The San Andreas fault at Wallace Creek **Class Exercise**

Note to the Professor:

This exercise is designed for college students at the introductory level in geology. Particular questions may require the students to conduct certain exercises or participate in appropriate discussions. Specifically, it is expected for questions 1 and 2 that the students will have walked the 2 km stretch from Wallace Creek southeast to the sag pond, and it is further expected that students will have a copy of the topographic map from Sieh and Wallace (1987) to use as they walk the 2 km. In addition, for question 1, students will need tape measures (preferably 25 m or longer) to measure the offsets. As each offset is measured, students should address questions pertaining to *where, precisely, the measurement should be taken*, and *what are appropriate estimates of uncertainty?* For questions 3 and 4, it is expected that students will have a copy of the notes and figures available for download on the Wallace Creek website, and it is advised that the professor explain the methods involved in calculating the slip rate at this site. A good discussion of this is presented in Sieh and Jahns (1984). Finally, question 5 requires that the students are able to answer question 3.

You are encouraged to select only the part(s) of these exercises which is (are) appropriate for your students, and you are encouraged to modify these questions and/or add to these questions as you see fit.

We hope you find this template useful.

References:

Sieh, K., and R. E. Wallace (1987). The San Andreas fault at Wallace Creek, San Luis Obispo County, California, *Geological Society of America Centennial Field Guide—Cordilleran Section*, pp. 233-238.

Sieh, K. E., and R. H. Jahns (1984). Holocene activity of the San Andreas fault at Wallace Creek, California, *Geological Society of America Bulletin* **95**, pp. 883-896.

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1.) From your field notes and map, produce a map of the San Andreas fault along the stretch we walked. Use the clean copy of the topo map we gave you at the end of the trip.

a) Show the fault in red, using dashed lines where the fault location is less certain or inferred.

b) Show the location of beheaded channels in orange. Be sure to get them all!

c) Show the location of shutter or pressure ridges in green.

d) Show the location of the sag pond in blue.

e) Label on the topo map possible offsets that you see along this stretch of the San Andreas using the geomorphology of the area. Use upper-case letters for features northeast (upstream) of the fault and lower-case letters for those to the southwest (downstream). Be sure to include the offsets we measured in the field. The letters don't necessarily have to correlate (*e.g.*, feature 'B' doesn't have to correlate with feature 'b').

f) Measure the offsets across the fault that you identified in part (e). Complete a table like the one below, for all of the offsets that you measured in the field or estimated on the map. To determine the possible age, assume a reasonable slip rate (use the value you determine in question 3, or use a value given to you by your professor; in any case, specify the slip rate you assume). *Note: the data in the table below is made-up.*

Upstream Feature	Downstream Feature	Possible Offset (m)	Possible Age (years)	"TM" (measured with a tape measure in the field) or "E" (estimated on the map)
A	a	25.1 ± 1.4	251 ± 14	TM
A	b	38.4 ± 2.2	384 ± 22	TM
C	e	150	450	E

2.) Summarize the evidence that you observed in the Wallace Creek area that can be used to argue that a fault runs through the region. It may be helpful to label any landforms you mention with numbers on your map from Question 1, and to refer to those numbers in your discussion. *A good answer to this question will <u>discuss</u> (not simply list) as many landforms as possible, and it will discuss the "coincidence" and geometrical arrangement of these landforms at this location.*

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3.) a) What is the slip rate across the San Andreas fault at Wallace Creek? Justify your calculations with the appropriate geologic observations and data—specifically, discuss how we determined the size and age of the offset across the San Andreas at Wallace Creek, and how they, in turn, can give us the slip rate. What sources of error must be considered in the measurement? (There are several!)

b) Explain, with the aid of several schematic diagrams, the creation and evolution of Wallace Creek. Specifically, what was the map-view geometry when the first channel was cut across the fault? What did the stream system look like just prior to creation of the presently active channel? What did it look like right after creation of the presently active channel? What will it look like after the presently active channel is abandoned?

c) Using stratigraphy and landforms (Figures 3 and 4), or extrapolating from the slip rate determined in part (a), assign an age to each major event in the evolution of Wallace Creek—*i.e.*, those that you depicted in part (b). Justify your conclusions clearly, succinctly, but completely.

4.) a) Use your notes from Wallace Creek and Figures 2 and 5 to compute the amount and rate of vertical displacement across the San Andreas at Wallace Creek.

b) How does the rate of vertical displacement that you computed compare to the rate of strike-slip displacement? Why is there any vertical displacement across this fault, at this location? Give some possible explanations.

5.) How does the relative motion between the North American and Pacific plates compare to slip rates you calculate for the portion of the San Andreas fault? Why might there be discrepancies in these measurements? If the discrepancies result from measurement errors, how might these errors be introduced, or how might our measurements be flawed? If the discrepancies are real—*i.e.*, the relative motion between the two places differs from the average slip rate across the San Andreas fault—what might account for the difference?