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Rise of Recent Coastal Eutrophication Chronicled by Sedimentary Mo

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Deterioration of coastal ecosystems owing to eutrophication is becoming a pervasive problem world-wide. Reconstructing the history of ecosystem degradation is often a key to devising effective control strategies. Geochemical indicators of palaeo-redox conditions are potentially useful, but some obstacles must be overcome. Direct observations over a ~50 yr period inadequately characterize the history of seasonal hypoxia and anoxia in Chesapeake Bay, an anthropogenically impacted estuary. Concentrations of Mo and Cu in ^{210}Pb-dated sediment cores from the central channel demonstrate mild Mo enrichments (0-4µg/g) and strong Cu enrichments (0-30 µg/g) with respect to crustal backgrounds. Temporally, Cu enrichment began earlier and stabilized in the last two thirds of the 20th century; Mo enrichment has grown during the last two thirds of the century. Copper enrichment is ascribed to pervasive, anthropogenic contamination, but Mo enrichment must be mostly hydrogenic, except in a section of the channel that receives additional Mo from the Calvert Formation (Early Miocene). Two geochemical mechanisms are inferred to promote Mo enrichment in sediments. Mn refluxing concentrates dissolved Mo near the sediment-water interface and sulphide substitution into molybdate induces particle-reactivity. These mechanisms operate primarily during summer periods of water column anoxia. Thus even though Mo fixation is believed to occur only within sediments in Chesapeake Bay, Mo enrichment is expected to reflect deep water redox conditions. The Mo enrichment profiles suggest that Chesapeake Bay has experienced increasing oxygen stress since the first half of the 20th century, but especially after 1960. This implication is broadly consistent with conclusions reached recently by others using different geochemical proxies. This paper illustrates some of the problems that must be overcome when applying palaeo-environmental indicators to the post-industrial world.