EESC 2100: Mineralogy

LAB 8: COMMON MINERALS IN METAMORPHIC ROCKS

Part 2: Minerals in Metapelites and Marbles

Learning Objectives:

- Students will be able to identify the most common minerals that occur in metapelitic rocks and marbles
- Students will be able to determine the rock type and facies of a metamorphic rock based on mineral assemblages

New Minerals: Garnet, Staurolite, Andalusite, Kyanite, Sillimanite, Serpentine, Talc, Tremolite

Review Minerals: Calcite, Dolomite, Quartz, Plagioclase, Diopside, Olivine, Muscovite, Biotite, Chlorite

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MINERALS IN METAPELITES

Shales are composed of clays, which are Al-rich silicates. Therefore shales are Si-Al-rich rocks, and contain variable amounts of K, Fe, and Mg. When shale is subjected to new pressure and temperature conditions during metamorphism, these chemical components will rearrange themselves to form a new assemblage of aluminous minerals depending upon the specific P-T conditions. Metamorphosed shales are referred to as **metapelites**.

Sheet silicates (**muscovite, biotite**, and **chlorite**) are common in metapelites, particularly at low metamorphic grade. **Garnet** [$(Ca,Fe,Mg)_3(Al,Fe,Cr)_2(SiO_4)_3$] is a common constituent of metapelites, and is the only common rock-forming mineral that is isotropic. **Staurolite** [$Fe_2Al_9Si_4O_{22}(OH)_2$] occurs in amphibolite-facies metapelites, and displays bright-yellow pleochroism. Both garnet and staurolite commonly contain abundant inclusions of other minerals. The resulting spongy texture in metamorphic rocks is referred to as **poikiloblastic.**

Aluminosilicates are common in metapelites of the amphibolite and granulite facies. Andalusite, kyanite and sillimanite are all polymorphs of Al_2SiO_5. **Andalusite** is the low-pressure polymorph. Andalusite crystals that display a dark, diagonal cross composed of carbon inclusions are referred to as

chiastolite. **Kyanite** is the high-pressure aluminosilicate polymorph. In hand-sample it can generally be distinguished by its bright blue color, bladed form, and its differential hardness (moderate hardness parallel to length; hard perpendicular to length). **Sillimanite** is the high-temperature polymorph. It is a fibrous mineral that is usually too fine-grained to see clearly in hand-sample. In thin section, the diamond-shaped cross-sections display a single good cleavage with and the long axes are commonly cross-fractured. Clots of acicular sillimanite are referred to commonly as **fibrolite**.

Examine the hand samples GARNET, STAUROLITE, ANDALUSITE, KYANITE, and SILLIMANITE. Document the physical properties of these minerals.

Examine the thin-sections GARNET, STAUROLITE, ANDALUSITE, KYANITE, and SILLIMANITE. Document the optical properties of these minerals.

MINERALS IN MARBLES

In addition to **calcite, dolomite**, and **quartz**, marbles may contain a number of low-Al minerals that contain Ca and/or Mg. These minerals include **forsterite (olivine)**, and **diopside (clinopyroxene)** which you have seen in previous labs. In addition, dolomitic marbles may contain the non-aluminous phyllosilicates **serpentine** [$(Mg,Fe)_3Si_2O_5(OH)_4$] or **talc** [$Mg_3Si_4O_{10}(OH)_2$], and the amphibole **tremolite** [$Ca_2Mg_5Si_8O_{22}(OH)_2$].

Examine the hand samples SERPENTINE, TALC, and TREMOLITE. Document the physical properties of these minerals.

Examine the thin-sections SERPENTINE, TALC, and TREMOLITE. Document their optical properties.

How can talc be distinguished from muscovite in hand-sample?

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How can talc be distinguished from muscovite in thin-section?

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How can serpentine be distinguished from chlorite in hand-sample?

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How can serpentine be distinguished from chlorite in thin-section?

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CLASSIFYING METAMORPHIC ROCKS

Review the physical and optical properties of calcite, dolomite, diopside, olivine, muscovite, biotite, and chlorite. Examine thin-sections METAMORPHIC 1, METAMORPHIC 2, and METAMORPHIC 3, and hand-samples METAMORPHIC A and METAMORPHIC B. Document the minerals present in each of the slides, and using this data and the table below, determine to which rock type, and metamorphic facies these rocks belong.

Rock Type	Greenschist Facies	Amphibolite Facies
Metabasite	Actinolite, Epidote, Chlorite, Albite	Hornblende, Plagioclase, Garnet
Metapelite	Chlorite, Muscovite, Biotite	Muscovite, Biotite, Garnet, Staurolite, Andalusite, Kyanite, Sillimanite,
Marble	Calcite, Dolomite, Serpentine	Calcite, Dolomite, Talc, Tremolite, Forsterite, Diopside

METAMORPHIC 1

Minerals Present: _____

Rock Type: _____

Facies: _____

METAMORPHIC 2

Minerals Present: _____

Rock Type: _____

Facies: _____

METAMORPHIC 3

Minerals Present: _____

Rock Type: _____

Facies: _____

METAMORPHIC A

Minerals Present: _____

Rock Type: _____

Facies: _____

METAMORPHIC B

Minerals Present: _____

Rock Type: _____

Facies: _____