Lab 6: Extensional tectonics

Fall 2005

1 The jargon of extensional tectonics

For the following terms, draw a simple illustrative diagram consisting of either a map and cross-section or a block diagram:

1. Listric fault

2. Detachment fault

3. Growth strata

4. Transfer fault

5. Breakaway fault

6. Graben

7. Core complex

In some cases, you might find it natural to draw one figure that encompasses more than one of these terms. Don't get carried away, though.

2 Ugly stuff

2.1 An old school cross-section

Before it was widely recognized that low angle normal faults existed, many detachments were mapped either as thrusts or unconformities. The cross-section below is an "old-school" section. Explain why this is probably not an accurate representation of the geology, particularly with reference to the expected stratigraphic relations around normal faults. (Your answer should be a concise and clear, and should explain what the problems are).

2.2 Not Admissible!

Show why the following simple cross-section cannot possibly be right by attempting to restore it.

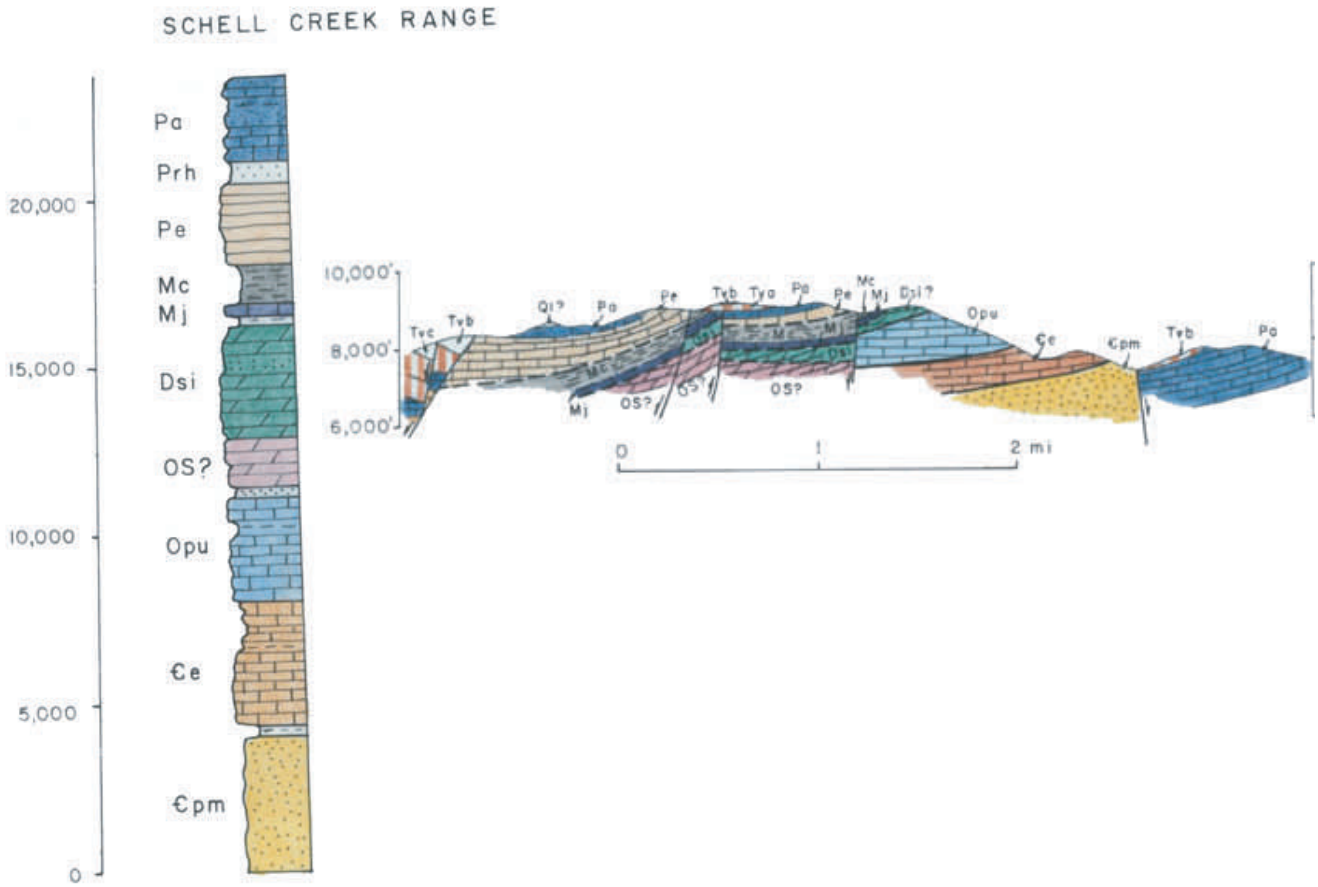

Figure 1: Old school, not cool

3 Whipple Mountains

The Whipple mountains are one of the best examples anywhere of a metamorphic core complex, and, incidently, are just a few kilometers from where we will be mapping in January.

Using the map from Spencer et. al. (1987):

1. Make a generalized version of this map that distinguishes upper plate rocks from lower plate rocks.

2. Construct the cross-section across the Whipples where the dashed red line is chosen. To keep it simple, make the Whipple detachment flat, limit yourself to 2 or three units. Definetly include the high angle faults in the upper plate.

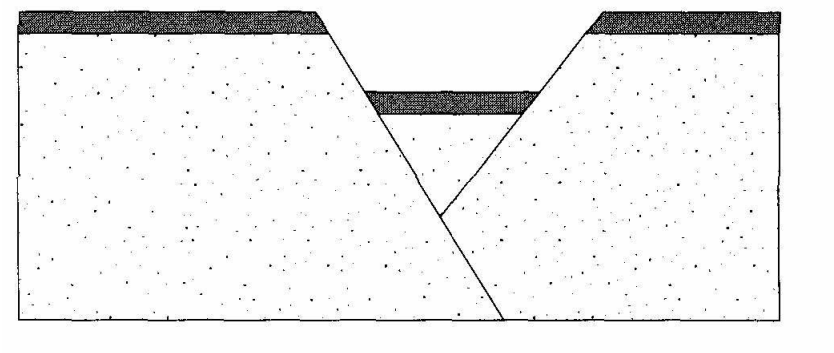

Figure 2: Ugly, but common.

4 Frenchman Mountain Quadrangle

Use the geological map of the Frenchman Mountain quadrangle (Castor et. al. 2000) to answer the following questions.

1. Generalize the cross-section A-A' from A to the Boulevard Fault zone. You want to limit the section to 5 or 6 units.

2. Restore the section from the Munitions fault to the Boulevard Fault. How much extension has occurred across this distance?

3. How old is the Munitions fault? How can you tell?

4. What kind of fault is the Boulevard fault? Are the relative orientations of units to the north and south of the fault compatible with the sense of slip on this fault?

5. What is the direction of extension for the main series of faults (i.e. the prominent imbricate set seen in cross-section A-A')? Note how the main series of normal faults have rather complicated geometries. Use these different approaches, and determine whether they are consistent: (1) Assume that the fault straie are faithful recorders of the slip vectors; (2) Use the rotation of beds in the hangingwalls of the faults to tell you the direction of extension; (3) Use the rotation of beds in the hangingwall of the Frenchman and Munitions Fault; How does this compare with the sense of strike-slip mapped on some segments of these small faults?

6. Is there evidence for a stage of extension earlier than that of the main faults considered above ? Which direction was extension directed (present-day coordinates)?

7. Has the direction of extension of Demolition fault time changed much from the extension direction you inferred in (5) ?

8. Do you think that Frenchman and Munitions fault are of broadly the same generation, earlier, or younger than the faults you considered in (5)? Explain your reasoning.