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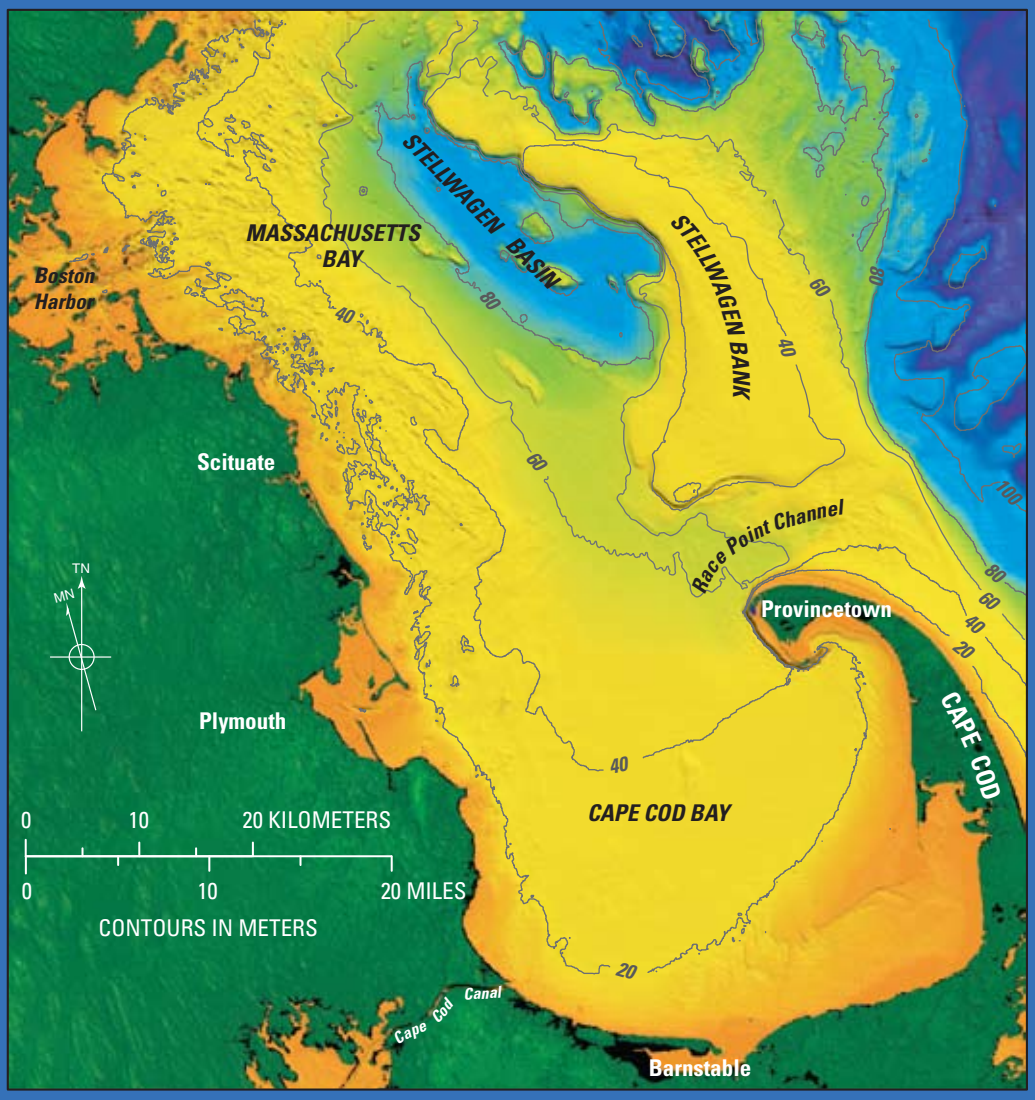
Processes Influencing the Transport and Fate of Contaminated Sediments in the Coastal Ocean—Boston Harbor and Massachusetts Bay



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Processes Influencing the Transport and Fate of Contaminated Sediments in the Coastal Ocean—Boston Harbor and Massachusetts Bay

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FOREWORD

This study of pollution and pollution abatement in Boston Harbor and Massachusetts Bay has been a model partnership between federal, state, and private entities (the U.S. Geological Survey, the Massachusetts Water Resources Authority, the U.S. Coast Guard, and the Woods Hole Oceanographic Institution). The multidisciplinary research program mapped the geology of the seafloor, carried out long-term oceanographic and geochemical observations, and developed numerical models of sediment transport to understand the distribution, transport, and fate of contaminants in this coastal system that has received waste since colonial times. The application of program results has saved millions of dollars of public money in construction costs during the $4 billion modernization of greater Boston's wastewater-treatment facilities, resulted in documented reductions in contaminant concentrations in harbor sediments, provided scientific information in public forums, and improved our understanding of where and how contaminants accumulate over the long time periods. The continuing focus of the program is to improve our ability to predict the fate of sediments and associated contaminants in this and other coastal environments, and thus to provide the scientific basis for decisionmaking.

Reducing coastal pollution requires cooperation from many components of society. In the case of Boston Harbor, local citizens, environmental groups, federal and state courts, the state legislature, industry, and state and federal agencies all worked to implement the harbor cleanup. It has been tremendously satisfying for participants in this USGS - MWRA-USCG-WHOI partnership to contribute, with the efforts of so many others, toward a cleaner, healthier coastal environment.

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Contents

Conversion Factors and Abbreviations

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
centimeter per second (cm/s)	0.3937	inch per second (in/s)
centimeter per year (cm/yr)	0.3937	inch per year (in/yr)
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Area	
square centimeter (cm^2)	0.155	square inch (in^2)
square kilometer (km^2)	0.3861	square mile (mi^2)
	Volume	
milliliter	1.057×10^{-3}	quart
liter	0.2642	gallon
	Flow rate	
meter per second (m/s) (ms^{-1})	3.281	foot per second (ft/s)
million liters/day	0.2642	million gallons per day (Mgal/d)
	Mass	
gram	2.205×10^{-3}	pound (lb)
kilogram per day	2.205	pound per day (lb/d)
	Stress	
Newton per square meter (N/m^2)	1	pascal (Pa)
	Speed	
knot	1.1508	statute mile per hour
knot	51.4	centimeter per second (cm/s)

On all maps in this report, latitude is given in degrees north, and longitude is given in degrees west.

ACRONYMS	DEFINITIONS
ECOM	Estuarine and Coastal Ocean Model
ERM	effects range median (index of toxicity)
ka	thousands of years ago
mab	meters above bottom
MDC	Metropolitan District Commission
MWRA	Massachusetts Water Resources Authority
phi	$\varphi = -\log_2$ (sediment grain diameter in mm)
psu	practical salinity unit
R^2	coefficient of determination
ROMS	Regional Ocean Modeling System
SWH	significant wave height
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WHOI	Woods Hole Oceanographic Institution

WATER AND SEDIMENT QUALITY UNITS

Clostridium perfringens, C. perfringens, or spores per gram (spores/g)

disintegrations per minute per gram (dpm/g)

kilogram per cubic meter (kg/m^3)

kilogram per year (kg/yr)

micrograms per gram (µg/g)

micromoles per square centimeter per year ($\mu mol/cm^2/yr$)

micromoles per kilogram (µmol/kg)

micromoles per liter (µmol/L)

milligrams per liter (mg/L)

milliliter (mL)

nanomoles per kilogram (nmol/kg)

parts per million (ppm)

CHEMICAL SYMBOLS

NH_4^+	ammonium
Ag	silver
C	carbon
Cu	copper
Pb	lead
Zn	zinc
^{137}Cs	cesium 137
NO_3^-	nitrate
NO_2^-	nitrite
Mn oxides	manganese oxides
Fe oxides	iron oxides
O_2	oxygen
^{210}Pb	lead 210
$^{239+240}Pu$	plutonium 239+240
^{234}Th	thorium 234
^{222}Rn	radon 222
S	sulfur
SO_4^{-2}	sulfate
Fe	iron
H_2S	hydrogen sulfide
Fe^{2+}	ferrous iron
FeS	iron sulfide

TIDAL SYMBOL	PERIOD (hours)	CONSTITUENT
M_2	12.42	Principal lunar semi-diurnal
N_2	12.66	Larger lunar elliptic semi-diurnal
S_2	12.00	Principal solar semi-diurnal
K_1	23.93	Luni-solar diurnal
O_1	25.82	Principal lunar diurnal