

# The Geology of Pacific Northwest Rocks & Minerals

## GEO143: Downtown Salem Field Trip

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Team Member Name(s): \_\_\_\_\_

The purpose of this trip is to see a variety of rocks used as commercial building stone in Salem. Building stones are selected mainly for their beauty and are not normally integral to the building structures. As you'll learn, many of these rocks were quarried from faraway places. Read the descriptions and answer the questions at each stop. **Bring your textbook as it is an important resource that you will need to complete this assignment.** We are using terminology in this lab that we have not reviewed in class yet, so if you find some terminology in the lab that you do not understand, you will need the textbook to help learn this new terminology.

**Begin** at Allann Bros. Coffee Bistro (The Beanery) at **220 Liberty St. NE, Salem**, just north of the corner of Liberty and Court Streets. Walk north.

**234 Liberty (in front of Café Shine)** – What looks like bricks here are actually blocks of quartz sandstone painted a rust-red color. The very fine, even layering in the sandstone tells us it was deposited in a fairly tranquil environment, possibly near a lake shore. Informally called “ribbon” sandstone.

**248 Liberty** (thin strip on either side of the large plate glass windows) – This igneous rock is similar to that used in the Vietnam Memorial in Washington, D.C., called “Indian Black Granite.” Don’t let the name fool you. The rock’s dark color tells us it crystallized from a mafic magma, meaning it is low in silicon/silica ( $\text{SiO}_2$ ) and high in the elements \_\_\_\_\_ and \_\_\_\_\_.

Is the rock fine-grained (i.e. aphanitic, with crystals too small to see), or coarse-grained (i.e. phaneritic, with visible crystals)? \_\_\_\_\_

Based on these observations and your igneous rock charts, what is the rock name? \_\_\_\_\_

**260 Liberty** – This granitic rock is called “larvikite” or “blue granite.” It is not true granite, but a rare variety of light-colored igneous rock so poor in silica ( $\text{SiO}_2$ ) that it contains very little if any quartz! This rock is from Finland and is known in the stone trade as “Blue Pearl.” The plagioclase crystals display an iridescent flash of colors known as the “schiller effect.” Schiller is common on plagioclase cleavage surfaces in medium-to-low silica igneous rocks. Schiller is caused when light scatters off different compositions of feldspar that are thinly intergrown with each other in a single crystal.

**280 Liberty** – (SE Corner of Liberty & Chemeketa St.) This is the oldest rock we will see today at 1.8 billion years old. That’s 1,800 million years old, or ~4.5 times older than any bedrock in Oregon! This rock is from a famous quarry in Minnesota and is called the “Cold Springs Granite.” Is it igneous, sedimentary, or metamorphic? \_\_\_\_\_

This rock formed at extremely high temperatures (high metamorphic grade) and began to partially melt.

What is this rock called? \_\_\_\_\_

Name the mafic mineral in this rock \_\_\_\_\_. How did you identify it? \_\_\_\_\_

Notice a few very large feldspar crystals; these are relict (pre-existing) from the parent rock and have survived metamorphism. What is a likely parent rock? \_\_\_\_\_

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Cross Liberty Street to west... then head south on Liberty.

**255 Liberty** – This rock is similar to 248 Liberty St. What is the rock's name? \_\_\_\_\_

**241 Liberty (PGE Bldg.)** – This building had the 1950s-era blue façade removed in 2012 to expose the original architecture and building material. What rock currently makes up the face of this building?  
\_\_\_\_\_

**225 Liberty – Jackson's Jewelers** – This coarse-grained igneous rock has nicely formed feldspar crystals that are dark in color and display the schiller effect. Based on crystal size, did this rock cool quickly or slowly? \_\_\_\_\_

What is the rock's name? \_\_\_\_\_

Notice some small dikes (tabular or vein-like igneous bodies) that cut across the rock panels in places. Some are coarser grained than the main rock and others are finer grained. Choose one dike and describe it. Approximately how wide is it? \_\_\_\_\_

Is this dike coarser-grained or finer-grained than the rock it has intruded into? \_\_\_\_\_

How does its composition compare to the main rock (i.e. more felsic, more mafic, about the same)?  
\_\_\_\_\_

**Starbucks** – Note the foliation (striping patterns) of the darker minerals in this light-colored rock. If you look around the edges of some of the slabs, it will help you visualize the orientation of the foliation in three dimensions. Is the foliation sloping down toward the street or down toward the building?  
\_\_\_\_\_

The red mineral is fairly common in metamorphic rocks. What is it? \_\_\_\_\_

Does this rock contain at least 50% platy minerals (muscovite and biotite)? \_\_\_\_\_

Name the rock: \_\_\_\_\_

The mineral assemblage, in particular the abundance of garnet, suggest a sedimentary (clay-rich) parent. Is this rock more or less deformed than the one we saw at 280 Liberty Street? \_\_\_\_\_

Turn west onto Court Street...

**377 Court St. – India Palace Restaurant** – Are the stones on this building and planter bed igneous, sedimentary or metamorphic? \_\_\_\_\_

What is the rock name? \_\_\_\_\_

Use a hand lens to look for quartz "overgrowths" on individual grains. Overgrowths here are Quartz grains were first rounded on a beach or in a stream, then were compacted and cemented into rock. After the rock formed, the old smoothed-off faces of the quartz crystals began to re-grow. The sparkle of the sandstone in the sunlight comes from many tiny faces of quartz crystals, reflecting sunlight like glitter.

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The thin, flat layers/beds in the rock tell us the sediments were deposited underwater, at little at a time in a fairly calm setting, perhaps with gentle waves. What is an example of such an environment?

Head west to Commercial St. Cross the street and turn to the south...

**179 Commercial St.** – Look down at the sidewalk. Blocks of translucent material (which let some light pass through) are made of a mineral we saw in lab. Which one? \_\_\_\_\_

**129 Commercial St.** – This is an old rock, at least half a billion years old. Is it igneous, sedimentary or metamorphic? \_\_\_\_\_

What is the name of this rock? \_\_\_\_\_

It is rich in potassium feldspar. Black streaks are hornblende crystals. Does this rock contain quartz? \_\_\_\_

What is a possible parent rock? \_\_\_\_\_

**Pioneer Trust Bank, corner of Commercial and State St.** – This is extremely coarse-grained gabbro, with plagioclase exhibiting the schiller effect. Examine the iridescent plagioclase crystals. What tells you these are plagioclase, not potassium feldspar?

Notice the concentric rings in some of the plagioclase crystals (one color in the center and a different color around the crystal edges). It is especially visible in the schiller reflections. This concentric effect is called “zoning.” Zoning is caused by the changing mineral composition that happens during crystallization. Based on Bowen’s Reaction Series, would the early-formed crystal cores be more sodium-rich or more calcium-rich than the later-formed rims? \_\_\_\_\_ (Recall from Bowen’s Reaction Series how one composition of plagioclase crystallizes first, changing composition as the temperature drops and the melt composition evolves.) Sketch one or two plagioclase crystals below, showing the zoning. Your sketch should show which areas are darker and which are lighter.

Head east on State Street, away from the river...

**379-383 State St. – Ma Valise Jewelry Store.** Beautiful verde antique (green “antique marble”) facing, probably from Vermont. Actually, it is not marble at all. Builders call it “marble” because it has a hardness near calcite... but it does not effervesce in acid. This rock forms from hydration and metamorphism of peridotite as slivers of the upper mantle get squeezed up between colliding tectonic plates. What is the rock’s name? \_\_\_\_\_

What is the composition of the parent rock (e.g. felsic, intermediate, etc.)? \_\_\_\_\_

Turn left on Liberty Street and walk north.

**135 Liberty St.** – This stop was covered up in 2013, but you can still answer the questions. The facing stones are black brecciated metamorphic rocks, showing evidence of solution and repair by white

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calcite. The outer panels facing the street show evidence of chemical weathering. This rock reacts with acid. What is the rock's name? \_\_\_\_\_

**155 Liberty St.** – Is this rock igneous, sedimentary or metamorphic? \_\_\_\_\_

Notice elongate green-black amphiboles (hornblende). Look for twin striations in the plagioclase. What color is the plagioclase? \_\_\_\_\_

Based on overall rock color and minerals present, is this rock ultramafic, mafic, intermediate or felsic? \_\_\_\_\_

What is the rock's name? \_\_\_\_\_

Name a silicate mineral that you would not expect to find here: \_\_\_\_\_

Why wouldn't it form in this rock?

Turn around and go back to State Street. Turn left (east) on State Street.

**416 State St. – Key Bank at the corner of State and Liberty.** The limestone bricks that face this columns are cut from coral reef limestone that has been somewhat recrystallized. Note the high porosity and permeability typical of the sponge-like reef rock. Can you see fossil coral? \_\_\_\_\_

In the Middle East ancient reefs make superb reservoir rocks for oil and gas.

The floor in front of the entry is fine-grained travertine that dissolved from the coral reef limestone and recrystallized. Recall that travertine is a freshwater limestone. What mineral are all these rocks made of? \_\_\_\_\_

What affect does rain have on these rocks – and why?

Continue east on State Street and cross the street at High Street.

**Corner of State and High Streets (512-516 State St.) – The Marion County Courthouse** is faced with a white metamorphic rock from Vermont. What mineral is it mostly made of? (hint: if you put a drop of acid solution on it, it would fizz vigorously) \_\_\_\_\_

What is the rock's name? \_\_\_\_\_

Despite the streaks, this rock is not foliated. Look closely with a hand lens to determine what light-colored mineral forms thin streaks in the rock?

What is the metallic mineral here? \_\_\_\_\_

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Walk east on State Street.

**Corner of Church and State Streets – Old Salem Post Office.** Does this white facing stone look similar to the last building? \_\_\_\_\_

This rock is also from Vermont. Here, the darker streaks in the rock include a yellow metallic mineral. The crystals do not look cubic as they might for pyrite. Can you identify this mineral? What is it?

\_\_\_\_\_

The foundation stone and steps of this building are very weathered granite.

Continue east on State Street and cross State Street at Cottage to the Art Museum.

**Corner of Cottage and State Streets – Hallie Ford Art Museum.** Above the doors is another white metamorphic rock, again from Vermont. Now look down at your feet. What metamorphic rocks pave the entry to the museum? \_\_\_\_\_

How did you identify it? \_\_\_\_\_

Multi-colored rings called “Liesegang bands” are a pattern in the rock created by ground water flowing through the rock and consequent weathering.

Continue east on the sidewalk and you will see that the building has a light-colored rock above and a darker, gray-brown rock below. The darker rock consists of milky-brown plagioclase crystals, black biotite, and possibly hornblende. This may be a simple diorite or possibly a cousin of the rare silica-deficient larvikite (“blue granite”) we saw at our third stop. Do these plagioclase crystals display schiller iridescence? \_\_\_\_\_

Note the arrangement of the crystals. This arrangement may be due to magma flow or crystal settling. Choose an area about 10-14 cm square and sketch the arrangement of the large plagioclase crystals in relation to one another:

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Turn south through the alley alongside Hallie Ford Museum. Then turn immediately left and cut through the parking lot, cross Winter Street. Continue up the wide sidewalk onto the Willamette University campus past the small Japanese garden.

Observe the **erratic** from the Missoula Floods with a plaque – Contrary to the date cited on the plaque, this boulder was deposited in Oregon 13,000-11,500 years ago, when we now know that catastrophic floods repeatedly filled the Willamette Valley with sediment-laden water and mini-icebergs from glacial Lake Missoula in western Montana. Is this boulder well-rounded? \_\_\_\_\_

This rock has traveled far. Why isn't it worn smooth and round from abrasion along its journey?

**Redwoods** - These trees (*Sequoiadendron giganteum*) are the Giant Redwoods. They are related to "dawn redwoods" (*Metasequoia glyptostroboides*), a variety that once dominated vast areas of western North America after the demise of the dinosaurs. Dawn redwoods were fossilized from 5 to 25 million years ago in what is now the John Day Fossil Beds National Monument and elsewhere in North America. Dawn redwoods (*Metasequoia*) recently became Oregon's official state fossil.

In 1944 a forester shocked the world by finding a grove of living dawn redwoods in a remote area of China. Since then, scientists have collected seeds and brought this fossil tree to life again on our continent!

Continue east on the path, past Town and Gown, to Eaton Hall.

**Eaton Hall** – The foundation of this building is a tuffaceous sandstone – that is, a sandstone made mostly of sand-size grains of pyroclastic volcanic material. In what year was this building constructed? \_\_\_\_\_

Describe and sketch the effects of weathering on this rock:

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Cross the street toward the Capitol Building.

**Back side of the Capitol Building** – Surprise! This building is faced with white Vermont marble. How does it look different from the marble at the Marion County Courthouse and the Old Post Office (page 4)? \_\_\_\_\_

What mineral(s) besides calcite can you identify here? \_\_\_\_\_

How did you identify it? \_\_\_\_\_

Walk around the north side of the Capitol Building, on the walkway through the small park.

**Circuit Rider statue** – Is this rock igneous, sedimentary or metamorphic? \_\_\_\_\_

Does it contain quartz crystals? (You may see this better if the rock is wet.) \_\_\_\_\_

Look closely with a hand lens to identify the mafic (dark-colored) mineral, what is it? \_\_\_\_\_

Is the rock plutonic or volcanic? \_\_\_\_\_

What is the rock's name? \_\_\_\_\_

Explain why this is the best name:

Stand back and notice the large, faint, dark smears in the rock. These are called “schlieren” and were formed from chunks of more mafic rock that were incorporated into the magma and were in the process of melting, just as the magma began to cool and harden. The largest remaining chunk or “xenolith” (“foreign rock”) is about 2 cm long. Its quartz appears milky – possible evidence that the solid piece was starting to melt.

**Jason Lee and McLaughlin statues** – The bases of these statues are very similar in composition to the first statue. What rock texture do you see here that was not at the Circuit Rider statue? \_\_\_\_\_

What mineral crystallized to make the large, well-formed crystals? \_\_\_\_\_ (Your knowledge of Bowen's reaction series and the order that silicate minerals crystallize may help here.)

**Oregon Veterans Medal of Honor Memorial** – What is the rock name for the plaque podiums? \_\_\_\_\_

Again, the composition is similar to the previous monuments. All have little to no potassium feldspar, which is typical of Oregon rocks.

On the north side of the column dedicated to Gary Martini is a large white plagioclase crystal showing excellent twin striations. You won't need a hand lens to see them!

Were these monument stones erected before or after those at the two previous stops? \_\_\_\_\_

How can you tell (other than reading the date!)?

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Go to the front of the Capitol Building.

**Capitol Building Entrance** – The steps and building foundation are a gray granitic rock with chunks of other rocks (xenoliths) incorporated into it. When you see xenoliths, it usually means the stone was quarried from the top or edges of a pluton, near the border with the surrounding rocks. Are these xenoliths more mafic or more felsic than the rest of the rock? \_\_\_\_\_

**Inside the Capitol (if open)** – The rotunda floor is gray fossil-bearing limestone and/or marble of Paleozoic age. The black stone is Cretaceous age fossil-bearing limestone. Walls are Cretaceous reefoid limestone with solution cavities that have been filled with grout of some kind. Flesh pink and tan colors in the walls come from iron oxides (hematite and limonite). There is a nice mineral display in the case in the hall on the right that has changing displays of minerals, etc.

Exit and head to the west side of the Capitol Building.

**“Marking an Old Trail” monument** – This boulder is quite weathered and altered at its surface, but you may find a relatively freshly-broken surface that reveals the rock inside. Note the year it was placed here: \_\_\_\_\_

What mineral would make the weathering rind reddish? \_\_\_\_\_

This mineral indicates a high content of what chemical element in the rock? \_\_\_\_\_

Find a surface that exposes fresh rock without lichens or rust. What color is the rock? \_\_\_\_\_

Is it fine-grained (aphanitic) or coarse-grained (phaneritic)? \_\_\_\_\_

Therefore, is it intrusive? \_\_\_\_\_

What is the rock name? \_\_\_\_\_

Is the rock likely native to Oregon? \_\_\_\_\_

Why do you think so?

Oregon Tribes plaques –What is the rock name? \_\_\_\_\_

The reddish color is common for what type of feldspar? \_\_\_\_\_

Was this rock likely quarried in Oregon? \_\_\_\_\_

Why do you think so?



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Continue west across the park to the painted cast iron fountain at the far west end, next to Cottage Street.

**Small round fountain** – The cast iron in the fountain is almost certainly from the Lake Oswego area where it was mined and smelted from the iron hydroxide mineral, limonite.

The pavers around the fountain are made of limestone and travertine. The travertine is similar to what we saw at Key Bank. You can see layering in it. The contorted zig-zag lines, on the other hand, occur in the limestone and are evidence that the rock partially dissolved under extreme pressure. Is the rock travertine more likely to form near the surface or to be deeply buried? \_\_\_\_\_

Identify which pavers are travertine and which are limestone? Describe how the two rocks look different from each other with regard to their porosity, density and colors.

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This concludes your Geologic Tour of Urban Salem. Turn this in at our next class meeting.