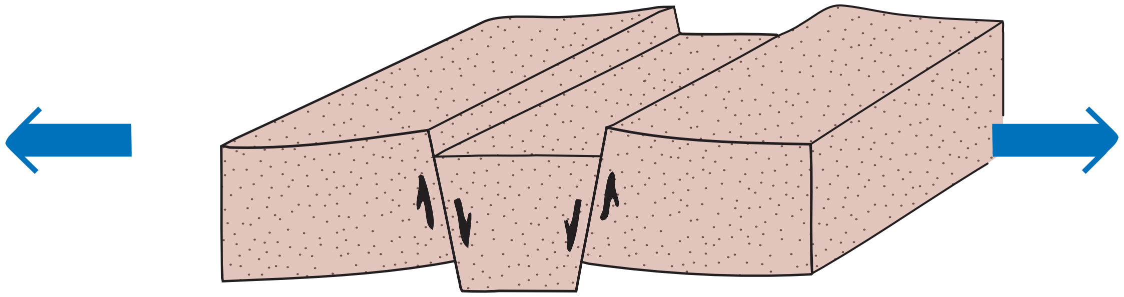
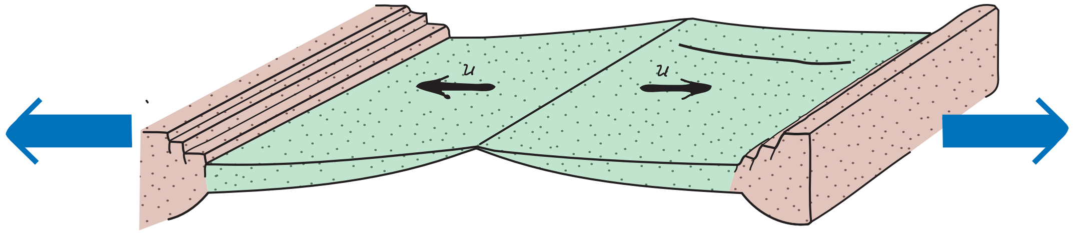
14-
Obduction/Kontinental Kruste

Wilson Cycle

Rifting

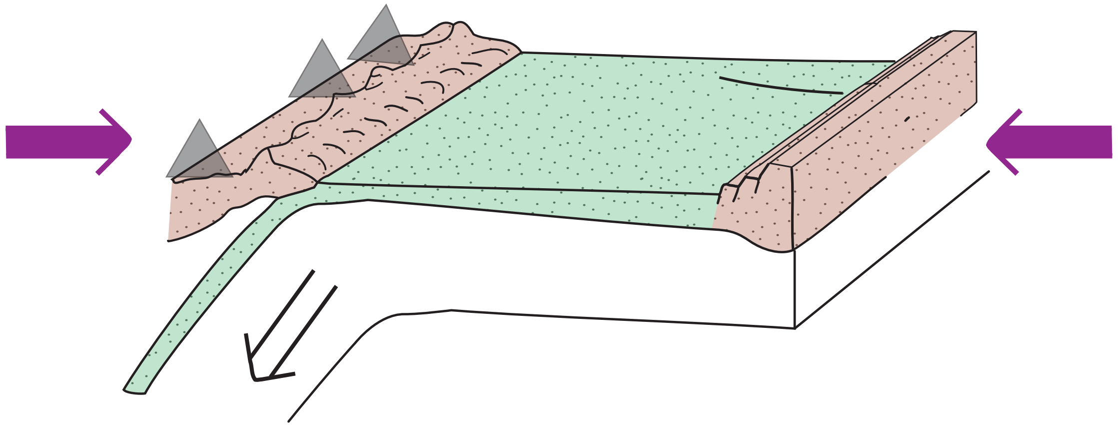


Ocean formation

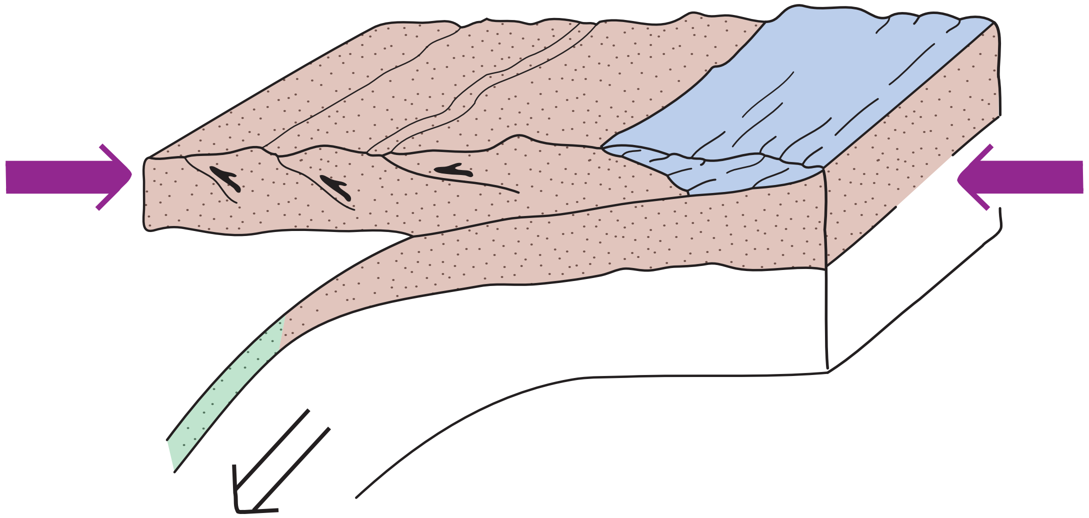


Obduction?

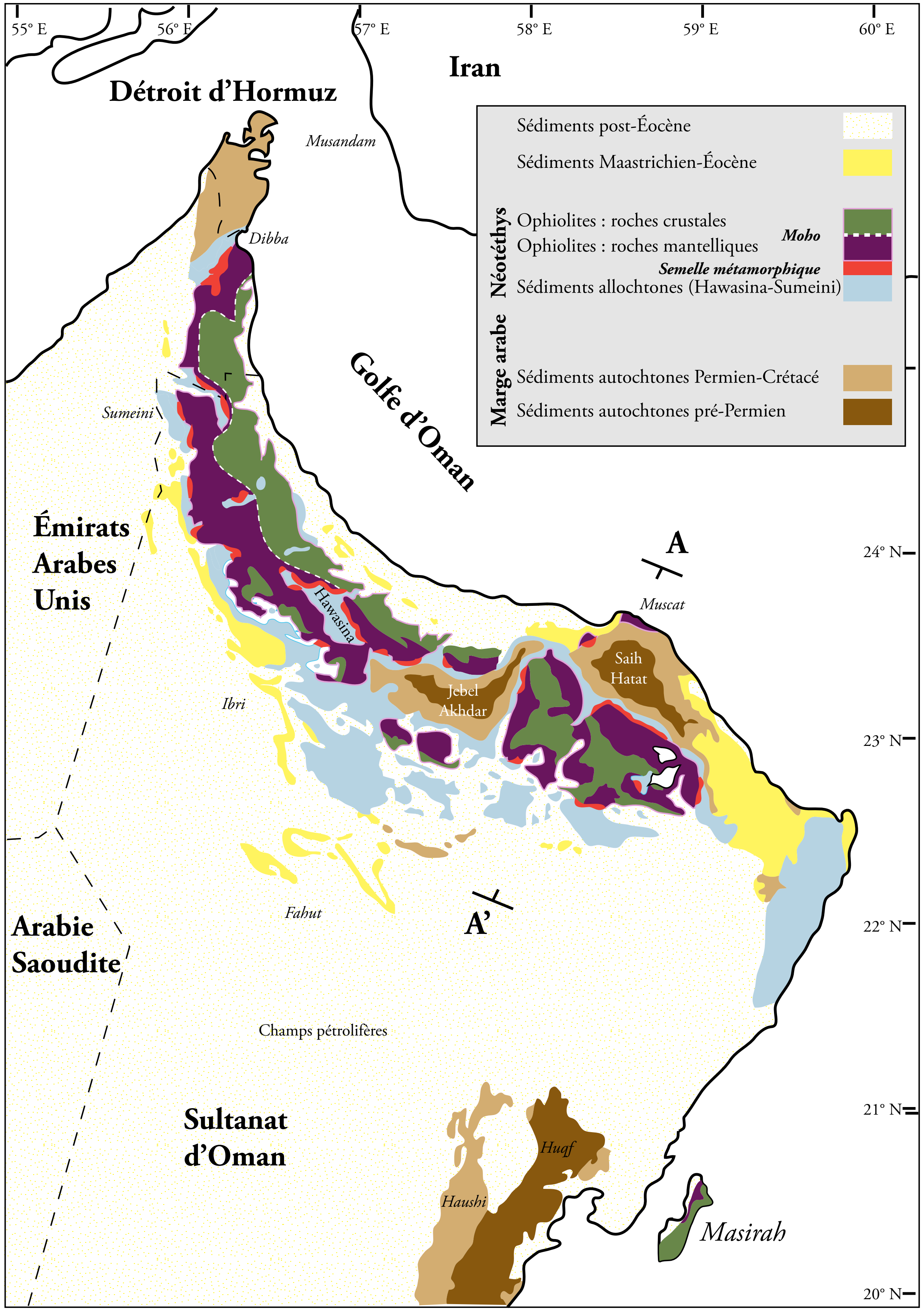
Subduction



Collision

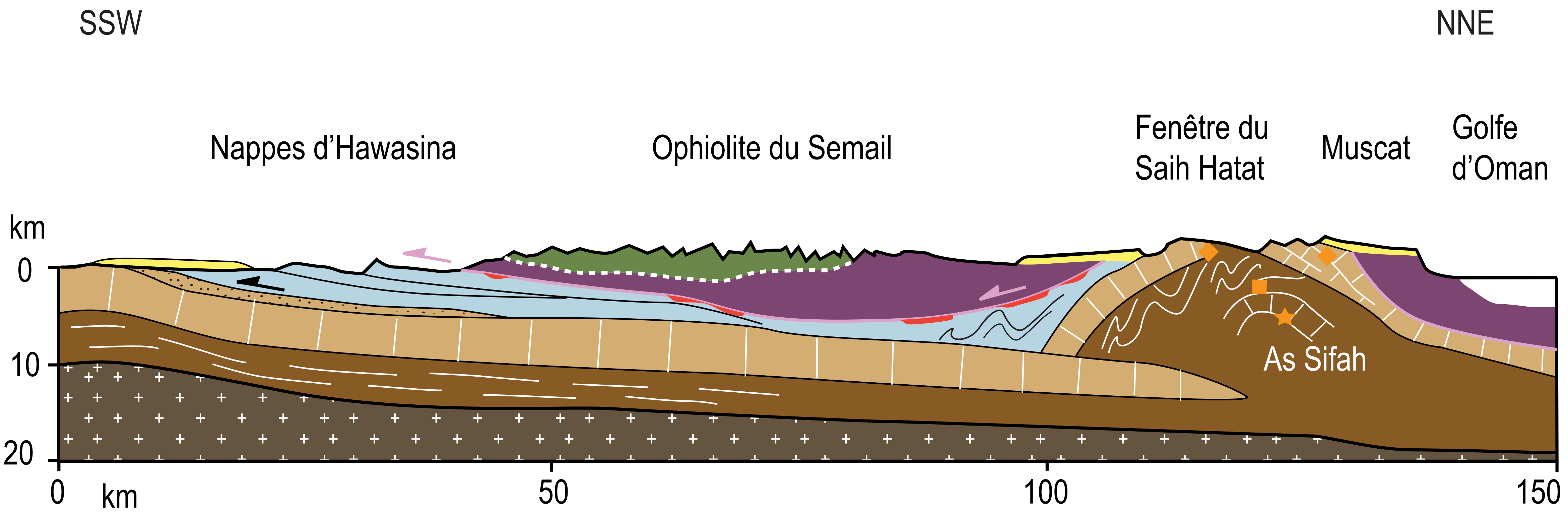


Oman, the best obducted ophiolite



Robert & Bousquet, 2010

Oman, the best obducted ophiolite



Plateforme arabe

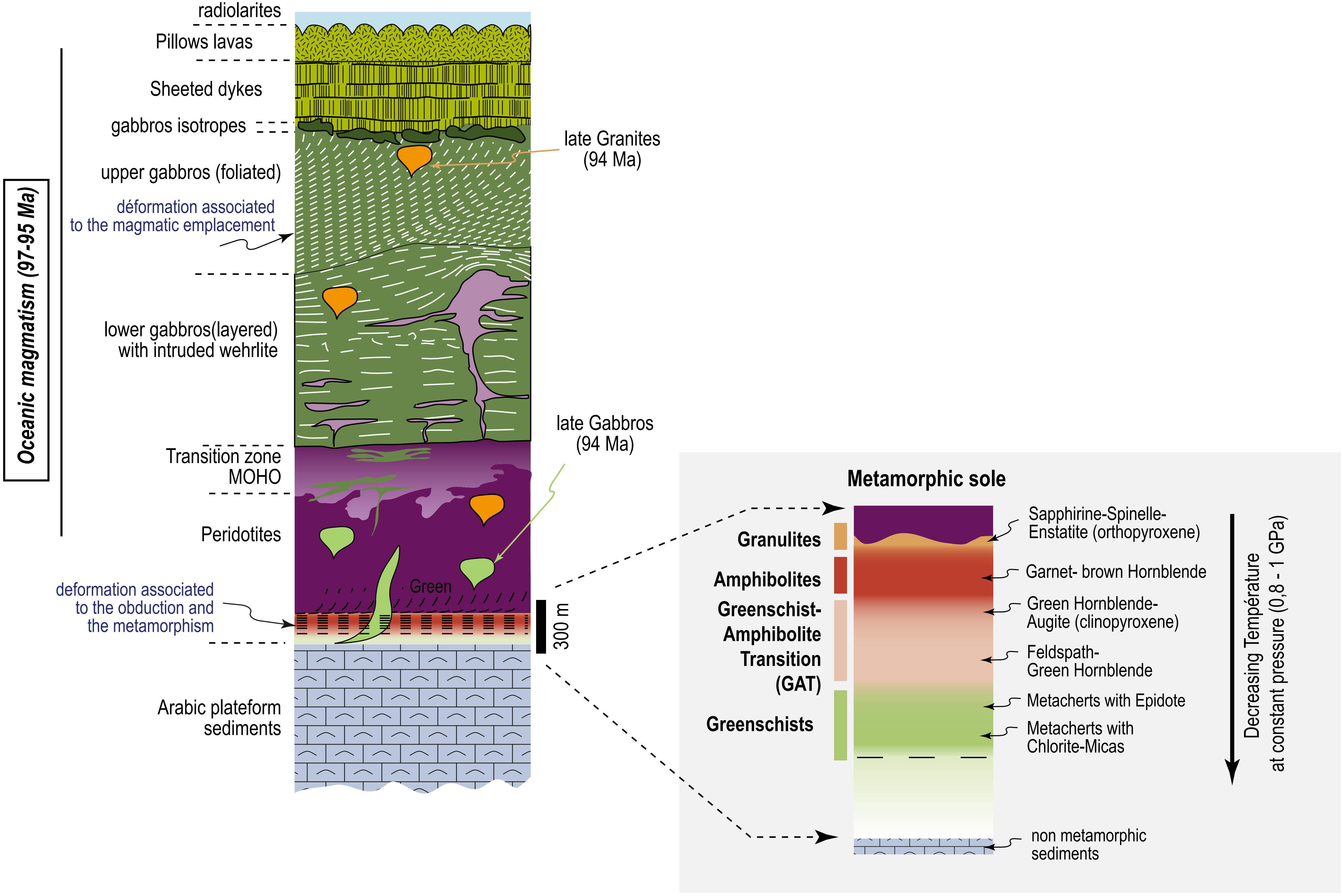
- 🟫 *Roches sédimentaires Permien-Crétacé supérieur*
- 🟫 *Roches sédimentaires Protérozoïque supérieur-Paléozoïque*
- 🟫 *Croûte continentale arabe*

Ophiolite de Semail

- 🟩 *Croûte (Gabbros, Basaltes)*
- 🟩 *Paléo-Moho*
- 🟪 *Manteau (Hazburgites)*

- 🟦 *Sédiments océaniques (nappes de l'Hawasina)*
- 🟨 *Tertiaire discordant*

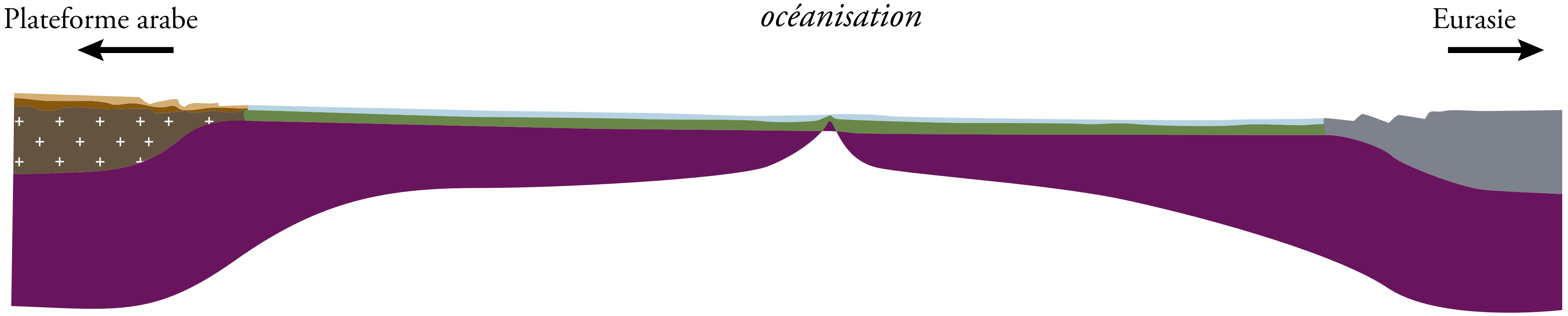
Robert & Bousquet, 2010



Robert & Bousquet, 2010

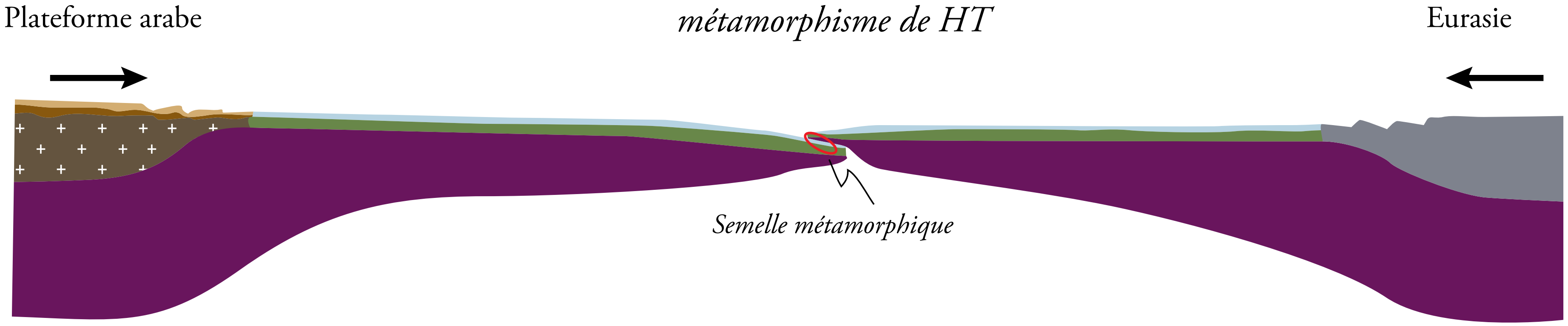
Formation de la Néotéthys (->95 Ma)

océanisation



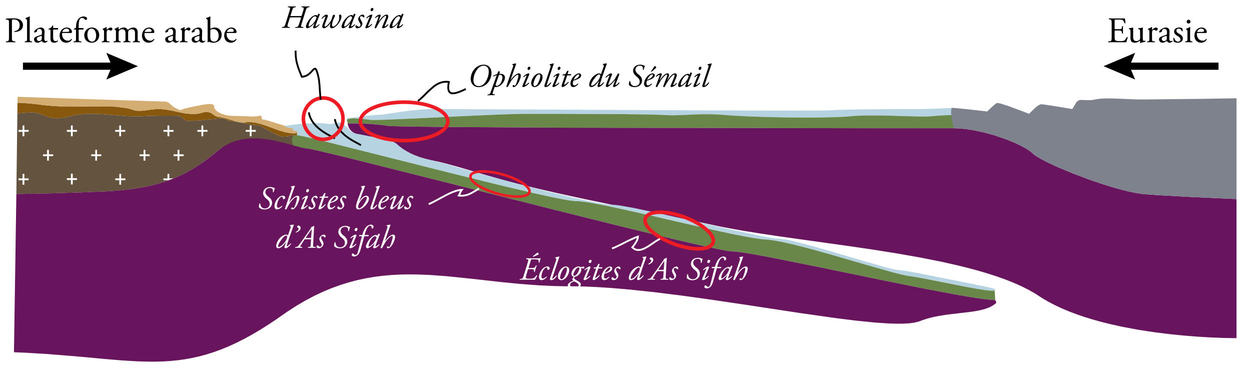
Obduction (~94 Ma)

formation de la semelle métamorphique
métamorphisme de HT



Subduction (~78 Ma)

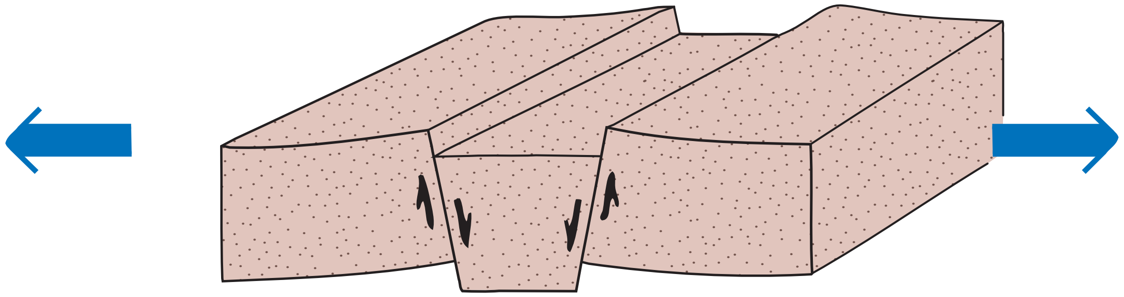
formation des éclogites et des schistes bleus
métamorphisme HP-BT



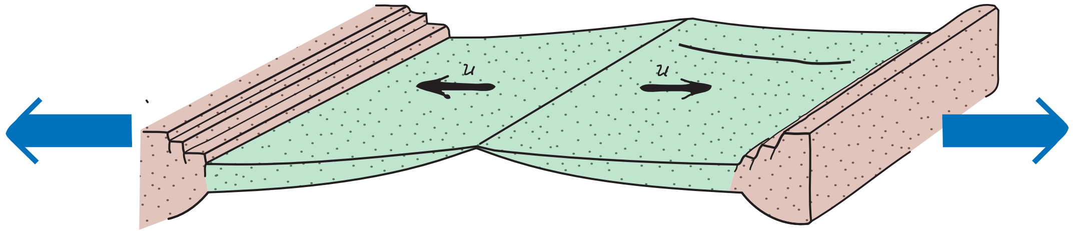
Robert & Bousquet, 2010

Wilson Cycle

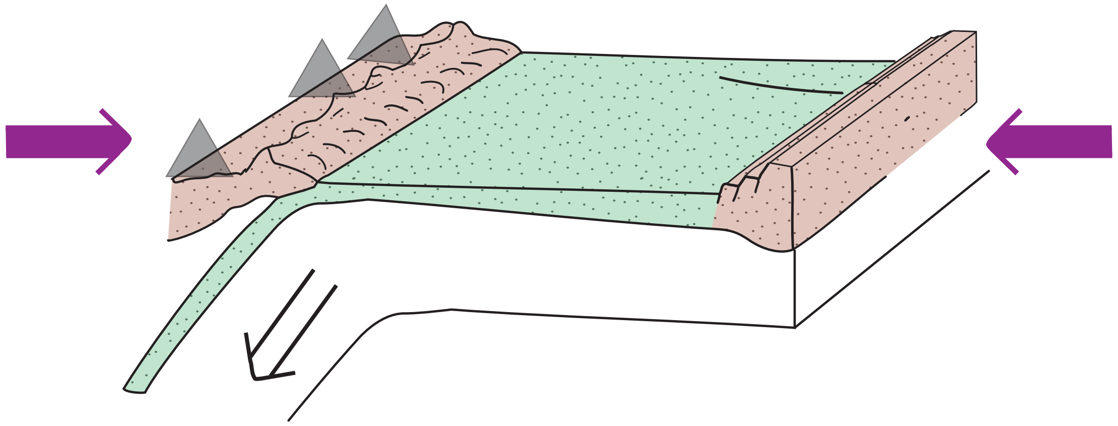
Rifting



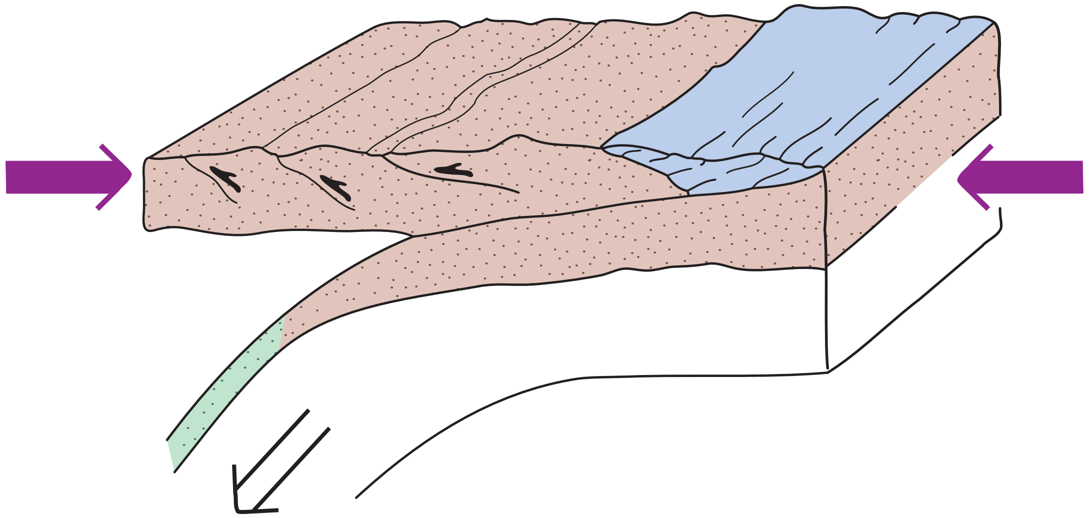
Ocean formation



Subduction



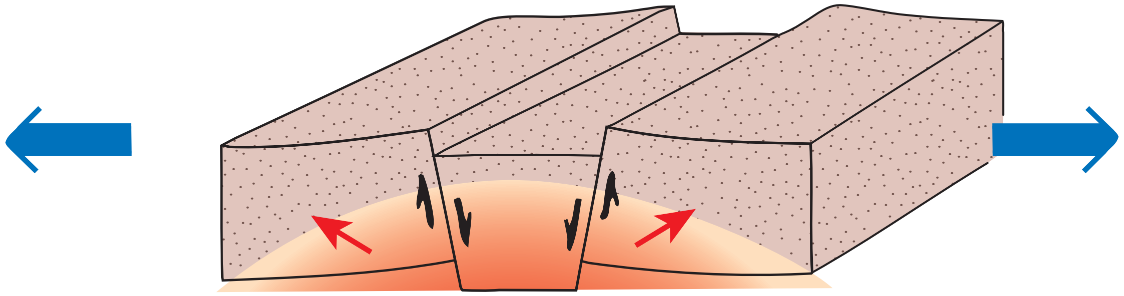
Collision



Robert & Bousquet, 2010

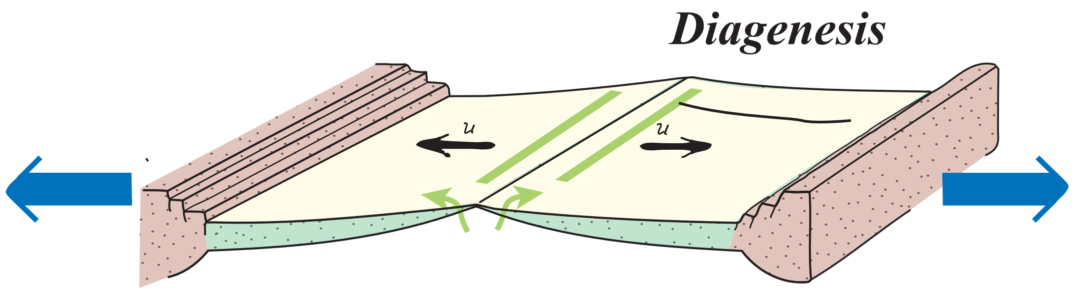
Wilson Cycle: Metamorphism

Rifting

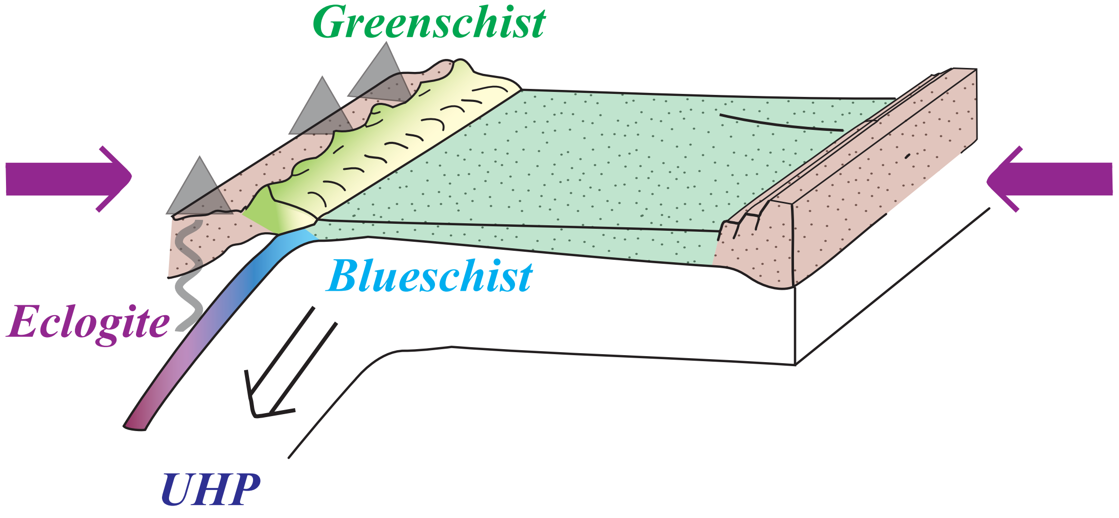


Heating of the crust
(Amphibolite, LP Granulite)

Ocean formation



Subduction



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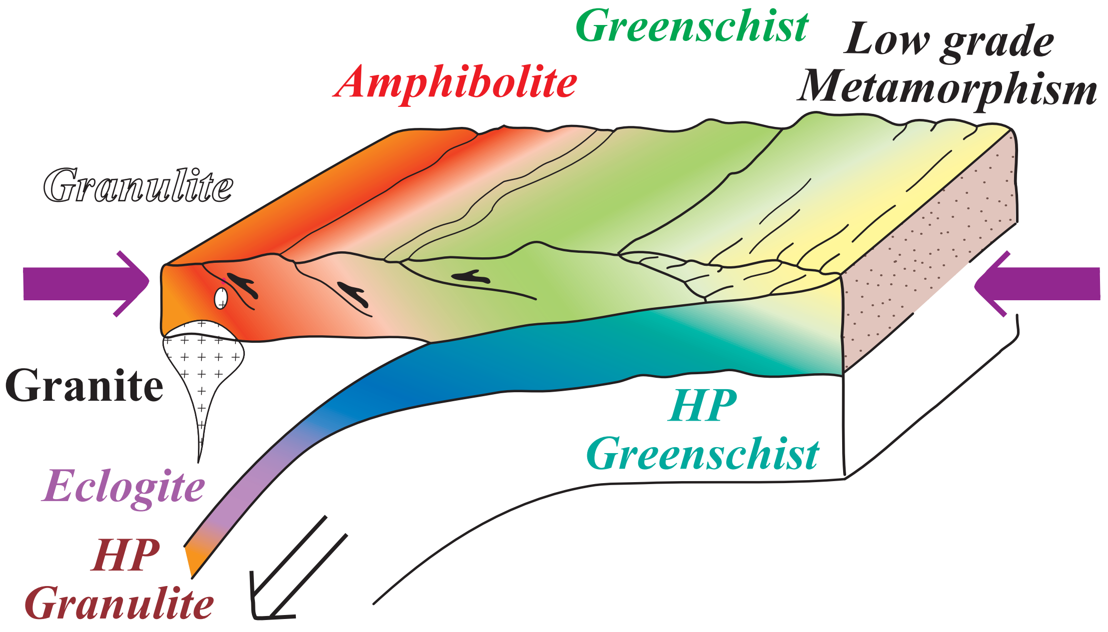
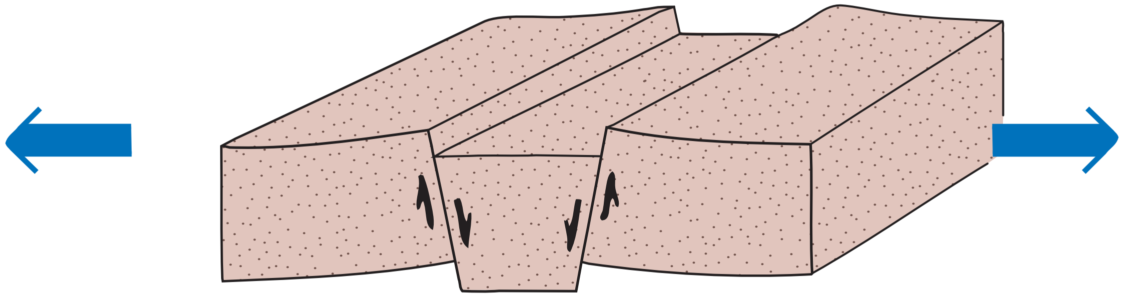


Robert & Bousquet, 2010

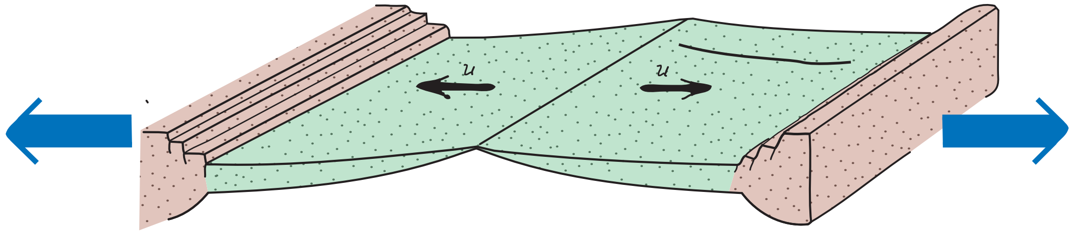
Wilson Cycle: *Volcanism*

Rifting



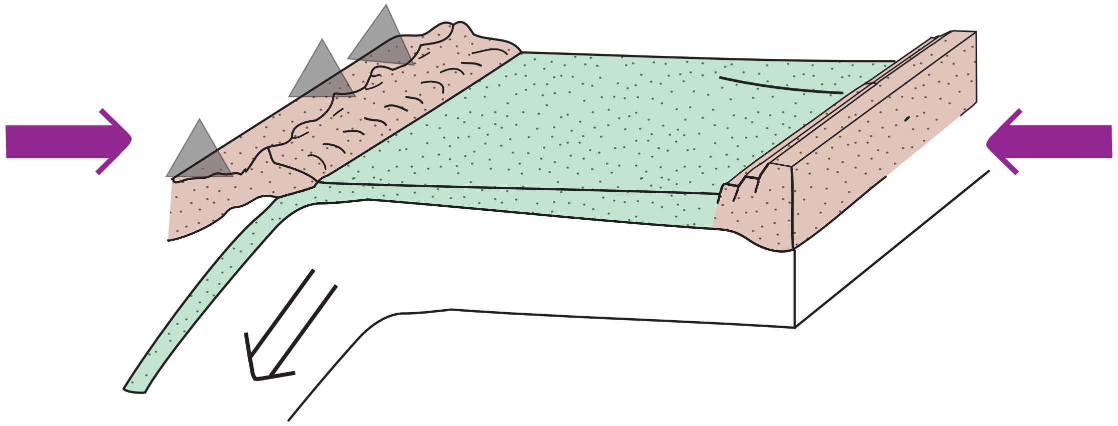
Alcalin

Ocean formation

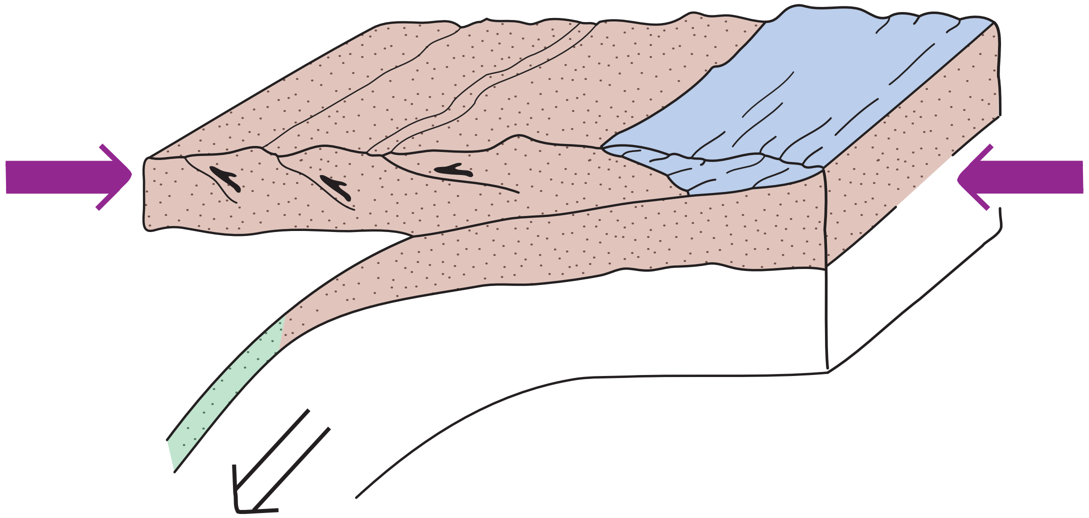


MORB=Tholeiite

Subduction



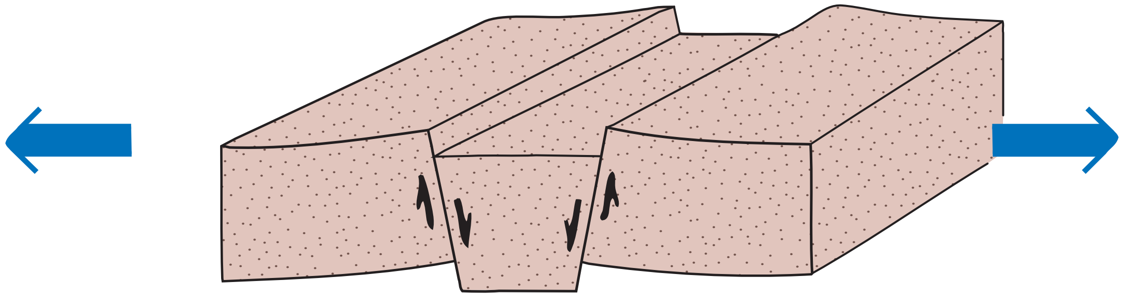
Collision



Calco-alcalin

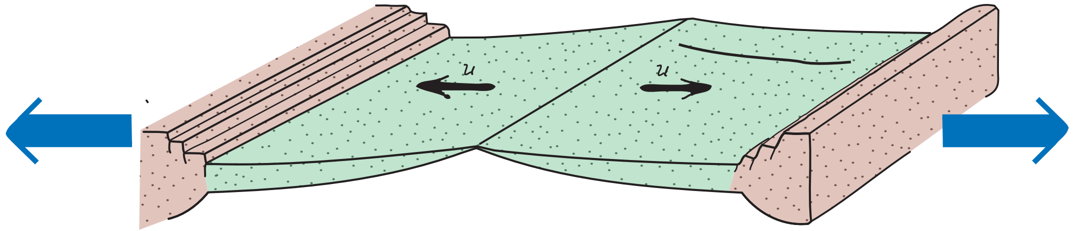
Wilson Cycle: *Sediment*

Rifting



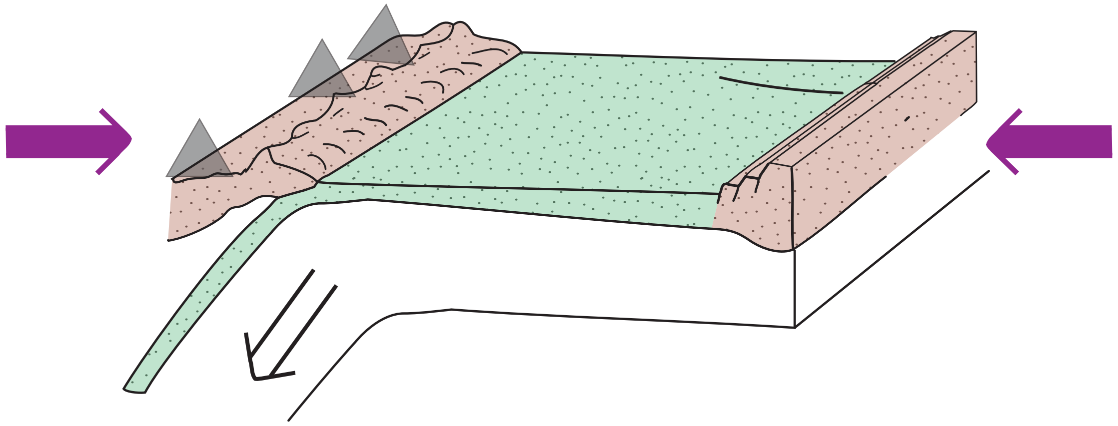
Evaporites, conglomerat

Ocean formation



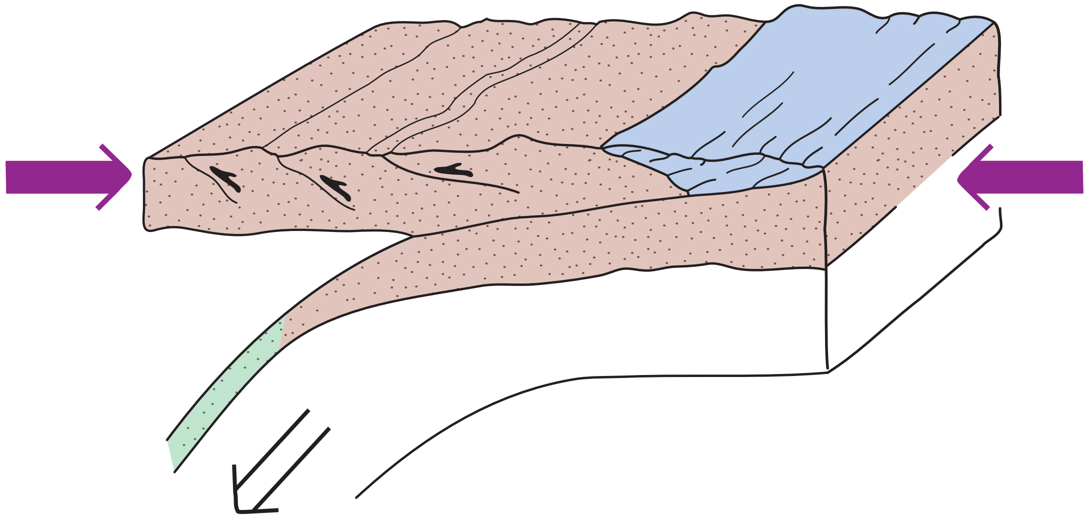
Radiolarite, carbonates

Subduction



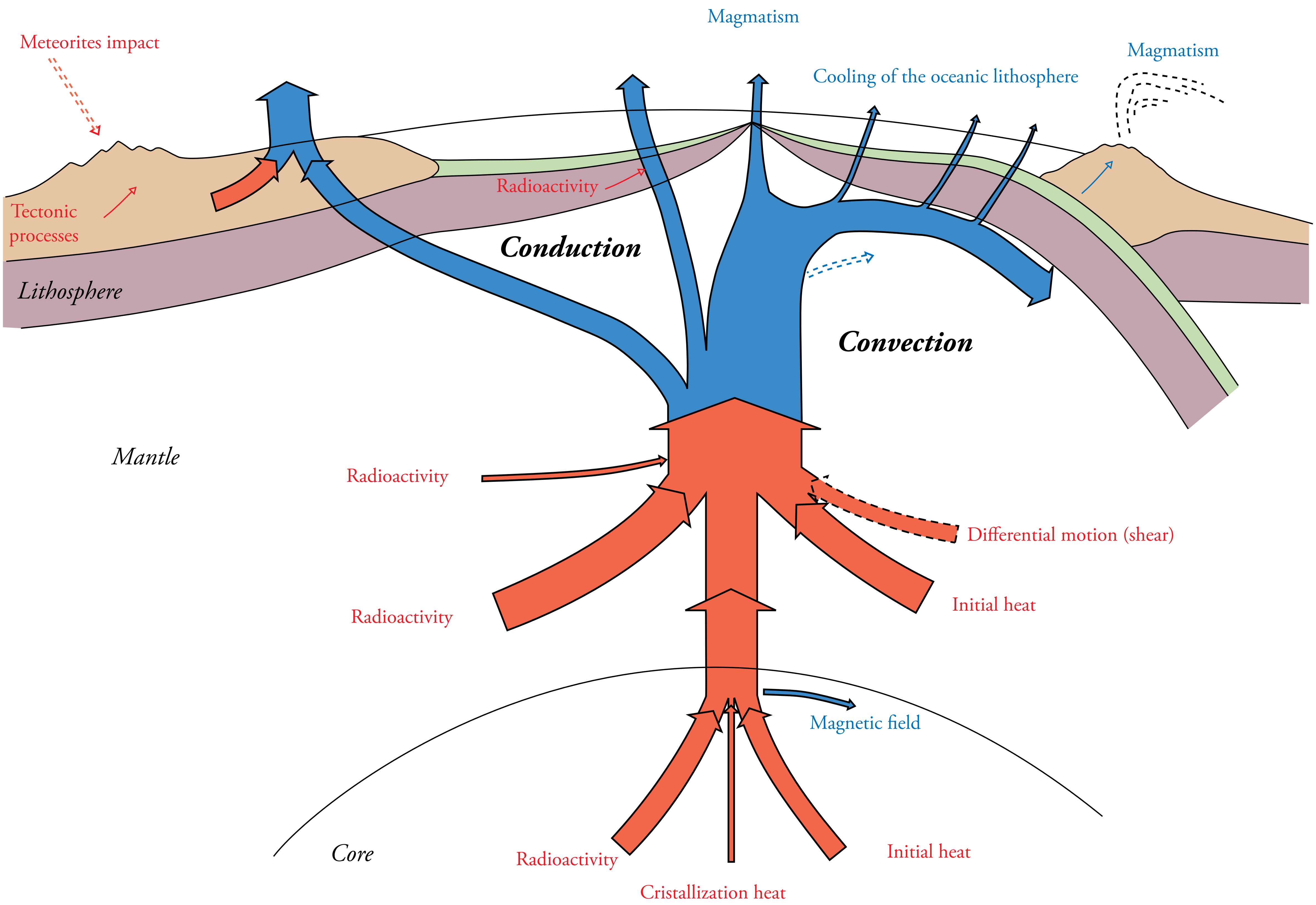
Flysch, turbidites

Collision

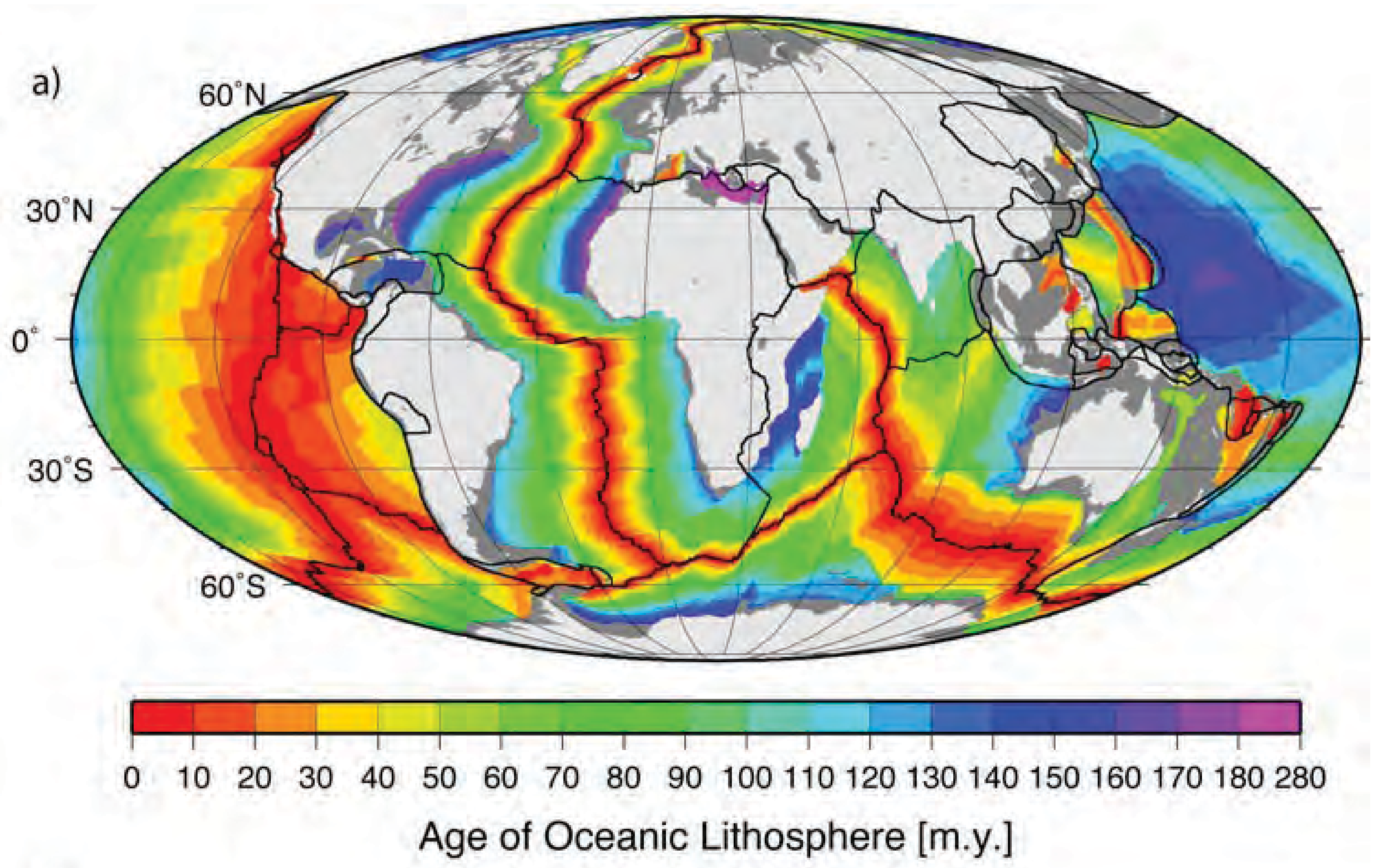


Molasse

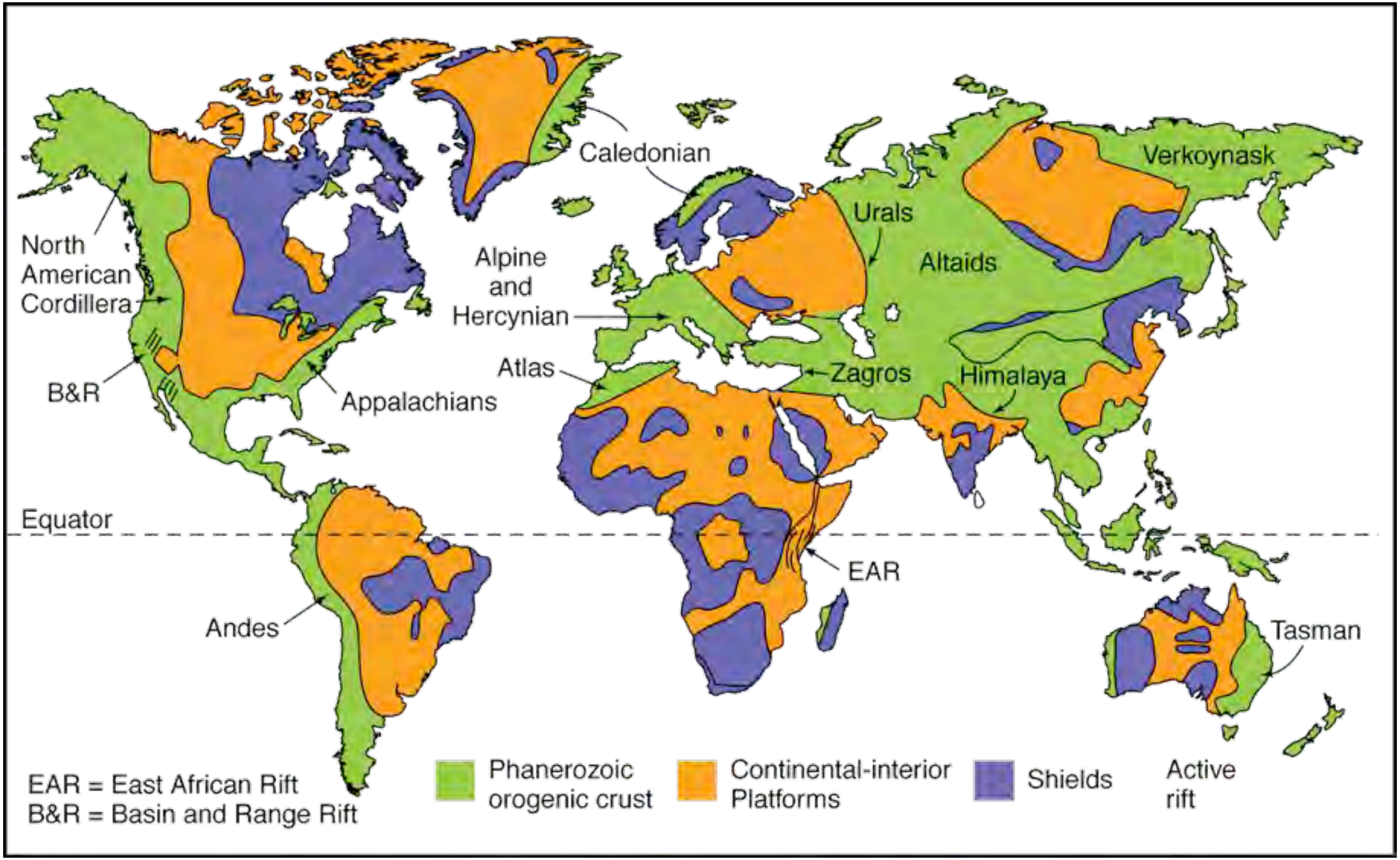
Earth heat flow balance



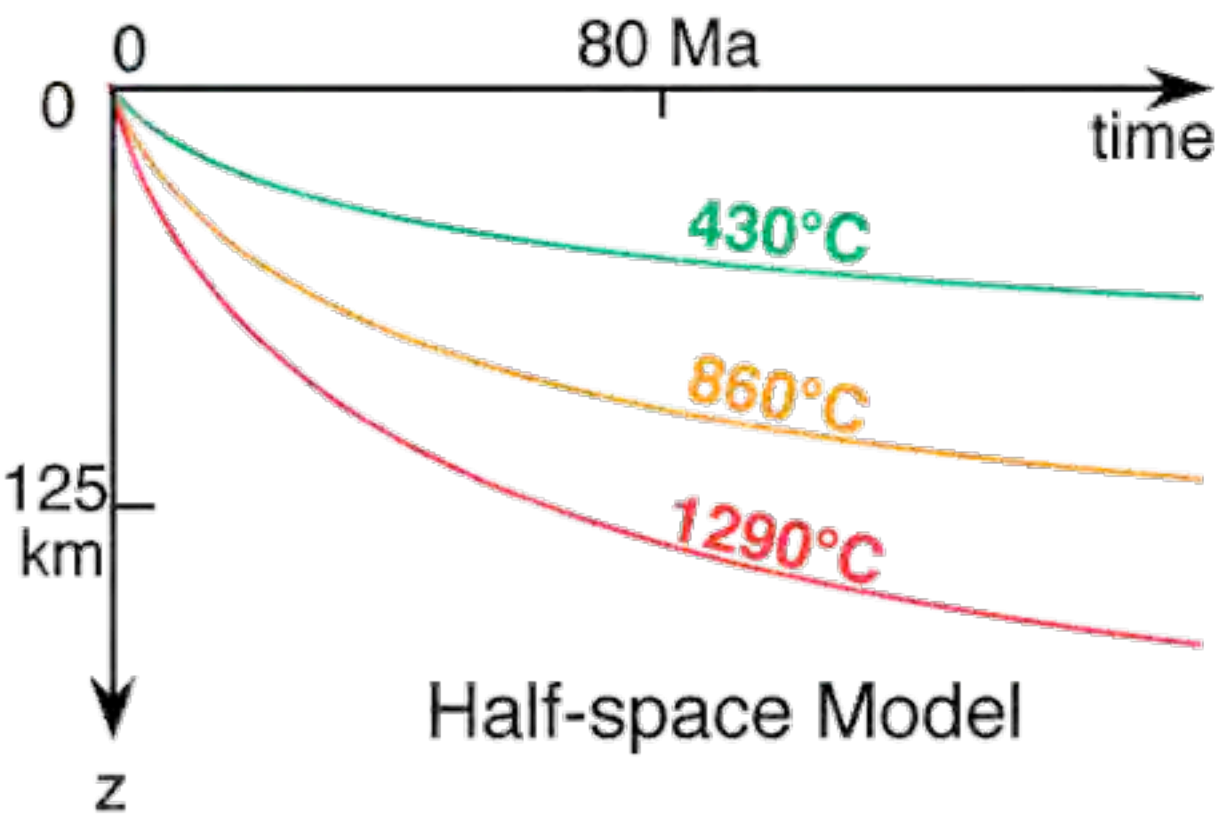
Oceanic crust ages

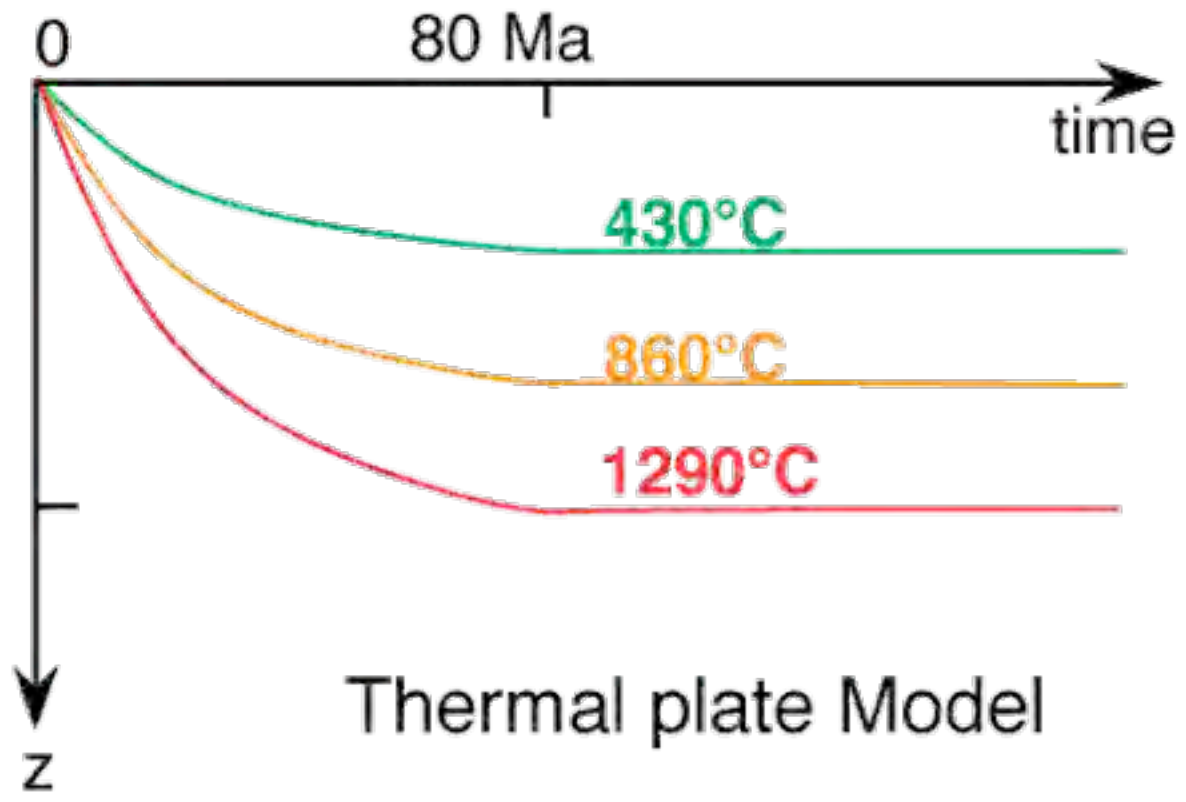


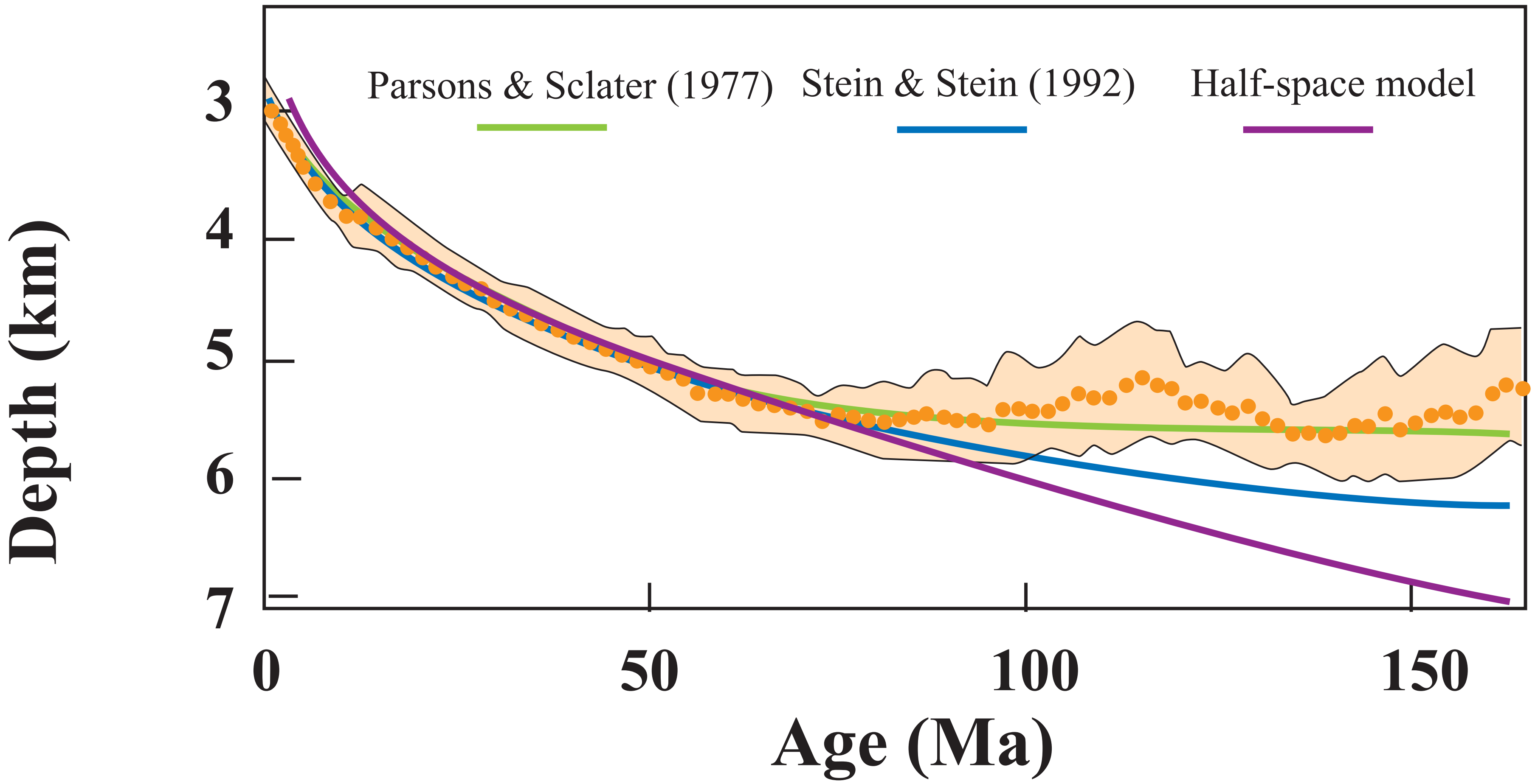
Continental crust ages



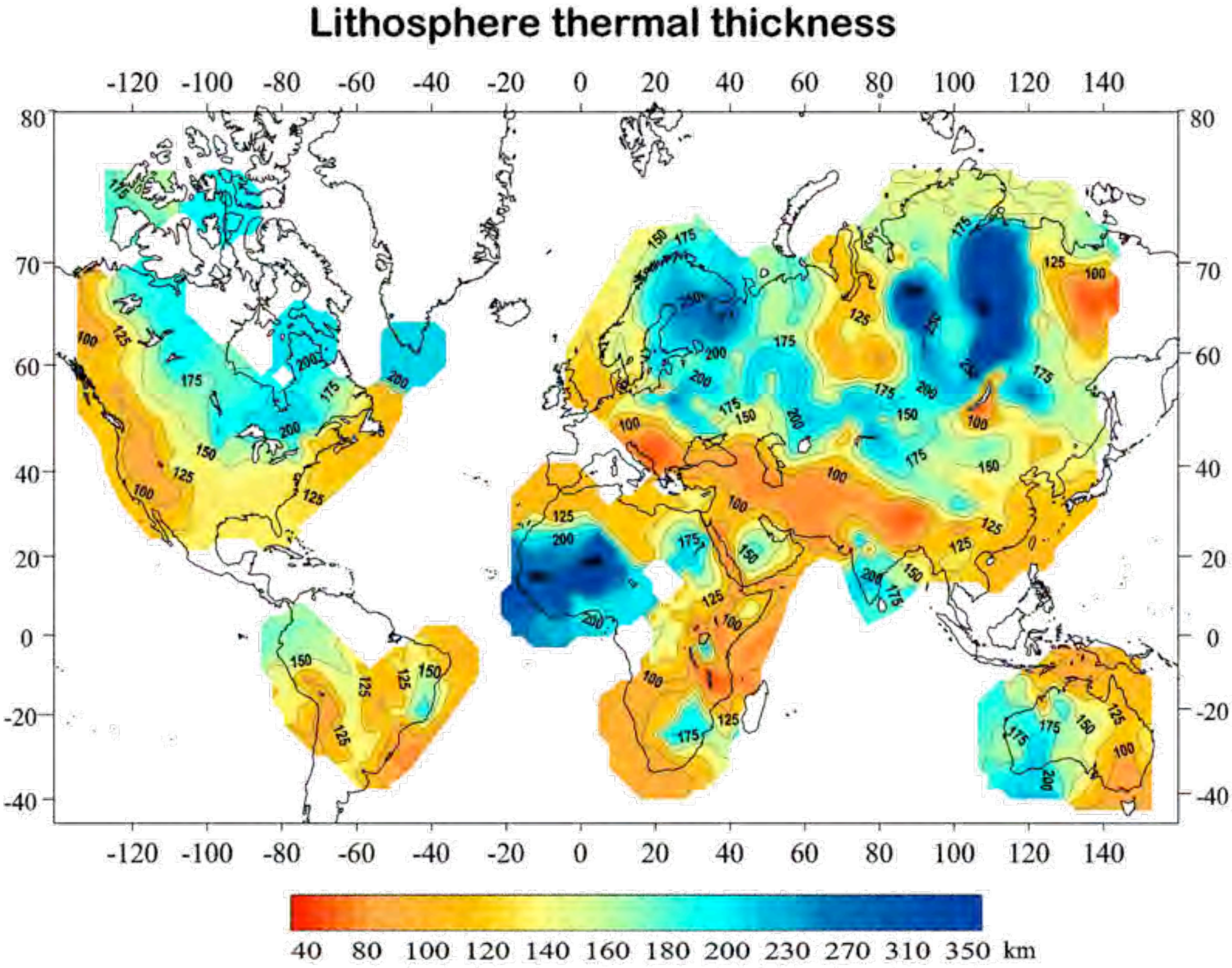
Oceanic lithosphere structure





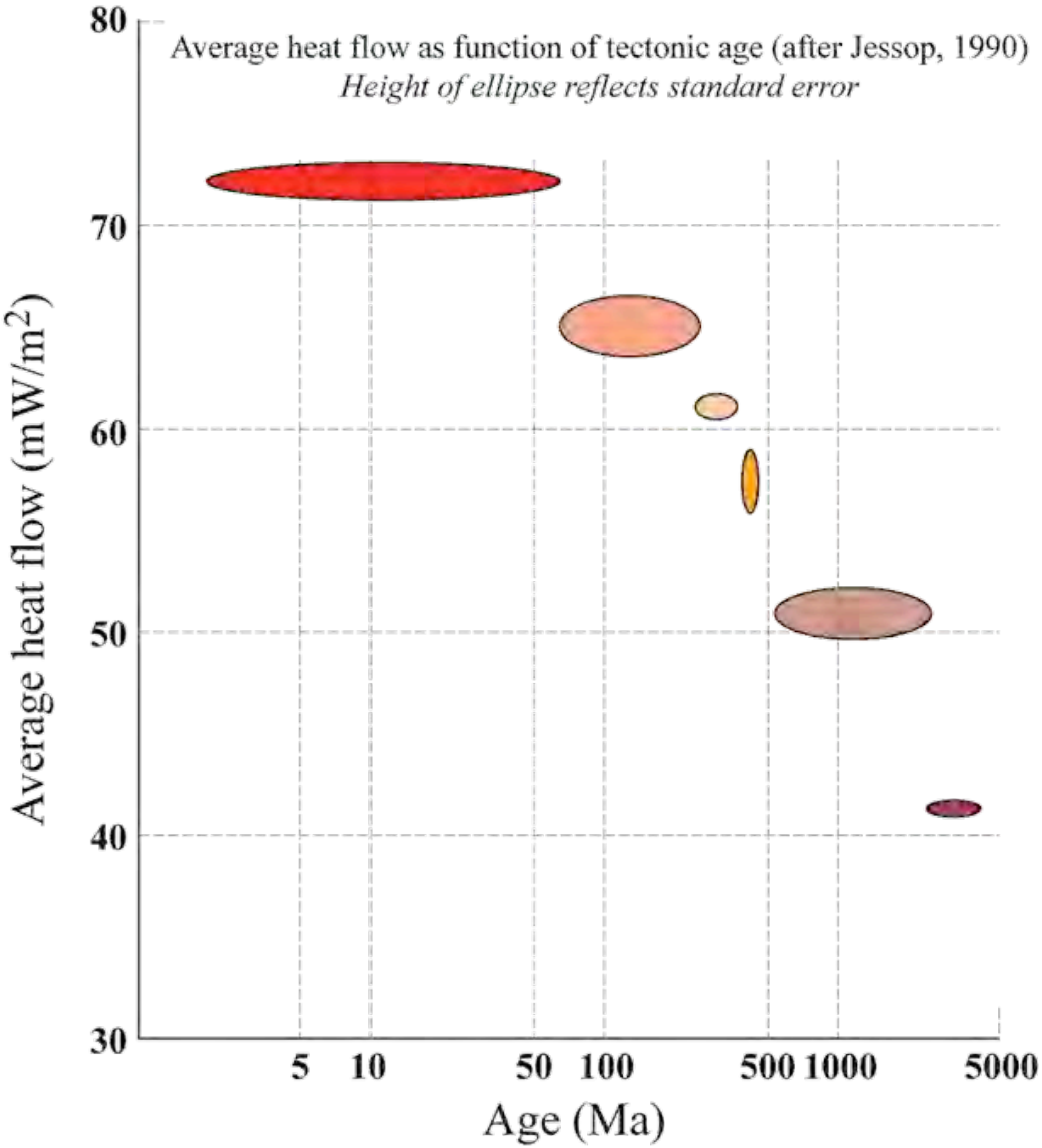


Continental lithosphere structure

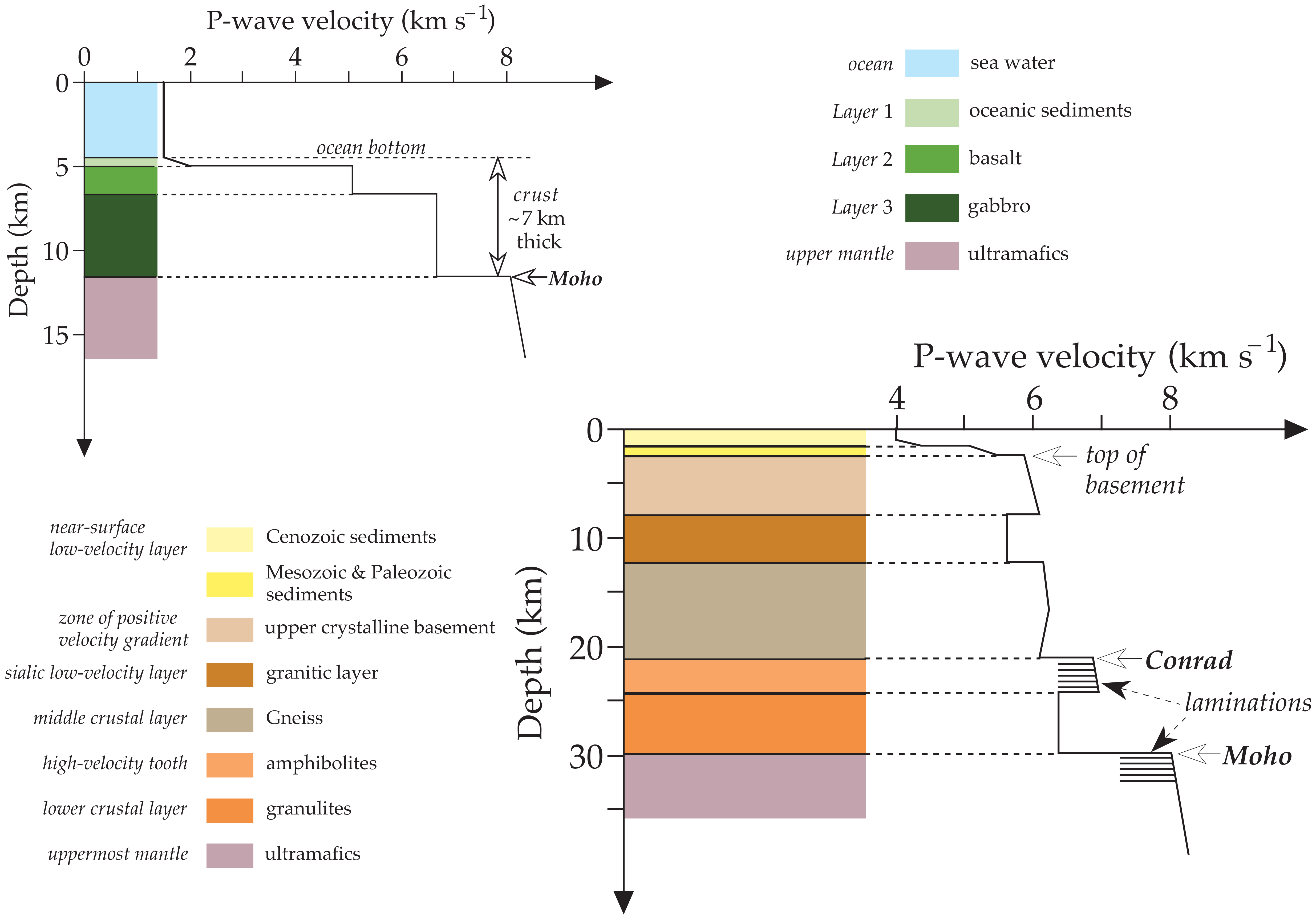


Artemieva and Mooney, 2001

Thermal evolution of the continental lithosphere



Oceanic vs continental crust

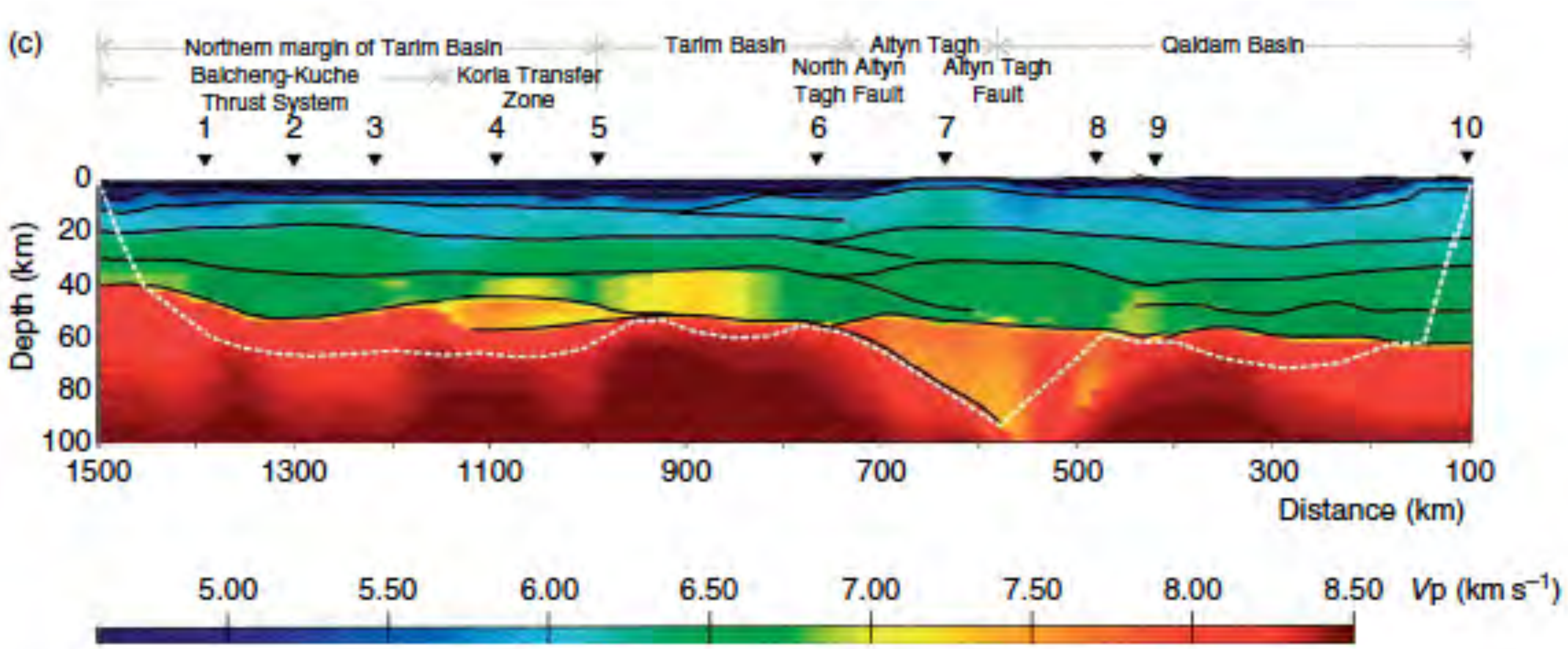


ocean	🟦	sea water
Layer 1	🟩	oceanic sediments
Layer 2	🟩	basalt
Layer 3	🟩	gabbro
upper mantle	🟪	ultramafics

near-surface low-velocity layer	🟨	Cenozoic sediments
	🟨	Mesozoic & Paleozoic sediments
zone of positive velocity gradient	🟫	upper crystalline basement
sialic low-velocity layer	🟫	granitic layer
middle crustal layer	🟫	Gneiss
high-velocity tooth	🟧	amphibolites
lower crustal layer	🟧	granulites
uppermost mantle	🟪	ultramafics

Example of continental crust

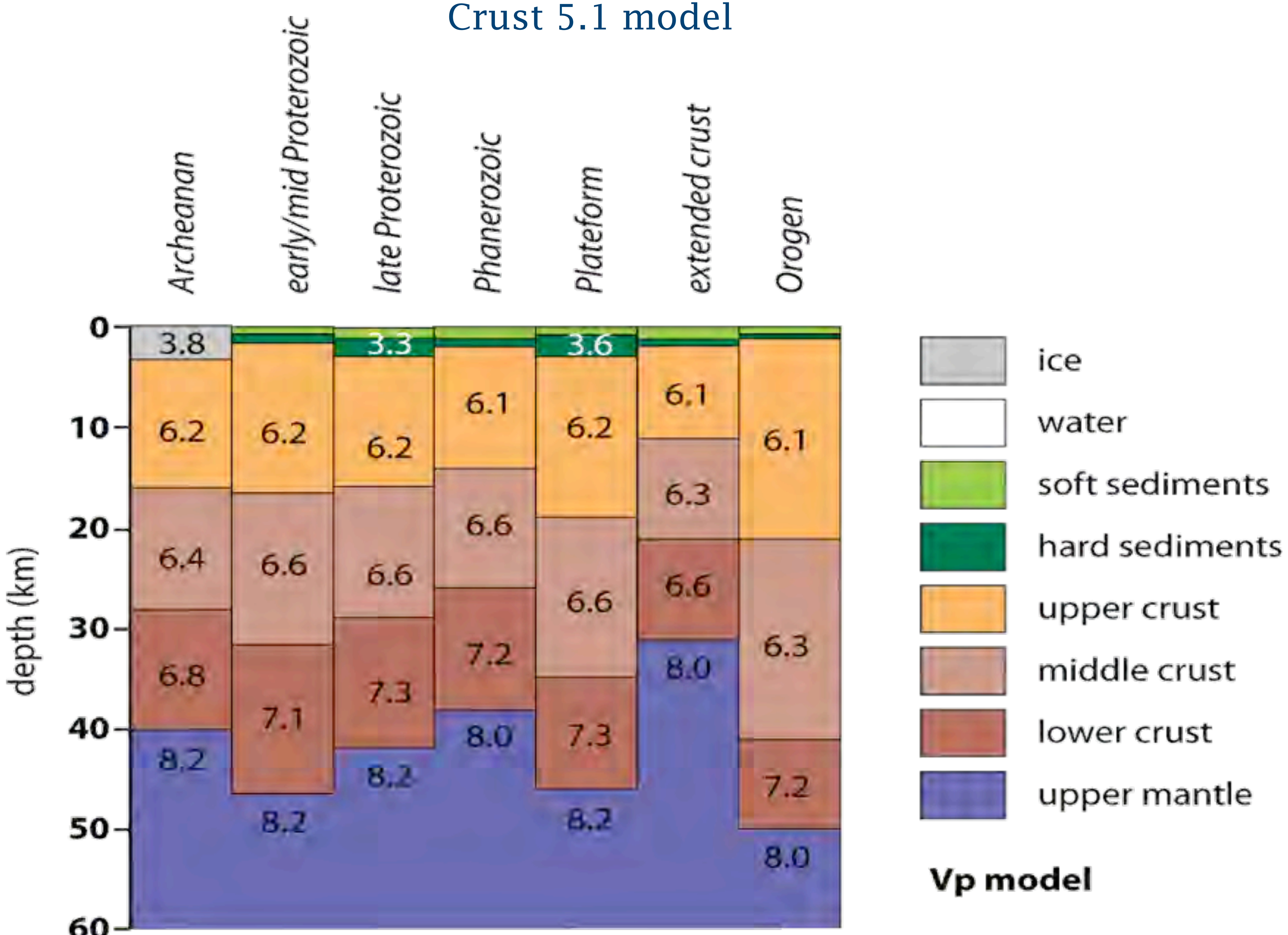
Crustal structure across the Altyn Tagh Range at the northern margin of the Tibetan Plateau



Modeling results along the seismic refraction/wide-angle reflection profile at the northern margin of the Tibetan Plateau. Crustal and uppermost mantle seismic velocity (Vp) model. Both Vp and Vs can be estimated for the crust from these data. Pn velocity ranges from 7.8 to 8.2kms-1.

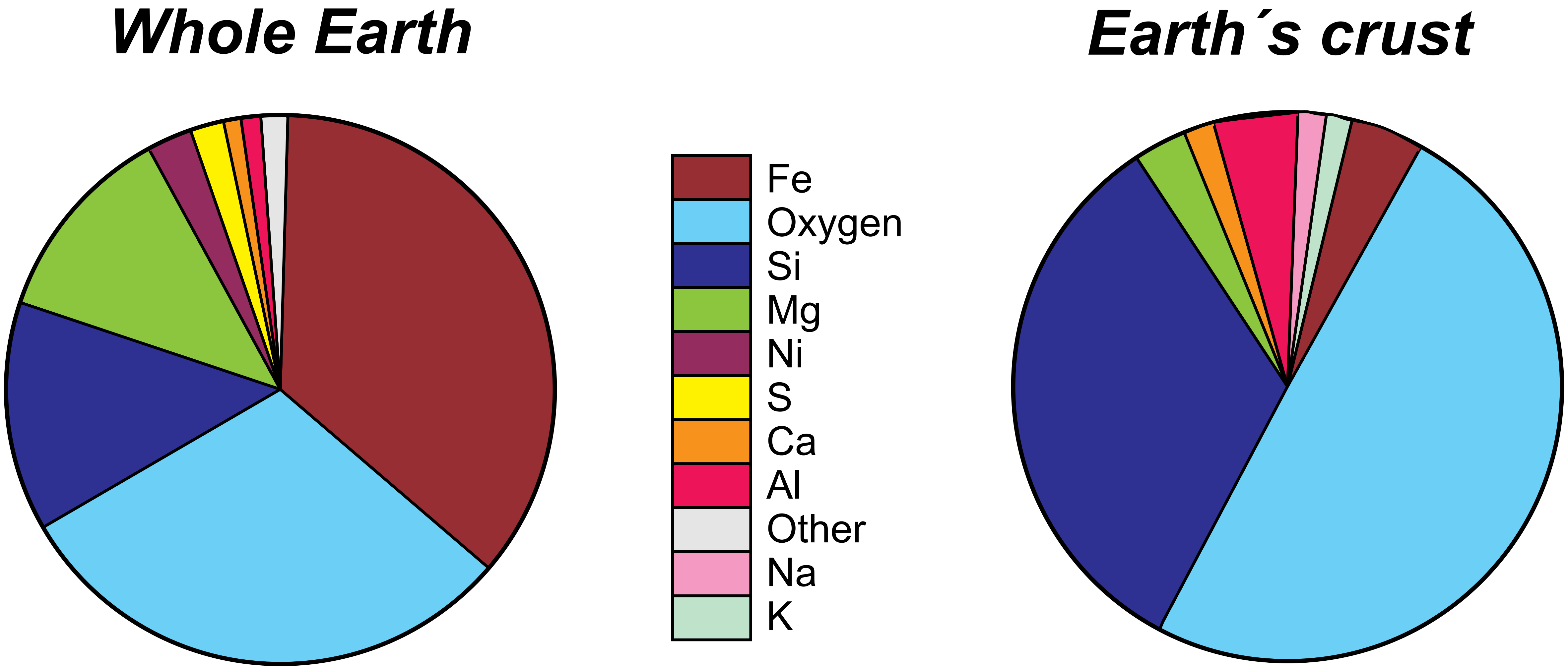
Different types of continental crust

Crust 5.1 model

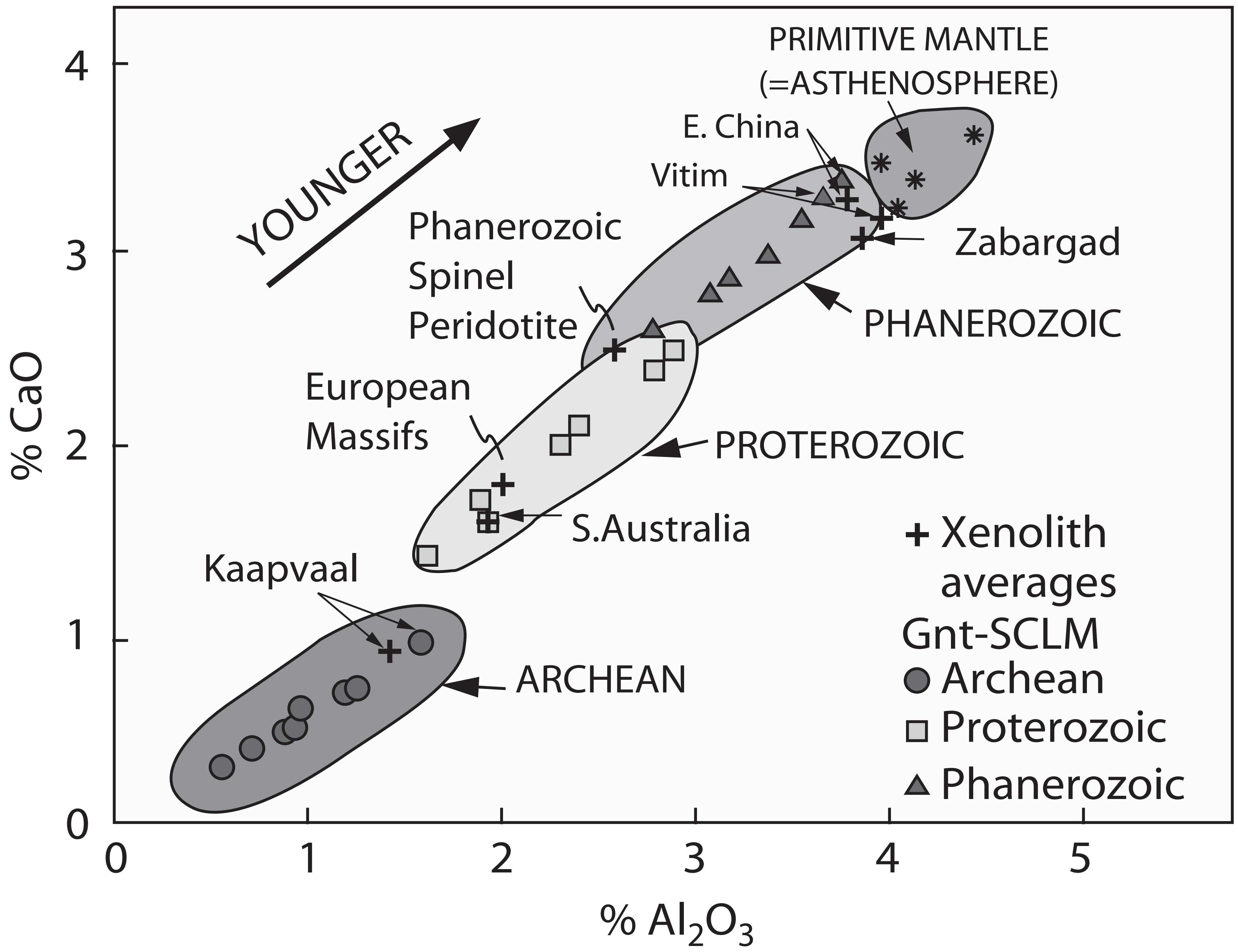


Mooney et al., 1998

Chemical composition of the continental crust

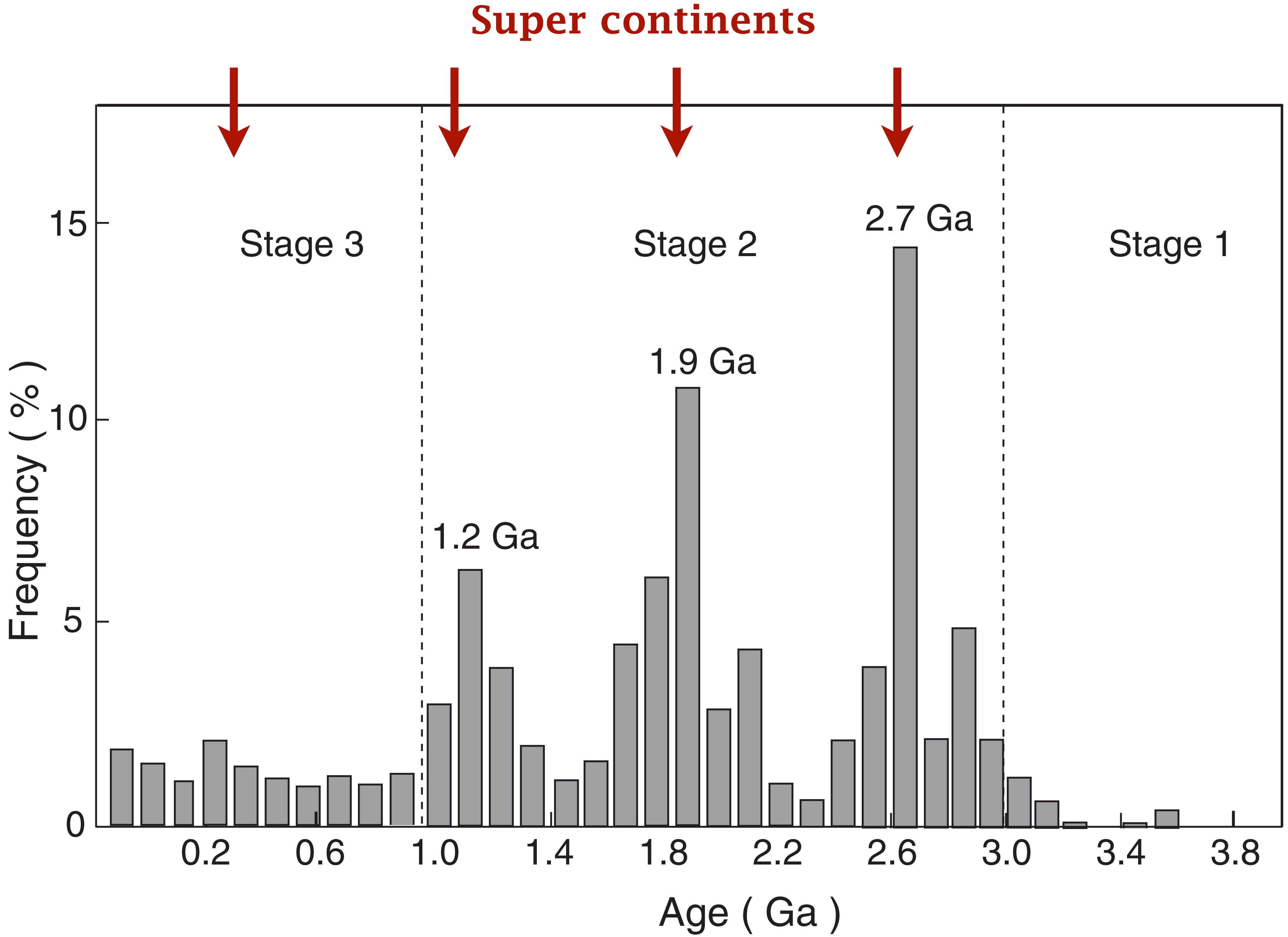


Chemical composition of the continental crust



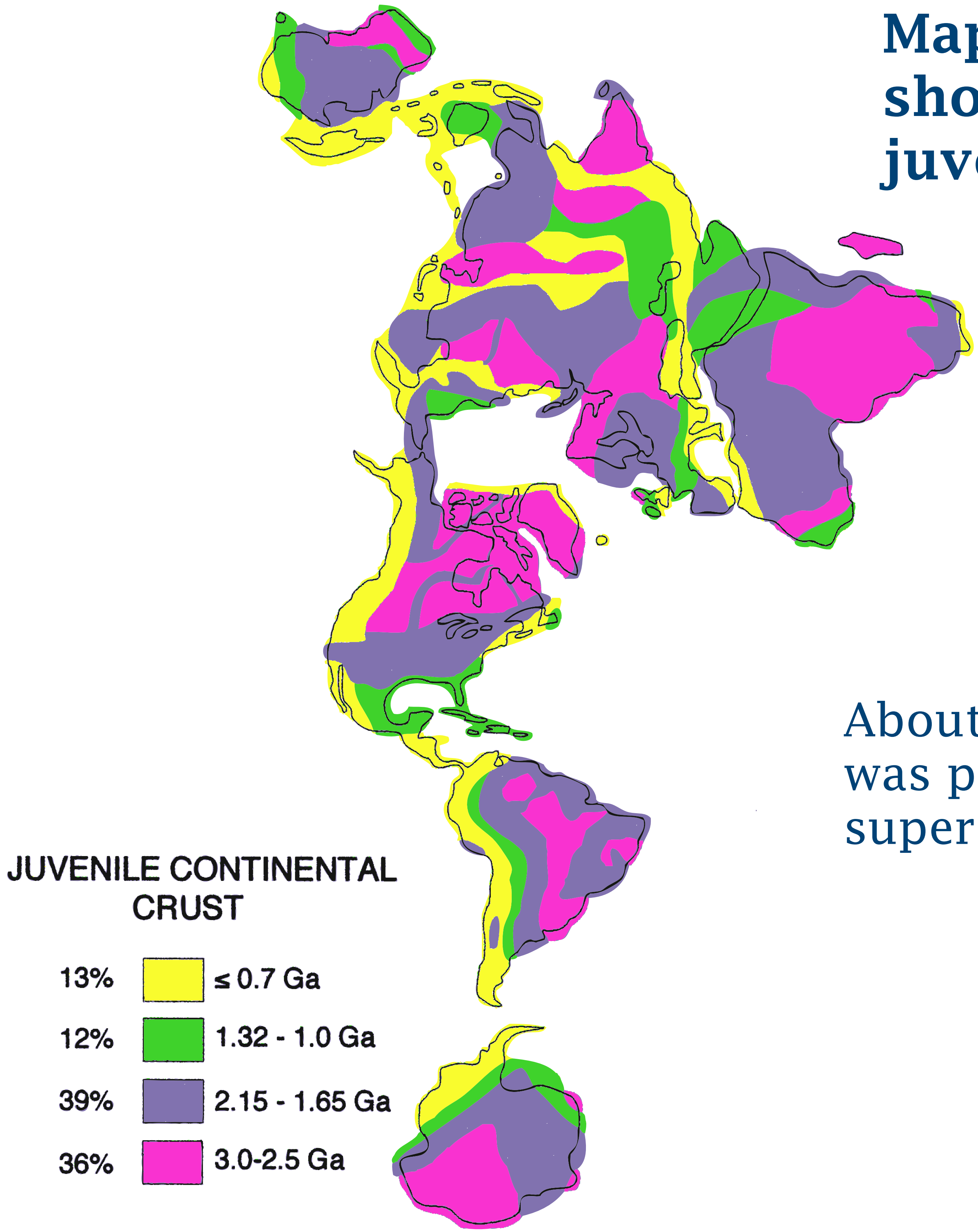
CaO-Al2O3 plot showing the range of subcontinental lithospheric mantle (SCLM) compositions for selected cratons that have been matched with ages of the youngest tectonothermal events in the overlying crust (after O'Reilly et al., 2001

Age of the continental crust



Plot showing the distribution of U-Pb zircon ages in continental crust
(after Condie, 1998)

Spatial distribution of the juvenile crust



Map of the continents showing the distribution of juvenile continental crust

About 75% of the continental crust was produced during the first two super event cycles.

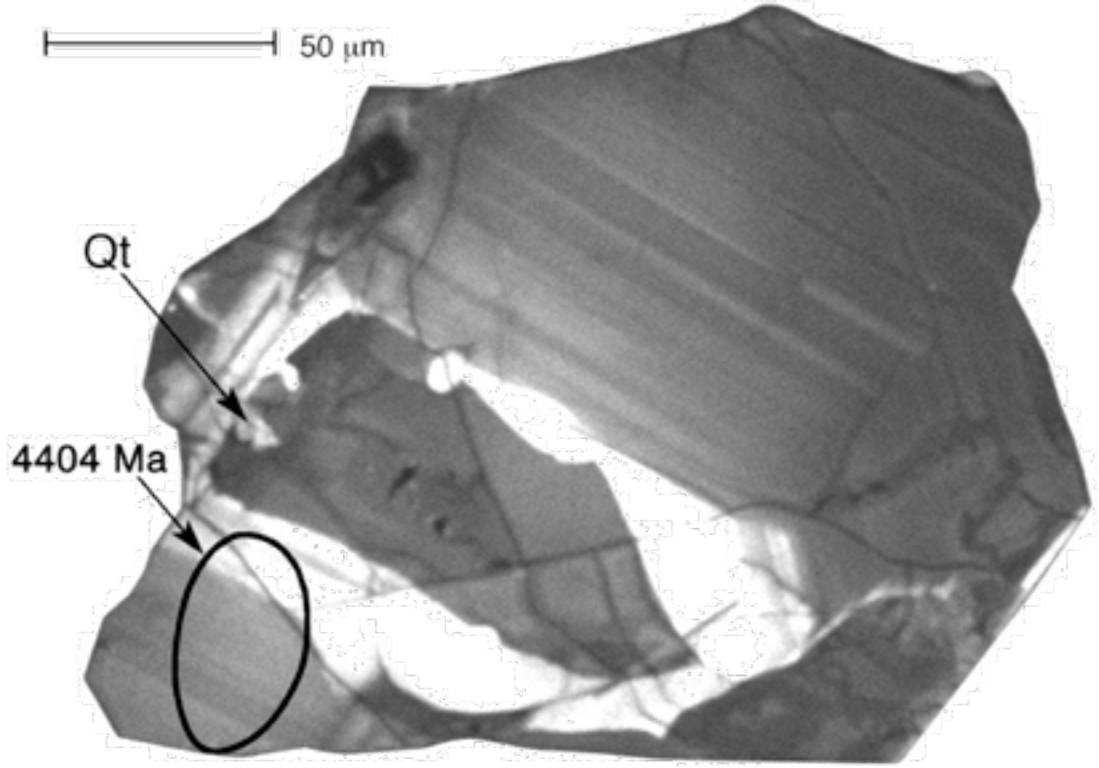
Condie, 1998

Age of the Earth

Age of Earth inferred to be 4.55 billion years old (Ga) based on radiometric age determination of meteorites such as Allende.

Age of the continental crust

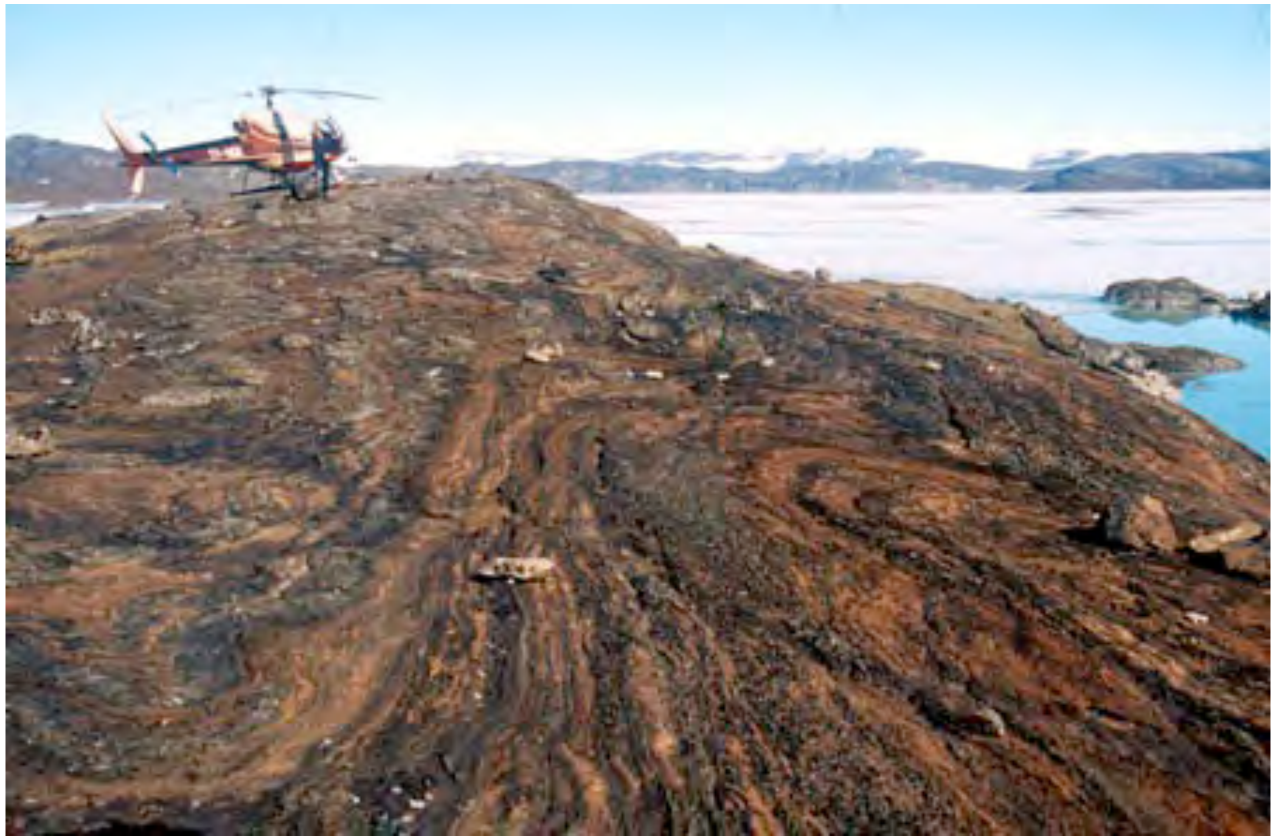
Red quartzite and conglomerate, Jack Hills, Western Australia (Peck et al., 2000, 2001)



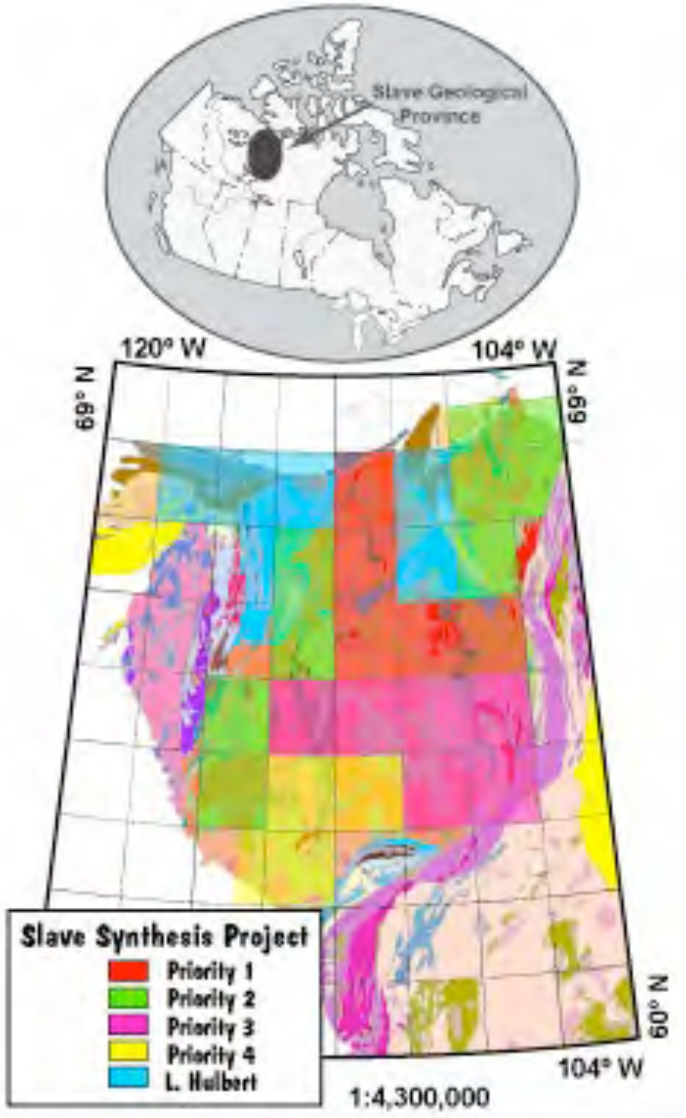
Zircon crystal (Peck et al, 2000)

Oldest dated mineral is zircon crystal 4.4 billion years old found in Western Australia

Age of the continental crust



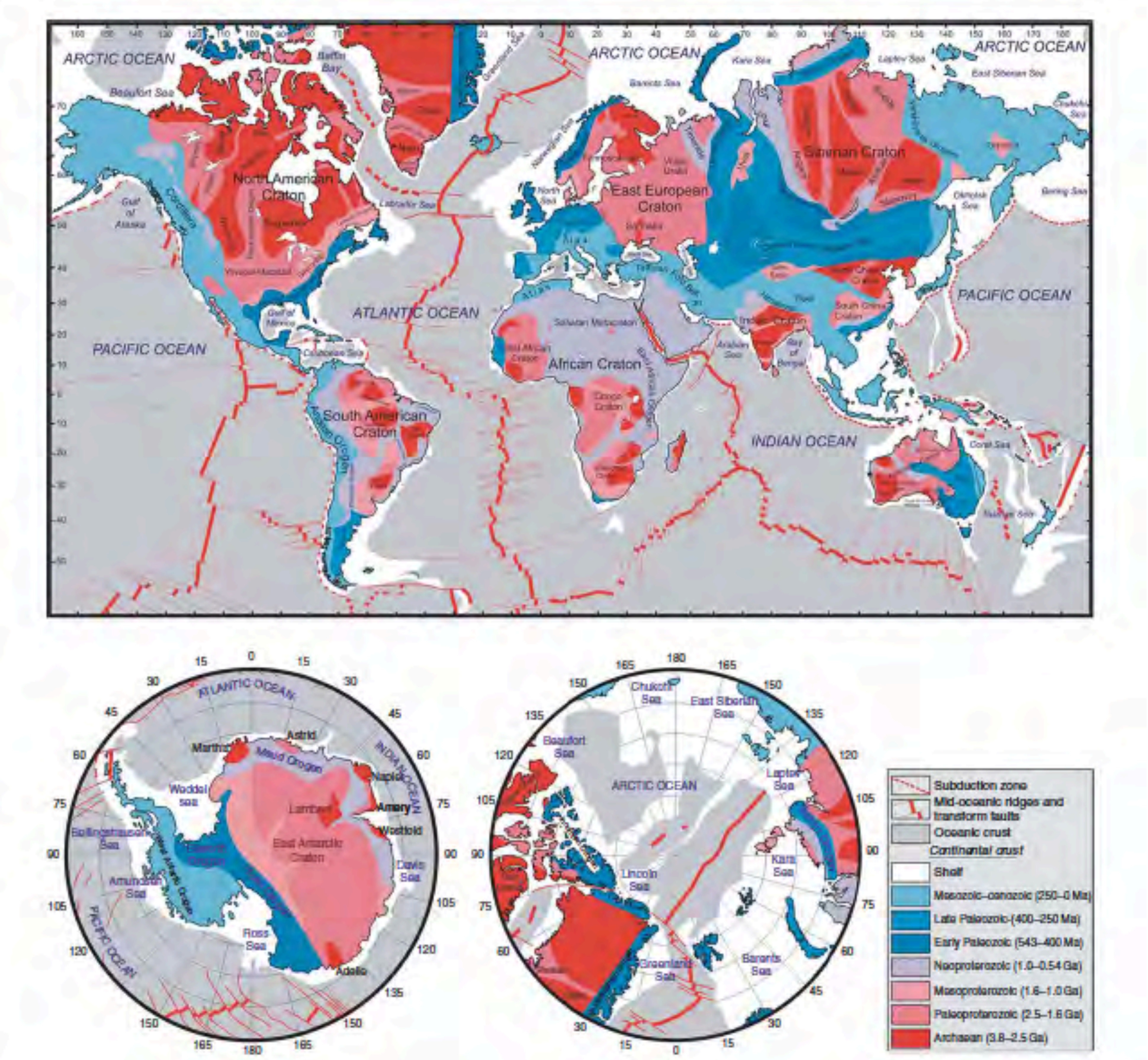
Isua Greenstone Belt, West Greenland
3.8 Ga (David Green, Denison Univ.)



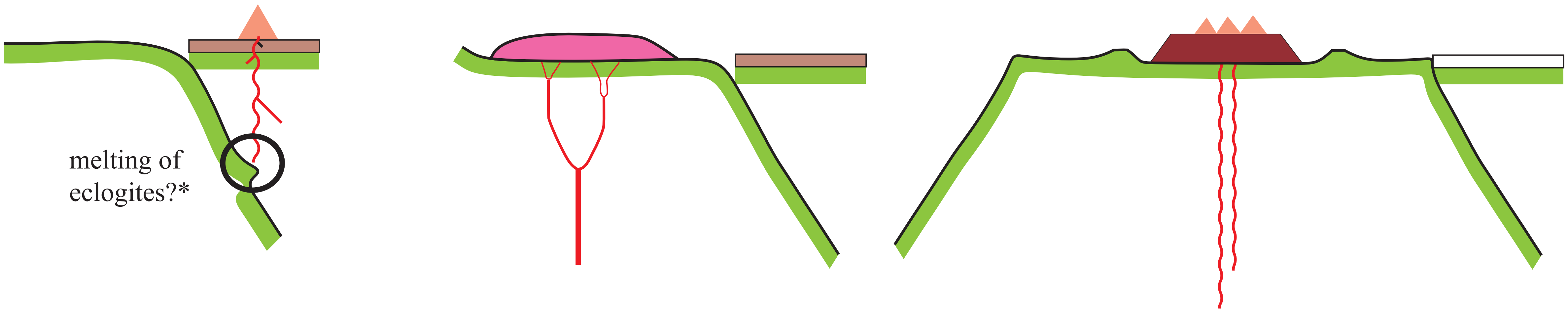
Acasta Gneiss, 4.04 Ga

Oldest dated rock is ~ 4 billion years old

Age of the continental crust



Models of continental protolith



a) Hot subduction

b) Oceanic Plateau Accretion

c) Loose-Plate Loading

a) hot subduction or subduction of mid-ocean ridges and young oceanic lithosphere makes production of felsic and intermediate liquids by melting of the hydrothermally altered oceanic crust possible. Contribution from the mantle wedge, the subcontinental lithosphere, and the overlying crust may be geochemically identified. The protolith is felsic to intermediate.

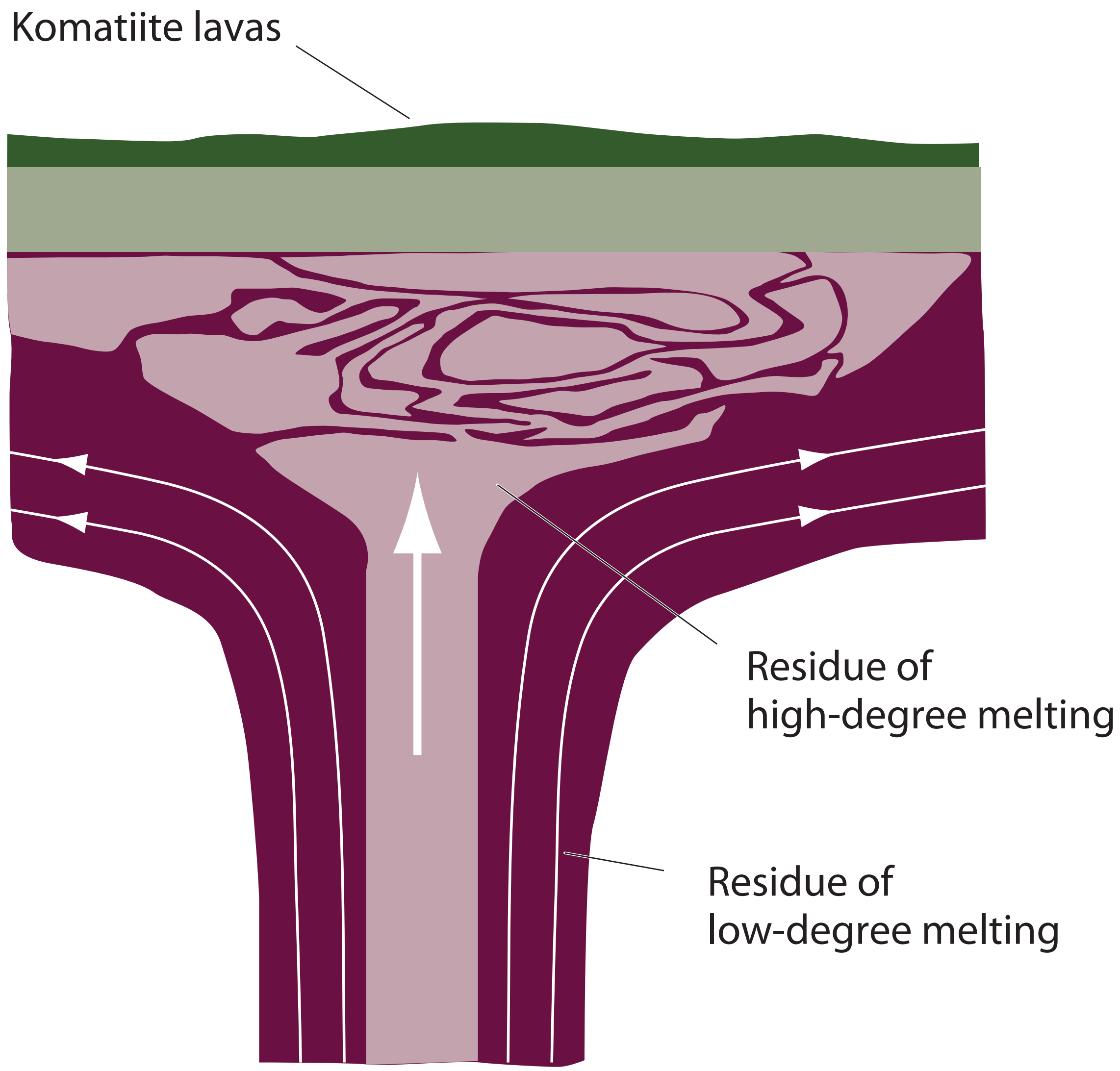
** Archean TTG could be produced by melting of hydrous eclogites (Rapp et al., 2003)*

b) accretion of oceanic plateaus created during superplume events (plume head).

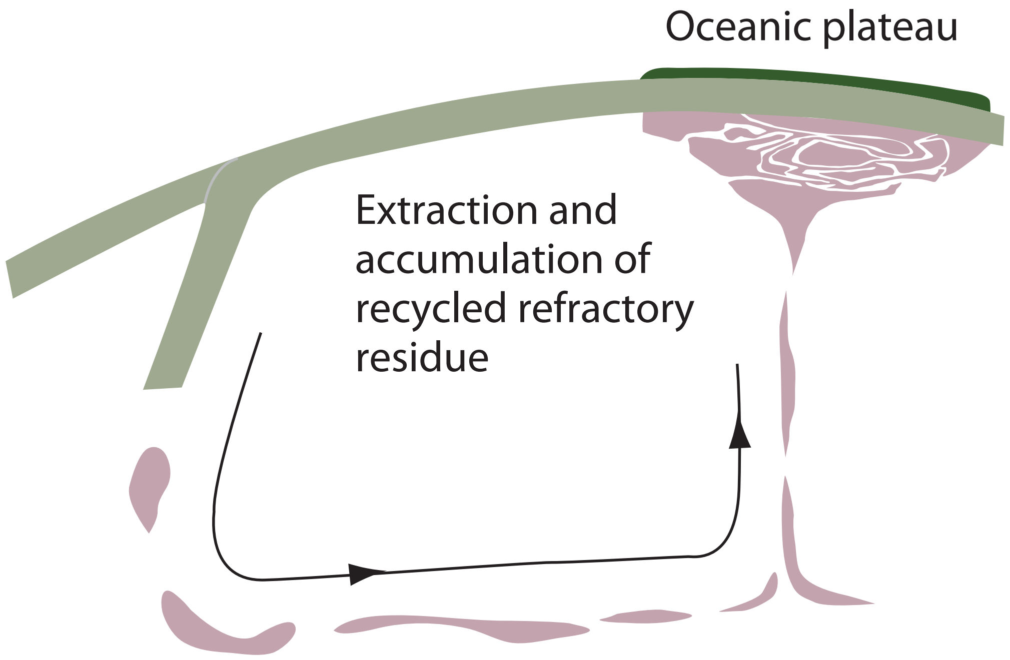
c) protracted loading by plume magma of a loose plate (not entrained by sinking lithosphere). In the last two cases, the protolith is basaltic. Crust is thickened and reaches critical buoyancy.

(after Albarède, 1998

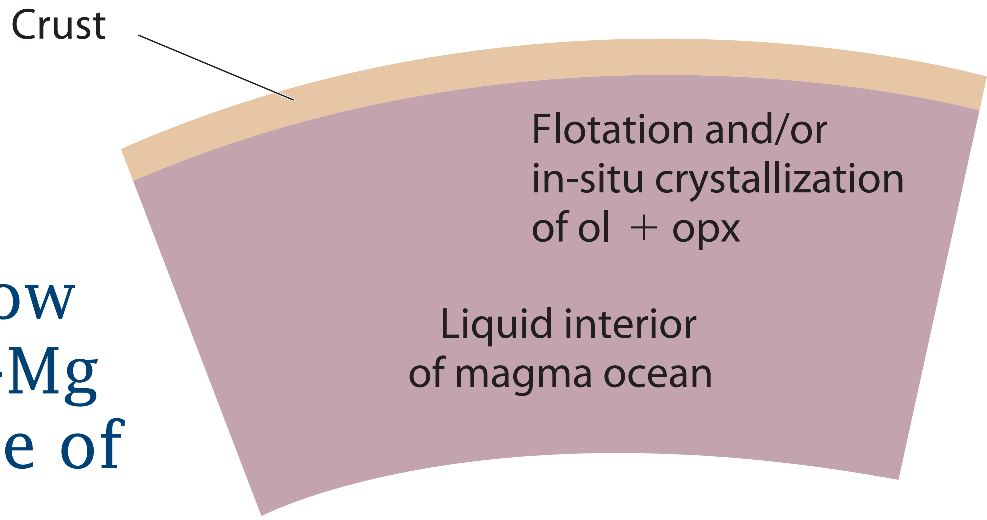
(a) Model 1: Segregation of residue from an upwelling mantle plume



(b) Model 2: Segregation of recycled refractory residue



(c) Model 3: Preservation of remnants of the crust of a magma ocean

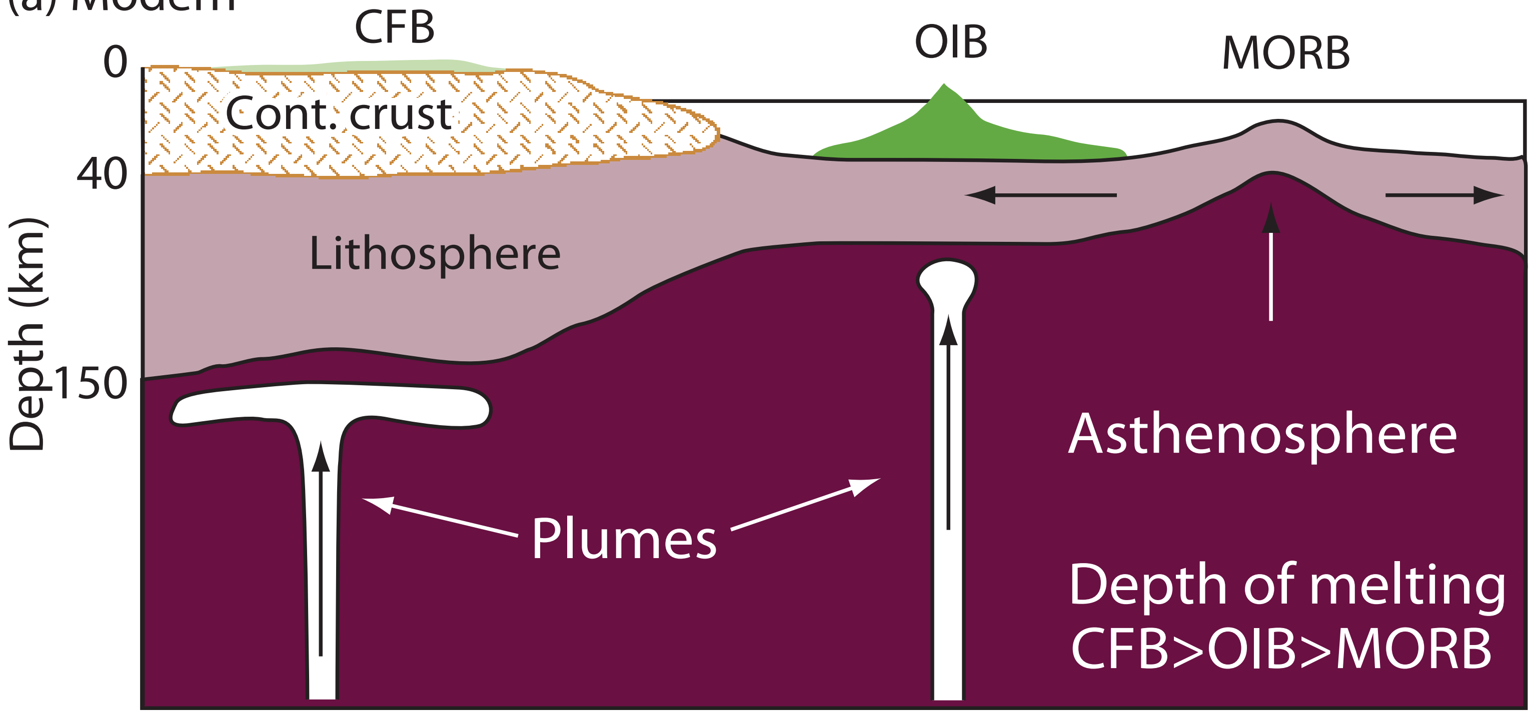


Three possible mechanisms that could allow the segregation and accumulation of high-Mg olivine and orthopyroxene near the surface of the Earth in the early Earth

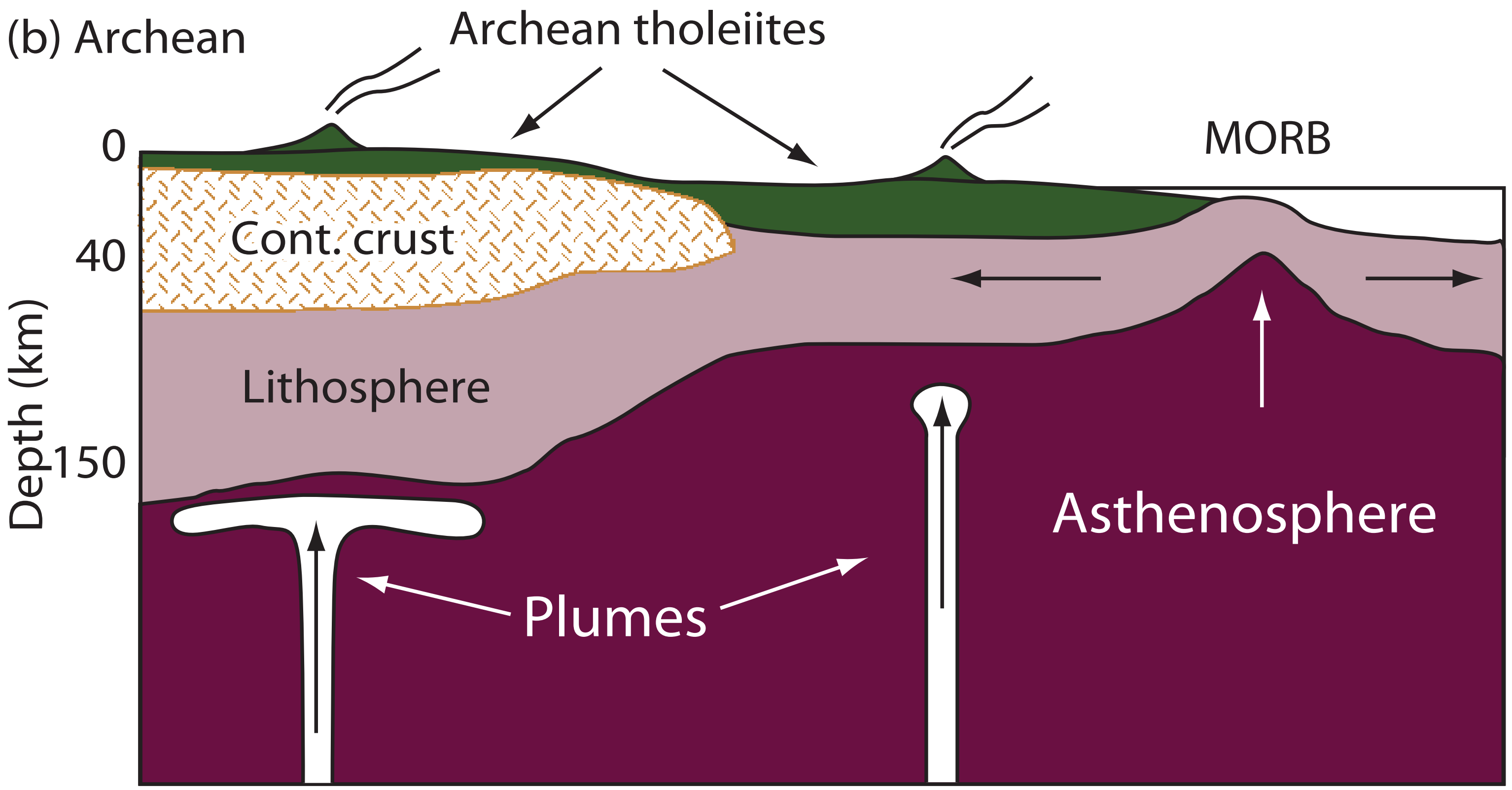
after Arndt et al., 2002

Model of komatiitic and tholeiitic basalt formation involving mantle plumes

(a) Modern



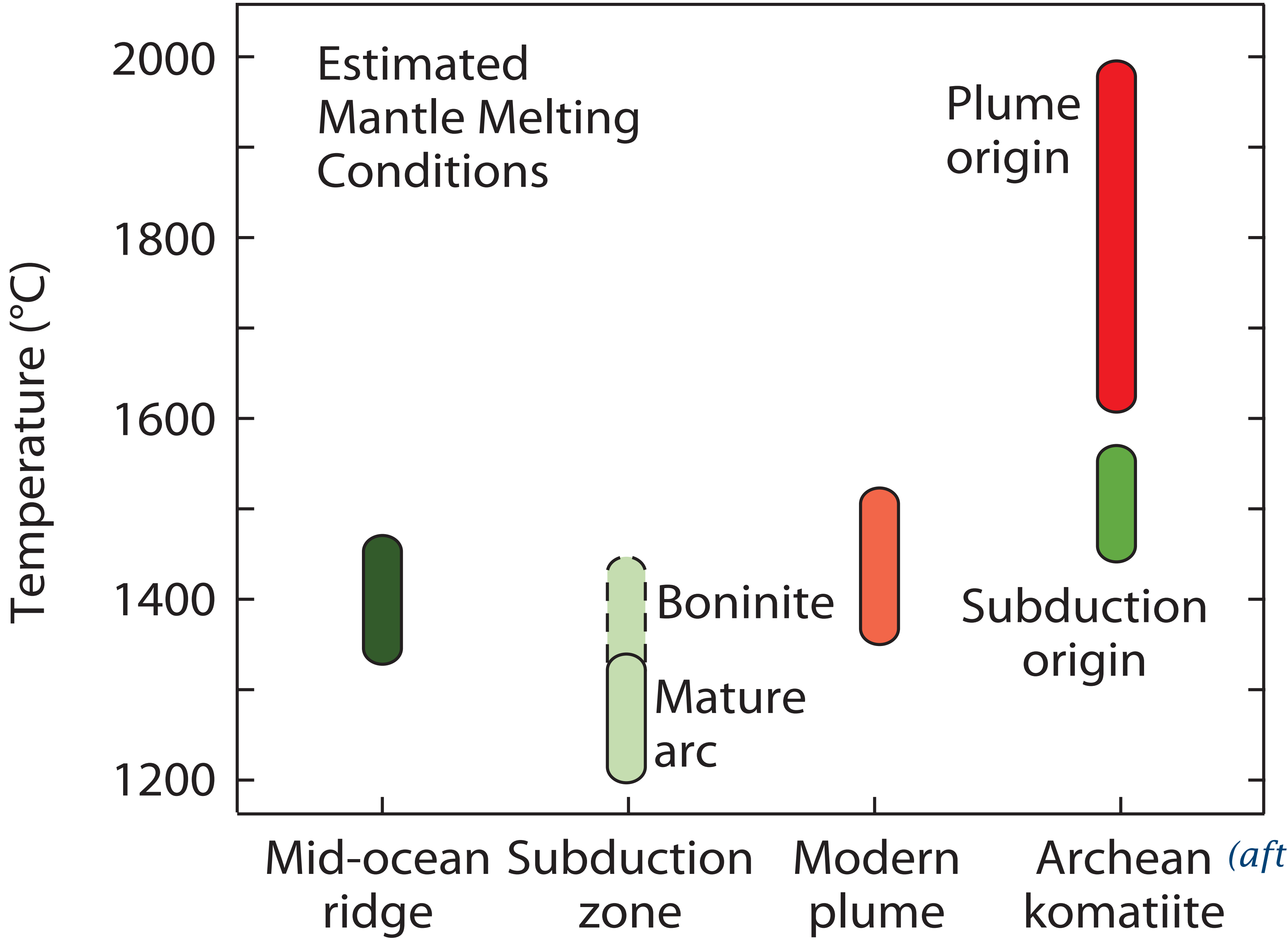
(b) Archean



Model shows the influence of lithospheric thickness on depth of melting where CFB is continental flood basalt, OIB oceanic island basalt, and MORB mid-ocean ridge basalt

(after Arndt et al., 1997)

Melting temperature *vs* age



(after Grove & Parman, 2004)

The range of mantle melt generation temperatures estimated for various modern tectonic settings compared to temperatures inferred for komatiite melt generation by a plume model and a subduction model