

# Laboratory Three

## Rock Genesis and Terrane Interpretation in the Wilson Cycle

### *“No Rock is Accidental”*

Last lab we identified a mixed suite of igneous, sedimentary and metamorphic rocks. This week we seek out places in the Wilson Cycles where these rocks may be generated.

#### **Wilson Cycle Test**

The first test in SST includes everything up through the lectures of Virginia Physiographic provinces and the descriptions of Virginia rocks, their distribution, interpretation, etc. This first test combines questions of both lab and lecture material, including especially Wilson Cycle concepts. Although anything from these two labs, and the accompanying lectures may be included on the first test, there is also a specimen identification/interpretation for the first test. These specimen interpretation questions will be constructed like the exercise you are doing in this lab today, except the rock specimens will be new. The cross section on which the rock locations will be noted will be the one on page 10 of this exercise.

#### **Sample Test Instructions:**

- There are six rocks. Only four of them are to be used.
- For each of the four locations on the Wilson Cycle identify the one rock that is most likely to have formed there.
- Write a description of the rock and give it a name.
- Write a justification for your choice.

## This Lab Contains Six Parts

### **PART ONE - Rock Description, Identification, Interpretation**

(Note: Depending on class size this part may be abbreviated, or eliminated)

At the beginning of the lab we will ask each of you individually to stand up in front of the class and talk about what you know about one of the rocks. The rocks will be chosen more or less at random when you come up. You will talk maybe a minute, not more than two minutes about your rock. This must be extemporaneous, followed by a Q and A where anyone can ask you about the rock.

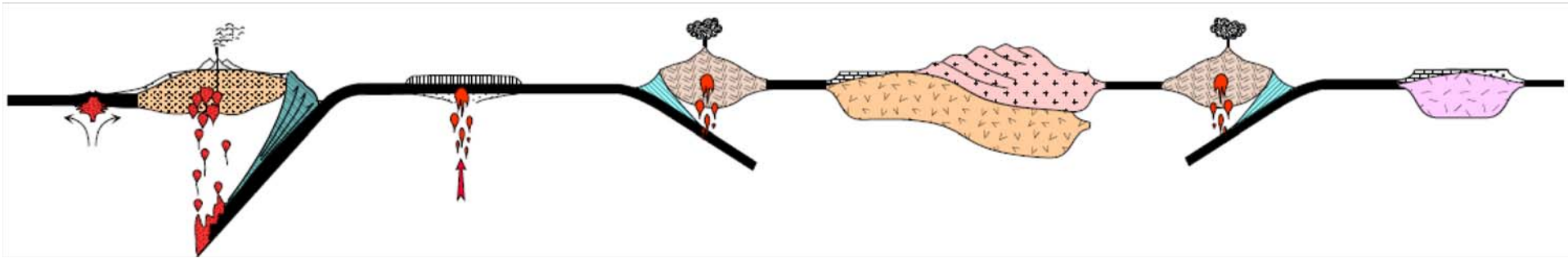
## PART TWO - PLATE TECTONIC RELATIONSHIPS

Below is a cross section of a portion of the Earth's lithosphere. Label it with the following plate tectonic features.

Forearc  
Backarc  
Craton  
Remnant Ocean Basin

Paired Metamorphic Belt  
Foreland  
Hinterland

Hot spot  
Suture zone  
All plate boundaries



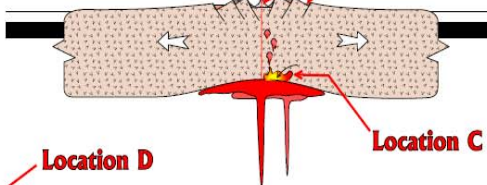
# A Wilson Cycle

2015 Version

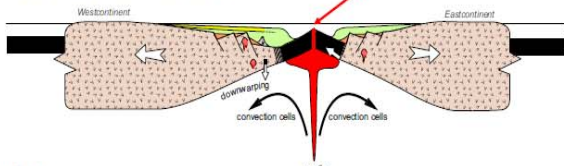
Stage A - Stable Continental Craton



Stage B - Initial Rifting



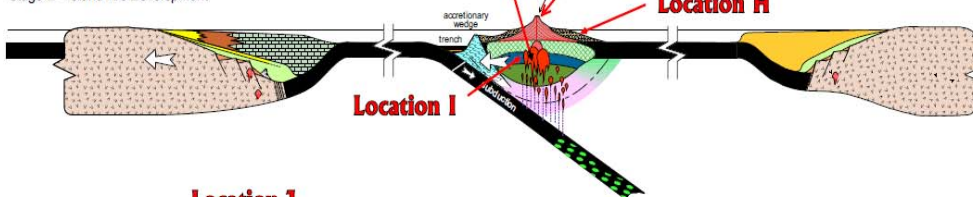
Stage C - Early Ocean Basin Formation



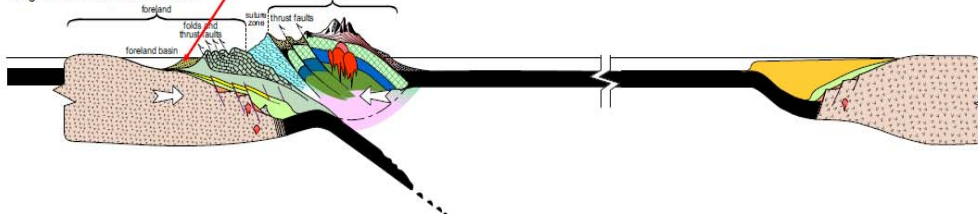
Stage D - Full Ocean Basin



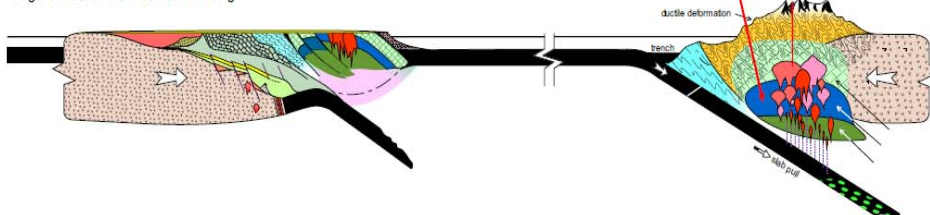
Stage E - Island Arc Development



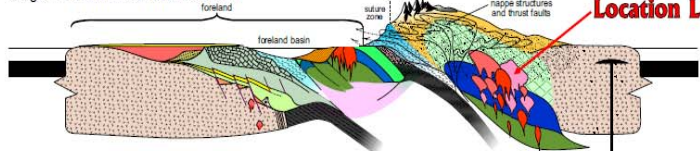
Stage F - Arc-Continent Collision



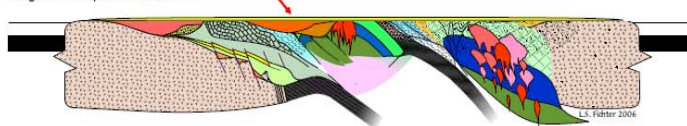
Stage G - Cordillera Mountain Building



Stage H - Continent-Continent Collision



Stage I - Peneplained Continent



## PART THREE - ROCK GENERATION IN THE WILSON CYCLE

### Instructions:

- Wilson Cycle Poster:** on the previous page, and in the posters provided in lab is the Wilson cycle with locations identified by letter.
- Rocks:** From the selection of 20 rocks you identified last week choose the one best rock that most likely formed in the tectonic conditions at the indicated location on the Wilson Cycle cross sections. More than one rock may fit the location, but there is *only one best* specimen.
  - Note you have 20 rocks to work with, but there are only 13 locations identified on the Wilson Cycle, meaning there are 7 orphan rocks you will not use.
  - In the spaces below briefly explain the process by which each rock formed. It is important to integrate everything you already know: plate tectonic processes and the specific conditions under which each rock forms.
- You are encouraged to work together with your partners on this project. Talking, debating, throwing ideas around, sorting out what you know and what you don't know is part of the process.
- Be able to explain your identifications and analysis so that both you and your listener are sure you understand why *no rock is accidental*.

**LOCATION A:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Extrusive igneous rock ejected onto a continental surface above a hot spot during the initiation of a rifting event (now low grade metamorphosed by a later event).*

- Describe tectonics and processes of formation.

**LOCATION B:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Clastic sediments eroded from felsic igneous basement and deposited in a graben developed along a region of continental rifting.*

- Describe tectonics and processes of formation.

**LOCATION C:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Igneous rocks emplaced in lower continental crust by fractional melting of lower continental TTG suite igneous rocks.*

- Describe tectonics and processes of formation.

**LOCATION D:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Extrusive mafic igneous rock ejected at a subaqueous oceanic rift center.*

- Describe tectonics and processes of formation.

**LOCATION E:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Carbonate sedimentary rocks deposited in shallow marine environments along a divergent continental margin in a tropical climate in the absence of clastic rocks.*

- Describe tectonics and processes of formation.

**LOCATION F:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Calcalkaline batholithic rock emplaced deep in the crust above a subduction zone.*

- Describe tectonics and processes of formation.

**LOCATION G:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Pyroclastic rocks generated by a composite volcano of intermediate to felsic (calcalkaline or TTG) composition in a volcanic arc system.*

- Describe tectonics and processes of formation.

**LOCATION H:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Sediments deposited in the short system backarc basin of a volcanic arc in moderate to deep water.*

- Describe tectonics and processes of formation.

**LOCATION I:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Oceanic lithospheric rocks (ophiolite suite layer 2) that have undergone intermediate grade metamorphism.*

- Describe tectonics and processes of formation.

**LOCATION J:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Sediments deposited in a shallow marine shelf within a prograding foreland basin created by the collision between a volcanic arc and a continent.*

- Describe tectonics and processes of formation.

**LOCATION K:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Original divergent continental margin clastic sediments undergoing upper-medium to high grade Barrovian metamorphism during a cordilleran orogeny.*

Describe tectonics and processes of formation.

**LOCATION L:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Proterozoic age plutonic, coarse grained rock with quartz, pyroxene, and feldspar (AMCG suite).*

Describe tectonics and processes of formation.

**LOCATION M:** Rock Number: \_\_\_\_\_ Name Rock: \_\_\_\_\_

*Sediments deposited on a peneplained continent.*

Describe tectonics and processes of formation.

▶ When finished ask your instructors to check your identifications and attributions.



## PART FOUR - ORPHAN ROCKS

### Instructions:

- You have seven rocks left over. Try to decide where in the Wilson cycle these rocks might be best found, and the rock genesis/tectonic conditions of formation.

Rock Specimen Number	Rock Specimen Name	Wilson Cycle Stage	Summary Interpretation (Rock Genesis Origins/Processes and/or Tectonic Conditions of Formation)

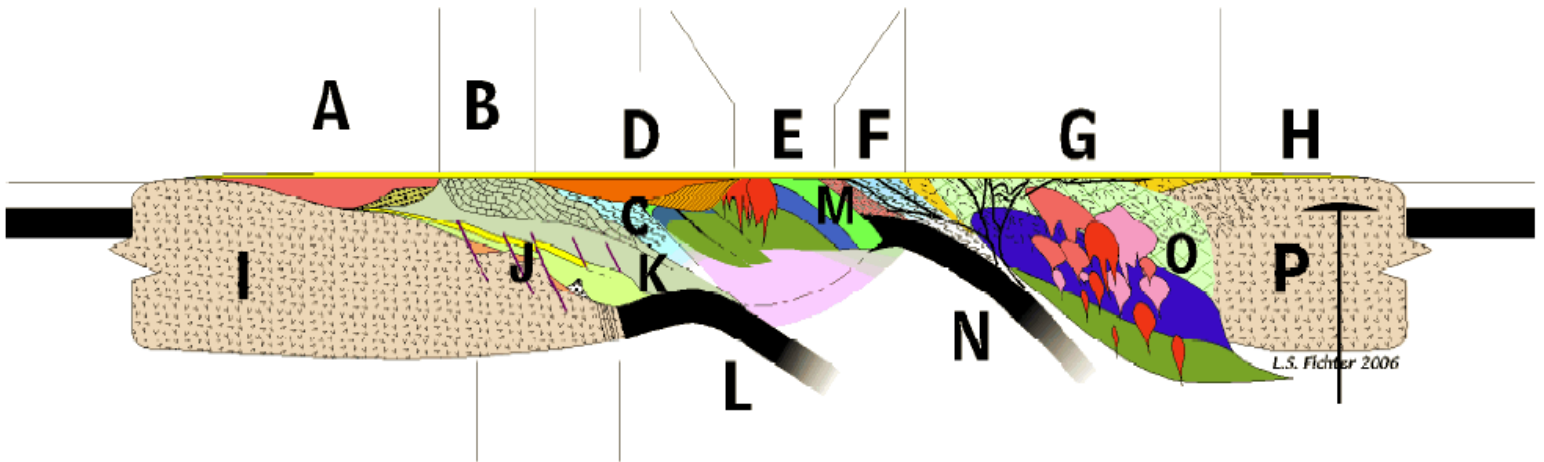
- ▶ When finished ask your instructors to check your identifications.

## PART FIVE - TECTONIC STAGES AND TERRANES<sup>1</sup> IN THE WILSON CYCLE

It is true that No Rock is Accidental, but any particular rock may form or be found more than once in a Wilson Cycle. Below is a copy of Stage I of the Wilson Cycle identifying by letter the various terranes generated during one Wilson Cycle.

### Instructions:

- For each terrane identify the Wilson cycle stage it was generated in.
- Identify from among our 20 rocks those that can reasonably be found in each tectonic terrane.



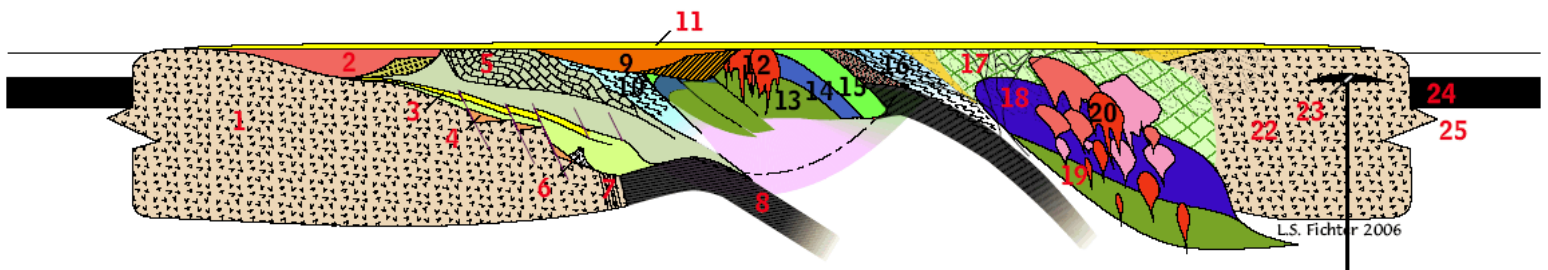
Location Letter	Wilson Stage?	Rocks Forming Here	Location Letter	Wilson Stage?	Rocks Forming Here	Location Letter	Wilson Stage?	Rocks Forming Here
A			G			M		
B			H			N		
C			I			O		
D			J			P		
E			K					
F			L					

<sup>1</sup> Wikipedia describes a terrane as “a fragment of crustal material formed on, or broken off from, one tectonic plate and accreted---”sutured”---to crust lying on another plate. The crustal block or fragment preserves its own distinctive geologic history, which is different from the surrounding areas (thus the occasional term “exotic” terrane).” We use the term terrane this way, but also to include any region of the crust whose rocks are different from and/or formed from different processes than rocks in adjacent terranes.

## PART SIX - ROCKS IN THE WILSON CYCLE

NOTE: *Do Not* use the rock specimens in the trays ! This problem is about being able to predict what a rock will be based on its location in the cross section below.

Below is a cross section of the final stage of the Wilson Cycle. For each numbered location predict the kind of rock that would form there. These are not the rocks you identified earlier, but rocks you would predict would be found at each of these locations. You should be able to identify in which stage of the Wilson cycle each rock formed, and identify the rock found at each numbered location.



Specimen #	Wilson Stage?	Rock Identification	Specimen #	Wilson Stage?	Rock Identification	Specimen #	Wilson Stage?	Rock Identification
<b>1</b>			<b>10</b>			<b>19</b>		
<b>2</b>			<b>11</b>			<b>20</b>		
<b>3</b>			<b>12</b>			<b>21</b>		
<b>4</b>			<b>13</b>			<b>22</b>		
<b>5</b>			<b>14</b>			<b>23</b>		
<b>6</b>			<b>15</b>			<b>24</b>		
<b>7</b>			<b>16</b>			<b>25</b>		
<b>8</b>			<b>17</b>					
<b>9</b>			<b>18</b>					