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A Thousand Year Flood Record from Little Packer Lake, Glenn County, California

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Our understanding of extreme hydrological events in California is limited by the shortness of the historical record. Permanent European settlement in the state began little more than two centuries ago, and detailed hydrological data were first gathered on a regular basis only in the second half of the nineteenth century. Obviously, probability estimates of infrequent events, such as "the hundred year flood" are based on records that are far too short. An alternative approach is to reconstruct past flood events by geomorphological or biological evidence, such as the existence of alluvial deposits above the normal channel of a river, or the presence of flood induced scars on river bank trees. This kind of evidence can offer a long-term perspective on flood frequencies in particular watersheds, but in most cases such records are incomplete. A problem is that major floods are inherently destructive; they tend to remove evidence of previous floods. In this paper we draw attention to a new source of paleoflood data: the sediments of oxbow lakes.

Little Packer Lake in Glen County, California is an oxbow lake that formed roughly seven hundred years ago when the Sacramento River changed its course. It has been isolated from the river for most of its existence, but occasionally this isolation has been broken when the Sacramento flooded and reoccupied its old channel. The history of these flood events can be reconstructed from the 7+ m of sediment that accumulated in the lake. In brief, during non-flood times fine grained sediments that are relatively high in organic content and low in magnetic susceptibility accumulate in the lake. In contrast, during flood events sediments that are predominantly low in organic content and high in magnetic susceptibility are deposited. The latter flood deposits are denser than the non-flood sediments and can therefore be distinguished on x-radiographs of sediment cores. Just what causes the variation in magnetic susceptibility is still not completely understood. Usually, high magnetic susceptibility

is a reflection of high iron content, however, preliminary geochemical analyses of flood and non-flood levels indicates no significant difference in iron content.

Our inference that density/magnetic susceptibility variations in Little Packer Lake sediments reflect flood events is supported by the "calibration" of the upper part of the cores against known flood history. There is a reasonably correlation between flood layers and known flood events over the past 200 years or so. Needless to say, the hydraulic regime of the river during this period had been changed dramatically due to the construction of levees and dams. Little Packer Lake is located between the levees and has therefore been flooded more frequently since levee construction than it was before. The reliability of the "calibration" is heavily dependent upon the accuracy of the chronology we establish for the sediment cores. In this study we have used three means of dating : 1) carbon 14, 2) lead 210, and 3) the first appearance of alien pollen types, such as *Eucalyptus* and *Erodium*. For various reasons carbon 14 and lead 210 dating has been problematic, but the overall chronology we have established is probably reasonably reliable.

The combined Little Packer Lake Record is based on three long cores (5 m, 6 m, and 7.5 m), plus a short core (1.3 m) that was used for calibration. The record indicates that there have been 4 major floods during the last 200 years. The 2 most recent "events" were probably multi-year floods that occurred after the construction of the levee system. Two major nineteenth century flood layers are probably attributable to the 1805 and 1862 floods. In the prehistoric period, major flood events are indicated to have occurred during the following periods (all dates A.D.): 1642 - 1677, 1553 - 1605, 1471 - 1538, 1401 - 1482, and 1360 - 1449. The 18th century appears to have been flood free, whereas the 15th century was characterized by relatively frequent flooding.

One important test of the Little Packer paleoflood record will be to extend the analysis to other Sacramento Valley oxbows. A short core from a nearby lake in Razor Slough suggests that the flood record is indeed a regional one. Theoretically, oxbow lake sediments from throughout the Sacramento Valley could be spliced together to provide a record that extends back many thousand years. Such a record, when well dated, could provide a valuable long term perspective on major flood events in this hydraulically exciting part of the world.