Geology 103 Name(s):

Lab 3: Sedimentary structures

Needed: Sedimentary structure specimens S1, S4 — S10, S12, S14 and S15.

Layering

S4: Parallel bedding

1. a. What is the rock name?

b. What defines the millimeter-scale bedding (**laminae**) on this rock? (Hint: it is **not** due to a change in mineralogy; in other words, there are **not** more dark minerals in the darker layers)

S1: Ripple marks

2. a. Are these ripples symmetrical or asymmetrical? Can you *infer*, then, that the depositing agent was moving in one direction or two?

b. What is the approximate **wavelength** of the ripples in centimeters?

c. Based on the two answers above, is it more likely that these ripples were originally deposited in a **desert**, a **river** or a **tidal flat**? Why? Hint: consider what medium was transporting the sediment and what direction(s) it was being carried in.

S5: Cross-bedding — Examine the sides of this rock; note that there are fine layers which are not horizontal. These are called **cross-beds**.

3. a. What **scale** bedding thickness is present in this rock (millimeter, centimeter or meter-scale?)? What (in the rock) defines this bedding?

b. Sketch the cross-bedding, especially around the **truncation** surface, where the cross-beds seem to be abruptly cut off. Please include a **scale**.

c. Do the cross beds tilt **upcurrent** or **downcurrent**? Indicate this as an arrow on your sketch on the previous page.

d. What is the grain size of the laminae which exhibit cross-bedding?

e. Is there cross-bedding in the gray layer above?

f. Why would you *not* expect it in the gray layer? (Hint: note grain size and the energy of the environment which that represents)

Soft Sediment Deformation

S6: Load (flame) structures — Examine the cut side of this rock, where the dark gray and black layers meet in an unusual shape (see arrow).

4. a. Is the black layer or the dark gray layer **finer-grained** (use a hand lens)?

b. Is the black layer or the dark gray layer easier to deform **plastically** when moist?

c. Is the black layer or the dark gray layer more **voluminous**, more **massive**, and more likely to deform the sediment underneath it?

d. Sketch the flame structure **right-side** (stratigraphic) **up**. (Note: the arrow does not *necessarily* show which way is up) Again, include a scale.

S7: Rip-up clasts — Examine the side of the rock; note that there are two *distinct* grain size layers — use the side with the tape for orientation.

5. a. What is the grain size within the rip-up clast?

b. What is the grain size within the **matrix** which contains the rip-up clast?

Rip-up clasts form when a strong sediment-laden current erodes the sediment layer underneath and carries some portions of it downstream.

c. Is there any **lamination** (fine layering) in the bottommost layer? Is there any lamination in the coarser-grain layer? Why does this make sense (in other words, how did the water speed change from the bottom to the top?)

d. Draw the rip-up clast and show the current direction of the water that ripped it up. Please show the scale!

S8: Drapery structure — Examine the face of the rock with the current direction arrows.

6. a. What grain size comprises the deformed laminae?

b. Draw a **sequence** of cross-sections that show a pile of originally parallel-bedded sediments undergoing drapery structure deformation. (Hint: start with one layer and add one more layer with each successive cross-section)

S9: Soft sediment deformation? — Examine the cut face of the rock; within the cracks is **secondary calcite**, which is calcite deposited by calcite-rich groundwater long *after* lithification of the rest of the rock.

7. a. Sketch a portion of the rock which shows the deformation of the layers.

b. Is this soft sediment deformation (before lithification) or secondary deformation (after lithification)? How can you tell?

c. Did **compressional** or **tensional** forces deform this rock?

Environment
S10: Mudcracks

8. a. Why do mudcracks form? What does this imply about the environment?

b. Why wouldn't you expect fossils in this rock?

c. Which way is **stratigraphic up** (crack side up or crack side down)? This is subtle but you can tell.

Current direction and orientation
S12: Tool marks

On either flat surface of the sample are a set of straight lines embossed in the rock (the lines occasionally intersect).

9. a. What generates these lines (called tool marks)?

b. What do the tool marks suggest to you about the inferred current direction? In other words, did the current vary or was it always in the same direction?

c. Describe how these tool marks be used to orient the rock with **stratigraphic up** in the correct direction.

Bioturbation
S14: Trace fossils — Examine the top of this rock (the black arrow points towards the top)

11. a. How do you know there are biologically created "holes" in this rock? What makes them stand out?

b. Sketch the evidence of biological activity. There should be one **track** and one **burrow**. Please put a centimeter scale on the sketch!

Summary
S15 — Examine the rock face with the tape.

12. a. List the different sedimentary structures found on this face (at least **three**).

b. Using the arrow directions given on the tape, which *letter* indicates the direction of the current? Which sedimentary structure(s) helped you decide this?

c. Which *letter* indicates the stratigraphically up direction? Which sedimentary structure(s) helped you decide this?

Sandstone from the Puget Group (Eocene) — On the back table is a large rock from this formation.

13. a. **Sketch** the rock so that it is oriented with the **youngest layer on top.** Your sketch should contain enough detail to be able to tell why you oriented the sketch this way; **label** the "up-indicating" sedimentary structure(s).

b. Show the **direction of water flow** on your sketch using an **arrow** on your sketch. Your sketch should contain enough detail to be able to tell why you oriented the arrow that way; **label** the "current flow-indicating" sedimentary structure(s).

c. Does **the water speed** change in the time this rock was deposited? Yes. Indicate relative water speeds using different size arrow (pointing in the correct current flow direction) for at least two of the layers within the rock.

d. Recall the list of depositional environments from Questions for Discussion 3; in what **depositional environments** could this rock have been deposited?