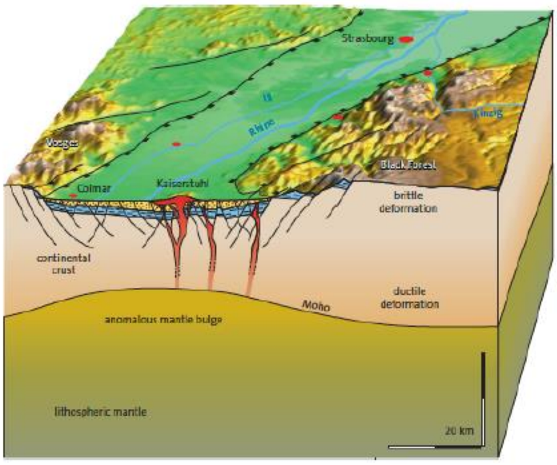
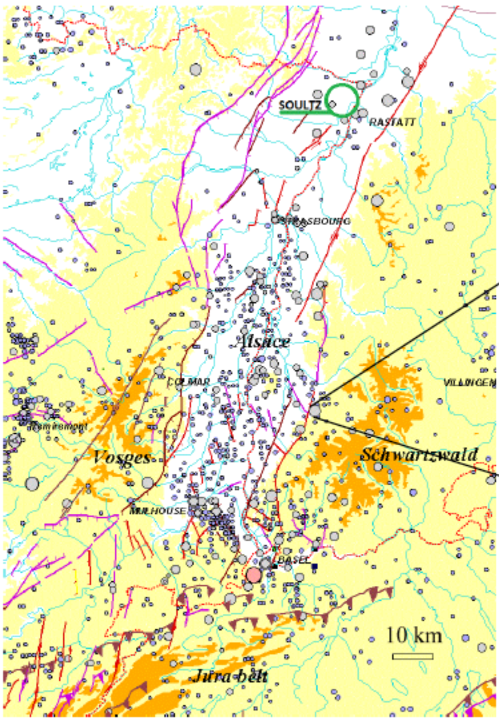
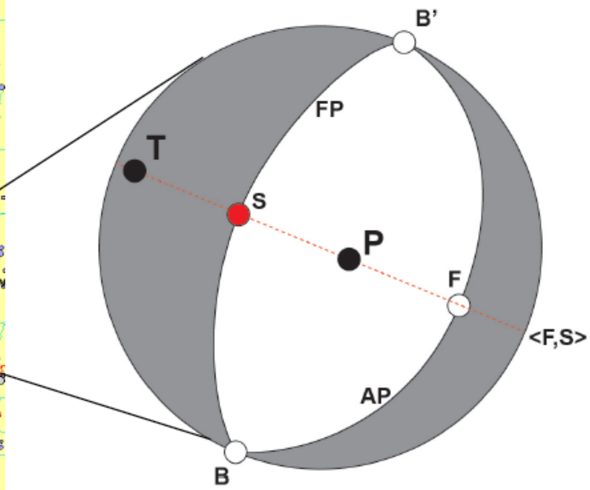
Question 8:



Narrow rifts – Upper Rhine Graben

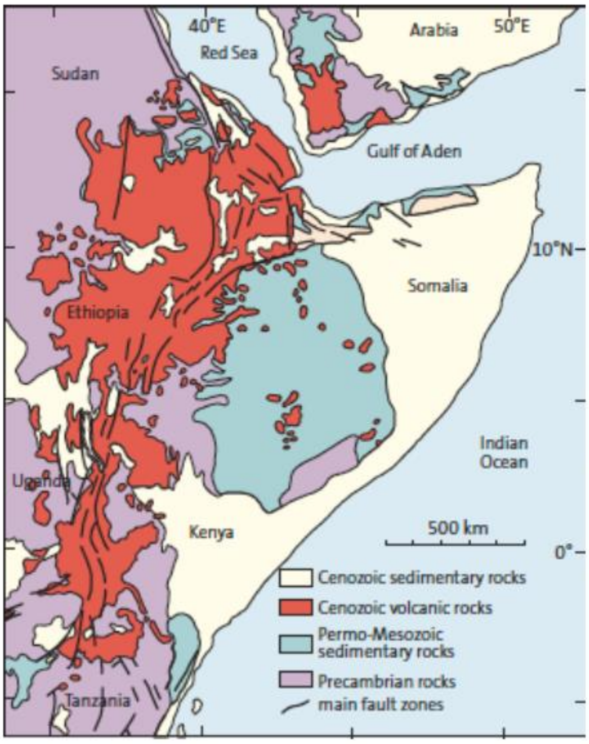


- Earthquakes foci (Early Tertiary)



- Steep normal faults

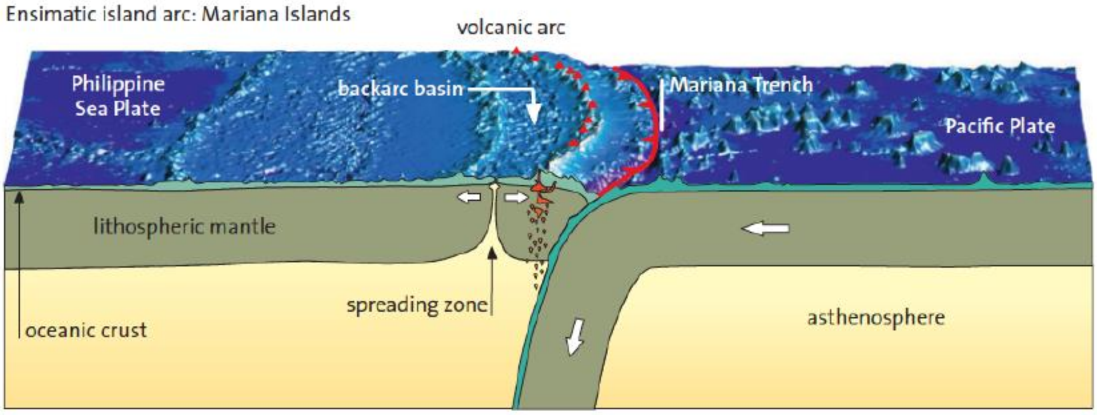
Narrow rifts – East African Rift



- Major **volcanism**
- slightly alkaline to tholeiitic basalts (~ 50% SiO_2)
- Higher amounts of partial melting of lithospheric mantle
- Rapid extension = more melting (think back to fast and slow spreading ridges)
- Alkalinity increase from graben axis to rift shoulder
- Kenya Rift shows decrease in alkalinity through time (extension speeding up)
- EAR show decreasing alkalinity (increasing extension) from south to north

Ensimatic island arc

Ensimatic island arc: Mariana Islands



Subduction of oceanic lithosphere below oceanic lithosphere form **ensimatic island arcs**. Island arc is underlain by oceanic crust.

Sima – Silicon and Magnesium, signifying oceanic crust composition

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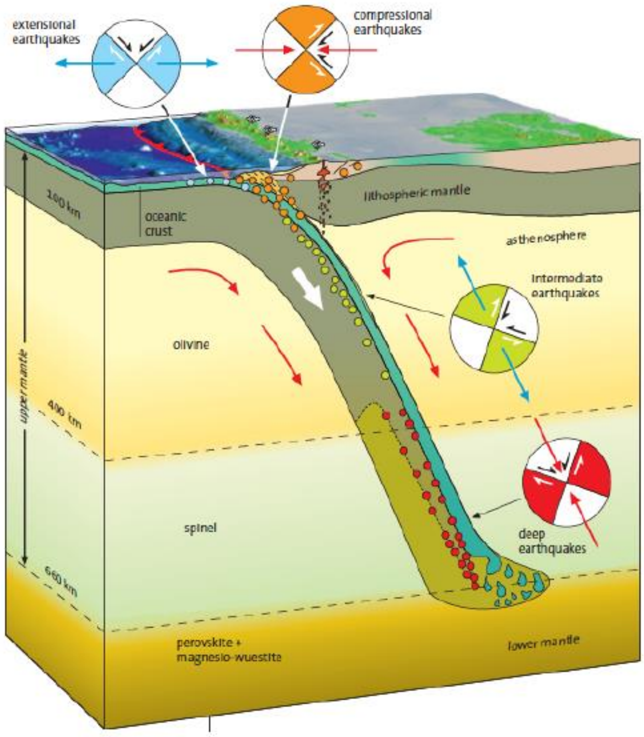
Shallow Earthquakes



Buldge

- normal faults (horizontal extension)
- up to 25 km depth
- Faults provide pathways to seawater to penetrate oceanic lithosphere and to change it to serpentinite.

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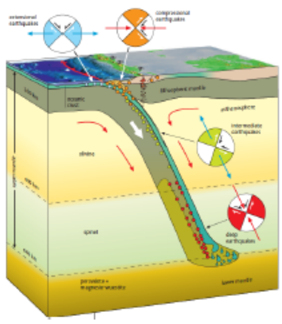
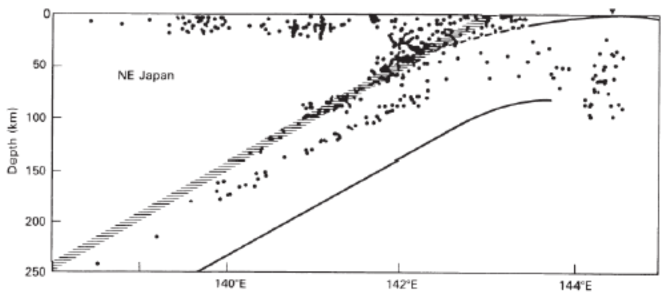
Intermediate Earthquakes





- Double seismic zone
- Upper zone = shear movement along plate boundary
- Lower zone = dehydration of lithospheric mantle serpentinite(dewatering = volume loss and microcracks = weakening = shear zones)

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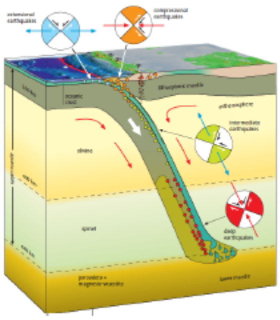
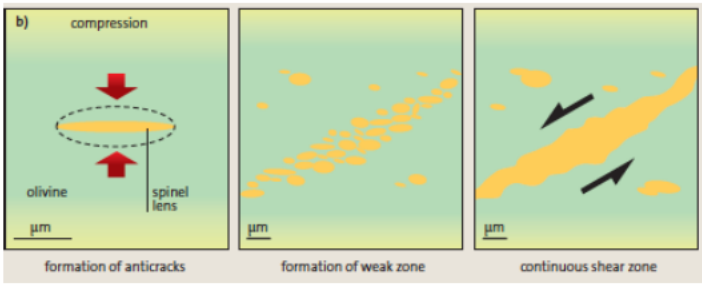
Deep Earthquakes





- Olivine transform to spinel (densification = volume loss and anticracks = weakening = shear zones)
- Shear not by a fracture plane but by superplasticity
  - Fine-grained mineral grains slip past each other along their grain boundaries.
  - Fast plastic deformation

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Magmatic arc geochemistry (Batholiths and volcanoes)

- Low-K tholeiitic series
  - Basalts and Fe-rich basaltic andesites and andesites
- Calc-alkaline series
  - Andesite, Al-rich basalts, moderately enriched in K (some dacite and rhyolite in continents)
- Alkaline series
  - Alkaline basalts, K-rich (shoshonitic lavas)

- Young subduction zones/near magmatic front
- Low depth mantle source (65-100 km)

- Old subduction zones
- Deeper mantle source (> 100 km)
- **Most common series**

- Old subduction zones
- Deeper mantle source (> 100 km)
- Least common

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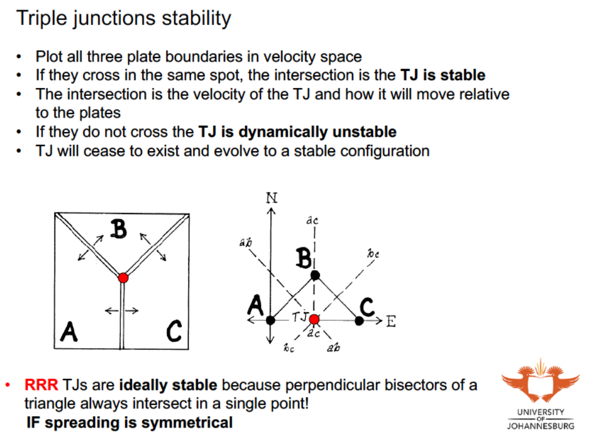
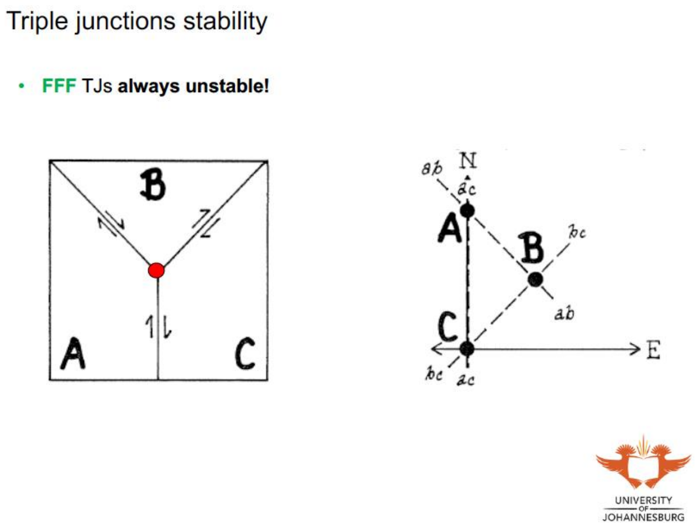
Question 9: Tectonic plates (20 marks)

9.1.
1 Pacific plate
2 Cocos plate
3 Nasca plate
4 Philippine sea plate
5 Antarctic plate

9.2. The plates rafer to the rheological lithosphere, the hard brittle outer shell of the earth. This includes the crust as well as the lithospheric mantle.

9.3.





Question 10: Supercontinent cycle (20 marks)

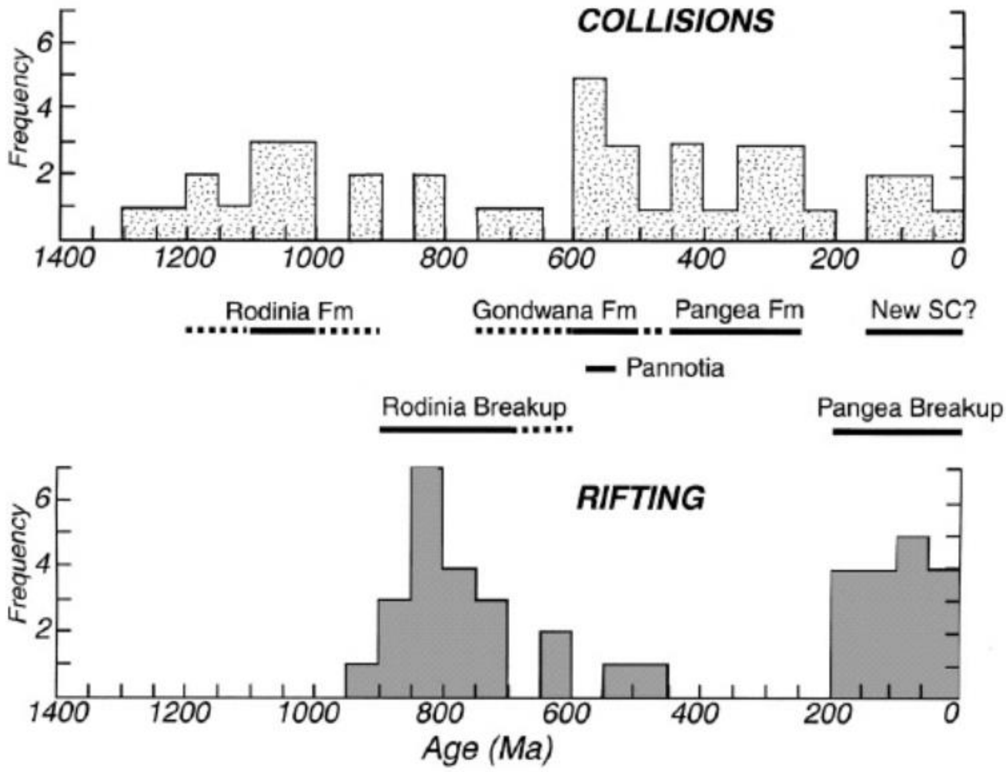
10.1.

Rodinia	1100-750 Ma
Columbia	1800-1350 Ma
Gondwana	550-180 Ma

Kenorland 2700-2500 Ma

10.2.

K.C. Condie / Journal of African Earth Sciences 35 (2002) 179–183

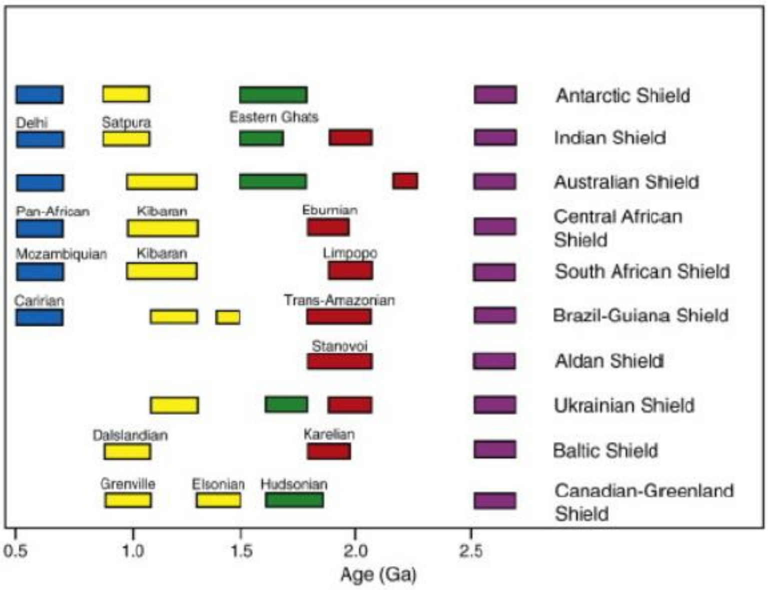


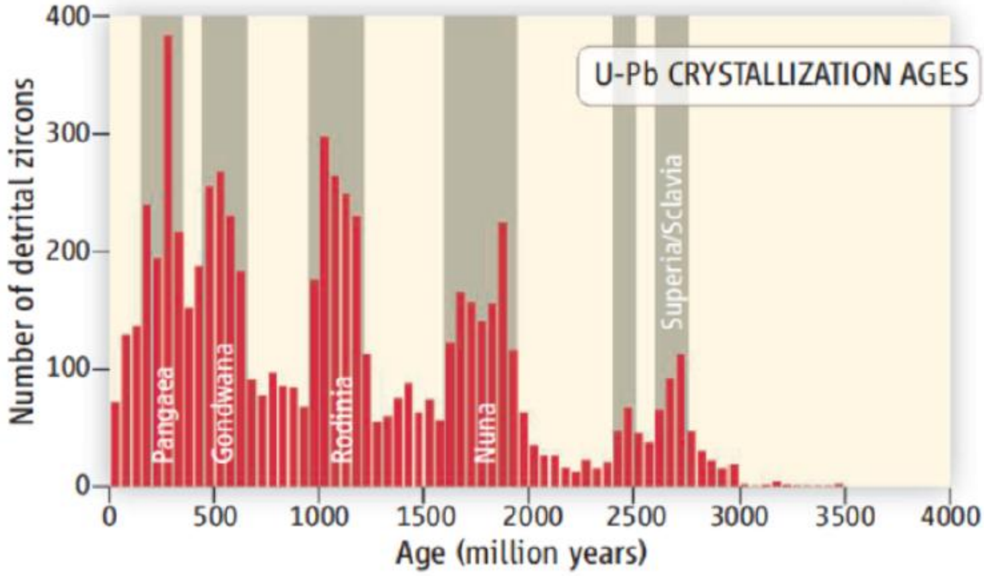
Gondwana Research
Volume 25, Issue 1, January 2014, Pages 4-29

GR focus review

The supercontinent cycle: A retrospective essay

R. Damian Nance [a], J. Brendan Murphy [b], M. Santosh [c, d]





Hawkesworth et al. (2009)