Career Episode One

Project: Investigation of Different Rocks using Petrographic Approach

Introduction

CE 1.1

In this career episode, I have written about my project that I completed during my last/eighth semester of the Bachelors degree. I was studying Mining Engineering from [redacted] University of Engineering and Technology. The work was thus done in the separate credits section from the [redacted], during the [redacted]. I completed this work in about [redacted]' time.

Background

CE 1.2.1

Throughout my engineering education, I had studied about multiple aspects of mining and minerals present under the surface of the earth. I had studied about petrographic approach or methods used for classifying and explaining rocks or minerals/ rocks forming minerals. I knew that this approach was taken from the field of geology. This approach uses a polarizing microscope to perform this and is able to cover the source, history, structural details, and occurrence of rocks that includes chemical as well as optical characterization. I had learnt that this study of target material would start with identifying the composition, fabric and characterization of the target materials. As different rocks are made up of different minerals this investigative technique helps studying and understanding them better.

This area of work was among those under discussion before the final year projects were finalized for students. I was interested in this area of study in my field in relation to completing a major project. I had discussions with the senior teachers and the scope of this project on this topic was decided.

CE 1.2.2

The goal of this project was to evaluate petrographic material and coming up with a safe and convenient work tool for sample preparation in form of thin sections. I especially highlighted the importance of this work because if successful, it could benefit other people who would work on obtaining and working on thin sections to save time.

My concern was that for petrographic investigation, there was a need of working on thin sections; however, the conventional method used to prepare these was dangerous. This is why I focused on tool preparation in this project that could yield thin sections of the target material in a better manner. Simply put, the broad aim of the project was petrographic investigation of rocks before and after the creating special tools.

CE 1.2.3

The objectives that I achieved for this project included:

- Working out a tool to obtain thin section of target material in a safer and easier way
- Preparation of thin sections of the target material
- Analysis of megascopic and microscopic properties of different rocks, thus investigating the structure, composition, colour, and texture of different rocks

CE 1.2.4

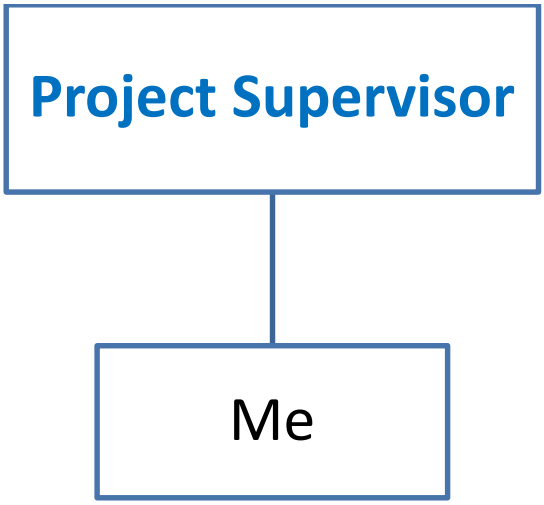

Fig 1.1 Project reporting mechanism

Personal Engineering Activity

CE 1.3.1

I consulted scholarly articles where research on my subject of interest was done earlier. I referred to different sources available online and read through my books to understand the topic better. I took some time to come up with a plan of work for this project, such that the set objectives could be met. I used to discuss all this with the supervisor, throughout, who helped me finalize the work plan.

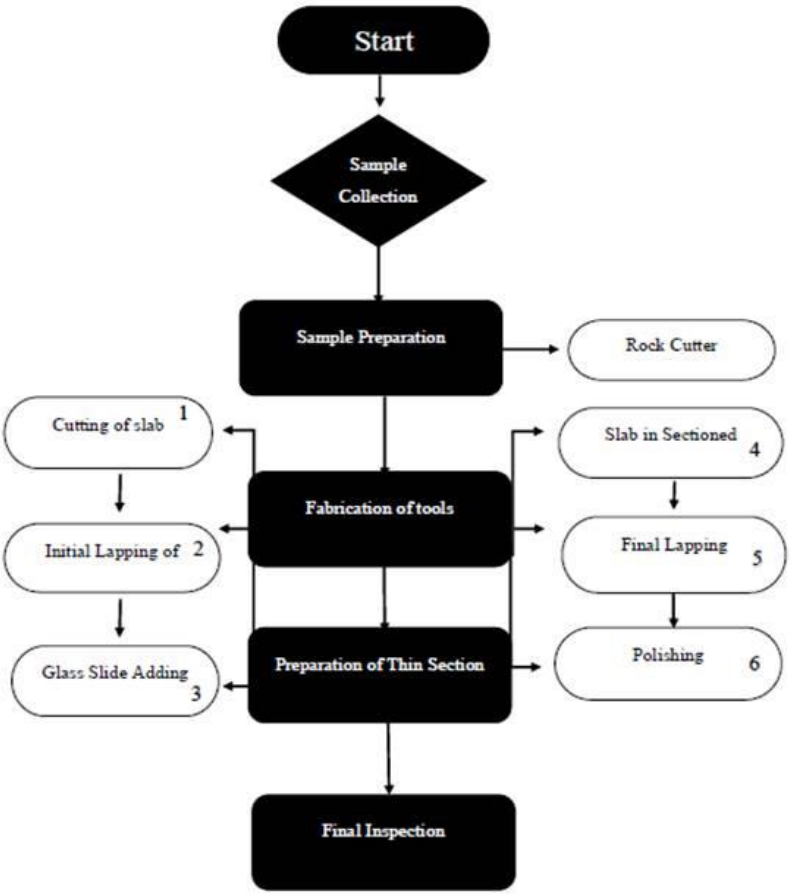

Fig 1.2, flow chart showing the track of this project

CE 1.3.2

When I began work practically, I started by collecting some samples of rocks that I had finalised with the supervisor. These were required for this project. In order to obtain variety, I obtained rocks from different sites. My aim here was to proceed with their size reduction processing. I knew that in the mining industry, samples were collected on regular basis that helped the concerned in their decision making regarding various things; be it exploring rocks, characterizing them, resource estimation, grade control, or designing of processing plants of some kind.

Fig 1.3, from collection of samples

CE 1.3.3

Then, I prepared samples for further processing. I had studied that sample preparation was a crucial step in analysis of minerals of any kind. I knew that the target here would be to achieve a homogenous sub-sample that is clearly typical of the material that was to be given to the laboratory. I knew that if I would not give enough emphasis on preparation, the analytical results would not be reliable. I took the samples and lay them down in the laboratory where I carefully scraped them and cleaned them. I cut out cylindrical shapes out of those using the available rock cutter in the laboratory. The problem was, like mentioned earlier that it was quite a struggle to use those conventional tools to thin out the samples. However, I obtained sub-samples by trying to thin those out. I have added the photograph below that shows what I had done to a given sample.

Fig 1.4, sample I had cut into cylindrical shape

CE 1.3.4

I had studied about fabrication of samples that was the act of integration of even elements using some clear procedure to make products. I had worked in the laboratory courses earlier where I learnt the processes of cutting, bending, and joining. In this work, I took to modifying the equipment of rock cutter as it played a crucial role in cutting of rock slides.

I was familiar with rock cutter machines in the laboratory at the department of [redacted] Mechanics under Mining Engineering. I used the large one to cut the rock sample that was directly collected from field. I cut out thin cylindrical pieces from it. Then, I moved to the other cutter that was smaller than this one. I cut out the prepared cylindrical rock on this second machine to make very thin strips so I could attach it in thin sections. I have added a photograph I had taken from the rock cutting machine.

Fig 1.5, One rock cutting machine

CE 1.3.5

I was able to obtain the sections of rock using the machines; however, like I have mentioned earlier, it was not a very safe approach and this was a concern in less developed settings that used this equipment. This rock cutting that I had used was without application of safety. Inserting rock into the cutter could also damage skin of the hands and gave scratching. In the form that I have just described, the rock cutter was as I have shown in the photograph added below.

Fig 1.6, rock cutter before application of safety

Now I had to closely consult with a mechanical engineering laboratory assistants and technical staff that worked in their workshops. I used to share my ideas and the requirement of the revised tools that I was trying to come up with. This needed regular discussions with the supervisor and those people. After thorough exchange of information and understanding of the requirement, I was able to make the rock cutter with better safety application. The mechanical work was done by the workshop staff. I had explained the design and got work done there in the work area.

CE 1.3.6

Basically, I had applied safety in the rock cutting plate used in this equipment. I proposed to insert two jaws in the plate such that I could fix the rock through this holder. I chose Aluminum metal for this holder as it offered light weight solution, easy availability and suitable corrosion resistance. Now, I knew that Aluminum plate could not be welded so I tightened the jaws using an Alky bolt. I worked with the technician and drilled holes myself into the jaws. I was able to fix the Aluminum stick containing the holder and thus tightened the work piece. I have added the photograph for the first rock cutting tool I had created that offered better safety.

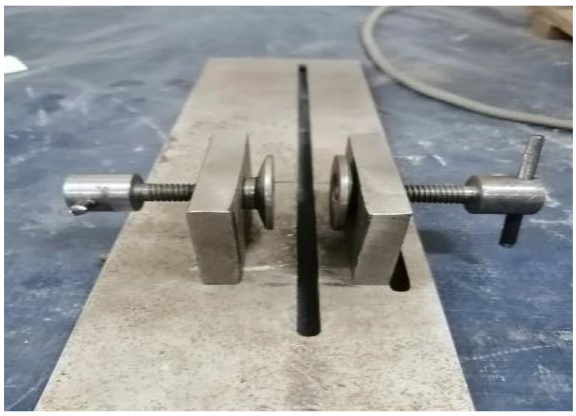

Fig 1.7, rock cutter fabricated tool with better safety (1)

CE 1.3.7

The next area I targeted was the power lap. I had studied and worked on lapping process that was a machining process that rubbed two surfaces together using an abrasive tool between them; this could be done using an automated machine or manually. I used abrasive powder and rubbed it really well. At the power lap machine, I placed the striped sample that I had prepared from the second type of rock cutter; I polished the sample so it became very thin. This way I easily attached it in between the two strips of the thin section. I have shown the power lap machine that I used in the photograph below.

Fig 1.8 power lap machine

I had the understanding of abrasives as substances that could be used for polishing, grinding, abrasion, scouring or cleaning. During this work, I had investigated the types of abrasive powders with different rages of grades. I had used a suitable one for the above mentioned work. I used it for polishing the petrographic slide and thus made it thin too.

CE 1.3.8

In order to prepare a thin section, I followed the steps I had read about in relation to the rock sample and work I was doing, and then discussed about with the supervisor. I cut a suitable size of slab for mounting on a slide using a diamond saw from a piece of rock or drill core; I knew that this step was right for the micro-clamp unit.

Fig 1.9, unit used for micro-clamp

While doing this, I labelled the slab on one side and let the other side be lapped and smoothened with 400 grit carborundum on a cast iron lap; then, I used 600 grit carborundum on a glass plate. I added a new glass slide that I attached to the lapping face of the slab using epoxy adhesive; I did so after drying this on a hot plate apparatus.

I then sectioned the slab into parts. I cut it down to the slide for which I used a narrow section saw. I used a thin section grinder on which I reduced its thickness further.

I combined powder with epoxy and then put it on a slide and allowed to drain it. I flattened the surface using a thin section grinder that was finished like a thin section.

In the next step, I achieved finished thickness of 30microns by lapping the section by hand on a glass plate using 600grits carborundum. I knew that I had an option of fine grinding using 1000 grit before polishing.

In the last step, I completed polishing by placing the slice on the holder and spinning it on a polishing machine where I chose to use nylon and diamond paste. I worked on this till the sample reached the desired polish for being placed under a microscope. After this, I planned to do a final inspection where I would check the material on polarized microscope so that I would analyse the petrographic rocks.

CE 1.3.9

I had understanding of how a polarized microscope worked. I used the one in the laboratory as shown below.

Fig 1.10, polarized microscope

I prepared the samples for microscope analysis as mentioned above. When performing microscopy, I placed the thin section slide under it such that polarizing light would fall on it. this way the samples would be clearly viewed. This is how the features were featured on the screen attached to the polarizing microscope and could be photographed.

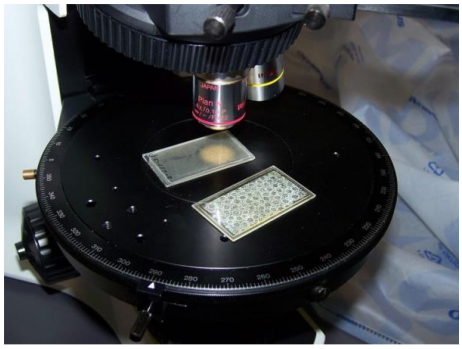

Fig 1.11, how I used the sample for viewing under polarized microscope

I had used ten samples that I had labelled BH-01 to BH-10. I analysed and recorded the megascopic and the microscopic features of the samples that I had prepared using the same standard ways that I have described above for any given sample. In order to record the investigation details, I made a table where I wrote the name of the sample, its colour, its texture (being medium or coarse grained, or equigranular), and added its description. This was an important part of the record.

CE 1.3.10

Then, I worked to record the microscopic details that I observed from the prepared samples using the polarized microscope. I used to capture images using the camera attached to this microscope. I used to label those as needed and add their description accordingly. I recorded this in form of a table as well.

For example, I have added the image of the sample BH-01. I had studied it before and after petrographic analysis, I wrote down its description.

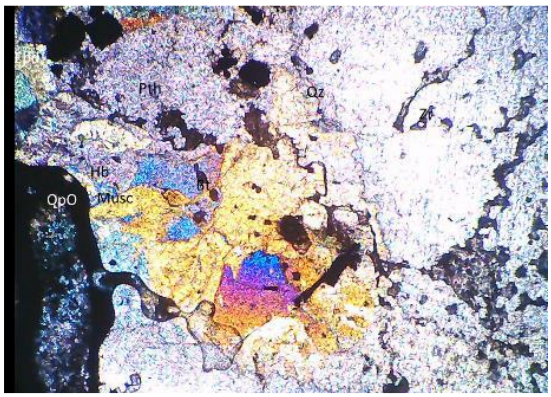

Fig 1.12, BH-01 sample

As all the investigated rocks represent the same area and igneous activity of broadly similar age, they would hardly, if at all, differ in terms of their degree of weathering/alteration. The thin section observation also precludes any significant weathering or alteration of the studied samples. The general scarcity and more importantly the random orientation and patchy distribution of micas in the studied rocks eliminate any possible adverse effect on their strength and mechanical properties due to the fourth of the factors listed above. In other words, the difference in the values of UCS, specific gravity, and water absorption of the investigated samples can only be ascribed to differences in their modal mineralogy and texture.

Summary

CE 1.4

I carried out this project to not only examine some samples after collection, but also to work such that the tools involved could be enhanced. A detailed petrographic investigation reveals that the studied samples represent mineralogy of different rock types, namely, alkali granite, alkali quartz syenite, and nepheline syenite. In addition to differences in modal mineralogy, these rocks also differ markedly in terms of their textural details, especially grain size and shapes.