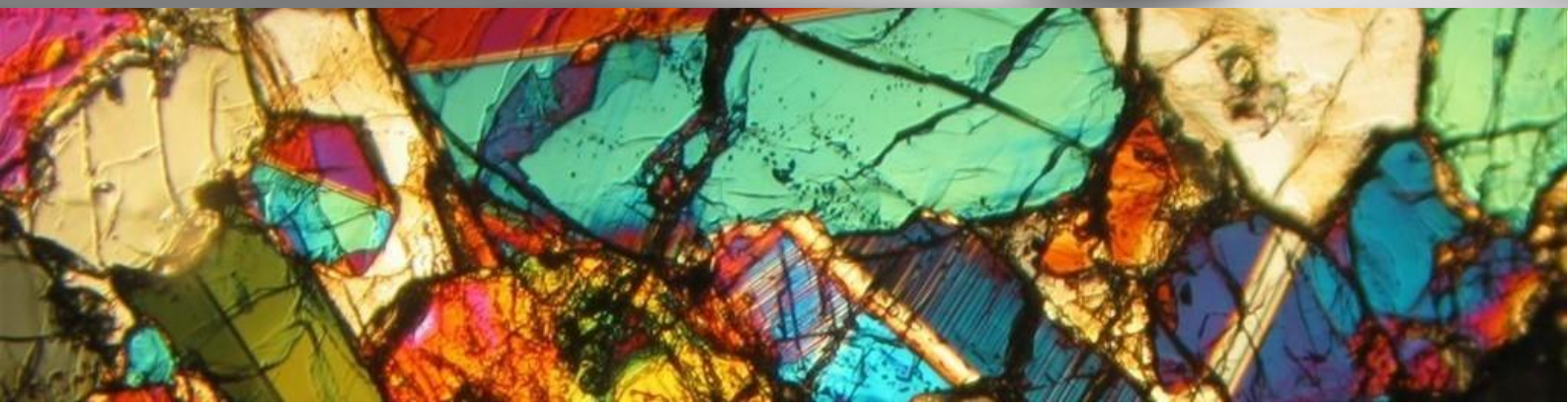
metkon
Technology behind Specimen



PETROGRAPHY GUIDE

metkon.com

QUARTER CENTURY OF EXPERIENCE

PETROGRAPHY

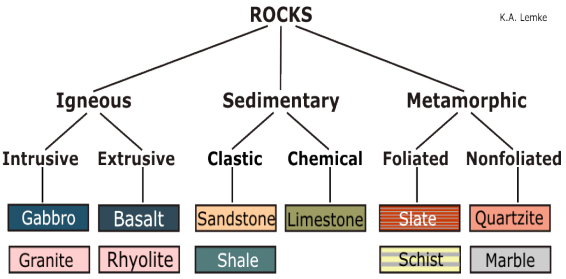
Petrography is the microscopic study of rocks, minerals or man-made materials. It is a powerful tool for investigating the composition, microstructure and inter-component relationships. Helps to:

- **Obtain a smaller, manageable sized specimen from the parent material,**
- **Expose the internal surface of interest for grinding;**
- **Reduce the thickness of the sample to minimize time for subsequent grinding as in thin sectioning.**

GENERAL

Petrology includes the subdisciplines of experimental petrology and petrography.

Experimental petrology involves the laboratory synthesis of rocks for the purpose of ascertaining the physical and chemical conditions under which rock formation occurs.



Petrology relies heavily on the principles and methods of mineralogy because most rocks consist of minerals and are formed under the same conditions. Also essential to petrological research is the careful mapping and sampling of rock units, which provide data on regional gradations of rock types and on associations unavailable by other means.

Petrography is primarily concerned with the systematic classification and precise description of rocks.

Petrography is the study of rocks in thin section by means of a petrographic microscope (*i.e.,* an instrument that employs polarized light that vibrates in a single plane).

In optical mineralogy and petrography, a **thin section** (or petrographic **thin section**) is a laboratory preparation of a rock, mineral, soil, pottery, bones, or even metal sample for use with a polarizing petrographic microscope, electron microscope and electron microprobe.

MAIN PETROGRAPHY APPLICATIONS

Geological Engineering

Archaeology

Concrete

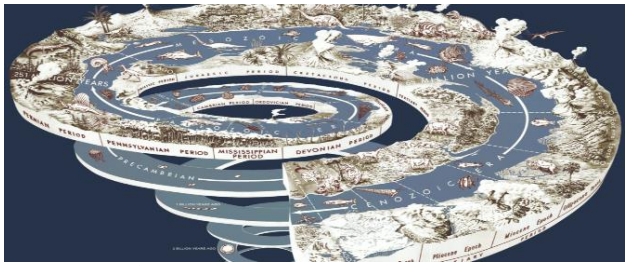
Astronomy

Coal

Mining

Petro Chemical

Restoration



Jeochronology

SAMPLE PREPARATION PROCEDURES

THIN SECTIONING

1 SECTIONING

The rock is cut from area of interest for analysis.

2 Sticking Specimen

The specimen is bonded to glass slide with adhesive resin

3 Resectioning

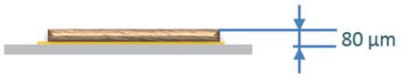
Re-sectioning of the specimen to a thickness of 0,5 - 2 mm to shorten the grinding process

4 Precision Grinding

The specimen is grinded to a thickness of 80µ (specimen + resin)

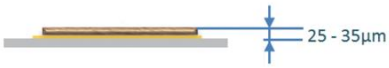
5 Lapping & Polishing

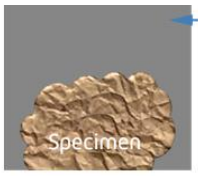
Automatic lapping & polishing of thin section with LAP-TS and POL-TS.
Final thickness 25 – 30µ
(specimen + resin)

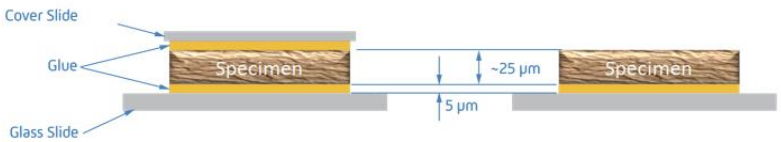


6 Microscopy

The thin section is ready to be observed under polarized light microscope IPP 902.







	Thin Sections + Glass Slide	Polished Thin Sections	Polished Sections
Microscope	**Transmitted Light**	**Transmitted + Reflected Light**	**Reflected Light**
Information	Composition Properties Textural Relationships Grain Density Porosity Type Paragenesis	Composition Properties Textural Relationships Grain Density Porosity Type Paragenesis	Composition Properties Textural Relationships

APPLICATION REQUIREMENTS

GEOCUT 302

	Order Code	Description
Equipment Used	14 04	GEOCUT 302
Attachment	GR 1811 15 05	Quick Clamping Device KKP 040 Vertical Clamping Device
Cutting disc	19-252	ø 250 Diamond Cut-off wheels for hard petrographic applications

GEOFORM 102

	Order Code	Description
Equipment Used	18 02	GEOFORM 102
Attachment	GR 1866 GR 1868 GR 1870 GR 1880 40 41 40 1000	Vacuum Pump Fixed Vacuum Stand Vacuum Chuck for Cutting Vacuum Chuck for Grinding Standard Slides 27x46x1.27 SiC Powder 1000 grit
Cutting disc	19 203	ø 200 Diamond Cut-off wheels
Grinding wheel	19 155	Ø 175 Diamond cup grinding wheel, 65 mic

GEOFIX & HOT PLATE & EPOCOLD Cold Mounting Set

	Order Code	Description
Equipment Used	45 61 45 65 29-505 29-506	GEOFIX HOT PLATE for GEOFIX EPOCOLD R Epoxy Resin(1000ml) EPOCOLD H Epoxy Hardener(230ml)
Attachment	29-551 29-552 29-553	Spatulas Mixing Beakers Embedding Form, ø 25 mm

FORCIPOL TS + FORCIMAT TS

	Order Code	Description
Equipment Used	36-21 TS 30 13	FORCIPOL TS FORCIMAT TS
Attachment	31 31 31 75 39-003-300 39-093-300	Aluminum Disc, 300mm Splash Guard, 300mm Ø300mm, Special Magnetic Foil Ø300mm, Thin Metal Plate
Sample Holder	33 10 33 11 33 40	LAP-TS special specimen holder POL-TS special specimen holder for polishing Individual force specimen holder (For LAP-TS and POL-TS holders)

GEOLOGICAL ENGINEERING

Minerals and rocks are the essential building blocks of the geosphere. Although there are over 3,000 species of minerals, only a few of them, such as quartz, feldspar, mica, amphibole, pyroxene, olivine and calcite, occur commonly as rock-forming minerals. Rocks are classified into three main types, igneous, sedimentary, and metamorphic, depending upon their mode of formation. Over geological time, rocks gradually are transformed from one type to another in what is termed the Rock Cycle. The origin of any particular rock can be determined by careful examination of its texture, composition, and internal structure, features that form the basis of rock identification and classification.

A rock is a solid, inorganic, naturally-formed substance without a particular atomic structure or chemical composition. It's probably easier to just remember that rocks are made up of two or more minerals. Examples of rocks include granite, limestone, marble, pumice, obsidian, sandstone, shale and slate. Each of these rocks consists of several different minerals, which are mixed up inside the rock through a variety of geologic processes.

Let's take granite, for example. Granite is mostly composed of three minerals: quartz, feldspar and mica. Each of these minerals can be found alone in nature, but here, they are mixed up inside of the rock.

Sometimes you see large chunks of one of these minerals inside of the granite. But, when you take the stone as a whole, you have to call it a rock.

Other rocks are much finer grained than granite, so it's not easy to spot the different minerals. Slate is a rock that was made from clay, and clay is composed of tiny, tiny particles.

In this application, rock samples will be prepared as Petrographic purpose.

SAMPLE PREPARATION PROCESSES

Sample has been cut and reduced the size for glass slide dimension on GEOCUT 302.

Before the operation, glass slide has been roughened by the help of 1000 grit SiC powder [40-1000].

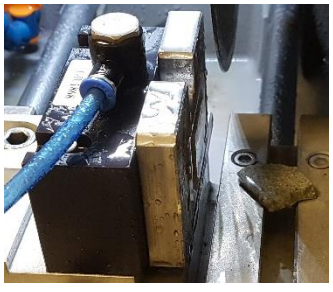
After the roughened glass slide step, preparing EPOCOLD mixture for bonding process of rock.

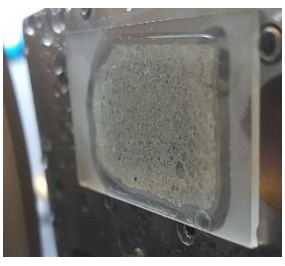
If the surface of the sample to be bonded is not planar, it may be necessary to smooth the surface manually with Forcipol TS.

Parameters for EPOCOLD mixture:

Parameters:	
Resin	5 part
Hardener	1 part
Mixing Time	About 2 min.
Curing Time	About 8 hours.

Sample ready for the Cutting and grinding operations on the GEFORM 102.





For grinding operations preferred these methode:

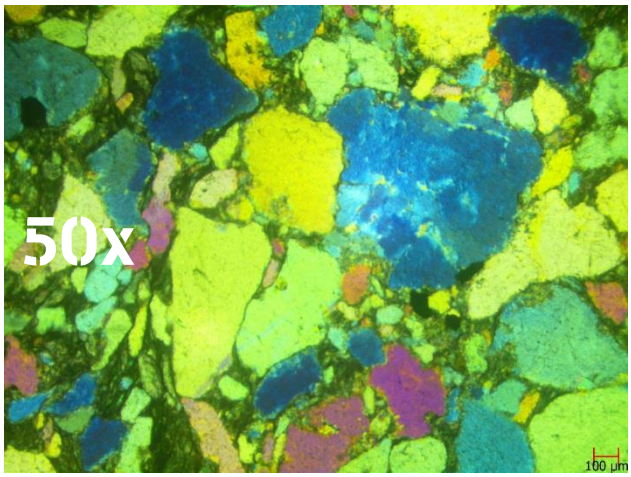
Sample has been grinded 100 µm steps by the help of GEOFORM 102's micrometer until to the thickness was reached 200 µm.

After reached 200 µm, grinding steps values decreased to 25 µm steps reached to the 100 mic thickness for sensitive grinding.

After the operation, preparation continued with automatic process on FORCIPOL-TS & FORCIMAT-TS.

Final grinding and polishing parameters can be seen below. On the final grinding step, sample need to checked under the microscope. often.

Sample final thickness about 40 µm.



	Surface	Abrasive	Lubricant	Force Per Sample (N)	Time Min.	Disc Speed Rpm.	Disc Speed Rpm.
Final Grinding	MAGNETO 6 38-050-006	Diamond	Water	5 N	As needed	50 CW	50 CW
Final Polishing	METAPO-B 39-033-300	DIAPAT-M 39-420-M	DIAPAT 39-502	5 N	8 min.	50 CCW	50 CW

CONCRETE

Concrete, in construction, structural material consisting of a hard, chemically inert particulate substance, known as aggregate (usually sand and gravel), that is bonded together by cement and water.

Concrete is characterized by the type of aggregate or cement used, by the specific qualities it manifests, or by the methods used to produce it. In ordinary structural concrete, the character of the concrete is largely determined by a water-to-cement ratio. The lower the water content, all else being equal, the stronger the concrete. The mixture must have just enough water to ensure that each aggregate particle is completely surrounded by the cement paste, that the spaces between the aggregate are filled, and that the concrete is liquid enough to be poured and spread effectively. Another durability factor is the amount of cement in relation to the aggregate (expressed as a three-part ratio—cement to fine aggregate to coarse aggregate). Where especially strong concrete is needed, there will be relatively less aggregate.

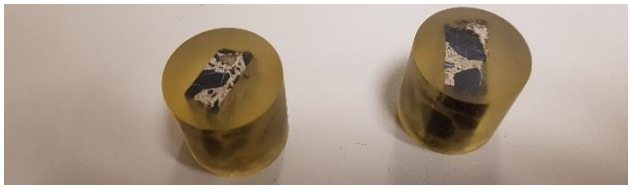
Concrete that has been hardened onto imbedded metal (usually steel) is called reinforced concrete, or ferroconcrete. Its invention is usually attributed to Joseph Monier, a Parisian gardener who made garden pots and tubs of concrete reinforced with iron mesh; he received a patent in 1867. The reinforcing steel, which may take the form of rods, bars, or mesh, contributes tensile strength. Plain concrete does not easily withstand stresses such as wind action, earthquakes, and vibrations and other bending forces and is therefore unsuitable in many structural applications. In reinforced concrete, the tensile strength of steel and the compressional strength of concrete render a member capable of sustaining heavy stresses of all kinds over considerable spans. The fluidity of the concrete mix makes it possible to position the steel at or near the point where the greatest stress is anticipated.

In this application, concrete part prepared as Petrographic purpose.

SAMPLE PREPARATION PROCESSES

Sample has been cut and reduced the size for glass slide dimension on GEOFORM 102.

The sample surface was hollow; therefore, the samples were molded to Ø25 mm embedding forms by using EPOCOLD cold molding products before bonding to the glass slide. Thus, the cavities in the sample were filled with the epoxy.

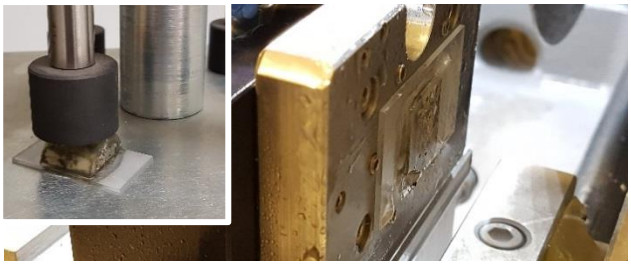


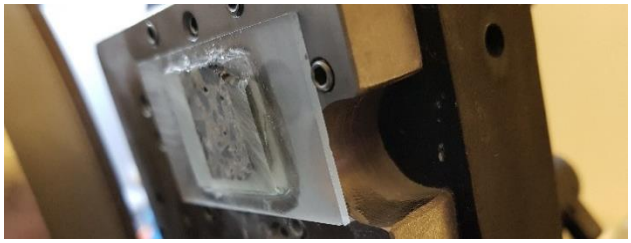
Before the operation, glass slide has been roughened by the help of 1000 grit SiC powder [40-1000].
After the roughened glass slide step, preparing EPOCOLD mixture for bonding process of concrete.

If the surface of the sample to be bonded is not planar, it may be necessary to smooth the surface manually with Forcipol TS.

Parameters for EPOCOLD mixture:

Parameters:	
Resin	5 part
Hardener	1 part
Mixing Time	About 2 min.
Curing Time	About 8 hours.





For grinding operations preferred these methode:

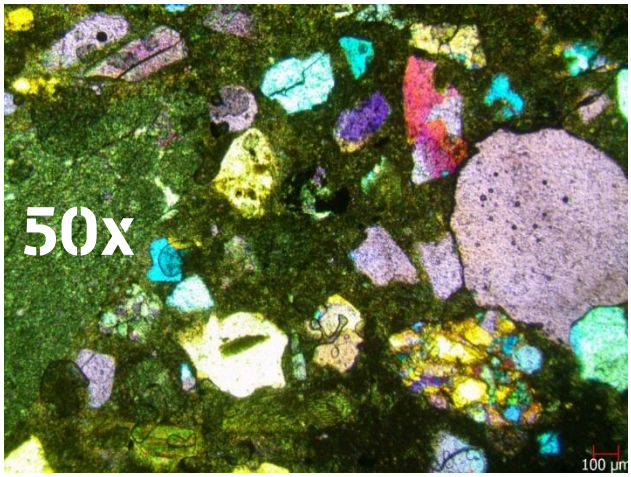
Sample has been grinded 100 µm steps by the help of GEOFORM 102's micrometer until to the thickness was reached 200 µm.

After reached 200 µm, grinding steps values decreased to 25 µm steps reached to the 100 mic thickness for sensitive grinding.

After the operation, preparation continued with manually process on FORCIPOL-TS.

Final grinding and polishing parameters can be seen below.
On the final grinding step, sample need to checked under the microscope. often.

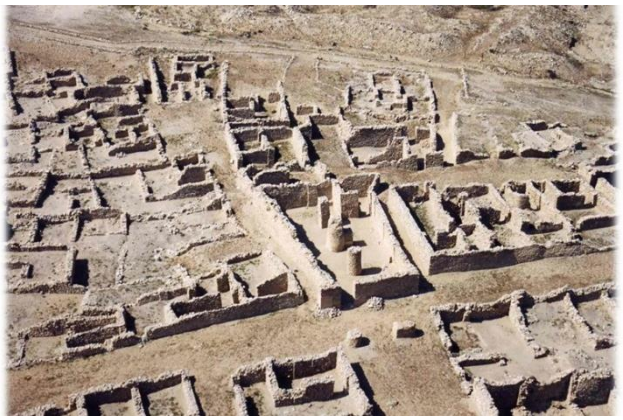
Sample final thickness about 30 µm.



	Surface	Abrasive	Lubricant	Force Per Sample (N)	Time Min.	Disc Speed Rpm.
Final Grinding	MAGNETO 6 38-050-006	Diamond	Water	5 N	As needed	50 CW
Final Polishing	METAPO-B 39-033-300	DIAPAT-M 39-420-M	DIAPAT 39-502	5 N	8 min.	50 CW

ARCHAEOLOGY

Archaeology, also spelled archeology, the scientific study of the material remains of past human life and activities. These include human artifacts from the very earliest stone tools to the man-made objects that are buried or thrown away in the present day: everything made by human beings—from simple tools to complex machines, from the earliest houses and temples and tombs to palaces, cathedrals, and pyramids. Archaeological investigations are a principal source of knowledge of prehistoric, ancient, and extinct culture. The word comes from the Greek archaia ("ancient things") and logos ("theory" or "science").



The 20th century saw the extension of archaeology outside the areas of the Near East, the Mediterranean, and Europe, to other parts of the world. In the early '20s, excavations at Mohenjo-Daro and Harappā, in present Pakistan, revealed the existence of the prehistoric Indus civilization. In the late '20s, excavations at An-yang in eastern China established the existence of a prehistoric Chinese culture that could be identified with the Shang dynasty of early Chinese records.

The Stone Age has been described and studied throughout the world; among the most sensational discoveries are those of L.S.B. Leakey, who found stone tools and skeletal remains of early man dating back 2,000,000 years in the Olduvai Gorge in Tanzania. Intensive work of great importance has brought to light early Neolithic sites at Jericho in Palestine; Hassuna, Iraq; Çatalhüyük, Turkey; and elsewhere in the Near East, establishing the origins of agriculture in that region.

Serious archaeological work began later in America than Europe, but as early as 1784 Thomas Jefferson had excavated mounds in Virginia and made careful stratigraphical observations. The 20th century saw a great increase in archaeological knowledge about prehistoric America: two startling advances were the discovery of the origin of domesticated crops (including maize) in Central America and of the Olmec civilization of Mexico (1000–300 BCE)—the oldest of the New World civilizations and probably the parent of all the others.

In this application, Atchana mound ceramic part prepared as Petrographic purpose.

-Late Bronze Age ceramic dish-

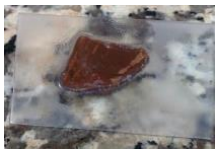
SAMPLE PREPARATION PROCESSES

Before the operation, glass slide has been roughened by the help of 1000 grit SiC powder [40-1000].
After the roughened glass slide step, preparing EPOCOLD mixture for bonding process of ceramic.

If the surface of the sample to be bonded is not planar, it may be necessary to smooth the surface manually with Forcipol TS.

Parameters for EPOCOLD mixture:

Parameters:	
Resin	5 part
Hardener	1 part
Mixing Time	About 2 min.
Curing Time	About 8 hours.



For grinding operations preferred these methode:

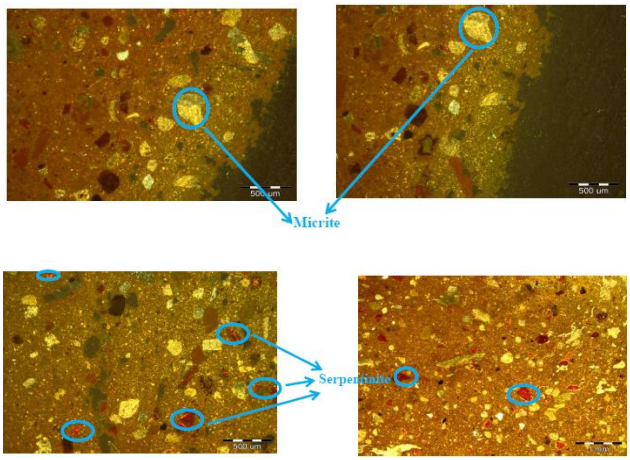
Sample has been grinded 100 µm steps by the help of GEOFORM 102's micrometer until to the thickness was reached 200 µm.

After reached 200 µm, grinding steps values decreased to 25 µm steps reached to the 100 mic thickness for sensitive grinding.

After the operation, preparation continued with automatic process on FORCIPOL-TS & FORCIMAT-TS.

Final grinding and polishing parameters can be seen below. On the final grinding step, sample need to checked under the microscope. often.

Sample final thickness about 30 µm.



	Surface	Abrasive	Lubricant	Force Per Sample (N)	Time Min.	Disc Speed Rpm.	Disc Speed Rpm.
Final Grinding	**MAGNETO 18** 38-050-018	**Diamond**	Water	10 N	1:30 min	50 CW	50 CW
Polishing Step 1	**METAPO-P** 39-013-300	**DIAPAT-M 6µ** 39-430-M	DIAPAT 39-502	10 N	2 min	50 CCW	50 CW
Polishing Step 2	**METAPO-B** 39-033-300	**DIAPAT-M 3µ** 39-420-M	DIAPAT 39-502	10 N	2:30 min	50 CCW	50 CW
Final Polishing	**PETRI** 39-090-300	**DIAPAT-M 1µ** 39-410-M	DIAPAT 39-502	10 N	4 min	50 CCW	50 CW

ASTRONOMY

It is often said that when the average person imagines what a meteorite looks like, they think of an iron. It is easy to see why. Iron meteorites are dense, very heavy, and have often been forged into unusual or even spectacular shapes as they plummet, melting, through our planet's atmosphere. Though irons may be synonymous with most people's perception of a typical space rock's appearance, they are only one of three main meteorite types, and rather uncommon compared to stone meteorites, especially the most abundant stone meteorite group-the ordinary chondrites.

Although there are a large number of sub classes, meteorites are divided into three main groups: irons, stones and stony-irons. Almost all meteorites contain extraterrestrial nickel and iron, and those that contain no iron at all are so rare that when we are asked for help and advice on identifying possible space rocks, we usually discount anything that does not contain significant amounts of metal. Much of meteorite classification is based, in fact, on how much iron a specimen does contain.

The Three Main Types of Meteorites:

IRON METEORITES

They are among the densest materials on earth and will stick very strongly to a powerful magnet. Iron meteorites are far heavier than most earth rocks-if you've ever lifted up a cannon ball or a slab of iron or steel, you'll get the idea.

In most specimens of this group, the iron content is approximately 90 to 95% with the remainder comprised of nickel and trace elements. Iron meteorites are subdivided into classes both by chemical composition and structure. Structural classes are determined by studying their two component iron-nickel alloys: kamacite and taenite.

STONE METEORITES

The largest group of meteorites is the stones, and they once formed part of the outer crust of a planet or asteroid. Many stone meteorites-particularly those that have been on the surface of our planet for an extended period of time-frequently look much like terrestrial rocks, and it can take a skilled eye to spot them when meteorite hunting in the field. Freshly fallen stones will exhibit a black fusion crust, created as the surface literally burned during flight, and the vast majority of stones contain enough iron for them to easily adhere to a powerful magnet.

Some stone meteorites contain small, colorful, grain-like inclusions known as "chondrules." These tiny grains originated in the solar nebula, and therefore pre-date the formation of our planet and the rest of the solar system, making them the oldest known matter available to us for study. Stone meteorites that contain these chondrules are known as "chondrites."

STONY-IRON METEORITES

The least abundant of the three main types, the stony-irons, account for less than 2% of all known meteorites. They are comprised of roughly equal amounts of nickel-iron and stone and are divided into two groups: pallasites and mesosiderites. The stony-irons are thought to have formed at the core/mantle boundary of their parent bodies.

Pallasites are perhaps the most alluring of all meteorites, and certainly of great interest to private collectors. Pallasites consist of a nickel-iron matrix packed with olivine crystals. When olivine crystals are of sufficient purity, and display an emerald-green color, they are known as the gemstone peridot. Pallasites take their name from a German zoologist and explorer, Peter Pallas, who described the Russian meteorite Krasnojarsk, found near the Siberian capital of the same name in the 18th Century. When cut and polished into thin slabs, the crystals in pallasites become translucent giving them a remarkable otherworldly beauty.

In this application, Meteorite sample will be prepared as Petrographic purpose.

SAMPLE PREPARATION PROCESSES

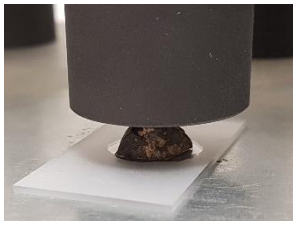
Before the operation, glass slide has been roughened by the help of 1000 grit SiC powder [40-1000].

After the roughened glass slide step, preparing EPOCOLD mixture for bonding process of Meteorite.

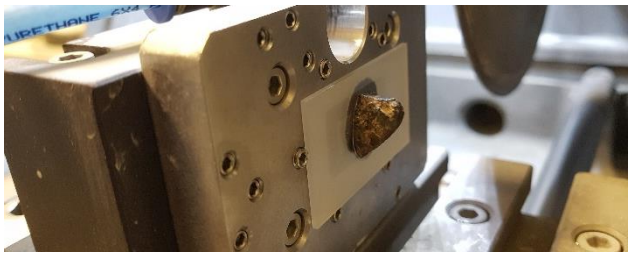
If the surface of the sample to be bonded is not planar, it may be necessary to smooth the surface manually with Forcipol TS.

Parameters for EPOCOLD mixture:

Parameters:	
Resin	5 part
Hardener	1 part
Mixing Time	About 2 min.
Curing Time	About 8 hours.



Sample ready for the Cutting and grinding operations on the GEFORM 102.



For grinding operations preferred these methode:

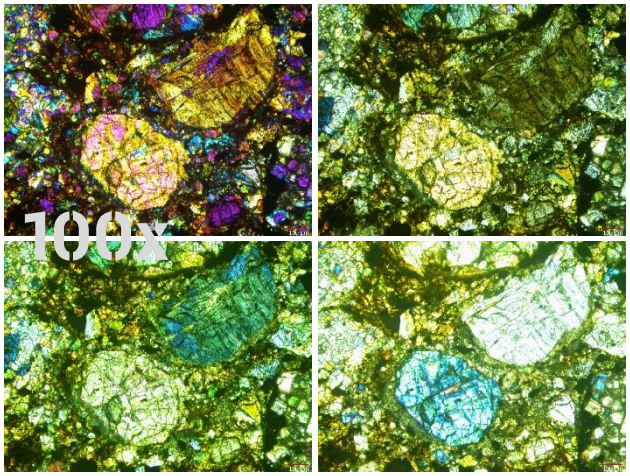
Sample has been grinded 100 µm steps by the help of GEOFORM 102's micrometer until to the thickness was reached 200 µm.

After reached 200 µm, grinding steps values decreased to 25 µm steps reached to the 100 mic thickness for sensitive grinding.

After the operation, preparation continued with manually process on FORCIPOL-TS.

Final grinding and polishing parameters can be seen below. On the final grinding step, sample need to checked under the microscope often.

Sample final thickness about 28 µm.



	Surface	Abrasive	Lubricant	Force Per Sample (N)	Time Min.	Disc Speed Rpm.
Final Grinding	MAGNETO 6 38-050-006	Diamond	Water	Manual	As needed	50 CW
Final Polishing	METAPO-B 39-033-300	DIAPAT-M 39-420-M	DIAPAT 39-502	Manual	8 min.	50 CW

MINING

Chalcopyrite is a brass-yellow mineral with a chemical composition of $CuFeS_2$. It occurs in most sulfide mineral deposits throughout the world and has been the most important ore of copper for thousands of years.
The surface of chalcopyrite loses its metallic luster and brass-yellow color upon weathering. It tarnishes to a dull, gray-green color, but in the presence of acids the tarnish can develop a red to blue to purple iridescence.
The iridescent colors of weathered chalcopyrite attract attention. Some souvenir shops sell chalcopyrite that has been treated with acid as "peacock ore." But, "peacock ore" is a more appropriate name for the mineral bornite.

The most obvious physical properties of chalcopyrite are its brassy yellow color, metallic luster, and high specific gravity. These give it a similar appearance to pyrite and gold. Distinguishing these minerals is easy. Gold is soft, has a yellow streak and has a much higher specific gravity. Chalcopyrite is brittle and has a greenish gray streak. Pyrite is hard enough that it cannot be scratched with a nail, but chalcopyrite is easily scratched with a nail.

In this application, chalcopyrite sample will be prepared as Petrographic purpose.

SAMPLE PREPARATION PROCESSES

Before the operation, glass slide has been roughened by the help of 1000 grit SiC powder [40-1000].

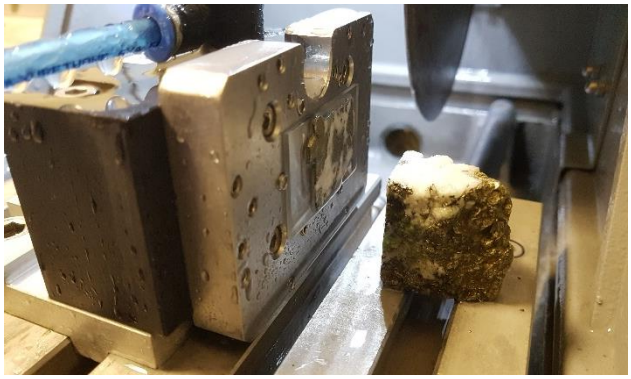
After the roughened glass slide step, preparing EPOCOLD mixture for bonding process of chalcopyrite.

If the surface of the sample to be bonded is not planar, it may be necessary to smooth the surface manually with Forcipol TS.

Parameters for EPOCOLD mixture:

Parameters:	
Resin	5 part
Hardener	1 part
Mixing Time	About 2 min.
Curing Time	About 8 hours.

Sample ready for the Cutting and grinding operations on the GEFORM 102.



For grinding operations preferred these methode:

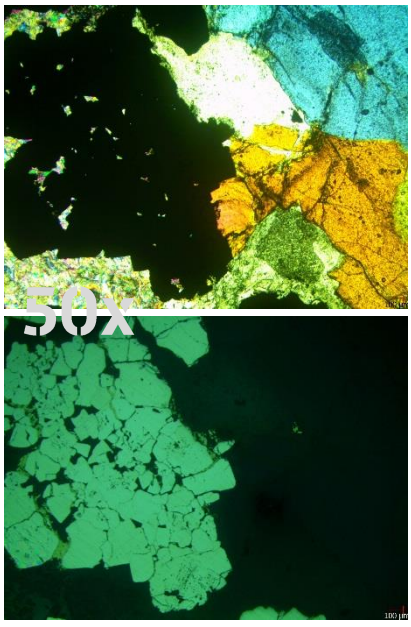
Sample has been grinded 100 µm steps by the help of GEOFORM 102's micrometer until to the thickness was reached 200 µm.

After reached 200 µm, grinding steps values decreased to 25 µm steps reached to the 100 mic thickness for sensitive grinding.

After the operation, preparation continued with manually process on FORCIPOL-TS.

Final grinding and polishing parameters can be seen below. On the final grinding step, sample need to checked under the microscope often.

Sample final thickness about 50µm.



	Surface	Abrasive	Lubricant	Force Per Sample (N)	Time Min.	Disc Speed Rpm.
Final Grinding	**MAGNETO 6 38-050-006**	**Diamond**	Water	Manual	As needed	50 CW
Final Polishing	**METAPO-B** 39-033-300	**DIAPAT-M** 39-420-M	DIAPAT 39-502	Manual	8 min.	50 CW

COAL

Coal is an organic sedimentary rock that forms from the accumulation and preservation of plant materials, usually in a swamp environment. Coal is a combustible rock and, along with oil and natural gas, it is one of the three most important fossil fuels. Coal has a wide range of uses; the most important use is for the generation of electricity.

Electricity production is the primary use of coal in the United States. Most of the coal mined in the United States is transported to a power plant, crushed to a very small particle size, and burned. Heat from the burning coal is used to produce steam, which turns a generator to produce electricity. Most of the electricity consumed in the United States is made by burning coal.

Coal is also used in manufacturing. If coal is heated the gases, tars, and residues produced can be used in a number of manufacturing processes. Plastics, roofing, linoleum, synthetic rubber, insecticides, paint products, medicines, solvents, and synthetic fibers all include some coal-derived compounds. Coal can also be converted into liquid and gaseous fuels; however, these uses of coal are mainly experimental and done on a small scale.

In this application, coal powder will be preapred as Petrographic purpose.

SAMPLE PREPARATION PROCESSES

Before the operation, glass slide has been roughened by the help of 1000 grit SiC powder [40-1000].

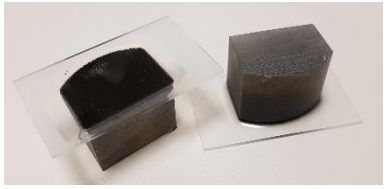
After the roughened glass slide step, preparing EPOCOLD mixture for bonding process of coal.

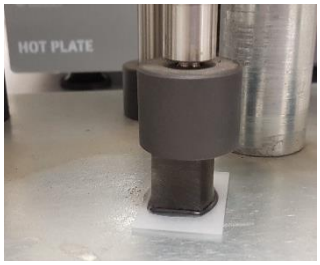
If the surface of the sample to be bonded is not planar, it may be necessary to smooth the surface manually with Forcipol TS.

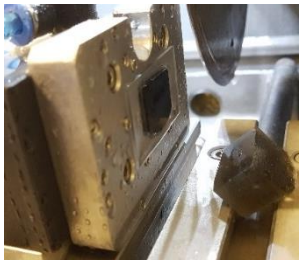
Parameters for EPOCOLD mixture:

Parameters:	
Resin	5 part
Hardener	1 part
Mixing Time	About 2 min.
Curing Time	About 8 hours.

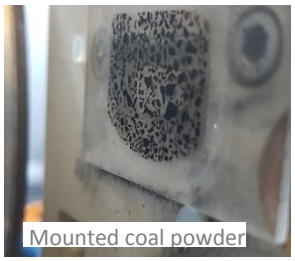
Coal powder has been prepared by 2 different method. First is mounted the coal powder with EPOCOLD cold mounting set. Second is bond the coal powder to glass slide by the help of EPOCOLD mixture (EPOCOLD used as a glue).







Samples ready for the Cutting and grinding operations on the GEFORM 102.


Mounted coal powder


Bonded coal powder

For grinding operations preferred these methode:

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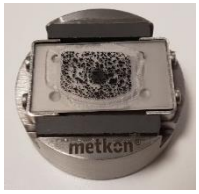
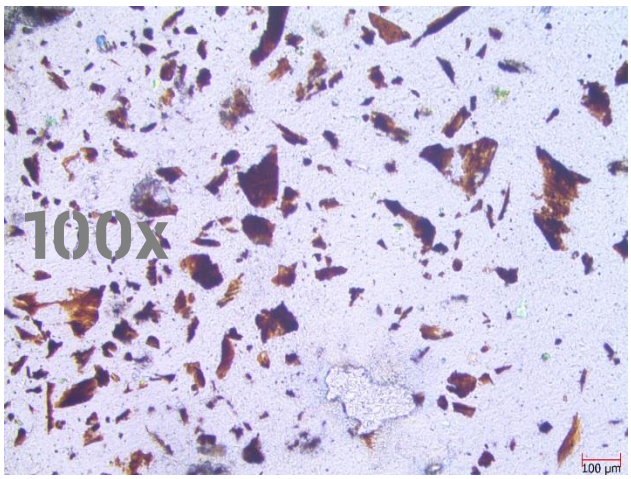
After reached 200 µm, grinding steps values decreased to 25 µm steps reached to the 100 mic thickness for sensitive grinding.

After the operation, preparation continued with manually process on FORCIPOL-TS.



Final grinding and polishing parameters can be seen below. On the final grinding step, sample need to checked under the microscope often.

Sample final thickness about 24 µm for mounted coal powder and about 15 µm for bonded coal powder.



	Surface	Abrasive	Lubricant	Force Per Sample (N)	Time Min.	Disc Speed Rpm.
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Final Polishing	**METAPO-B** 39-033-300	**DIAPAT-M** 39-420-M	**DIAPAT** 39-502	Manual	8 min.	50 CW