Activity 23: Igneous Rock Identification

Maine Geological Survey

Objectives:

To provide students with the opportunity to analyze the textures of various igneous rocks and use these textures as a basis for the classification and identification of common igneous rocks. To develop "visual identification skills" for the common igneous rocks found in Maine.

Time:

This activity is designed to last at least two class periods.

Background:

Igneous rocks are those that cool from molten rock materials known as magma. Igneous rocks are classified on the basis of their texture and their mineralogical composition. Texture is the overall size, shape, and arrangement of the mineral grains that make up the rock. Plutonic igneous rocks (intrusives), those that cool slowly deep within the earth, are coarse-grained and are classified on the basis of minerals identifiable with the unaided eye or with low (10X) magnification. Volcanic igneous rocks (extrusives), those that cool rapidly at or near the surface of the earth, are frequently too fine-grained to allow the student to identify individual minerals. There is a crude correlation between the color of the rock and its composition. Rocks containing more silica, such as granite and rhyolite, are generally lighter in color. Dark colored rocks (black, dark brown, dark green) commonly have the composition of gabbro or basalt.

A simplified igneous rock classification chart is included as well as a percentage composition chart. These may be reproduced for student use.

Maine is rich in igneous rock bodies. These rocks have provided the basis for much of the mining and quarrying activity that has taken place in the state over the years. Gem tourmalines, aquamarines, topaz, and other gem materials are found in Maine's igneous rocks. The Sebago Lake and Bottle Lake batholiths, which were proposed sites for radioactive waste storage facilities, are igneous rock formations. Mount Katahdin and Mount Desert Island, two of the state's premier natural attractions, are essentially igneous in composition.

Materials:

A previously assembled set of numbered, igneous rock samples should be available for each group of students. See suggested list below. In addition each student group will need a magnifier, identification charts, notebooks, pens, and percentage estimation charts. NOTE: You may wish to display typical, massive "rock forming" samples of quartz, orthoclase (microcline), plagioclase (albite), and dark minerals (ferromagnesians) such as hornblende, biotite, and black tourmaline. These would be for visual reference during the exercise.

Suggested List of Igneous Rocks		
Plutonic	**Volcanic**	**Porphyritic**
Granite	Basalt	Porphyritic granite
Gabbro	Rhyolite	Hornblende andesite
Diorite	Andesite	
Granitic pegmatite		
Peridotite		

Samples of these rock types may be collected at a number of points around the state; some locations are listed in the CREST Field Trip Guidebook. A carefully collected and documented suite of specimens can become a major teaching resource for many years.

Procedure:

First the students should sort the rocks into one of the three categories - plutonic, volcanic, or porphyritic. All student groups need to have consensus on this. For each of the plutonic rocks, use the percentage estimation chart (Figure 1) to determine the approximate proportion of minerals. Then use the identification chart (Figure 2) to determine the specific name of each specimen. Granite, which should be the first sample, has been filled in on the student sheet. You may wish to do granite with the group, modeling the process you go through to determine that the sample is granite. Have the students repeat this process until all of the samples have been identified. Then have students, in groups, answer the associated questions. You may wish to add questions based on your own specific suite of samples. There are no special safety precautions for this lab exercise.

Follow-Up:

Have students do the activity on metamorphic rocks; metamorphic rocks are the other big family found in the state's bedrock.

Take a field trip to a local igneous rock outcrop. Granite quarries are ideal, as are pegmatite locations. Pay special attention to the changes in texture and composition near the contacts between rock units (see Figure 3).

NOTES: If you plan to do a lot of work with rock and mineral specimens and don't wish to spend time gluing numbers onto samples, an excellent alternative is to purchase a number of Specimen Tray Inserts (Ward's #30E3610, $4.25 each). Each tray will hold up to twenty 3x4 inch specimens. You can number the white compartment sections with a grease pencil and make up kits for different labs as needed. Make certain that all specimens get put into the trays in proper sequence. A printed copy of the sequence can stay with your copy of the activity from year to year.

Students living in the towns of Litchfield, Monmouth, Wales, Sabbatus, and adjoining areas (about 200 square miles) may bring in a rock known as syenite. This is a coarse grained igneous rock, similar to granite, with the mineral nepheline replacing most if not all of the customary quartz. It is distinctive in appearance, and while not a common igneous rock, does occur in this part of the state.

References:

Activity modified by Duane Leavitt from the Earth Science Source Book, edited by John R. Carpenter (Center for Science Education, University of South Carolina, Columbia, South Carolina, 1987).

Name_____

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Maine Geological Survey

Student Sheet

Purpose:

To develop some skills in identifying igneous rocks.

The ability to identify the more common igneous rocks on sight is a valuable one here in Maine as at least 30% of the state is underlain by igneous bedrock. We see igneous rocks exposed on hill tops, in river valleys, and at the seashore. Igneous rocks also have considerable economic value. Many of the state's pegmatite rock bodies (very coarse-grained granite veins) are mined for such gem materials as tourmaline, aquamarine, and topaz.

Igneous rocks are classified on the basis of texture and composition. Texture is the overall size, shape and arrangement of mineral grains that make up the rock. The size of the grains is very important.

Materials:

- One set of numbered igneous rock samples
- Hand lenses or magnifying glasses
- Percentage estimation and identification charts (see Figures 1-2)
- Notebooks, pens, and possibly a small ruler.

Part I:

Group all of the rocks, on the basis of texture, into three groups: volcanic, plutonic, or porphyritic. The entire class needs to have a consensus of which rocks belong in which category. Your teacher will assist you in this discussion. See definitions below.

Plutonic rocks have cooled very slowly and have a coarse grained texture. *Of our samples the following numbers are plutonic rocks:*

Volcanic rocks have cooled quickly and show fine grained texture. You may be unable to see individual mineral grains even with a hand lens. *Of our samples the following numbers are of volcanic origin*:

Porphyritic rocks have had at least TWO cooling phases and contain larger mineral grains, called phenocrysts, in a mass of finer grained material. *The following samples display porphyritic texture*:

Part II:

For each plutonic rock listed in Part I above, use the attached percentage estimation chart to determine the approximate ratio of minerals, and, using the identification chart, identify each species by name. You may not need all of the spaces provided. The first one has been done as an example.

Example:

Minerals present and relative proportions	
Quartz	40%
Feldspar	30%
Mica	15%
Dark Minerals	15%

Species name: Granite

Sample #:

Minerals present and relative proportions	

Species name: _____

Sample #:

Minerals present and relative proportions	

Species name: _____

Sample #:

Minerals present and relative proportions	

Species name: _____

Sample #:

Minerals present and relative proportions	

Species name: _____

Sample #:

Minerals present and relative proportions	

Species name: _____

Sample #:

Minerals present and relative proportions	

Species name: _____

Part III:

Place the volcanic rocks in order from lightest color to darkest color. List the number and what you think the species name is. Again, you may not need all the lines provided.

LIGHTEST _____

_____

_____

INTERMEDIATE_____

_____

_____

DARKEST _____

_____

_____

Part IV:

List the numbers of the samples that have porphyritic texture. Your teacher will aid you in naming these.

_____	_____
_____	_____
_____	_____

Discussion Questions:

1. Explain in your own words how igneous rocks are classified.

2. How can you tell something about the place of formation of an igneous rock just by looking at it? Explain.

3. How do you describe the composition of a plutonic igneous rock?

4. Why are porphyritic igneous rocks interpreted to have undergone two stages of cooling? Which particles cooled first, the larger ones or the smaller ones? Explain.

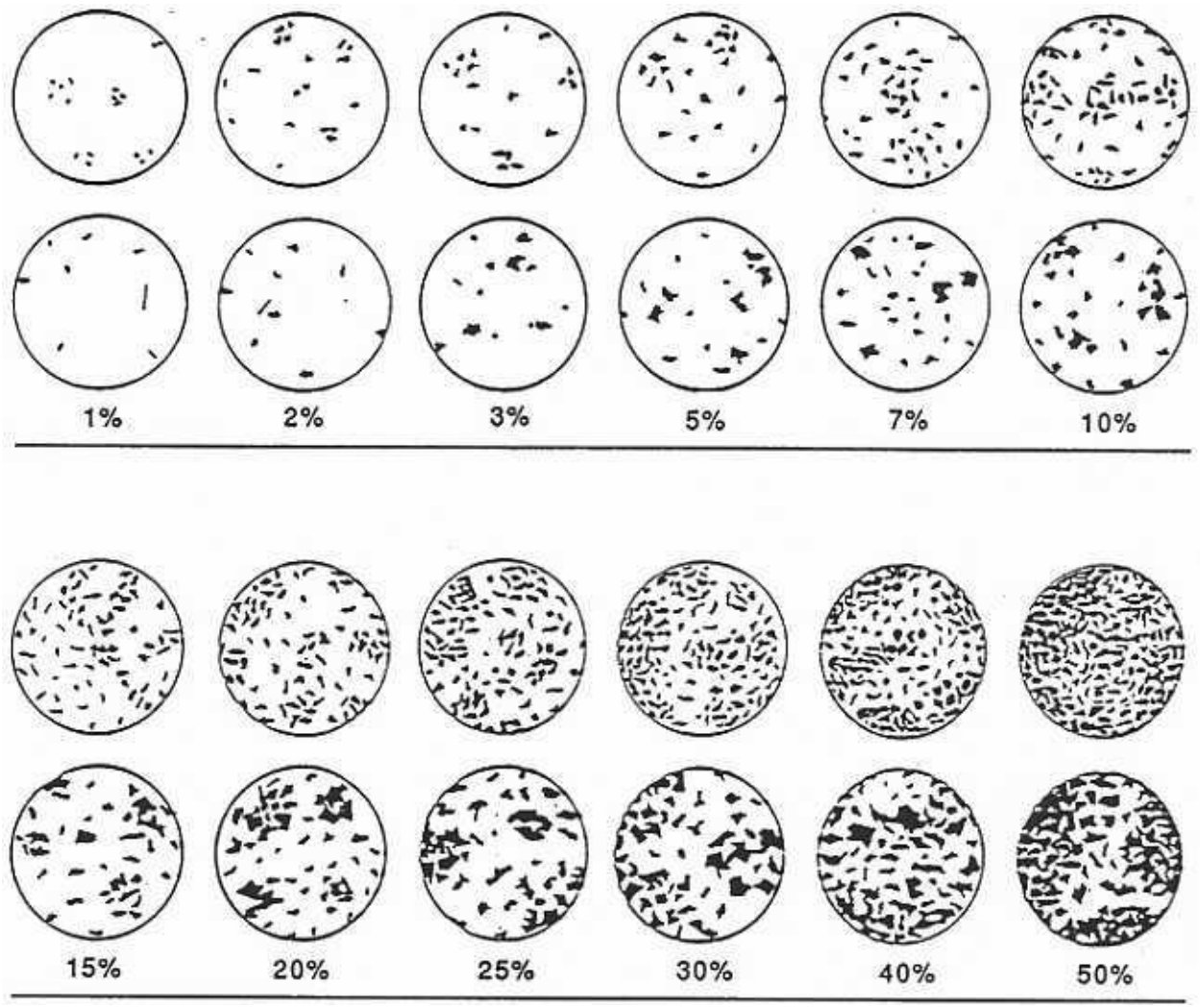

Figure 1. The following diagrams represent approximate percentages occupied by a dark mineral grain in the total area of the circle. The top row in each block represents fine-grained particles while the bottom row represents coarse-grained particles. (Source: J. R. Carpenter (ed.), 1987, Earth Science Source Book: Center for Science Education, University of South Carolina, Columbia, South Carolina.)

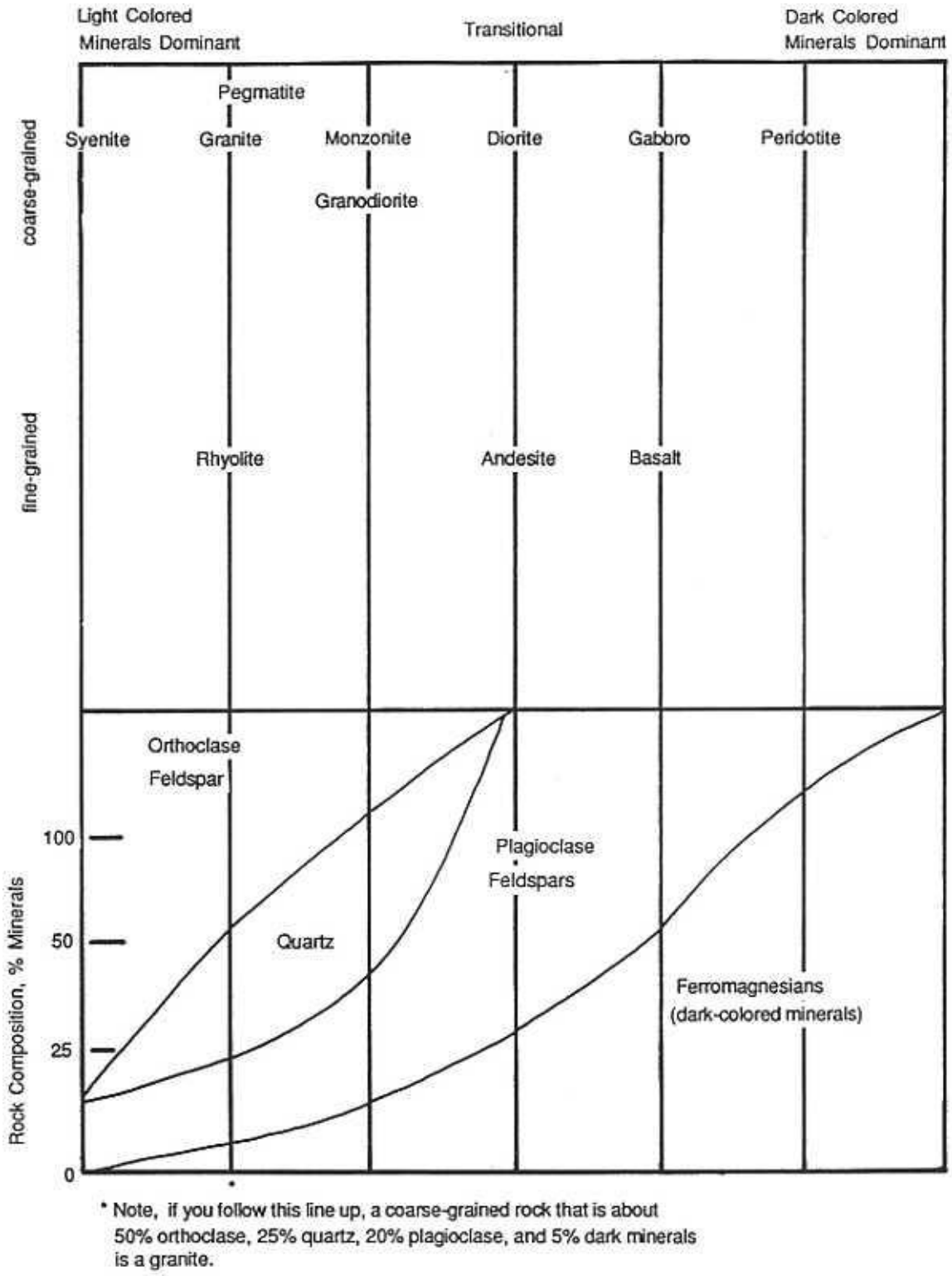

Figure 2. Igneous rock identification chart. (Adapted from S. Judson and M. E. Kauffman, 1990, Physical Geology: Prentice-Hall, Inc., Englewood Cliffs, New Hersey, 8th edition.)

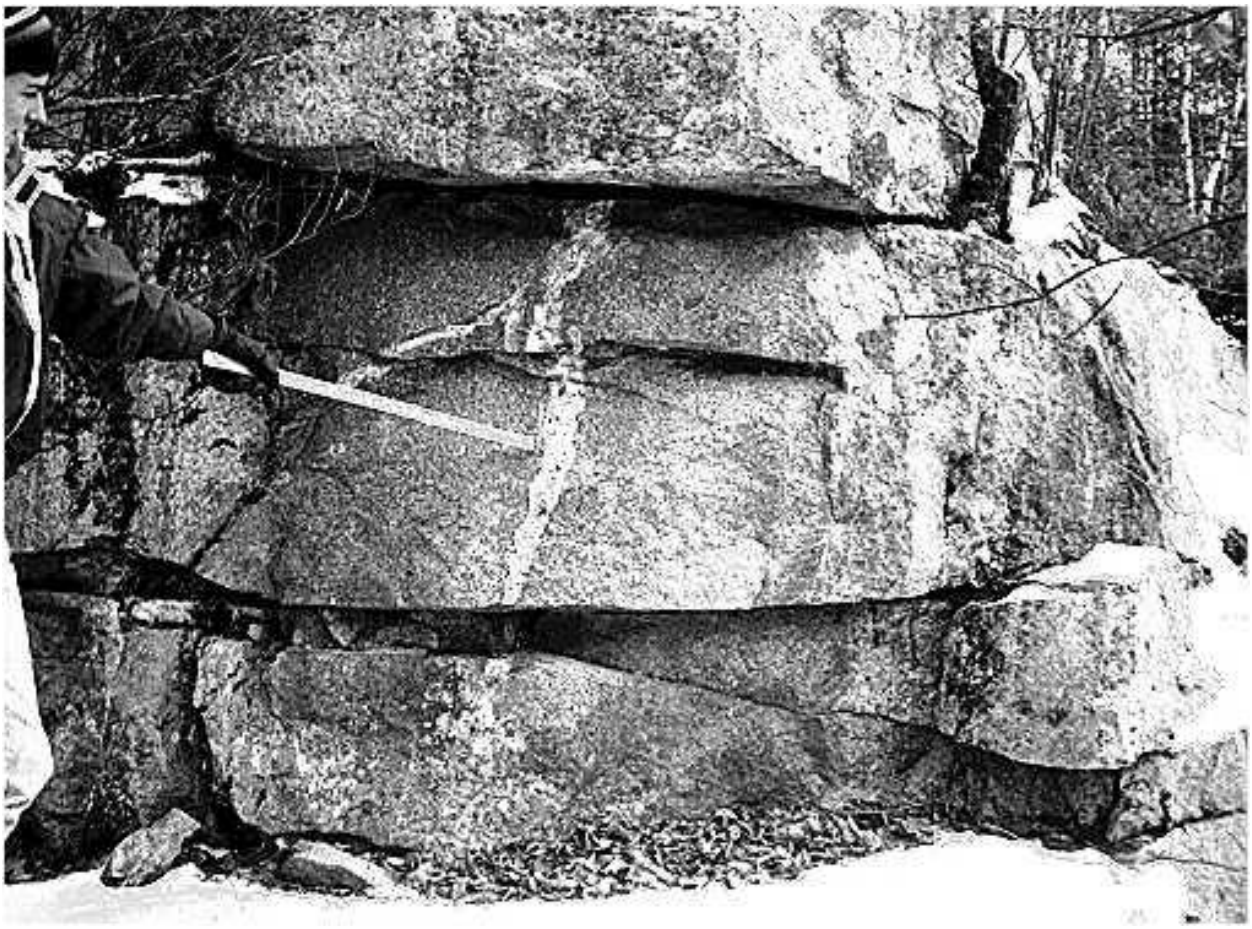

Figure 3. A small-scale intrusive dike in one of western Maine's granite quarries. These quarries offer countless opportunities for students to study, firsthand, the interplay between igneous activity and metamorphism. Sample collection, mapping, constructing sequential photographic displays, and other activities can be conducted by students.