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# Improving Surface Quality of Petrographic Sections

## Purpose

Petrographic sample preparation has been around for many years. Preparing thin sections of rock and minerals for microanalysis, microstructure characterization, and mineral identification is common in the field of geological science. Sample preparation is critical in minimizing artifacts induced into the sample from mechanical deformation, cracking, and voiding. In the case of petrographic sections where electron backscatter diffraction (EBSD) techniques are used, the amount of deformation the specimen has must be eliminated as best as possible. This report outlines a basic polishing technique to help reduce the amount of surface damage, and thus mechanical deformation to improve EBSD results.

## Procedure

Petrographic samples generally require cutting in to relatively thin sheets (generally on the order of a few hundred microns thick) using a low speed diamond wheel saw. Sections of rock and mineral were cut into slices approximately 25mm x 50 mm using a low speed saw, such as the Model 650. Following cutting the sections are mounted to glass slides of similar dimension using an adhesive, such as a well penetrating epoxy. The section are generally sanded down using a series of silicon carbide abrasive papers, generally following a process flow of 240 grit, 320 grit, 400 grit, and 600 grit. Polishing is done using either diamond suspension or diamond pastes on a polishing cloth.

The sections obtained for this application had already been prepared using the techniques listed above. The surface finish still exhibited some mechanical deformation and damage in the form of scratches and small pits located in the minerals of the section. To improve the results obtained for EBSD the surface must be extremely smooth and free of any artifacts as described above. Using a precision lapping fixture and polishing machine, these sections were polished to eliminate the subsurface damage and to improve the surface quality of the sections. Each slide was mounted using a low melting point wax (MWM070). The slides were clamped onto the mounting block using a Model 112 Sample Mounting Fixture to ensure a uniform, parallel wax layer between the slide and the mounting block. Following wax mounting the sample/mounting block assembly was mounted into the Model 147D Lapping and Polishing Fixture. This polishing fixture is capable of holding samples up to 66 mm in diameter, and has a digital micrometer to help control the thickness of the specimen to within 1 micron. After the petrographic slide was mounted to the Model 147D, the entire assembly was placed onto the Model 920 Lapping and Polishing Machine for semi-automatic polishing. A workstation, Model 92022, was used for holding and rotating the Model 147D during polishing and is shown in Figure 1.

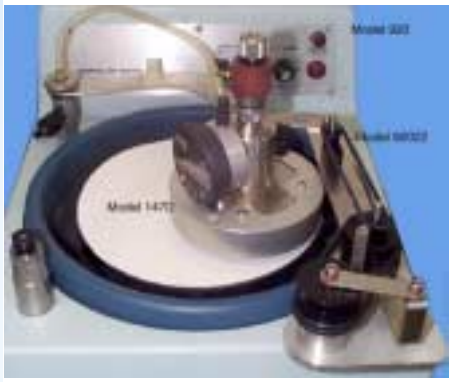

**Figure 1:** Image showing the Model 147D Lapping and Polishing Fixture mounted onto the Model 920 Lapping and Polishing Machine. The Model 147D is rotated and held in place using the Model 92022 Workstation. Oscillation of the fixture across the lapping plate surface is possible but was not used in this application.

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The polishing process used for this application was implemented based on previous sample preparation applied to the petrographic sections. A polishing cloth was used with diamond suspensions to polish the surface and eliminate mechanical damage induced from previous steps. The consumables and processing parameters are given below:

| **Stage 1** | | **Stage 2** | | **Stage 3** |
|---|---|---|---|---|
| Cloth: Sanypol™ Medium (PSM08A-10) | | Cloth: Sanypol™ Medium (PSM08A-10) | | Cloth: Sanypol™ Medium (PSM08A-10) |
| Diamond: 1 µm polycrystalline (DS010-16) | | Diamond: 0.5 µm polycrystalline (DS005-16) | | Colloidal Silica: 0.05 µm (CS1-16) |
| Load: 600 grams | | Load: 300 grams | | Load: 600 grams |
| Wheel Speed: 75 rpm | | Wheel Speed: 75 rpm | | Wheel Speed: 75 rpm |
| Time: 3 hours | | Time: 3 hours | | Time: 45 minutes |

**Table 1:** Parameters used during the preparation process.

**Results**

Following the specimen preparation process each petrographic slide was cleaned using acetone and isopropyl alcohol to remove any surface contamination from the polishing process. Images of selected areas of the petrographic slide prior to polishing and following polishing are given below. It is clear that the polishing protocol developed has greatly enhanced the surface quality of the sections and will enhance the quality of the EBSD image.

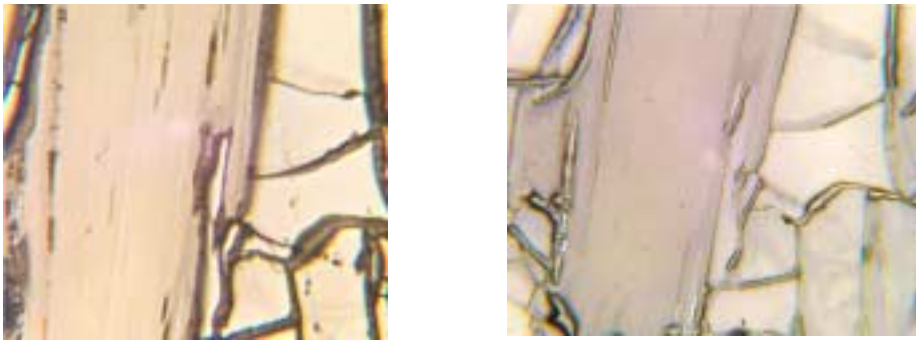

**Figure 2:** Reflected light images of first petrographic section prior to polishing (A) and following the polishing process (B). Note the reduction in the amount of subsurface damage and scratches as evidenced by the smooth surface. Reduction in the amount of preferential polishing at the edges of each mineral can also be observed. Magnification: 200x.

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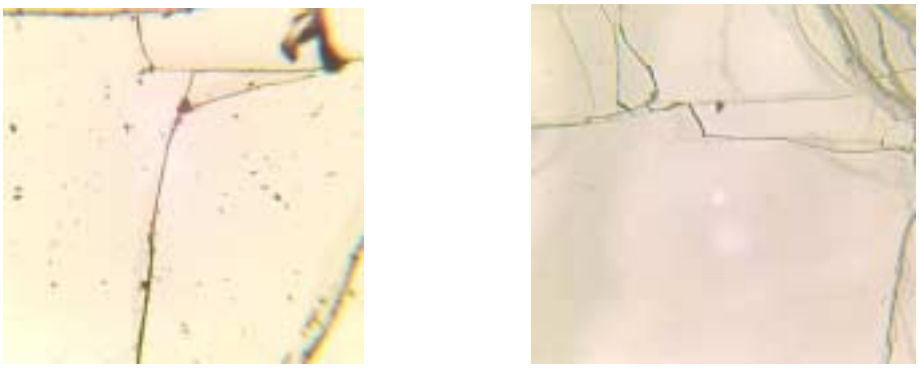

**Figure 3:** Reflected light images of second petrographic section prior to polishing (A) and following the polishing process (B). The reduction of subsurface damage is clearly visible again in these images. Magnification: 200x.

## Conclusion

Petrographic specimens can easily be prepared and improved using the South Bay Technology specimen preparation systems. Using precision equipment, high quality abrasives, and smart consumables selection, excellent results can be achieved that will improve specimen quality.