

## Quadrant II – Transcript and Related Materials

**Programme: Bachelor of Science (Third Year)**

**Subject: Geology**

**Paper Code: GEC- 109**

**Paper Title: Metamorphic Petrology**

**Unit: II**

**Module Name: Regional Metamorphism: Characteristics and Products**

**Module No: 13**

**Name of the Presenter: Ms Magnolia Aurea Miranda**

---

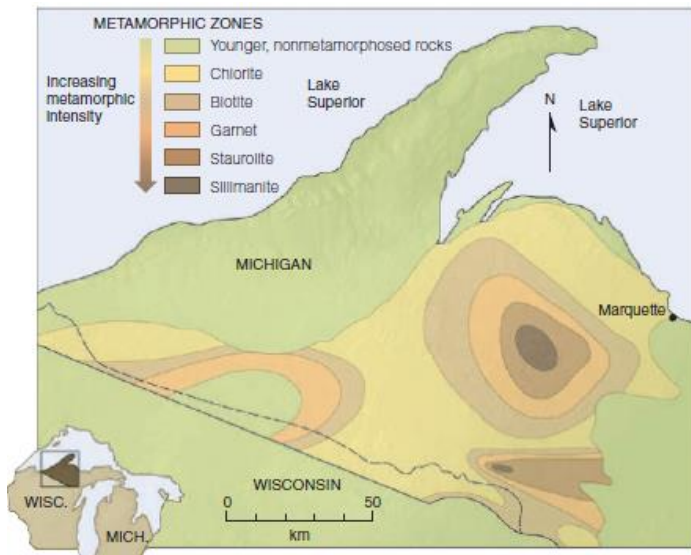
### Notes

#### **Field Characteristics of Regional Metamorphism**

**Regional metamorphism** refers to metamorphism that affects a large body of rock, and thus covers a great lateral extent. Three principal types of regional metamorphism are identified: orogenic metamorphism, burial metamorphism and ocean-floor metamorphism.

**Orogenic metamorphism** is associated with convergent plate margins and involves one or more episodes of orogeny with combined elevated geothermal gradients and deformation. Hence, the rocks are foliated. Orogenic metamorphism and granitic plutons are often intimately associated. Chemically active fluids are invariably present.

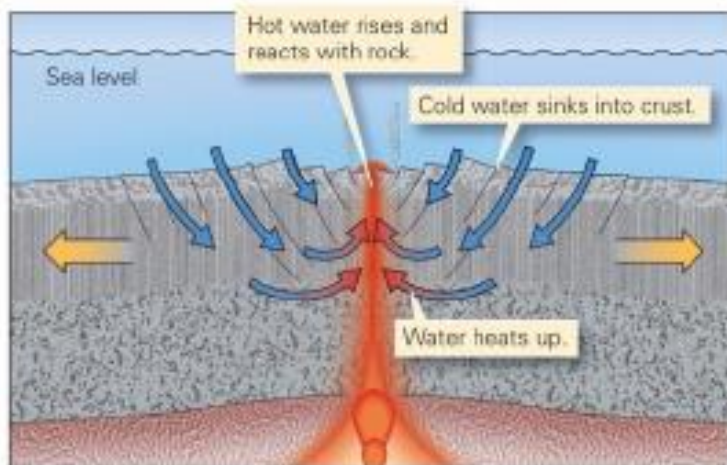
These metamorphic rocks usually show a gradation of metamorphic intensity from areas that were subjected to the most intense pressures, highest temperatures, or both to areas of lower pressures and temperatures. Such a gradation in metamorphism can be recognized by the metamorphic minerals that are present. The metamorphism may exhibit a simple domal pattern, centering on the metamorphic/igneous core where heat input as well as thickening and uplift were the greatest.



Metamorphic Zones in the Upper Peninsula of Michigan  
 source: Monroe, S. J and R. Wicander. (2014). The Changing Earth: Exploring Geology and Evolution (5<sup>th</sup> edition). Brooks Cole Publishers. p. 195

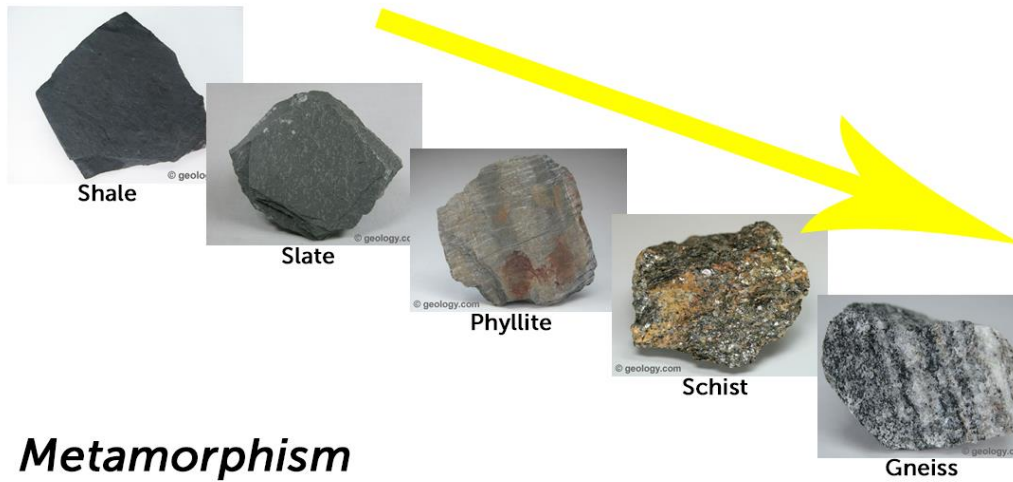
**Burial metamorphism** is low-grade metamorphism that occurs in sedimentary basins due to burial by successive layers. Metamorphism is caused due to increased pressure and temperature related to burial. The metamorphic conditions vary from diagenesis to the formation of zeolites, prehnite, pumpellyite, laumontite, and at deeper levels, minerals found in the lower grades of some exposed orogenic belts. Deformation is mild, but the weight of the overlying sediments may cause sufficient compression to impart a foliation to the metamorphic rocks forming at depth. Igneous activity is not associated with this type of metamorphism. Chemically active fluids are invariably present.

**Ocean-floor metamorphism** was coined by Miyashiro et al. (1971) to describe the type of metamorphism affecting the oceanic crust near ocean ridge spreading centers. The metamorphic rocks exhibit considerable metasomatic alteration, notably loss of Ca and Si and gain of Mg and Na in most cases. These changes can be correlated with exchange between basalt and hot seawater.



Ocean floor metamorphism  
 Source: Marshak, S. (2019). Essentials of geology (6<sup>th</sup> edition). Norton & Company, Inc.

## Products of Regional Metamorphism



## ***Metamorphism***

Source: <http://www.luckysci.com/wp-content/uploads/2014/08/metamorphic-rock-series.jpg>

A **slate** is low grade metamorphic rock. It is compact, very fine-grained, with a well-developed cleavage. Freshly cleaved surfaces in slates are dull.

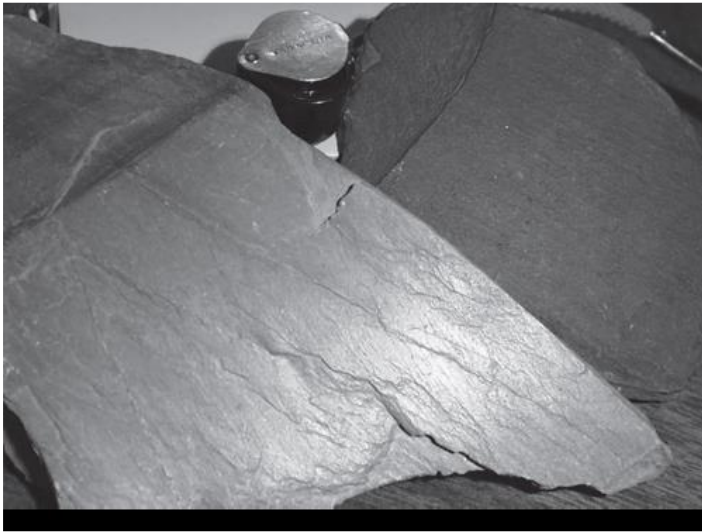


Slate

Source:

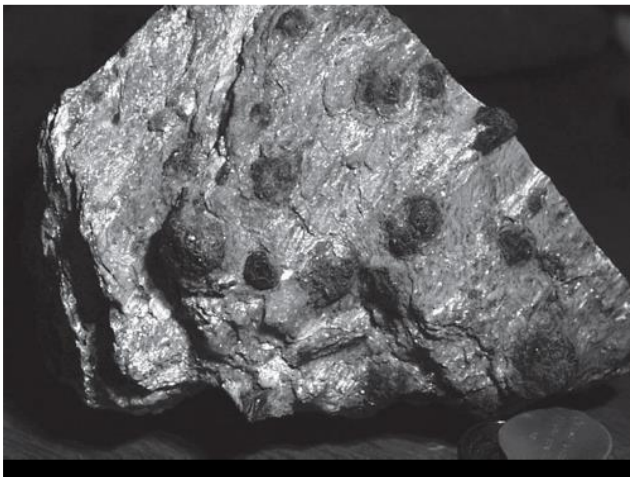
<https://geologyscience.com/wp-content/uploads/2018/04/Slate.jpg>

**Phyllite:** A rock with a schistosity in which very fine phyllosilicates (sericite/phengite and/or chlorite), although rarely coarse enough to see unaided, impart a silky sheen to the foliation surface. Phyllites with both a foliation and lineation (typically crenulated fold axes) are very common.



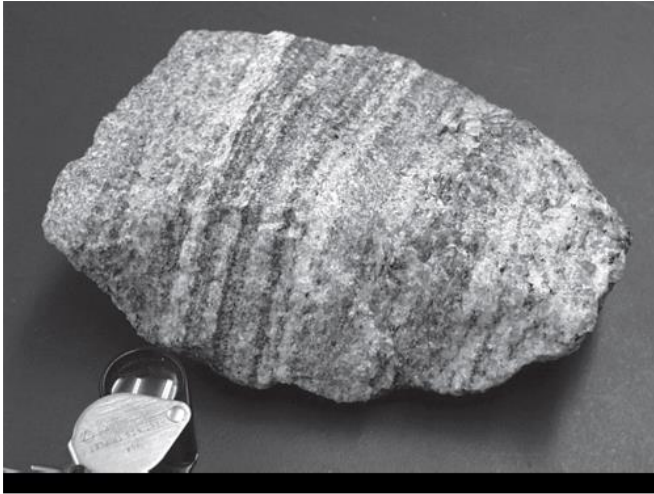
Phyllite (left) and slate (right).  
Source: Winter J D., (2011)  
Principles of Igneous and  
Metamorphic Petrology. PHI  
Learning Pvt. Ltd. p. 494

**Schist:** A metamorphic rock exhibiting a schistosity wherein the foliated minerals are coarse enough to be identified by the naked eye.



Garnet Muscovite Schist  
Source: Winter J D., (2011) Principles  
of Igneous and Metamorphic  
Petrology. PHI Learning Pvt. Ltd. p.  
494

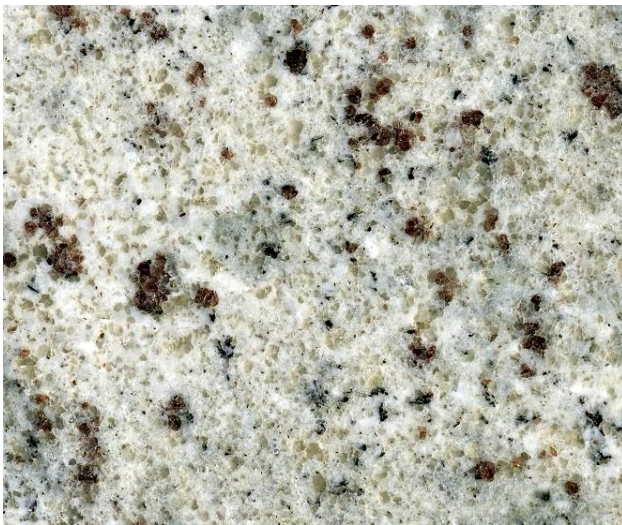
**Gneiss:** A metamorphic rock displaying gneissose structure. Gneisses are typically layered (also called banded), generally with alternating felsic and darker mineral layers. Gneisses may also be lineated, but must also show segregations of felsic-mineral-rich and dark-mineral-rich concentrations.



Gneiss

Source: Winter J D., (2011)  
Principles of Igneous and  
Metamorphic Petrology. PHI  
Learning Pvt. Ltd. p. 494

**Granulite :** An equigranular, high-grade rock of pelitic, mafic, or quartzo-feldspathic parentage that is predominantly composed of OH-free minerals. Muscovite is absent, and plagioclase and orthopyroxene are common.



Granulite

Source:[http://www.alexstrekeisen.it/immagini/diagrammi/granulite2020\(1\).jpg](http://www.alexstrekeisen.it/immagini/diagrammi/granulite2020(1).jpg)

Ocean floor metamorphism results in a rock called **spilite**. Metamorphic alteration causes the plagioclase of the basalts to become “albitized” as the basalts exchange Ca for Na in the seawater. Hence, forming spilites. Alteration of feldspars and mafics also produces chlorite, calcite, epidote, prehnite, zeolites, and other low-temperature hydrous products.



Spilite

Source: [https://www.researchgate.net/publication/325250785\\_Pillow\\_lavas\\_of\\_the\\_Vares\\_are\\_a\\_Bosniaa\\_and\\_Herzegovina/figures?lo=1](https://www.researchgate.net/publication/325250785_Pillow_lavas_of_the_Vares_are_a_Bosniaa_and_Herzegovina/figures?lo=1)