

Thin section

With VINCI Technologies equipment

Petrography and Petrology studies



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Introduction

The microscopic investigation of solids such as minerals, rocks, ores, ceramics and fossils under polarized light relies on a material's optical and morphological properties. Notably, thin section microscopic observation remains the standard and most efficient material characterization method.



Polarized versus Non-polarized

Thin section polarized-light microscopy is a simple, cost-effective and non-destructive technique utilized to delineate crystalline or amorphous solids at varying scales and spatial resolutions; thereby allowing the different phases to be studied within their textural framework. Estimates of chemical composition and insight into the solid's genesis can be deduced via unique textural characteristics (structure, fabric, phase, assemblage, phase relationships, reaction textures).

Thin section analysis serves as a basis for Petrography and Petrology studies. Sample preparation requires specialized, precise equipment having a high level of repeatability and accuracy regardless of sample type. Vinci Technologies covers the entire preparation process from initial chipping to the final polishing.

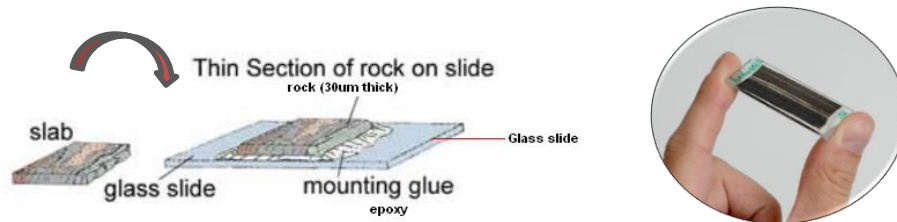
Thin section

User-friendly and safe, our equipment incorporates features such as hazard-free diamond impregnated blades, mounted clamping mechanisms to facilitate tasks, housing and covers to contain debris and projectiles, coolant feeding and recovery system and vacuum suction ports to adhere samples.

Thin Section

A thin section is a pre-prepared 30 μm (= 0.03 mm) +/- 2 μm thin slice of solid material, having at least one glass slide glued to one of its sides with epoxy. Placed between two polarizing filters at the right angle, the in-situ minerals' different optical properties alter the colour and intensity of the reflected light.

Rock specimens are often friable and brittle by nature therefore thin section preparation requires meticulous, reliable slabbing, grinding, lapping and polishing machines.



Thin Section description

Typical rectangular thin sections are 26 mm x 46 mm, although Vinci equipment permits size customization. Samples are often enclosed by two glass slides to isolate the sample and prevent contamination. The epoxy glue utilized to do so must be isotropic so as to not impede polarized microscopic observations. Epofix is used for embedding and impregnation.

The epoxy ideally has an index of refraction of 1.54, although it could be slightly higher, 1.56 in some cases. A high quality thin section can be prepared from core chips, sidewall cores, core and plug samples (consolidated and unconsolidated) and drilling mud cuttings.

A perfect source rock thin section contains plentiful information:

- shale volume,
- shale distribution
- porosity varieties and abundances with a discussion of diagenesis
- diagenetic sequence
- porosity origins
- development, controls on porosity and permeability

Outlined below are the standard procedures and tools utilized to prepare thin section samples:

- ↳ Slabbing
- ↳ Cutting
- ↳ Embedding
- ↳ Initial face grinding or lapping
- ↳ Bonding
- ↳ Slicing
- ↳ Lapping or grinding to 30 μm thickness
- ↳ Polishing

Thin section

This process consists in carving out a cubic fragment from a larger, irregularly shaped, cumbersome volume. The fragment, denoted as the chip, will progressively be transformed into a thin section.



Rock chip obtained from slabbing

Slabbing: RSS-400 Radial slabbing saw

The RSS- 400 Radial Slabbing Saw is a versatile diamond impregnated radial blade used for sectioning large specimens down to a manageable size. In this step a rock is slabbed multiple times to enable a sedimentological description, core photography and sample area selection in the case of heterogeneous rock. The device warrants maximum cutting depth and length of 5 and 12 inches, respectively.



RSS-400



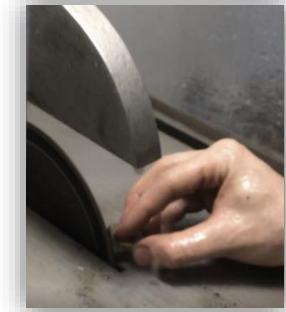
Large irregular rock slab down

Cutting: CS-200 Cutting saw

The CS-200 provides a supplementary, highly precise manual rock cutting method. The device warrants maximum cutting depth and length of 5 and 6 inches, respectively.



CS-200



Down to a small cubic shape

The bulk material is manually fed through the blade while a splash shield and deflector protect the operator from debris and projectiles. The diamond impregnated blade's high quality and stability ensures specimen integrity during cutting operations. Moreover, the blade edge is dull and cutting is achieved by a fine layer of diamonds impregnated on each side of the blade, thereby ensuring a hazard-free operation.



Safe operation

Embedding: VEU - Vacuum embedding unit

This step is compulsory for highly brittle and friable rocks. The impregnation resin fills pores, and prevent crack initiation and propagation. To augment its effectiveness, embedding is carried out in a vacuum environment via the resin dispenser. Its flexibility facilitates resin deposition and attaining a flat, parallel finish. The latter is crucial in obtaining perfect thin sections.

The Vacuum Embedding Unit permits 10 simultaneous, isothermal specimen impregnations at up to 80°C. The chips are fitted into rubber moulds and placed polished side up on the heated base plate which results in resin viscosity reduction and homogeneous impregnation. The chamber's see-through walls permit continuous monitoring. On average, the epoxy will cure in 20-30 minutes. The latter is fed by the resin dispenser nozzle after the chamber has been vacuumed. The vacuum, controlled with a leak valve, releases trapped bubbles and augments the curing time, to maximize impregnation quality. Optionally, the vacuum pump can be integrated into the instrument for standalone operation.



Resin impregnation for highly brittle and friable rocks



VEU

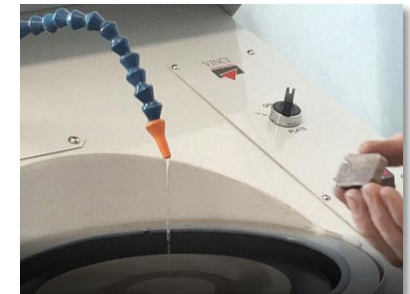
Initial face grinding or lapping : LGP-250 Lapping & grinding machine

This step is to prepare flat and relief-free-sample surface for bonding/cementing the sample on to a glass slide. This critical operation can be performed by either the LGP-250 or the LM-500.

The latter is a fully automated device capable of concomitantly handling up to 24 samples. The LGP-250 manual device is capable of lapping, grinding and polishing (different rotating plate).



LGP-250



Lapping on cast iron discs with silicon carbide powder

Bonding: BJ-12 Bonding jig

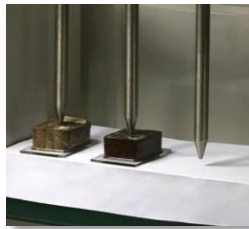
Post-first face lapping, a glass slide is glued to the lapped chip face. The bonding jig ensures uniform bonding material thickness. Another essential step, the success of grinding, lapping and polishing relies heavily on bonding quality.

Specifically, the objective is to obtain a very thin and bubble-free layer of glue. If chemical analyses are not part of the experimental protocol, a cover slip should be added to protect the sample, and increase the microscope image quality (cover slip fills light scattering surface cracks and pits).



BJ-12

Up to 12 small samples (26x46, 27x47, 28x48, 30x45 mm) or 6 large samples (50x75 mm) can be bonded coetaneously. Moreover, the base plate can be heated up to 80° to polymerize and harden the glue.



Uniform pressure & heated plate

Slicing: SS-150 High precision Slicing Saw

The SS 150 machine warrants rock chip slicing down to a 200 µm thickness with extreme precision prior to the final lapping. The compact bench-top unit is made of a heavy duty frame that provides a stable and vibration free base. A sliding weight arm enables the end user to effortlessly exert a constant, continuous force on the specimen for a high quality finish; partially attained by the highly stable 150 mm blade. The desired thickness is preset by means of a digital micrometer with a 5 µm resolution. A versatile vacuum chuck warrants various chip sizes. Cutting is performed in a see through, hermetic enclosure that reduces noise and contains coolant and debris, resulting in a cleaner and more enjoyable operation. The compartment also protects the machine's sensitive electronic and mechanical components. The frame encompasses a cabinet housing a coolant filtration and recirculation unit made of a 10 liter tank, filter and induction pump. Moreover a top shelf is included for storage purposes.



SS-150



Slicing down to 200 µm with extreme precision

Lapping to final thickness 30μ: LM-500 Lapping machine

An ultimate lapping procedure is required to reduce the sample down to its final thickness. The latter can be achieved with the aforementioned LGP-250 and LM-500 machines. The LGP-250 series are best suited for low volume sample processing whereas the robust LM-500 is built for industrial scale, fully automated operations.



LM-500



Prepare up to 6 chips or 24 thin sections at once

The device is mainly composed of a rotating grooved cast iron plate, a chip lapping jig, a precision thin section lapping jig, a lapping thickness tuning tool, an unevenness correction rim and an abrasive fluid (e.g. silicon carbide) dispensing and recycling system. Via a control panel, the operator can manually control the apparatus or run it in the automatic mode.

The grooves on the cast iron plate provide a greater material removal rate by preventing an accumulation of the abrasive particles between the plate and the specimens.

The lapping jig retains specimens using a vacuum mounting technique and allows precise control of specimen orientation on the lapping plate. The chip lapping jig's bottom is interchangeable allowing the use of a 3 large-chip holder or a 6 small-chip holder. The thin section lapping jig's configuration is similar and can hold up to 12 large samples or 24 small samples. The correction rim corrects plate misalignment, yielding a perfect flat, parallel surface. Moreover, the silicon carbide solution dispenser ensures an immaculate finish and its automatic operation occurs only when the plate is rotating to optimize consumption.

Slicing and grinding to final thickness 30μm: SG-200 slicing and grinding machine

The SG-200 is a semi-automatic device designed for two rapid simultaneous sample slicing or grinding.



SG200

Thin section

A versatile vacuum chuck designed for various slide sizes adheres the sample during slicing. Highly accurate positioning screw type micrometers control slicing and grinding thicknesses.



Two samples simultaneously



Highly accurate positioning

The SGL-200 incorporates the same features as the SG-200 with the addition of lapping capabilities by virtue of a top-mounted rotating place, thereby saving time and space.



SGL-200

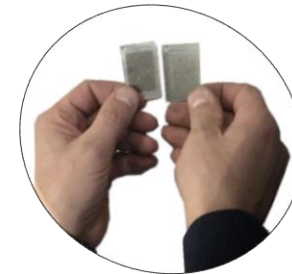
Sample polishing: AP-250 and LGP-250-P Polishing machines

High reflectivity can be achieved by polishing the sample once the sample thickness has been decreased to 30 μm . The automated polishing machine AP-250 performs simultaneous, flawless polishing of up to 4 thin sections with low relief, ultra-flat surfaces and minimum edge roll.

The device functions with both polishing cloths and magnetic polishing discs. A grinding and polishing head can be combined for better results. The final polishing is performed with diamond or oxide polishing suspensions as they remove any minute deformations. Polishing operations are performed the fastest with the AP-250.



AP-250



High quality finish



LGP-250-P

The alternative LGP-250 equipped with a special head allows the efficient, simultaneous polishing of up to 4 thin sections. Variable weights apply a force to hold the sample's position on the disc. Unlike the AP-250 model, the LGP-250 accepts thin-sections as well as chips.