Title of the Unit: Unit 3, Module

Name: Anisotropic Fabric and

lineation and metamorphic rocks.

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So in this particular module we are going

to outline various anisotropic fabrics

that develop in metamorphic rocks and

highlight lineation and metamorphic rocks.

Also highlight few other fabrics

that develop in high strain rocks.

At the end of this module,

We will learn the difference between

isotropic and anisotropic fabric, list

the various kind of anisotropic fabric,

and define the term lineation.

Anisotropic fabric. Complex interactions

between solid state recrystallization

and ductile formation that results

from imposed no- hydrostatic stresses

are widespread in metamorphic systems.

These interactions are expressed in

the penetrative anisotropic fabrics of

tectonites that are seen mostly in

regional dynamothermal settings in orogens.

These are also seen in deep shear

zones to strained contact aureoles.

Dynamothermal setting is where you

have both deformation as well as heat.

Imposed anisotropic fabric reflect the

pervasive solid state flow of the rocks

in response to non hydrostatic stresses.

Here the fabric has different

aspects and different directions.

Rocks that show such fabric includes slates,

schists and gneisses.

Elongated minerals here will

show preferential orientation.

The rock may have layers of contrasting

mineral composition such as in Gneissis.

What is Tectonite? Tectonite

Is a deformed rock with the texture that

records the deformation by developing a

preferred mineral orientation of some kind,

the fabric of tectonite is a complete

spatial geometrical configuration of

its textual and structural element.

Anisotropic fabric can be classified

as planar.

Linear and planar linear.

Planar fabric is expressed by a

set of closely spaced sub-parallel

faces within the rock body.

This is referred to as foliation.

Foliations may be irregular, curved,

or even folded when deformed.

Primary foliations is that kind

of foliations, such as bedding,

planes which survive metamorphism,

they are pre-deformational ones,

Whereas secondary foliations are

deformational ones that are created

or imposed such as slaty, cleavage,

schistosity and compositional layering

of gneissis, that are developed due to

the process of deformation on the rocks.

What are the different types of foliations?

One is the compositional layering.

Then you have preferred orientation

of platy minerals,

shape of a deformed grains,

such as if you have a conglomerate,

the pebbles in the conglomerate,

when deformed,

can show a foliation. Grain size variation.

Preferred orientation of praty minerals

in a matrix without preferred orientation.

Preferred orientation of lenticular

mineral aggregates. Preferred

orientation of even fractures, or a

combination of few of the above.

This is image, showing compositional

layering imparting of foliation in a rock.

So let us take a look at few of these

anisotropic fabrics that have been

imposed that results in foliations.

The 1st is a slaty cleavage.

It is a type of a continuous cleavage,

in which, the individual mineral grains

are too small to be seen by unaided eye.

It is a fine penetrative foliation.

It is defined by closely spaced planes,

along which the rock cleaves

easily, when hit with a hammer.

Slates are usually aphanetic, very fine grain.

Individual members,

hard to see with the naked eye

and have a dull last lustre on the

well developed slaty cleavage.

The cleavage planes may lie parallel

to the original bedding or across

it depending on the direction of

the applied non-hydrostatic stress.

This is an image of a rock that

shows slaty cleavage and it

is a continuous cleavage kind.

Then we have Phyllites.

These have slightly coarser

continuous cleavage.

They have a lustrous sheen, seen on

the foliated surfaces, as, the grain

size is slightly coarser than, that of slates,

and when these individuals aligned,

crystals become large enough

to be seen with the naked eye.

That is,

the grain size is developed

to a medium to coarser grain.

The foliation is termed as schistosity.

It is a coarse penetrative foliation.

It is characterized by more

intensely metamorphic rocks, due

to which the relict magnetic as

well as the sedimentary features

are totally erased.

The rock here usually breaks

irregularly along planes of schistosity.

There are commonly lineated,

expressed by long segregation

of contrasting minerals due to

metamorphic differentiation.

Examples: chlorite and mica schists.

Slate, phyllites and schists are

strongly foliated,

and they formed under low grade

metamorphism due to the abundance

of phyllosilicate grains as compared

to higher grades of metamorphism.

Thus giving or preferred orientation

to these grains.

This is a hand specimen of

phyllite showing lustrous sheen

on the foliated surface.

This is a hand specimen

showing chlorite schist.

Crenulation cleavage or schistosity

is a type of spaced cleavage and

not a continuous cleavage, that is,

developed during crenulation. What is crenulation?

Crenulation is a

type of a regular folding with a

wavelength of 1 centimeter or less.

So, when the creation of a pre-existing

foliation develops, you can get

a crenulation cleavage that

is, oriented parallel

to the actual planes of the crenulations.

In this particular image,

you can see to the right, a crenulation

cleavage that is developed parallel to

the actual plane of the crenulation.

Then let us take a look at gneissic

banding or weakly foliated rock as

defined by the parallelism of

in-eqaunt mineral grains, due to mechanical

compositional layering that develops

due to metamorphic differentiation.

The rock here do not break easily along

the foliation. When the rock consists

of a millimeter to centimeter scale,

layering in which the mineral proportions,

colors,

and textures may vary,

and, along which there is no particular

strong tendency to break the fabric is

said to be gneissic and the rock that

shows such fabric is called as a Gneiss.

These are very poor in platy minerals and

represent a higher grade of metamorphism.

Gneiss is a medium to coarse grained granoblastic,

to ,

Lepidoblastic fabric. Lepidoblastic

Texture, is a metamorphic texture

in which you have platy minerals

such as your chlorites,

Micas, talc, graphites are

aligned preferentially.

The producer planar fabrics.

Compositionally,

these are made up of dominantly quartz and

feldspar, usually showing you the granoblastic

texture or fabric and

micas which show you the planar fabric.

This is an image of a hand specimen

that is showing gneissic banding.

Let us come to the definition of

Lineation, lineation as any repetitively

occurring set of parallel to subparallel

visible linear feature in a rock.

It is a pervasive feature.

Lineation may be defined by, alignment of

the long axis of an elongated mineral grain,

that is a mineral lineation. Lineation

of a elongate mineral aggregates.

Parallelism of hinge lines or

of small scale folds,

that is your crenulation lineation

Intersection of two foliations

usually gives a line,

so that is also lineation

and slickensides striations or fibres

also impact lineation to rock.

Lineation may become curved or distorted.

A purely lineation without associated

foliation may be expressed by

preferred orientation of columnar

or acicular mineral grains,

such as amphiboles or by linear segregation

of contrasting mineral aggregates.

But rocks with only linear fabrics

are rare and usually the rocks also have

some sort of foliations along with lineation.

For example,

Linear streaks of micaceous aggregates.

Also define a foliation because of the basal

plains of the mica grains are parallel.

Let us take her example.

Look at few of the fabrics that are

developed in very high strain metamorphic

terrains such as in fault and shear zones.

Here you have shear stresses are

very important in development of

textures and structures in metamorphic

rock. Here shear and recrystallization

causes elongated elements.

Remember,

deformation tends to break minerals

down to smaller grains and sub grains,

whereas heat that accompanies metamorphism

tends to bring them up again.

In highly deformed rocks,

such as in fault zones and shear

zones where there are elevated

temperatures and pressures, imparts

such types of fabrics to rock.

With either bracket brittle

or ductile granulation,

large initial grains such as phenocryst

or more resistant minerals may be

left surrounded by finer crushed material.

The larger shear bounded grains

are called as porphyroclast and

are commonly lenticular or eye shape.

Such as their called as “augen” because

of the branching of the micro shears

around them.

If these porphyroclast are surrounded

by matrix of finer crushed material

that is derived from them as they

are rotated or grounded down,

this texture is called as a motor texture.

In this particular image you can

see feldspar clasts,

which is basically a type of a

porphyroclast that have survived

deformation and therefore it is

giving a fabric to the rock.

This is another type of a porphyroclast of

an orthoclase that is seen in deformed

granitic gneiss and you can see that

the biotite grains that are there

or the folium of biotites are

seen anastomosing around this clasts.

Let us take a look at Augen fabric.

Gneisses with ovoidal mega

cryst are called as Augen Genisses.

It's a type of porphyroclastic texture

where the alkali feldspar or plagioclase

fekdspars occurs as clasts.

This is an image in field showing the

sheared granitoid showing a very strong

foliation wherein you have the dark bands,

usually being biotite,

and the lighter bands

of quartz and feldspars.

The original feldspar pheocrysts have

resisted the deformation and therefore

remain lenticular as Augen shaped.

Then let us take a look at Mylonitic fabric.

A very fine grained,

usually aphanetic, hard, streaked,

foliated, may contain presence of

less deformed ovoidal relict grains.

That is a Flaser fabric.

It is an anisotropic fabric,

produced in an intense deformation,

through cohesive solid state,

ductile flow under non-hydrostatic

stresses, leading to a tectonic

reduction in grain size.

The grains under the microscope

will show you in intense strains,

for example, undulose extinction like

seen and quartz in such types of rocks.

Flaser fabric is a type of my

mylonitic fabric in which the ovoidal

megacrysts that have survived deformation

lie in a finer mylonitic matrix.

The MEGACRYSTS or porphyroclast

fragments have similar composition

to the minerals in the matrix.

These are your reference, thank you.