EFFECTS OF LAND USE CHANGE ON TOMALES BAY, CALIFORNIA: NEW IDEAS FROM OLD TRACERS

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ABSTRACT

Humans, through their use of the land, have become a significant force in altering the surface of the earth. This is especially true with respect to agriculture. Globally, agricultural practices have doubled the erosion rates on land. In this study, a series of 3-meter sediment cores from Tomales Bay, California were used to interpret historical land use changes in the Tomales Bay watershed, and to the bay itself. A model was developed to determine sedimentation rates as a function of time for all cores, using the stable isotopic composition of organic carbon in the sediments. This model was based on the assumption that the mineral surface area of the sediment is controlling the amount of organic carbon buried in the sediments.

This approach showed a dramatic increase in sedimentation rates for all cores between 1850 - 1900. The lowest calculated sedimentation rate was 1 kg $m^{-2}yr^{-1}$ (~ 0.2 cm yr^{-1}) and the maximum value was 12 kg $m^{-2}yr^{-1}$ (~ 2.4 cm yr^{-1}). Around the same time period, the terrestrial carbon normalized syringyl and vanillyl phenol concentrations dropped by half, the syringyl / vanillyl phenol ratio increased slightly as did the vanillyl acid / aldehyde ratio. These results suggest that there was a major perturbation in the Tomales Bay watershed coincident with the European colonization of the region around 1850. This was probably due to the onset of animal and crop agriculture.

If mineral surface area is controlling organic carbon preservation in Tomales Bay, which has a wide range of mass accumulation rates and organic matter sources, then the preservation of organic matter is largely decoupled from its production.