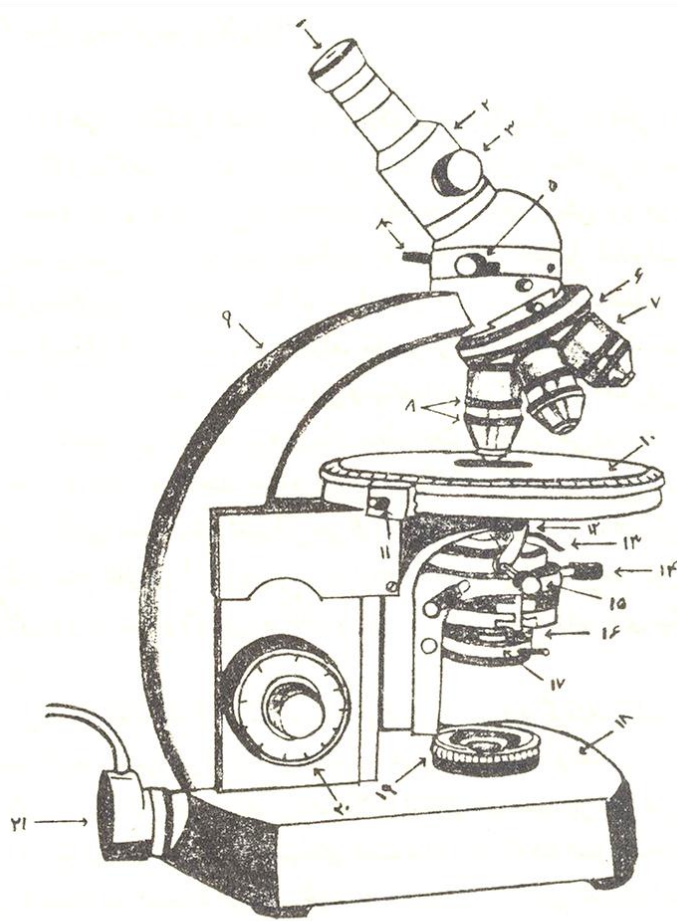
■ میکروسکوپ بیناکولار:

□ دوچشمی هستند و فقط اجسام را بزرگ می کنند. در زمین شناسی در قسمت فسیل شناسی کاربرد بیشتری دارد.

■ میکروسکوپ انعکاسی:

□ برای شناسایی کانی های فلزی مورد استفاده قرار می گیرند. (زیرا این دسته از کانی ها نور را از خودشان عبور نمی دهند) از این نوع میکروسکوپ برای مطالعه شکل و اندازه کانی ها، بررسی مراحل کانی سازی، وضعیت و رابطه نسبی کانی ها با یکدیگر استفاده می شود.

اجزای میکروسکوپ :



شکل ۱: ساختمان یک میکروسکوپ پولاتریزان از نوع زایس

- | | |
|---|--|
| ۱ - چشمی یا اکولر | ۲ - لوله میکروسکوپ |
| ۳ - پیچ عدسی برتران | ۴ - اهرم آنالیزور |
| ۵ - محل وارد نمودن تیغه‌های کمکی | ۶ - صفحه گردان جهت حمل و تعویض شیشی |
| ۷ - شیشی یا ابژکتیف | ۸ - پیچ‌های تنظیم شیشی |
| ۹ - دسته میکروسکوپ | ۱۰ - میز دوار و مدرج |
| ۱۱ - پیچ جهت مهار کردن میز دوار | ۱۲ - عدسی فوقانی کندانسور |
| ۱۳ - اهرم دیافراگم فوقانی (دیافراگم اریس) | ۱۴ - پیچ تنظیم کندانسور |
| ۱۵ - اهرم جهت بکار انداختن عدسی فوقانی کندانسور | ۱۶ - پولاتریزور |
| ۱۷ - محل وارد نمودن تیغه‌های کمکی | ۱۸ - پایه میکروسکوپ |
| ۱۹ - دیافراگم تحتانی | ۲۰ - پیچ جهت تنظیم تصویربرداری میکروسکوپ |
| ۲۱ - دستگاه تولید نور پولاتریزور | |