1999 SCEC Report:- Weldon

The principle goals of this project were to date the stratigraphy that contains paleoseismic events 6-12 at Wrightwood, CA on the San Andreas fault, and to continue synthesizing this extensive data set for publication.

Substantial progress was also made pulling together the trench data for the Wrightwood paleoseismic site. Figure1 shows a completed map that includes all trenches excavated at the site, and a complete topographic map (including locally-surveyed data in and around the depression and digitized USGS topography outside), superimposed on a rectified low elevation air photo. Now that all of the data are synthesized into a common, usable format we are working to write topical papers on the site. My colleague, Tom Fumal of the USGS, is completing an Open-File report containing the trench logs, I am working on a JGR paper summarizing the paleoseismic event data, Gordon Seitz is writing up a paper on the dating, and Glenn Biasi is working on conditional probabilities of earthquakes resulting from the data developed at this site.

We submitted 12 peat samples for C-14 analysis to Beta Analytic and received results that were internally inconsistent stratigraphically, and largely inconsistent with existing dates. We concluded that there was a serious problem. We subsequently sent 10 samples to the University of Washington lab, which yielded results that were internally and externally consistent. By chance, at about the same time, we also received results from similar peat samples from the Pitman Canyon site on the San Andreas and sites along the Xianshiuhe fault in China, from both Beta Analytic and the Livermore accelerator lab. These showed similar inconsistencies to those from Wrightwood, and permitted us to interpret the problem to be differences in pre-treatment.

Subsequent analysis of splits of samples with different pretreatments and SEM images of the residuals associated with aggressive treatment confirms this hypothesis.

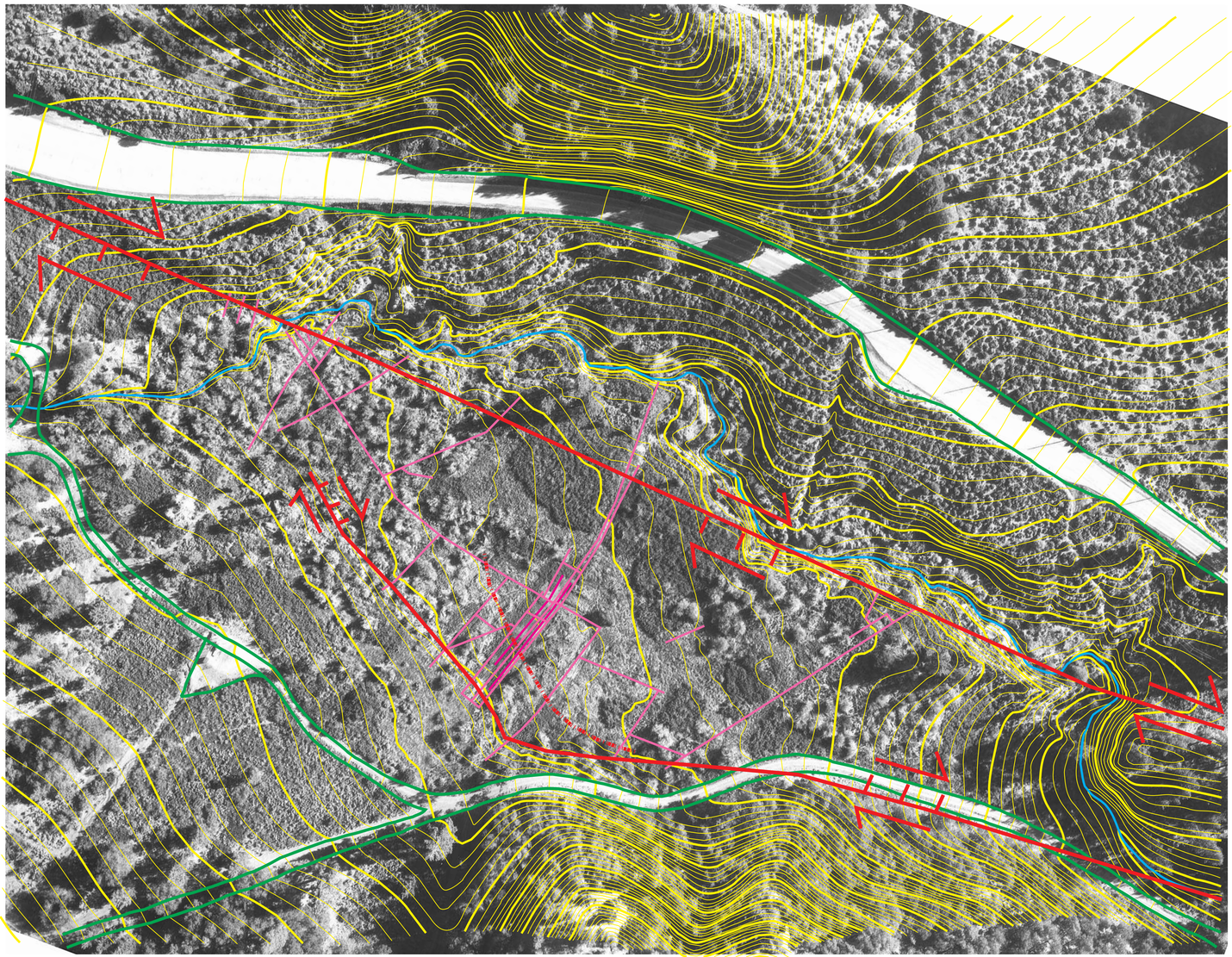
This can be seen in the Wrightwood data by separating samples with different kinds of pretreatment. If all of the data are plotted together (Figure 2a) one sees a broad scatter. However, when the samples that were treated with only an acid wash (AO) or an acid wash with a very weak base wash (AWA) are plotted, all of the samples are stratigraphically consistent Figure 2b).

A plot of more aggressively treated samples (AAA=acid/alkali/acid) yields a scatter (Figure 3), with scattered samples that are clearly too old, but also with many samples that appear to be consistently too young compared to the AO samples. Stratigraphic relationships and SEM scans of AAA residuals indicate that the samples that are older than the consistent AO and AWA samples are contaminated with charcoal.

The younger samples appear to be contaminated by small roots. This conclusion is based on SEM scans and 2 root dates (labeled #3 on Figure 3). When we began dating samples at Wrightwood, we were concerned about the small rootlets in the peats, that we realized could not be totally removed from the samples. So we chose 2 peats, dated them without special effort to remove the microroots, dated splits that were painstakenly cleaned and dated the roots removed. We found that the roots had ages consistent with one to two peats higher than the peat they occupied. This was consistent with our field impression that these small paper-like roots originated in peat layers and reached down 1-2 peat/debris flow sequences. Because the bulk and root-free samples yielded identical results we stopped worrying about the microroots, and returned to our previous process of picking out the obvious ones and sieving out the rest.

The presence of substantial components of charcoal and roots in the very aggressively treated (AWA) samples indicates that they were concentrated by the treatment process and thus play a significant role in samples in which the base-soluble component was removed. Since the base-soluble component (often called the humic acid fraction) makes up 50-90% of the samples, the small amount of young (roots) and old (charcoal) contamination was not obvious until samples were aggressively treated.

In summary, this indicates a serious problem with all sections dated by peats. Those dated with samples aggressively treated to remove the more soluble humic acid component are likely to be very wrong because of the concentration of small fractions of insoluble contaminants. Those dated in the traditional fashion (AO or AWA) will give more reliable results, but may be systematically shifted in age by a small fraction of pervasive insoluble contamination. Stratigraphic consistency of sites with less aggressively treated samples (AO or AWA), may indicate that this contamination is small enough to overwhelmed the in situ formed humic acids, but detailed analysis of splits that date only the humic acid component (ie the material soluable in based washes, not the residual) should be undertaken to confirm this hypothesis.



The Wrightwood paleoseismic site. Located 4 km NW of the Los Angeles San Bernardino County line, CA. Green outlines roads (including HW#2, north of the site, and the water company access, to the south). Yellow is topography, with 1 meter intervals - heavy are 5 m; red locates the main traces of the San Andreas Fault; purple are the 23 trenches.

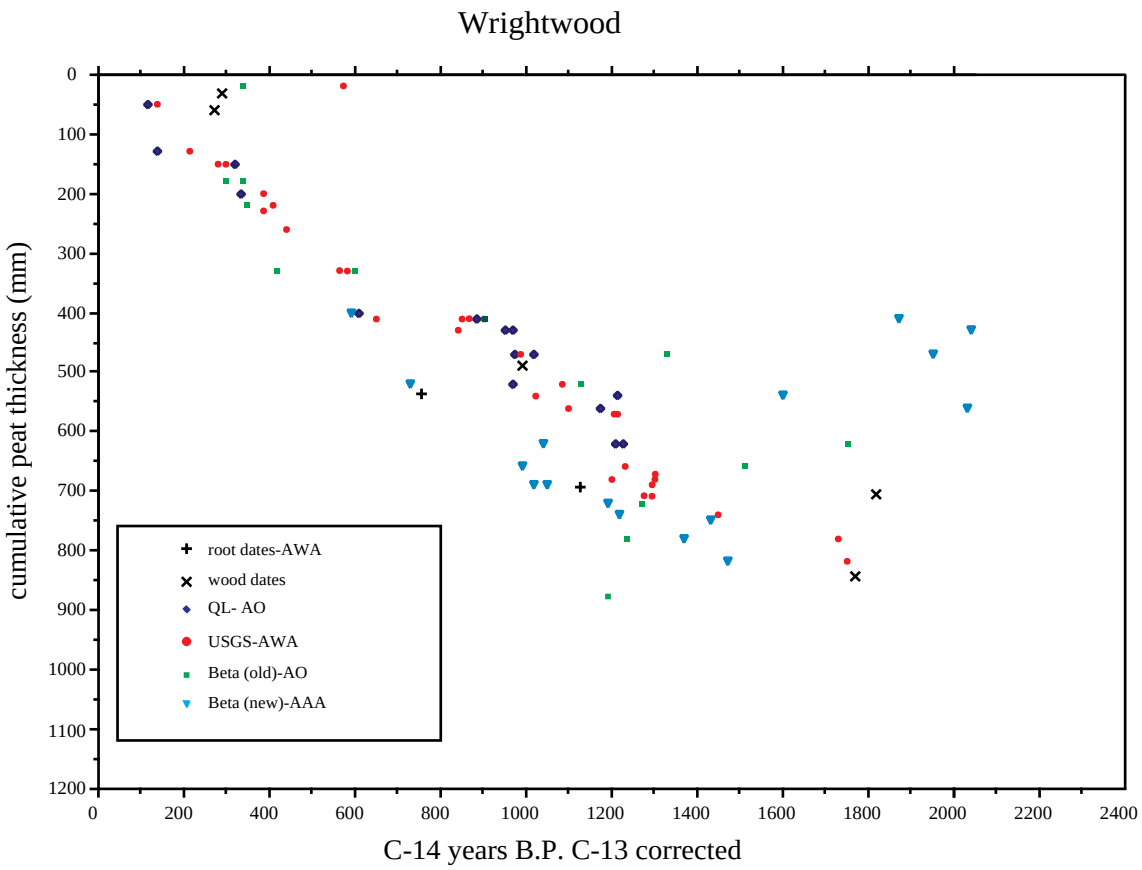

Wrightwood
cumulative peat thickness (mm)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
root dates-AWA
wood dates
QL- AO
USGS-AWA
Beta (old)-AO
Beta (new)-AAA
C-14 years B.P. C-13 corrected

Fig. 5 a)

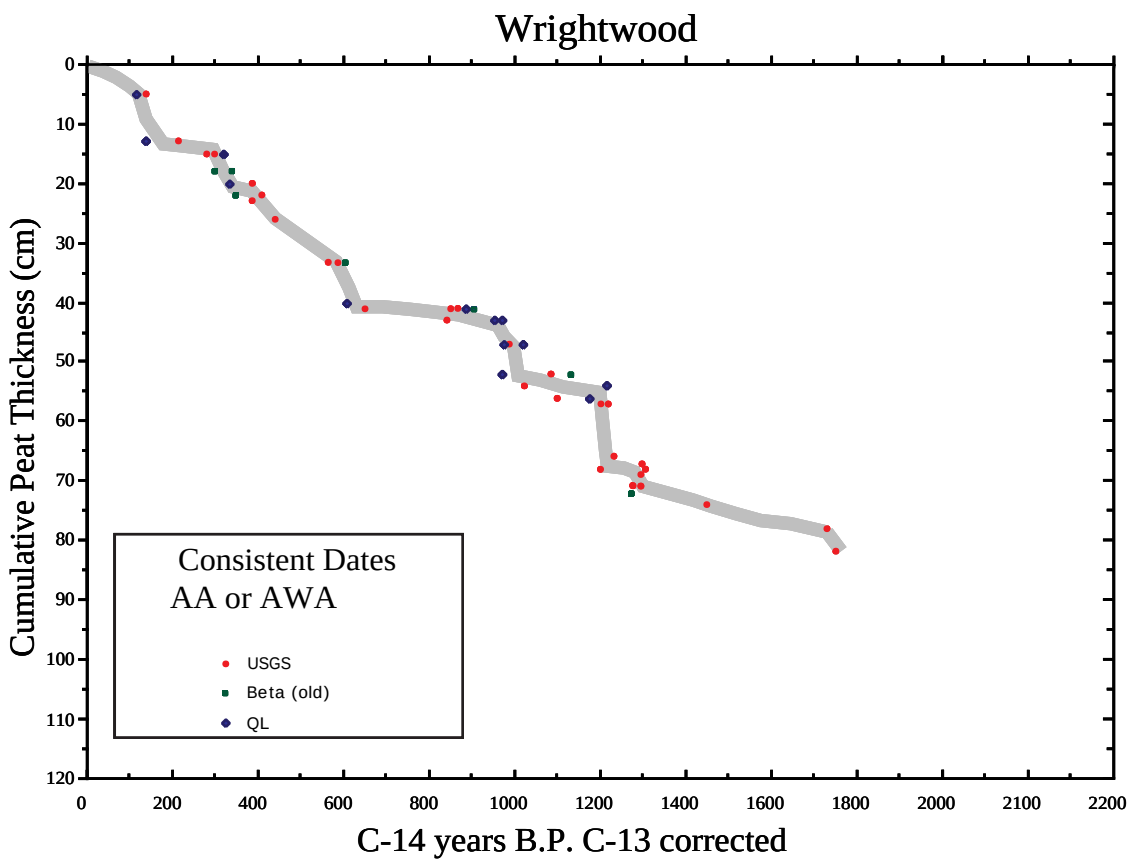

Wrightwood
Cumulative Peat Thickness (cm)
0
10
20
30
40
50
60
70
80
90
100
110
120
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2100
2200
Consistent Dates
AA or AWA
USGS
Beta (old)
QL
C-14 years B.P. C-13 corrected

Fig. 5 b)

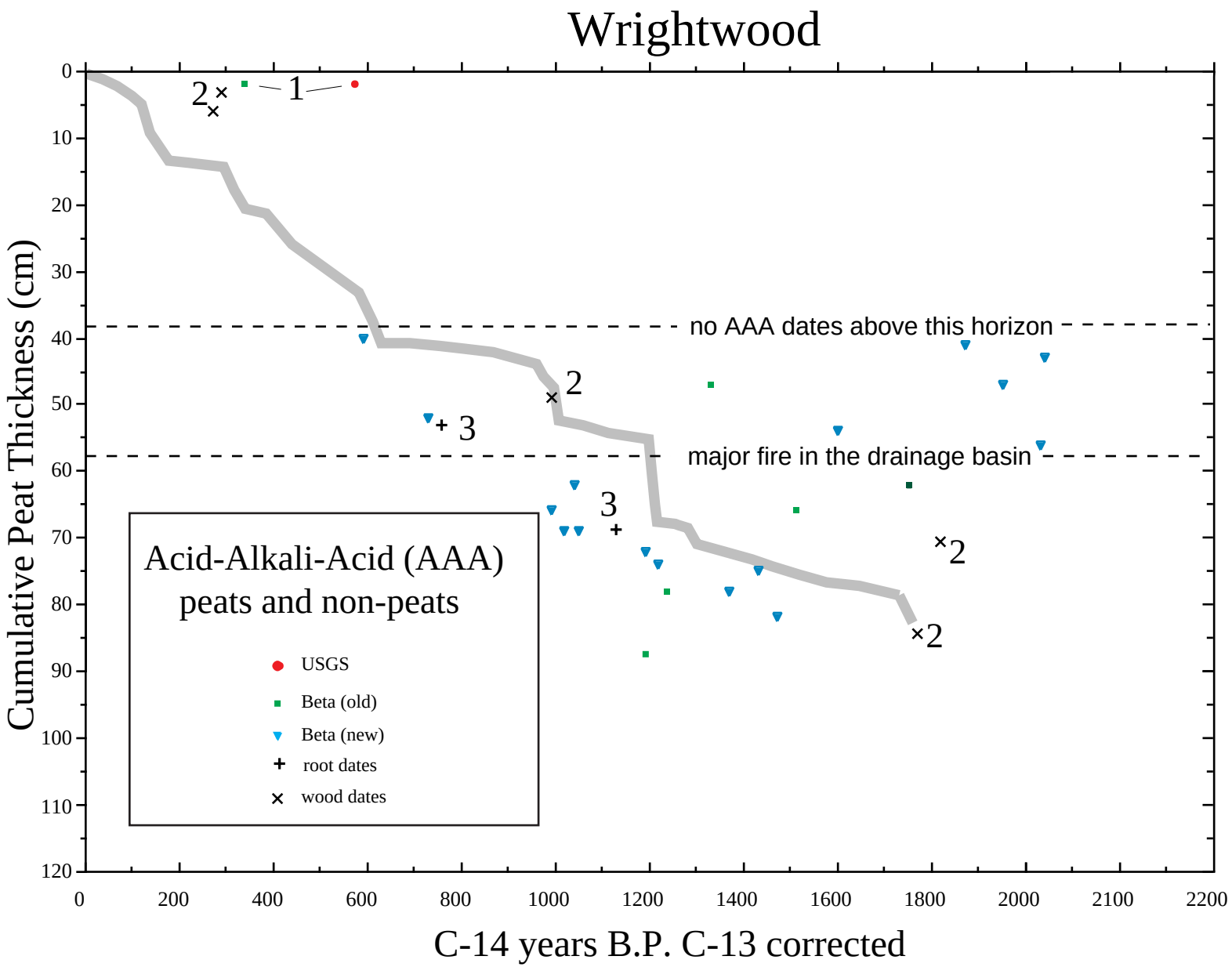


Fig 5 c)

1 - peat 140 samples, only exist in fault graben, almost certainly contains detrital material exposed from older peats
2 - small sticks or pine cones in clastic units, they must be >/= than the actual age
3 - roots invading peat from overlying peat layer