Σ-NOTES

THE SUM OF OUR EXPERIENCE

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PREPARATION OF PETROGRAPHIC THIN SECTIONS

Introduction

Petrography is the study of rocks and minerals using a microscope. Cross sections are useful for the identification of rocks, minerals and ores and to the characterization of properties such as cleavage, twining, reflectance and so forth.

There are two types of specimens prepared for petrographic analysis, thin sections and polished bulk specimens. Polished bulk specimens are similar to metallographic specimens in that the surface is prepared for examination with a reflected light microscope. Thin sections, on the other hand, are observed with a transmitted polarized light microscope.

The general preparation sequence for making transparent thin sections is as follows: sectioning, vacuum impregnation, grinding, cementing to a slide, resectioning, grinding and polishing. The preparation of thin sections is considerably more difficult than preparing polished bulk specimens. Generally, a thin section must be prepared to a thickness of approximately 30μm, with near perfect parallelism.

Preparation Procedure

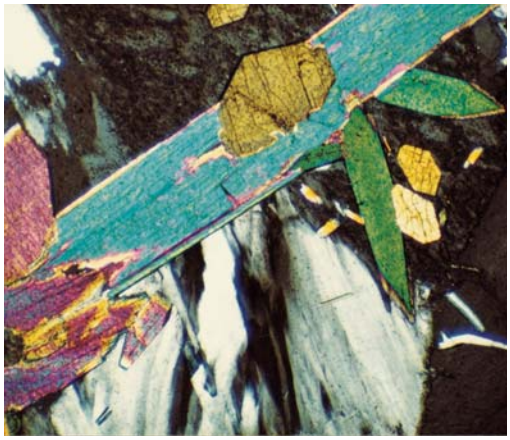
1. Thin sections begin with bulk sectioning to create a section approximately 3mm thick. Less well consolidated materials should be sectioned to produce a thicker section, up to 10mm in thickness.

2. Thoroughly clean and vacuum impregnate with EpoThin® Low Viscosity Epoxy to fill the pores and mechanically support the specimen material.

3. Grind the specimen “chip” to produce a flat, smooth surface, free of gross deformation. When selecting grinding and polishing abrasives, the chip is placed into one of two categories: Soft Materials (Sulfides, Carbonates, Sandstones, etc.) or Hard Materials (Granite, Basalts, Quartz, Chert and Ores). Table 1 and Table 2 present abrasive recommendations for each category. The first row represents rough grinding.

4. Determine if the entire surface of the chip has been ground flat. Hold the ground surface against light at approximately a 45 angle. An evenly reflective surface indicates that the entire surface has been ground properly. A non-uniform, dull surface may indicate that the entire surface has not been ground flat and should be ground for a longer time.

Note that some minerals, such as Biotite, may remain dull in appearance even after proper grinding. Do not remove excessive material as this may result in exposing un-impregnated pores.



Acmite, thin section, in polarized light. 100x.

5. Prepare to cement the chip to a glass slide. First, thoroughly clean the specimen to remove all loose abrasive and other residues, and then dry. Next, pregrind one side of the glass slide. This produces a slide of a more uniform thickness and the roughened surface aids in establishing a good bond. To control the slide thickness, use the 30-8001 Glass Slide Holder or the PetroThin® system. Generally, loose silicon carbide abrasive powders, with grit sizes of 600 or 1000 (P1200-P2000), may be used on a cast iron lap for grinding slides.

6. Attach the chip to the glass slide with epoxy using the recommendations below:

- Measure the resin and hardener according to the directions. Blend the ingredients thoroughly, but gently to avoid excessive formation of air bubbles. Allow the mixture to sit for a few minutes before using. This will allow any remaining entrapped air to rise to the top.
- Apply the epoxy sparingly to the ground surfaces of the chip and the slide.
- Carefully place the chip, adhesive side down, onto the coated slide. With moderate pressure move the chip back and forth over the slide to force out excess adhesive and air bubbles.

7. To obtain a uniform adhesive thickness, the PetroBond™ bonding fixture is recommended. Place the fixture on a hot plate to hasten curing of the epoxy. The temperature should not exceed 50 °C (122 °F). It takes approximately two to three hours for the epoxy to cure when heat is applied. Without

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the application of heat, thin sections may take 40-48 hours to cure properly depending on the ambient temperature.

8. Resection the specimen to reduce the thickness of the chip and minimize grinding time. Re-sectioning can be accomplished by using an IsoMet® Precision Saw or the PetroThin® Thin Sectioning System. When using an IsoMet® Precision Saw, a vacuum chuck (11-1188) is recommended for securing the glass slides.

9. Continue the preparation process using the methods outlined in Tables 1 and 2. To prevent overgrinding of the chip, the slide can be placed in a Thin section slide holder (30-8000). This device has boron carbide stops, which prevent grinding past 75µm thickness including the cement layer.

10. Examine the specimen using transmitted light once it has been ground to the desired thickness.

11. Continue the preparation sequence by polishing the specimen. A polished thin section can be examined with either a transmitted or reflected light microscope. Other advantages of a polished thin section include the following:

- Mineral hardness may be determined
- Chemical tests can be performed on the polished surface
- The time consuming procedure used for applying the cover glass is eliminated

Table 1. Abrasives for the Preparation of Soft Materials

Surface	*Abrasive/Size*	*Lubricant*
CarbiMet® Abrasive Disc *OR* Cast Iron Lap	240-600 (P280-P1200) grit SiC 600-1000 (P1200-P2000) grit SiC	Water Water mixed with CoolMet® (50:50) or lapping oil
UltraPol™	6µm diamond paste	MetaDi® Fluid or lapping oil
UltraPol™	1µm diamond paste	MetaDi® Fluid or lapping oil
MasterTex®	MasterPrep® 0.05µm	Distilled water

Table 2. Abrasives for the Preparation of Hard Materials

Surface	*Abrasive/Size*	*Lubricant*
UltraPrep™ metal bonded diamond disc	125-45µm diamond	Water
ApexHercules™ H	9µm diamond	MetaDi® Fluid
ApexHercules™ S	6µm diamond	MetaDi® Fluid
TexMet® 1500	3µm diamond paste	MetaDi® Fluid or lapping oil
UltraPol™	MicroPolish® II 0.3µm	Distilled water

Automation

Grinding and polishing thin sections by hand requires a great deal of expertise and time. Grinding by hand also tends to favor one side or the other of the thin section, eventually making one side thinner.

The PetroThin® system is self contained consisting of a diamond cutting blade, a diamond grinding wheel, and a vacuum chuck that accepts five sizes of glass slides. Two precision micrometers are used for controlling cutting and grinding of the thin section.

To grind the thin section, it is moved into the path of the grinding wheel as the micrometer accurately advances the thin section. Depending on the hardness and the friability of the specimen, 10-20µm of the specimen surface can be removed in one pass.

Ultra-Thin Section Preparation

Very fine grain materials consist of crystals that are smaller than 30µm in size. In that case, the typical thin section may contain several layers of the fine crystals and obscure microscopic observations. In order to best examine such a specimen, it is sometimes necessary to prepare ultra-thin sections.

Conventionally grinding the thin section further is unsuitable because at this thickness even light pressure can destroy the specimen. Instead, vibratory polishing is recommended. The vibratory polishing method is very gentle and removes material very slowly. Generally, specimens are polished with fine abrasives, such as 1µm diamond, on a TexMet® 1500 Pad, or with sub-micron size alumina on a MicroCloth® Pad using a VibroMet® 2 Vibratory Polisher.

*Equipment**

IsoMet® Family of Linear Precision Saws
PetroBond® Thin Section Bonding Fixture
PetroThin® Thin Sectioning System
VibroMet® 2 Vibratory Polisher

*Consumables**

IsoMet® Diamond Wafering Blade
EpoThin® Low Viscosity Epoxy
UltraPrep™ Diamond Discs
ApexHercules™ H & S Diamond Grinding Discs
CarbiMet® Abrasive Discs
TexMet® 1500
UltraPol™
MetaDi® Fluid
MasterTex® Polishing Cloth
MasterPrep® Alumina Polishing Suspension
MicroPolish® II 0.3µm Deagglomerated Alumina

****For a complete listing of Buehler Equipment and Consumables, please refer to Buehler's Equipment Buyer's Guide and Buehler's Consumables Buyer's Guide***

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