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12.001 Introduction to Geology
Spring 2008

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Tides

Earth-moon system creates a double pull on Earth's water as it rotates around a common center:

1. Gravitational toward moon
2. Centrifugal (inertial) away from moon

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Both of these deform the water envelope of Earth and create a high tide. Earth's surface "slides" under the water envelope during its daily rotation.

TIDES

The Sun also creates a gravitational pull on the water envelope.

1. Earth rotates daily on its axis, and
2. Earth-Moon system rotates daily on its axis,
3. Moon orbits Earth monthly...

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Hence, in one month we experience two highest high tides (called “spring tides”) and two lowest high tides (called “neap tides”).

Spring tides occur when Solar tide and Lunar tide overlap.

Neap tides occur when Solar tide and Lunar tide are opposed.

Tidal braking changes day length

Tidal braking: days lengthen by 2.3 milliseconds/day/century

620 Mybp: 21.9 hours

900 Mybp: 20.9

2.5 Gybp: 17.1 – 18.9

3 Gybp: 14

3.2 Gybp: 15

(Williams, 1997, GRL)

(Walker et al., 1983)

(Ericsson and Simpson, 2000)

NW coast of Scotland



Elkins-Tanton

St. Anne's, Nova Scotia



Elkins-Tanton

Beach cobbles from northern Maine



Elkins-Tanton

Pothead whale, NW coast Newfoundland



Elkins-Tanton

St. Finton's, Newfoundland



Elkins-Tanton

Sea stack, St. Finton's, Newfoundland



Elkins-Tanton

Barrier islands



Drowned river valleys of the East Coast: Land subsidence + sea level rise



Sea level rise: Beach erosion = 1:100

Sandy shorelines erode
~100 increments for every
1 increment of sea-level
rise.

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copyright restrictions.

For a 1 m rise by 2100,
beaches will recede 100 m

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copyright restrictions.

**Many Hawaiian beaches
suffer erosion because their
dunes have been destroyed
(even before seawalls have
been built)**

**Coastal dunes are a storehouse
of sand for the beach**

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copyright restrictions.

**When erosion strikes a coast,
the traditional reaction is to build
a seawall.**

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copyright restrictions.

**But when seawalls are built on
coasts experiencing chronic
erosion, the beach disappears**

**Because of this management
practice, Hawaii has lost
many beaches**

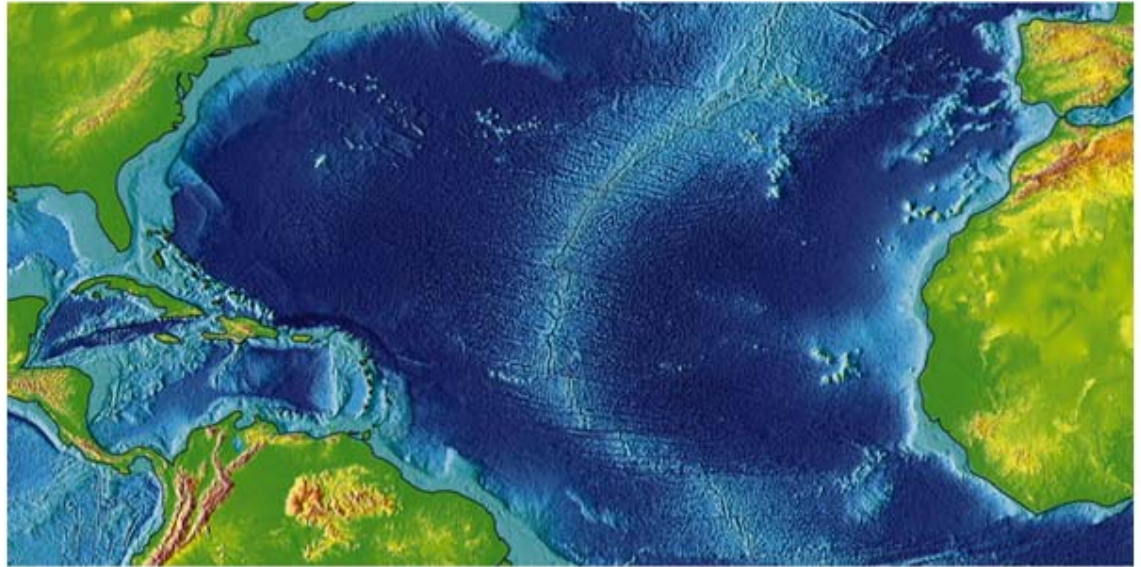
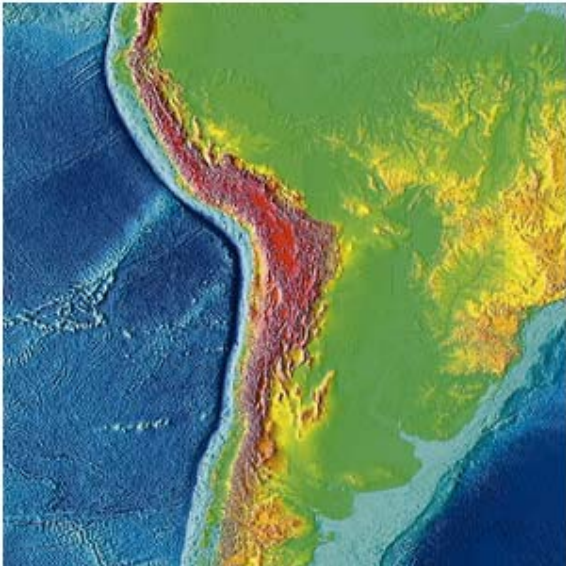
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**Seawalls worsen erosion by
impounding dune sand.**

**This starves the beach, often leading
to accelerated
erosion on adjoining beaches –
widespread beach
loss can develop**

Continental shelves are apparent in bathymetry



Turbidity currents

See: Grand Banks
Slide

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Nova Scotia history

www.littletechshoppe.com/ns1625/cable01.jpg

Following a powerful earthquake off Newfoundland in 1929 submarine cables in the area of a slump area broke immediately but cables downslope broke up to several hours later. Apparently a dense current of suspended sediment traveled several hundred kilometres across the sea floor.

Turbidites



USGS

Namibian turbidite

Ecole des Mines de Paris

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Sources of Hawaiian waves

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Winter north swell
Summer south swell
Trade wind waves
and swell
Kona storm waves
Hurricane waves and
swell