A GPS Cluster in the Eastern Mojave Desert: Studying Rheology with Postseismic Transients

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Introduction

One goal of the PBO should certainly be to improve our understanding of the rheology of different parts of the plate boundary. Given that all we can observe is deformation, we will be able to infer rheology only if the driving force is known—and most of the time it is not. One case in which it is relatively well-known is in the response to the change in stress created by an earthquake (another is surface loading). This suggests that a component of PBO should target areas around large earthquakes for which postseismic relaxation might be observable.

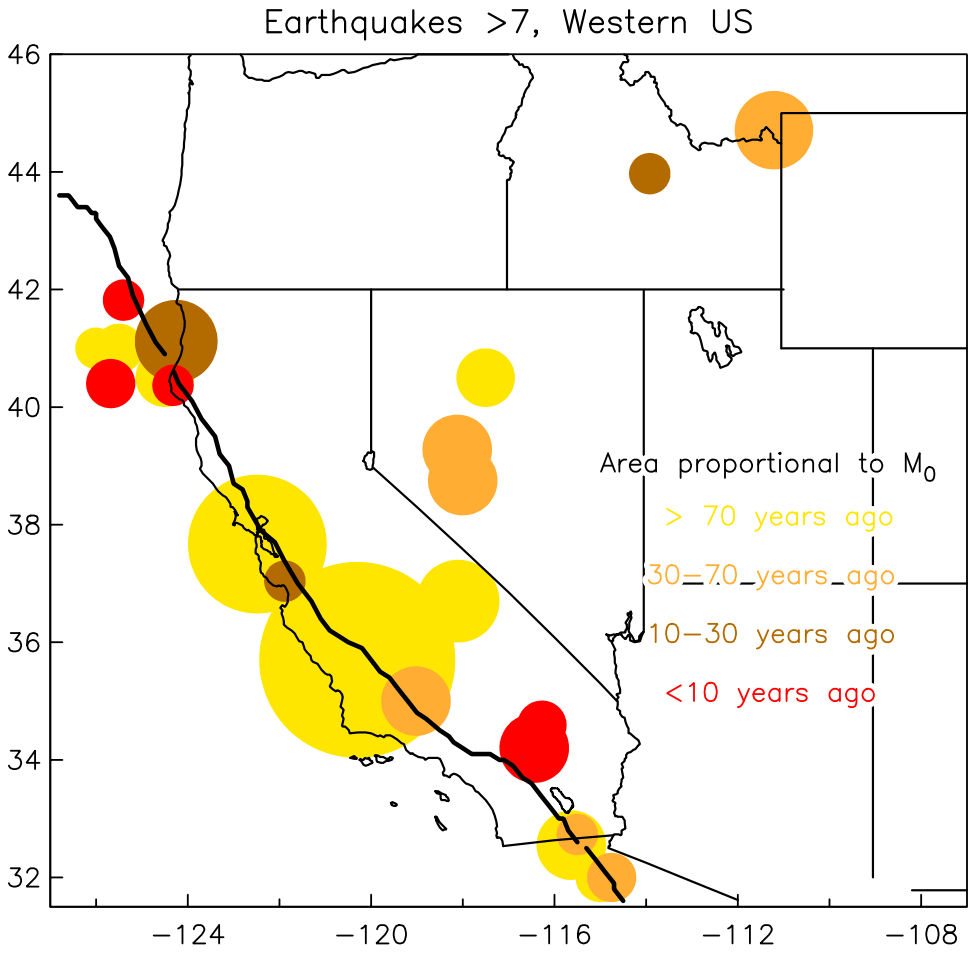

Figure 1

Figure 1 shows candidate earthquakes for the conterminous US: the largest earthquakes of the past 150 years, plotted with areas proportional to moment. Figure 2 shows the events of the last 70 years as moment vs time for events onshore. (Of course, much

larger sources are available in Alaska: the 1964 earthquake, on the scale of Figure 1, would more than fill the page.) The biggest events (1857 and 1906) are on the plate boundary, but there are a number that are not. From the standpoint of determining rheology from postseismic signals the plate boundary is a bad place to be: the interseismic signal has to be removed, and there is a good chance of the measurement being disturbed by another earthquake. Of course, if our aim is to study the interplay of the earthquake cycle and rheology the boundary is the place to be—but not for studying rheology alone.

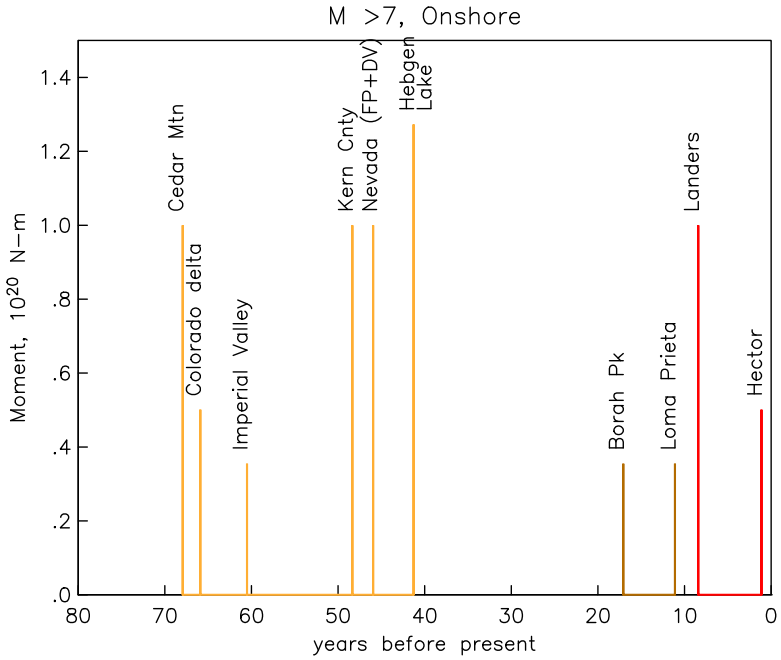

Figure 2

Figures 1 and 2 suggest three possible candidate earthquakes for rheological studies: the 1954 Nevada sequence (plotted in Figure 2 as one event), the 1959 Hebgen Lake shock, and the Landers/Hector Mine pair. The latter two, viewed as one event, have a combined moment exceeding any of the others, and they are a lot more recent: if the decay time is 10 – 30 years, as suggested by loading and other postseismic studies, events in the 1950's are 1 to 2 *e*-folding times away from us already. While the Landers/Hector pair is certainly within the plate boundary, it would seem to be near the edge. As the seismicity (Figure 3) and lack of Quaternary faulting shows, the region east of the Hector shock is not very active: it would appear to count as nearly stable, all the way to the Rio Grande rift. We therefore propose that the PBO should instrument this area, from the region of the Hector earthquake (already covered by SCIGN sites which could be "adopted" by PBO) into the western edge of the Colorado plateau (about 112° W), to provide an outer boundary to compare with.

Given that the time constants involved are measured in decades, we do not see a role for strainmeters in this cluster, but would restrict it to continuous GPS; given that we are looking for time variations, survey-mode GPS would not be appropriate. The total

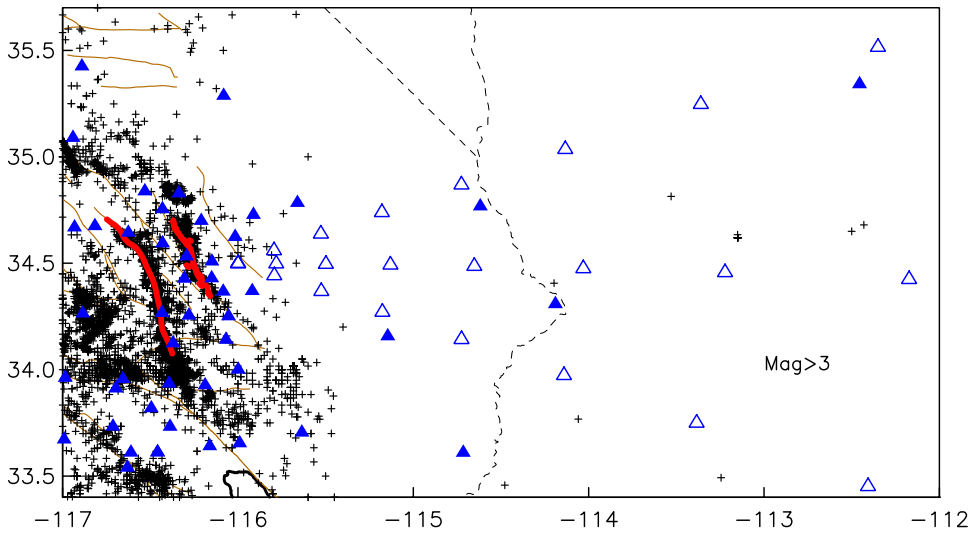

Figure 3: Seismicity (1950 to 2000), recent ruptures (red), existing CGPS (solid blue triangles) and proposed (open blue triangles).

distance to be spanned would be 350 km; we suggest that three profiles running E, ENE, and ESE be set up running outward from the Hector cluster, with spacings starting at 20 km and with a increasing spacing to the east; these three profiles would require about 20 new stations. Simulations indicate that velocities of up to 5 mm per year would be expected close to the rupture, decaying with distance and diffusing outwards.

While it might also be appropriate to have a third profile running NNE, we feel that this direction is adequately covered by the Yucca Mountain cluster in SBAR, which we assume will continue to operate under DOE support.

The other reason for not attempting a NNE line is to avoid permitting complications with the Mojave National Preserve. The eastern Mojave is not part of this, though many of the ranges in it are Wilderness areas and so not possible locations. However there remain enough corridors between these to enable the kind of sparse deployment proposed here.