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Sr and Nd Isotopic Compositions and Trace-element Concentrations in San Francisco Bay Cores Distinguish Sediment Deposited from Hydraulic Gold-mining and Mercury Mining

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In a core from San Pablo Bay, a combination of isotopic and metal compositions distinguish among: 1) sediment deposited before any mining activity; 2) sediment released by hydraulic gold-mining; 3) sediment deposited between 1950 and 1980; and 4) near surface sediment. There is a gap in the core between 1880-1950. Sr and Nd isotopic compositions indicate that the source of sediment in San Pablo Bay between 1850 and 1880 (as dated by comparative bathymetry) was different from the sediment source after 1950. The $^{87}\text{Sr}/^{86}\text{Sr}$ of sediment deposited between 1850 and 1880 ranges between 0.7085 and 0.7100, (ϵNd -5.0 to -7.0) whereas sediment deposited since 1950 has $^{87}\text{Sr}/^{86}\text{Sr}$ between 0.7065 and 0.7090, (ϵNd -3.5 to -5.0). The $^{87}\text{Sr}/^{86}\text{Sr}$ of sediment in abandoned hydraulic gold-mines in the Sierra-Nevada is approximately 0.7110. Thus, an input of sediment mobilized by hydraulic gold-mining is the most likely explanation for the increased $^{87}\text{Sr}/^{86}\text{Sr}$ values in the older sediment. Accompanying the more radiogenic Sr isotopic compositions are elevated Hg, Pb, and Cu concentrations and decreased Ni and Cr relative to background concentrations. These metal concentrations are also consistent with derivation of sediment from the hydraulic gold-mines.

Between 1852 and 1884, approximately 3.5×10^6 kg of Hg were added to sediment in hydraulic gold-mining areas to extract Au. The average Hg concentration in Bay sediment deposited during the time of hydraulic gold-mining is 0.30 ug/g. Background concentrations of Hg in San Francisco Bay determined from sediment deposited before mining activities began are approximately 0.05 ug/g. Mercury concentrations in near surface sediment range between 0.15-0.35 ug/g. The highest concentrations of Hg (up to 1.0 ug/g) in the Bay cores occur in sediment deposited after 1930-1950 but before 1980. While hydraulic mining was stopped in 1884, mercury mining remained active around the Bay area until the mid-1970s. The greatest concentrations of Hg in the Bay cores and thus the greatest exposure of Bay organisms to Hg occurred after hydraulic gold-mining ceased and after most of the sediment released by hydraulic mining was transported to the Bay and buried.