Student Name: **Grade:**

Physical Geology 101 Lab
Geology of Tourmaline Surfing Park, San Diego CA

Introduction & Purpose: The coastal geology of San Diego County is beautifully exposed in bluffs of Tourmaline Surf Park. Sedimentary rocks of Cenozoic ages were deposited there within various types of coastal marine depositional settings over time. Several unconformities and an ancient fault are also exposed there. The purpose of this lab is to observe, describe, sketch, photograph, and interpret various geologic features in the sea cliff at Tourmaline Surf Park.

Directions: Answer the fieldtrip questionaire as we go - one formation to the next - and also complete the stratigraphic section for Tourmaline Beach on the stratigraphic section blank provided. Plot the above data on the provided on your stratigraphic section as we walk past the rocks viewed in the sea cliffs.

1) Fill in the section with the proper geologic symbol for the rock type represented for each interval of rock type observed. See the table of rock symbols for the correct symbol used to indicate the various rock types.

2) Give the formation name and age that would appear on a geologic map for that unit.

3) Write a brief description of each formation on the diagram in the space adjacent to the specific rock unit. This description should include:

a) The range of rock types in the formation. (For example, conglomerate with lenses of silty sandstone.)

b) A standard geologic description of the rock type. (For example, if the rock is a conglomerate with silty sandstone matrix: estimate the size range of clasts and matrix material, describe the composition of the clasts and matrix material, the roundness or angularity of the clasts, the sorting of the clasts.)

c) List the fossils observed, unusual minerals, sedimentary structures, the presence of graded bedding or cross bedding or other features that tell something about the depositional environment.

d) Name the interpreted depositional environment.

I. LOWER SECTION STOPS: THE ROCKS AT THE NORTH END OF BEACH:

Here near at the point, we will observe the **Mt Soledad Formation**. The Mt Soledad is exposed in the cliff and is early Tertiary Period/Eocene Epoch in age (52 million years).

A. OBSERVATIONS AND ANALYSIS OF THE MT SOLEDAD FORMATION:

1) What specific rock type(s) make up the Mt Soledad Formation? (Hint: two types; one being coarse-grained detrital sedimentary rock containing large rounded rock fragments):

Rock types :_____ and _____

2) Estimate the rock fragment sizes within the Mt Soledad Formation (consider the pebbles and cobbles clasts, AND finer-grained matrix):

Avg Clast size: ____ cm **Matrix material:** _____ **Clast or Matrix supported?** _____

3) Name the three major rock types that make up the cobbles in the Mt Soledad Formation.

Answer: _____, _____, and _____

4) The Mt Soledad Formation contains a unique set of cobbles, called "Poway" clasts, which have an exotic origin.

a) List the *rock type* and *age* for the "Poway" clasts.

Rock Type: _____ *Age* _____ **myo**

5) Briefly explain *Where* these exotic clasts came from, and *How* those clasts ended up in this formation in coastal san Diego.

Answer: _____

_____

_____

6) What two sets of evidence within the Mt Soledad Formation indicates that the sediment in this formation was: a) *moved a significant distance from its source*, AND
b) *deposited in a high energy environment?*

Answers: a. _____ and **b**_____

7) What was the most likely depositional environment for the Mt Soledad Fm?

Answer: _____

8) What was the most likely depositional environment for the Mt Soledad Fm?

Answer: _____

9) What evidence suggests this depositional environment for the Mt Soledad Fm?

Answer: _____

10) How do cut-and-fill deposits form?

Answer: _____

11) LABEL and SKETCH the Mt Soledad Formation on your Stratigraphic Column Worksheet.

II. MIDDLE SECTION STOPS – FATHER SOUTH ALONG TOURMALINE BEACH:

Here we observe the Scripps Formation unconformably overlying the Mt Soledad Formation. Note that the entire section of rocks here are tilted (dipping) to the south. This tilting is due to the growth of Mt. Soledad a few miles to the northeast. Mt. Soledad is being pushed up along a compressional bend in the Rose Canyon Fault Zone. Therefore, as we head south we will be walking "up-section" through the whole sequence, where the Mt Soledad Formation will eventually pass under the beach, giving way to the overlying Scripps Fm. The **Scripps Formation** is also Eocene age (approx. 46 million years old) and formed in the middle to lower sections of an offshore sea submarine canyon.

A. OBSERVATIONS AND ANALYSIS OF THE TOURMALINE FAULT

2) There is a fault that cuts and offsets the Mt Soledad and Scripps Formations here. Closely observe the characteristics of this fault. Make observations and take measurements of the faults: **a)** Strike and dip, **b)** Apparent offset direction and amount**; c)** Slickensides

Fault Strike and Dip: _____ _____ See any slickensides? _____

Offset Motion: Hanging Wall moved Up or Down? _____

What type is fault is it? _____ **What type of stress caused it?** _____

B. OBSERVATIONS AND ANALYSIS OF THE SCRIPPS FORMATION:

1) Note the contact between the underlying Mt Soledad Fm and the overlying Scripps Fm.
Questions: Is this contact considered an unconformity? If so, which type?

Answer: _____

3) What specific rock types make up the Scripps Formation?

Answer: _____ and _____

4) What's the special name for the package of numerous, thin layers in the Scripps Fm?

Answer: _____

5) How do turbidite layers form? _____

6) What 2 sets of evidence in the Scripps Fm indicates that the sediments in this formation were deposited in a *submarine canyon environment? What are they?*

Answer:_____ and _____

7) Estimate the dip angle (tilt angle with respect to the horizontal) **of the Scripps Formation. Are these rocks dipping (tilted downward) toward the north or south?**

Dip angle: _____

8) As you continue walking north along the base of the sea cliff, notice how "messed up" (folded, swirled, etc.) the Scripps Formation is in some spots. These irregular swirls are the result of underwater mass movement events (slides, slumps, etc.) that occurred in this rock unit as it was being formed. **Did this deformation occur when the Scripps Formation was still soft sediment or after it hardened into a rock? Briefly explain your answer.**

Answer: _____

9) Now, walk down the beach along the base of the sea cliff. Keep walking south until you notice a series of criss-crossing fractures filled with a very soft, clear mineral. This mineral was precipitated inside cracks in the rock by groundwater. **What mineral is this?** *Hint: it's very soft and it doesn't fizz in hydrochloric acid.*

Answer: _____

10) LABEL and SKETCH the Mt Soledad Formation on your Stratigraphic Column Worksheet.

III. UPPER SECTION STOPS - SOUTHERN END OF TOURMALINE BEACH:

A. OBSERVATIONS AND ANALYSIS OF THE SAN DIEGO FORMATION:

Before you reach the parking lot, higher up on the sea cliff, is a layer of conglomerate that overlies the Scripps Formation. This rock layer forms the base of the Pliocene **San Diego Formation** (less than 3 million years old). Observe the south-dipping contact between the underlying Eocene Scripps Formation and the overlying Pliocene San Diego Formation.

1) Type of unconformity bounds the Scripps and San Diego Fms? _____

2) What span of time does this unconformity comprise? _____ my

3) What specific rock types make up the San Diego Formation? There are three.

Answer: _____, _____, and _____

4) Further down the beach, south of the parking lot, you'll notice that the sandstone exposed in the sea cliff contains numerous fossils within the San Diego Formation.
<u>Identify and Record</u> all the different fossils you observe. Note: at a minimum, you should be able to find at least two different types of fossils. Look carefully! You'll see 'em!

Fossil #1: _____ **Fossil #2:** _____

5) What 2 sets of evidence in the San Diego Fm indicates that the sediments in this formation were deposited in a *rather quiet shallow offshore shelf environment ?*

Answer: _____ and _____

6) **<u>LABEL and SKETCH</u>** the San Diego Formation on your Stratigraphic Column Worksheet.

Figures

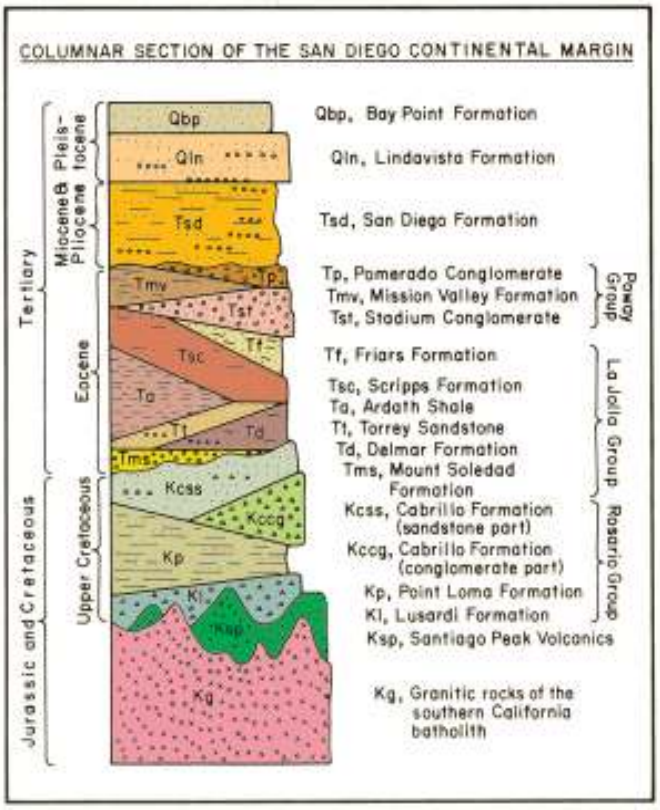


Figure 1.

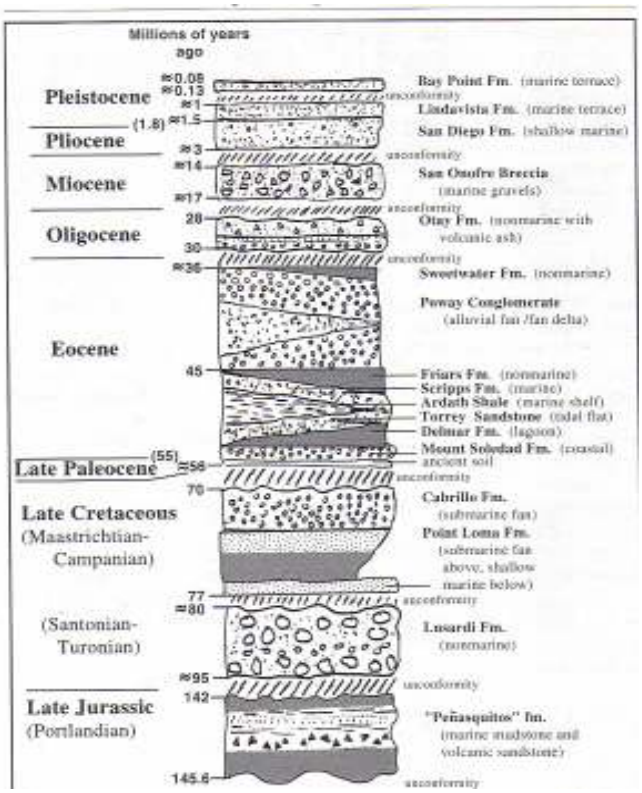


Figure 2.

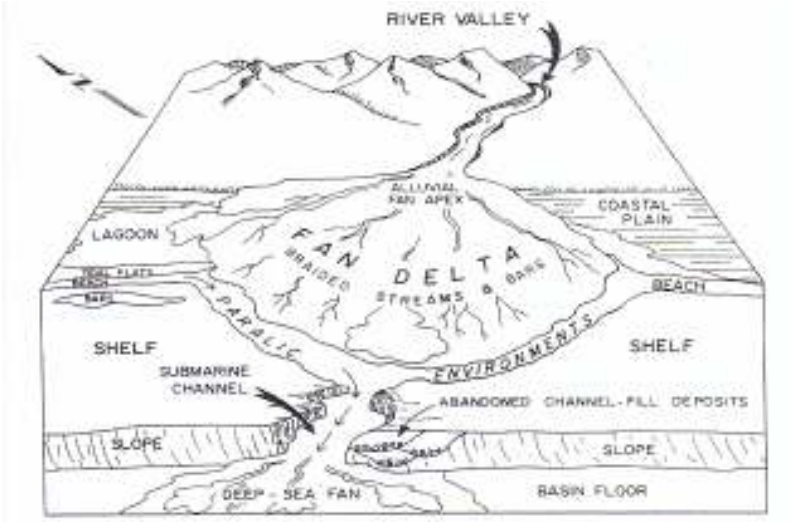


Figure 3.

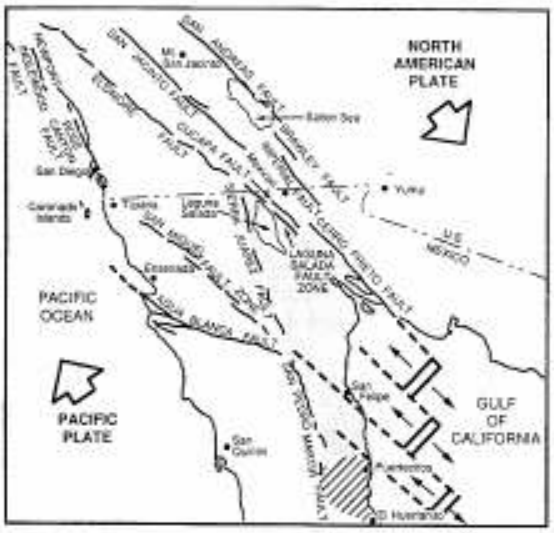


Figure 4.

Figure 5.

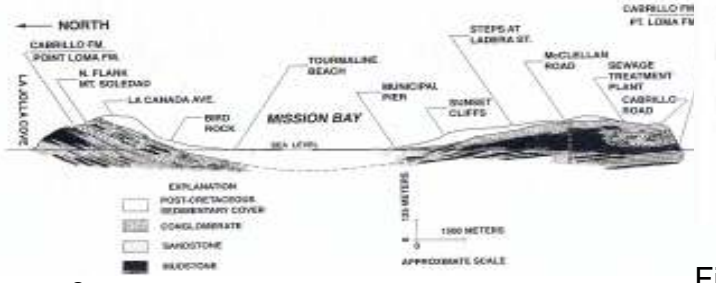


Figure 6.

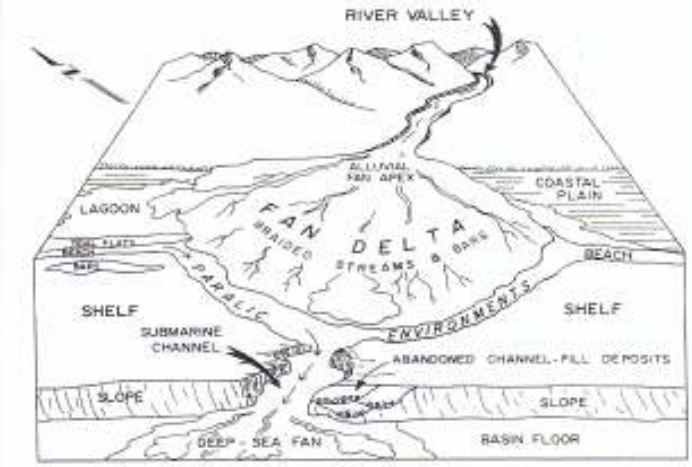
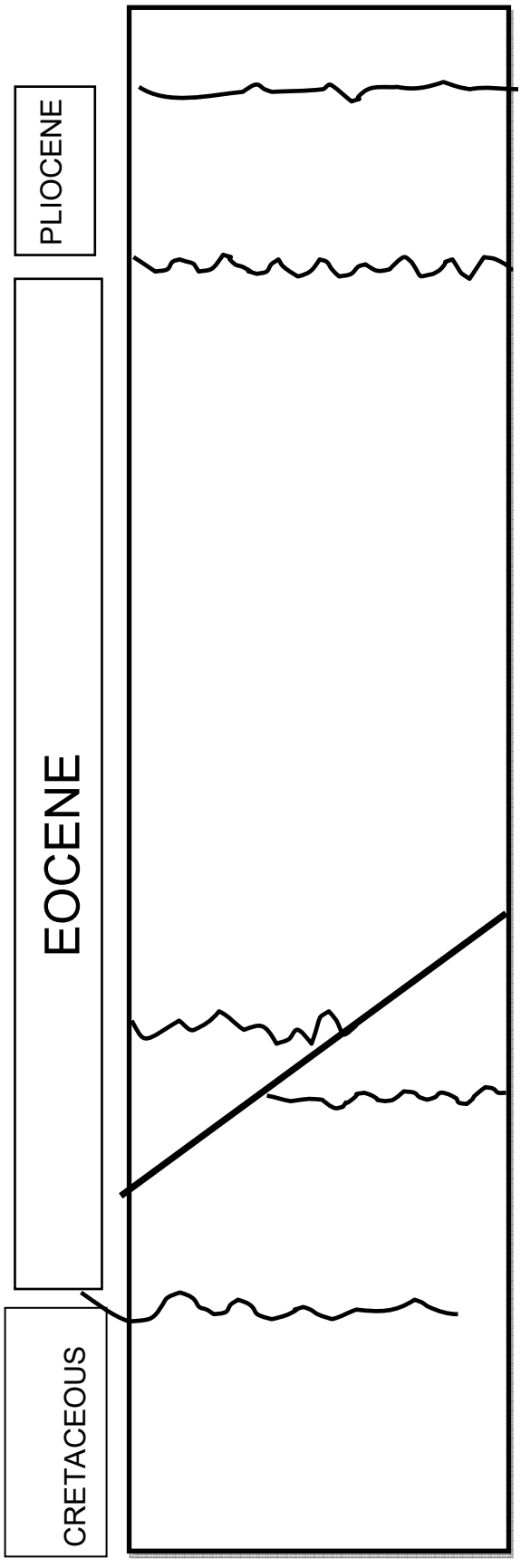


Figure 7.

Tourmaline Beach Stratigraphic Column

Field Notes:



UNCONFORMITY: _____

UNCONFORMITY: _____

FAULT: Strike: _____ Dip: _____ Type : _____

UNCONFORMITY: _____

UNCONFORMITY: _____