

Geology 1001: Section 4
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Nature and Origin of Ocean Floor
Plate Boundaries

Ocean floor has been mapped extensively using
and direct observations from

RIFTING, The Origin of Ocean Basins
Divergent Boundaries

- Rifting is initiated when warm ,
stretches and ,
breaks into
- Two branches continue to separate,

one branch becomes
= aulacogen,

e.g. Rio Grande Rift, NM

- have characteristics of ;

high , normal faulting = ,
frequent shallow

- amazing fauna, ore deposits

- Characterized by graben in center
 - most ridges split by
 - over 1 mi deep and 10's miles long
- Widens and expands until
e.g. Red Sea and Gulf of Aden
- As rift margin subsides,
continental shelves,
- When rifting is ,
rift edges are no longer plate margins or
= passive continental margins

e.g. Atlantic margins, Gulf of Mexico
- Site of development of Ocean Floor/Crust

- As plates diverge, new crust forms at

e.g. Mid-Ocean ridge - 40,000 km across all major ocean basins

- ROCK ASSEMBLAGES at Divergent Margins

- Crust is consistent in

comprised of layered sequence :

- Ophiolite suite - group of rocks that comprise
— a cross section of the
(top to bottom)

1. Thin blanket of deep
2. Pillow
3. Sheeted
4. Gabbros - (goes here)
5. Sheared
6. Massive

- These characterize boundaries

- found, in part, at
(e.g. Newfoundland).

CONVERGENT Boundaries

When ocean plates encounter less dense plates, they may subduct -

Ocean-Ocean in

– melange:

scraped off during collision

– blueschists:

– accretionary wedge:

edge of overriding continent,

later uplifted to form

– possible emplacement of ophiolite by

– volcanic arc: a chain of
the subducted plate.

forearc basin - a sediment trap (depression) between
rocks are mixture of

backarc basin - a sediment trap (depression) on
rocks are from

● Rocks found:

– accretion of

- additional burial of sediments associated with trench to form
- subduction, melting of the mantle wedge and production of
- low pressure metamorphism associated with (other part of the paired metamorphic belt)

Continent-continent interface

- due to buoyancy, do not subduct at a subduction zone, but
- produces thick section of highly (e.g. Himalayas)
- boundary between collided continents is
 - locally present
- local microplate collision of small amount of rocks to a plate produces terranes (e.g. Florida was originally part of Africa).

Origin and Shaping of Continents

- Components of a continent:

1. -

broad areas of crystalline rocks, found in interior,

e.g. Canadian Shield, Adirondack Mtns, NY

2. - where shield is covered by thin veneer of

3. Shield + Platform =

tectonically stable for a vast period of

edge is marked by mountains, plains, shelves

- Origin of Continental Lithosphere

- Once continents form, they do not
some crust ca. old

- developed from origin hot and ultramafic lava
see pg. 222-224 in book

- Displaced terranes - terranes that have moved by plate
- have different rocks than surrounding
- e.g. Western N. America.
- Microcontinents - pieces of continental lithosphere broken from .

PHANEROZOIC PLATE RECONSTRUCTION

- 490 Ma

- 350 Ma

- continents of

Kazakhstania and Siberia

- 250 Ma

- single supercontinent

(oceanic crustal record starts at about 200 Ma)

- 200 Ma

- breakup of Pangea along

- 140 Ma

- splitting of

- northward journey of

- 65 Ma (end of the age of)

- widening of the
splitting of

- development of

● later - collision of

Mechanisms of Plate Motion

What drives plate motion?

- Convection in the mantle?

heat from the Earth's interior causes

lithosphere "rides" on

however, can convection occur in the more solid lower mantle?

- Thermal Plumes

- vertical plumes of

- narrow, 100-250 km, originate at ,

lift up overlying ,

(cooling mantle descends thru entire mantle, not at plate boundaries above cells)

- Ridge push, slab pull or plate sliding?

- rising magma at ridges

- however, compressional features are , rather tears are

therefore it suggests that plates are .

- as the slab subducts, the weight

- warm low density rocks may
but gravity alone can not account for plate motion.

- Most likely mechanisms are combination of the above, initiated by mantle convection, crests develop, material slides off, etc.