Plate Tectonics

12.001 – 10-15 October 2012
Courtesy of NOAA. Map in the public domain.
Courtesy of NOAA. Figure in the public domain.
Source: Discovering Plate Boundaries by Dale S. Sawyer.
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Photograph of trench across large scarp at the Rito Seco site. The trench exposed Santa Fe Formation (QTsf) and overlying fluvial gravel on the upthrown side of the fault and a sequence of three well-defined colluvial wedges (CW 1, CW 2 and CW 3) and remanents of a probable old, fourth wedge (CS 4) on the downdropped side of the fault zone. Event horizons (EH) show the ground surface at the time of each surface-faulting event.

Courtesy of USGS. Photograph in the public domain.
LAGEOS satellite

Goddard Geophysical and Astronomical Observatory

Courtesy of NASA. Photographs in the public domain.
Owens Valley VLBI antenna

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PLATES 2004
Atlas of Plate Reconstructions
(750 Ma to Present Day)
> 2.0 Ga

Archean cratons
(positions unconstrained; Rae and Hearne in present-day locations)

Courtesy of Geological Society of America. Used with permission.
1.96-1.92 Ga

Slave-Rae collision,
Arc accretion: Rimby, Taltson, Thelon arcs

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1.92-1.86 Ga

Juvenile arcs form during ocean closure:
Great Bear, La Ronge, Torngat, Little Belt arcs
1.86-1.84 Ga

Continued juvenile arc accretion: Narsajuaq, Pembine-Wausau; Wopmay orogen; Southeast thrusting along Snowbird tectonic zone

Courtesy of Geological Society of America. Used with permission.
1.84-1.82 Ga

Trans Hudson orogen:
Superior-Rae-Hearne continent-continent collision, includes accretion of Sask craton;
Elves Chasm arc outboard of Mojaví
Continued shortening across Trans Hudson orogen; closure of Great Falls Tectonic Zone and Vulcan Zone; accretion of Medicine Hat Block, and Wyoming Province

1.82-1.80 Ga

Courtesy of Geological Society of America. Used with permission.
1.80-1.76 Ga

Accretion of Archean(?)
Grouse Creek Block and Selway Terrane;
Mojave Province and Yavapai arcs outboard

(Whitmeyer and Karlstrom, 2007)

Courtesy of Geological Society of America. Used with permission.
1.76-1.72 Ga

Accretion of Mojavia(?) and Yavapai Province, as a Banda Sea style assembly of arcs
1.72-1.68 Ga

Yavapai province:
Yavapai granitoids stitch juvenile terranes with older provinces;
~1700 Ma quartzite deposition;
Mazatzal arcs outboard

Accretion of Mazatzal and Labradorian Provinces, as juvenile crust
1.65-1.60 Ga

Mazatzal province: Mazatzal granitoids stitch juvenile terranes with older provinces; ~1650 Ma quartzite deposition

Courtesy of Geological Society of America. Used with permission.
Accretion of Granite-Rhyolite Province, Elzevir Block & Pinware terrane, as juvenile crust

1.55-1.35 Ga

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1.48-1.35 Ga

Granite-Rhyolite Province: A-type plutons stitch much of southern Laurentia

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1.3-1.0 Ga

Grenville orogen: Continent-continent collision of Laurentia with African and South American cratons; SE transfer of Caborca block

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1.3-0.95 Ga

Grenville orogen:
Granitoids intrude juvenile belts as far west as Colorado

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1.2-1.1 Ga

Midcontinent Rift system:
Keweenawan, Ft. Wayne rifts;
Intrusion of MacKenzie and Animikie dikes

(Whitmeyer and Karlstrom, 2007)

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0.78-0.68 Ga

Rifting along western margin of Laurentia;
Intrusion of Gunbarrel dikes, Deposition of Windermere Supergroup

(Whitmeyer and Karlstrom, 2007)

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0.62-0.55 Ga

Rifting along eastern margin of Laurentia; Opening of Rome Trough

(Whitmeyer and Karlstrom, 2007)

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Rifting of Argentine Precordillera from Ouachita embayment; Opening of Oklahoma Aulacogen, Reelfoot Rift

~ 0.535 Ga

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1. Continental rifting
(ex: E. Africa)

Image by MIT OpenCourseWare.
2. Formation of seafloor spreading center (ex: Red Sea)

Image by MIT OpenCourseWare.
3. Widening ocean basin  
(ex: Atlantic)
4. Initiation of subduction (ex: Pacific Rim)
5. Subduction of spreading center (ex: Juan de Fuca Ridge)
6. Closing of ocean, formation of collisional orogen
(ex: closure of Iapetus Ocean to form the Appalachians)
Forsythe & Uyeda, 1975

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