

Tatort

Plattengrenze

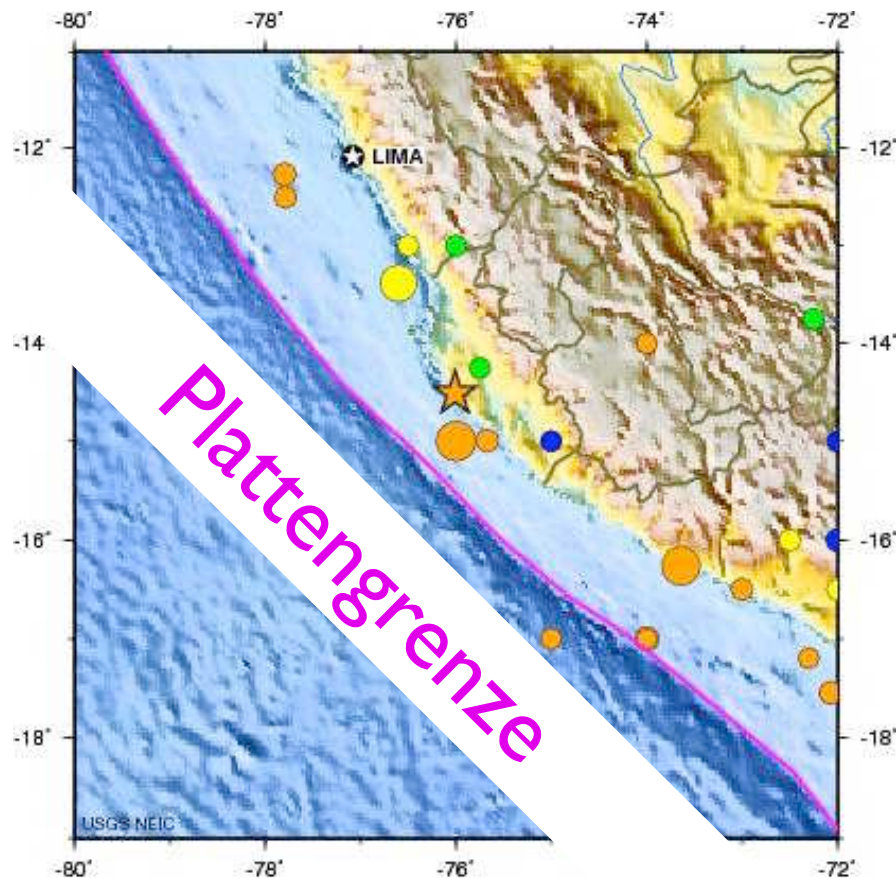
Fokus Erdbeben (2)

Renée Heilbronner
Geologisch-Paläontologisches Institut
Departement Umweltwissenschaften, Universität Basel

Magnitude 6.9 - Near The Coast Of Central Peru 2011 October 28 18:54:33 UTC

1990-heute

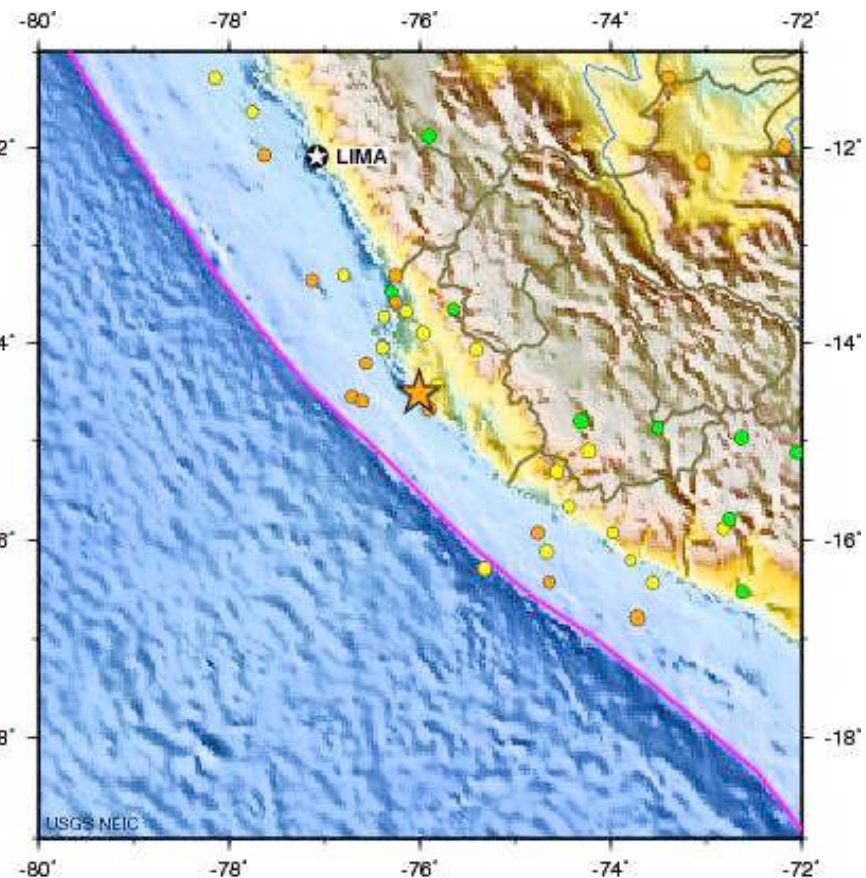
2011



NEAR COAST OF CENTRAL PERU

2011 10 28 18:54:33 UTC 14.51S 76.01W Depth: 23.9 km

Magnitude 7 and Greater Earthquakes Since 1900



NEAR COAST OF CENTRAL PERU

2011 10 28 18:54:33 UTC 14.51S 76.01W Depth: 23.9 km

Seismicity in 2011



Platten, Plattengrenzen und tektonische Prozesse

- Plattentektonik
- Konstruktive Plattengrenzen (spreading ridges)
- Destruktive Plattengrenzen (Subduktionszonen)
- Transform-Plattengrenzen (strike - slip)

Platten und Plattengrenzen

Lithosphärenplatten

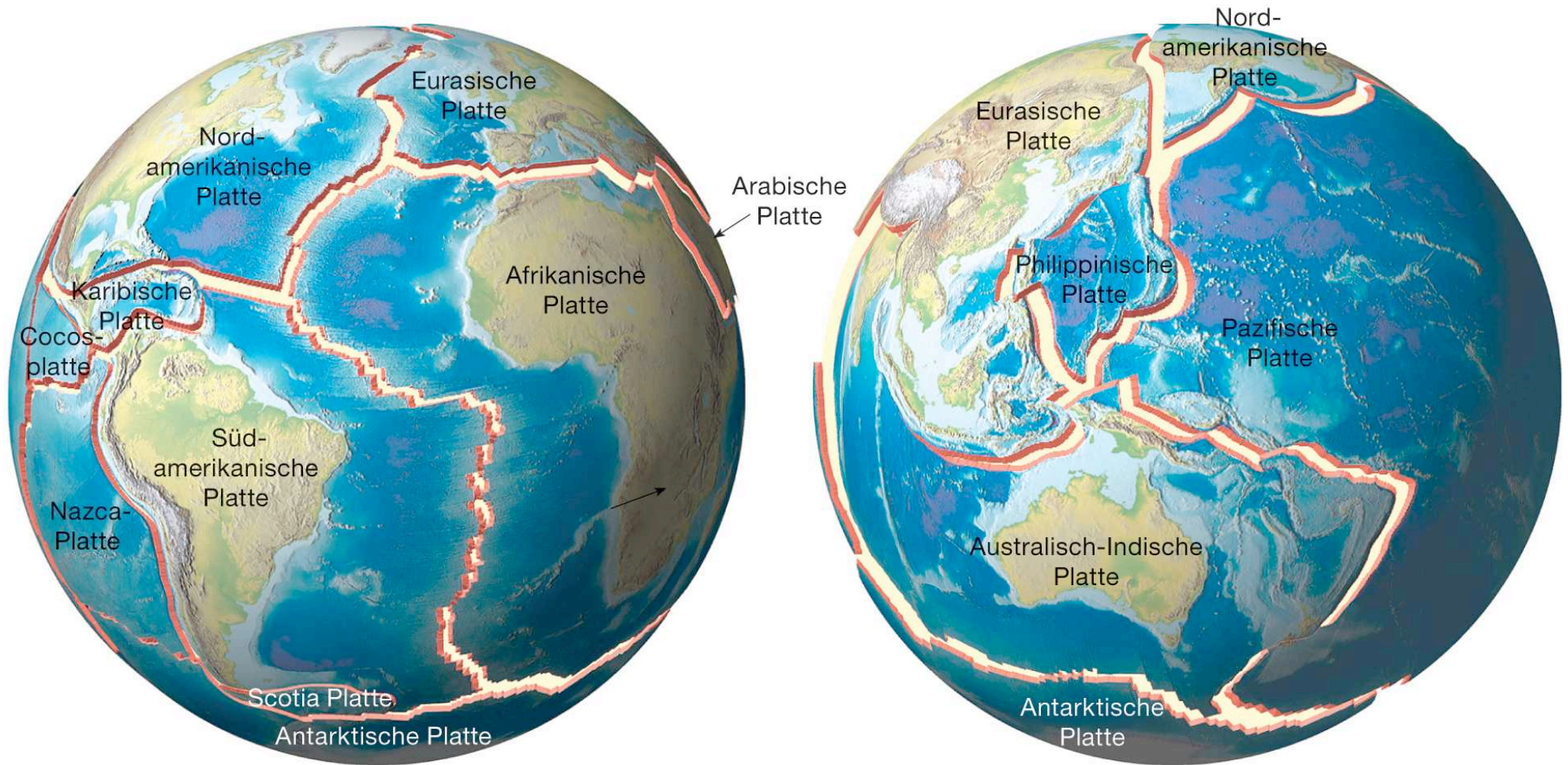
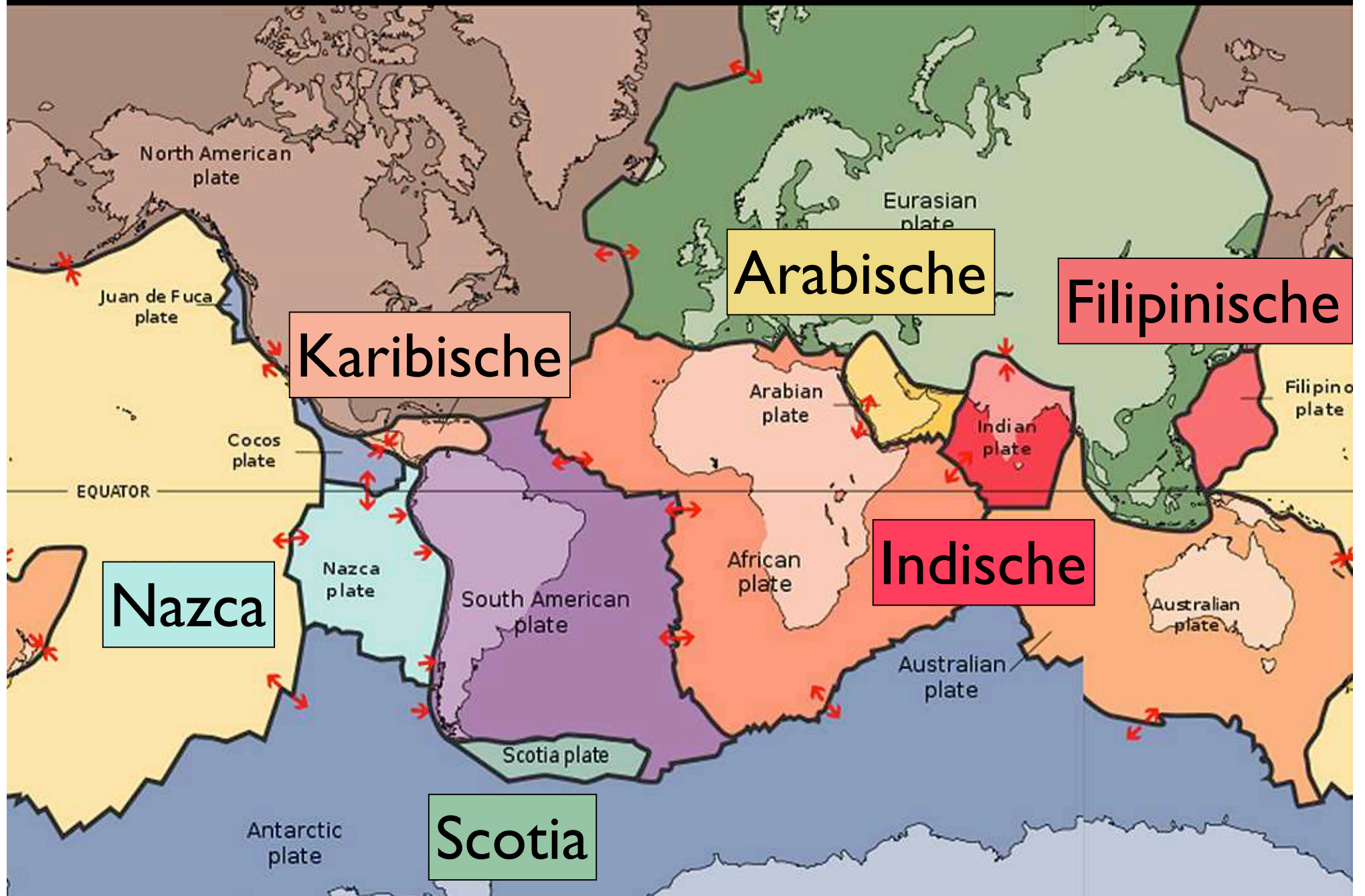


Abbildung 2.19: Die Darstellung einiger Lithosphärenplatten der Erde.

Die 8 grossen tektonischen Platten

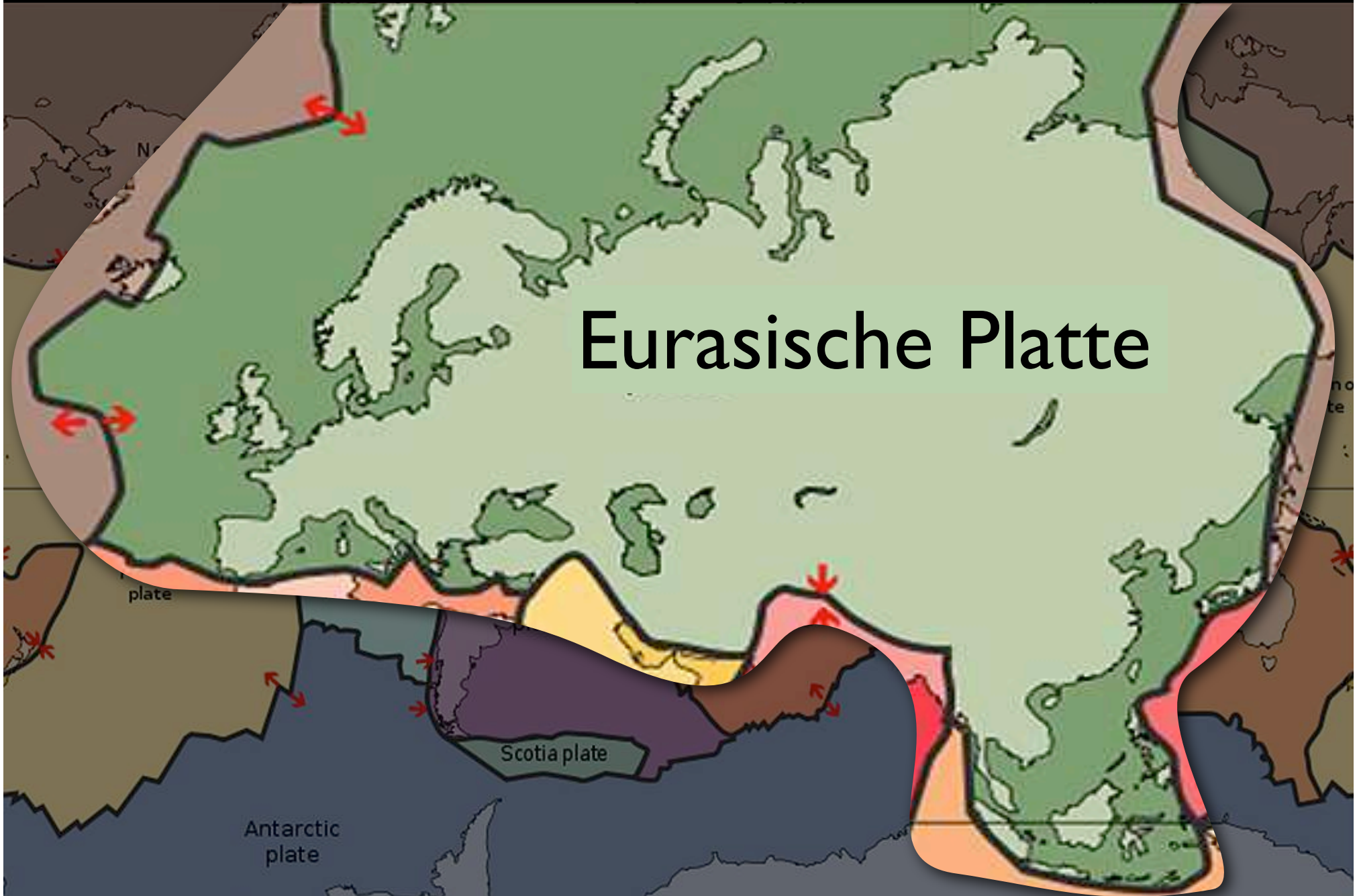


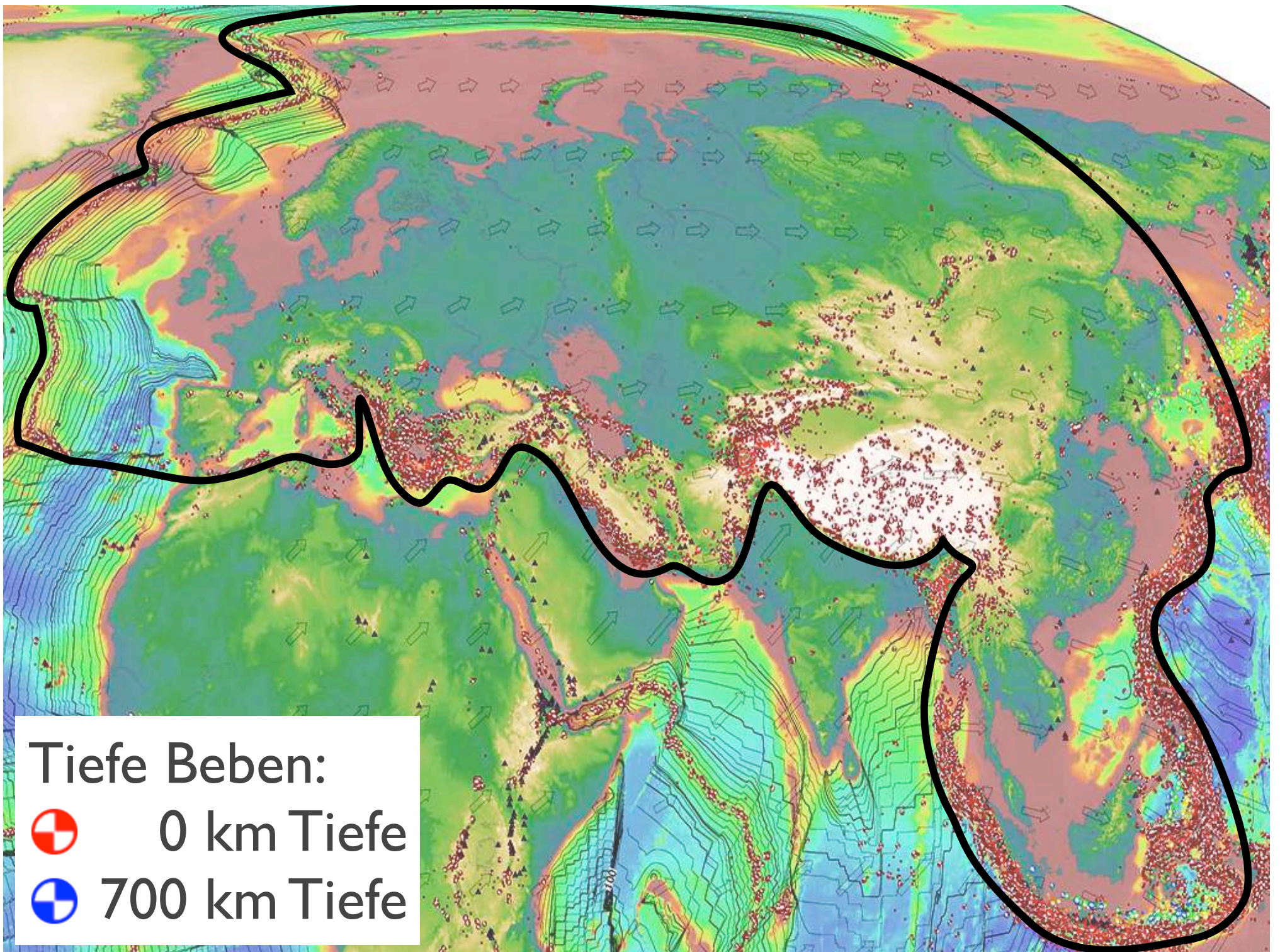
Die 6 kleineren tektonischen Platten



Plattentektonisches Puzzle

Eurasische Platte





Tiefe Beben:



0 km Tiefe



700 km Tiefe

Nachbarn

Nordamerikanische

Nordamerikanische

Eurasische Platte

Pazifische

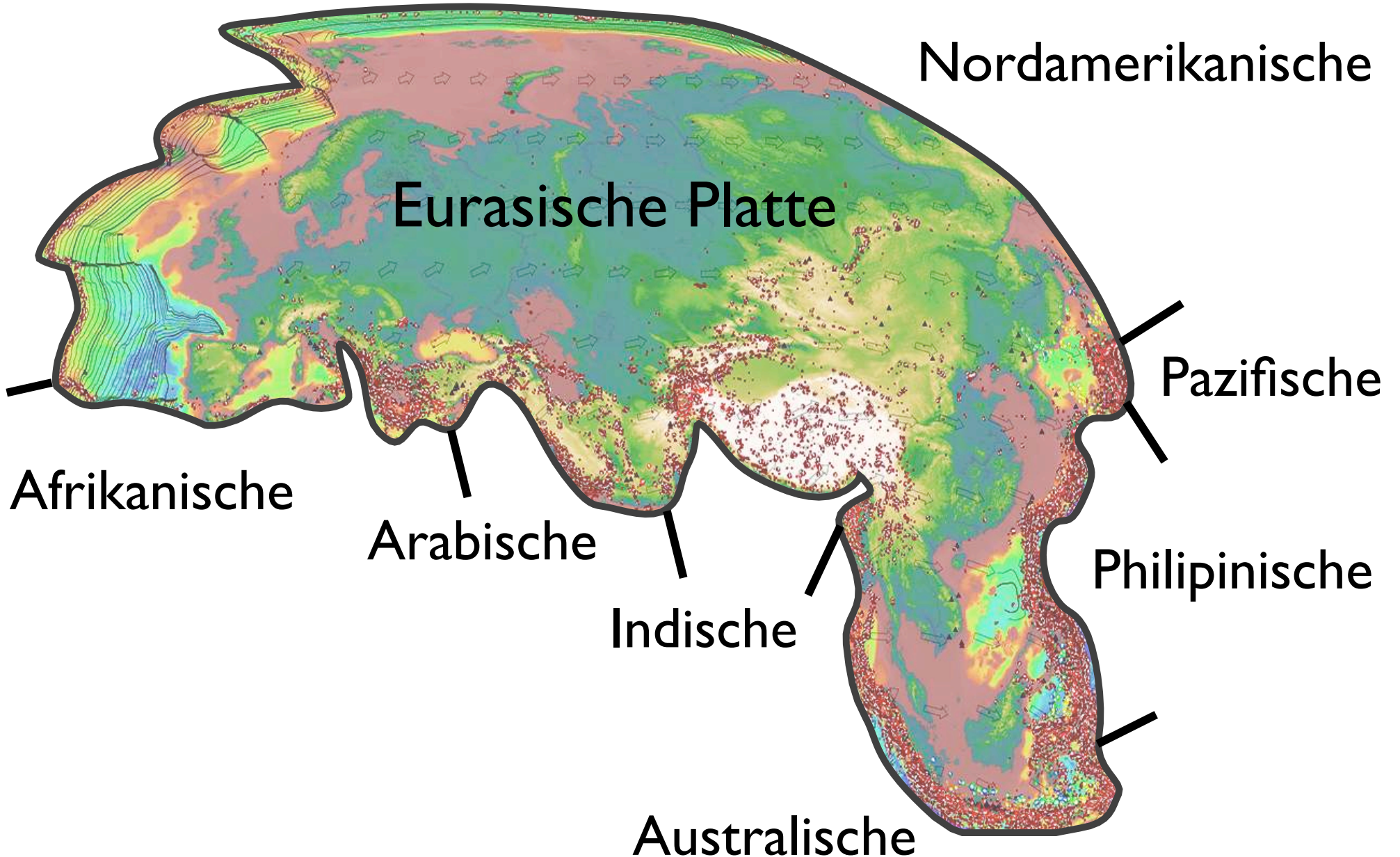
Afrikanische

Arabische

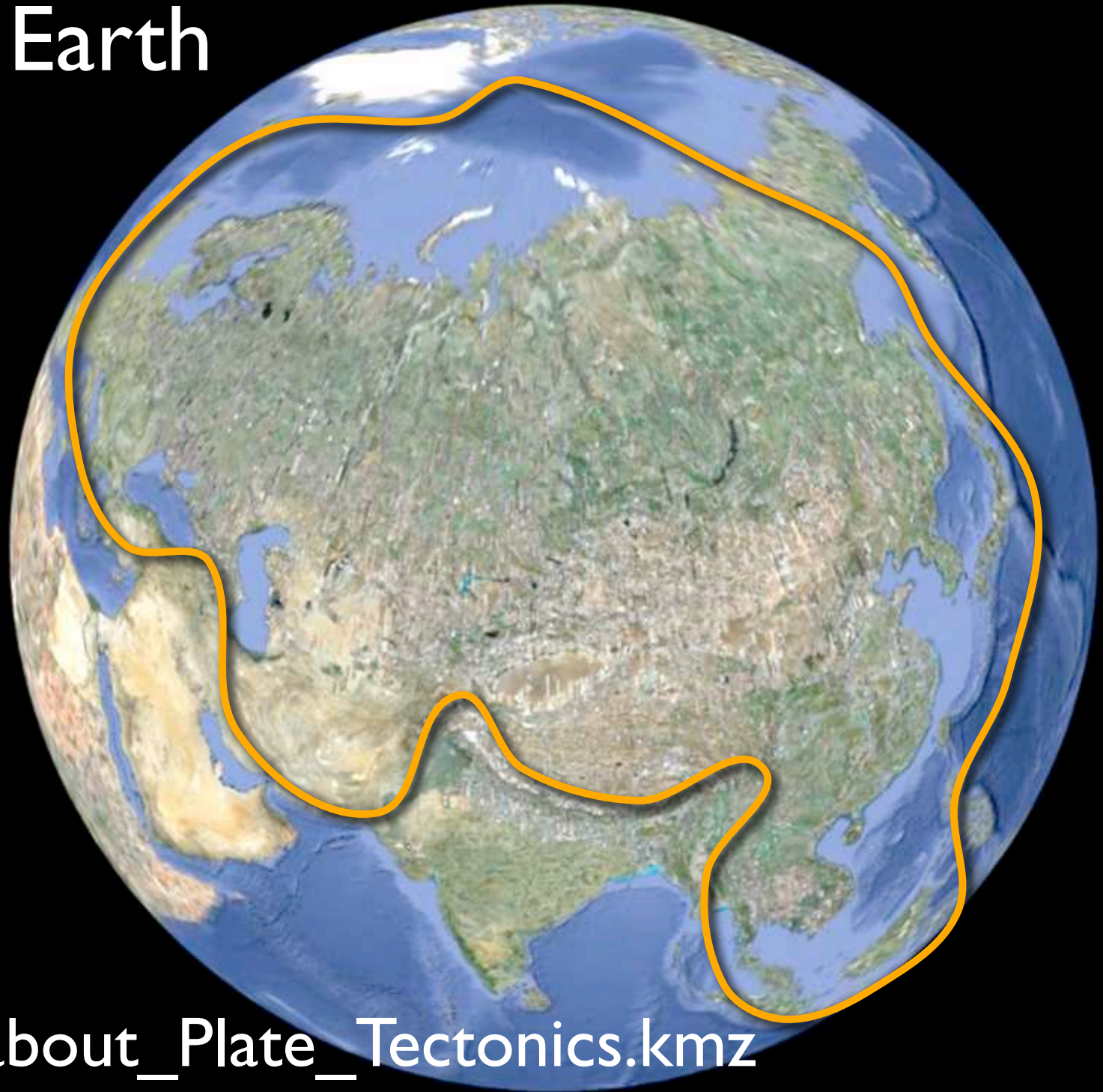
Philippinische

Indische

Australische



google Earth



• [Learn_about_Plate_Tectonics.kmz](#)

Search

Places

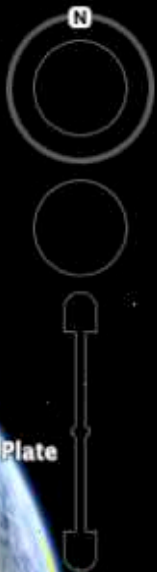
My Places

- [USGS Real-time Earthquakes](#)
M 1+, past 7 days. Earthquakes update every 5 minutes.
- [ShakeMap: b0006bqc](#)
- [Historic Earthquakes](#)
M 3+, past 90 days; M 4+, past year; M 5+, past 5 years; M 6+, since 1970. Earthquakes are updated once per day.
- [Global Topography V14.1](#)
Global Topography V14.1 SEAFLOOR DEPTH - Colors and 500m contours represent variations in seafloor depth
- [Largest Earthquakes in the World Since 1900](#)
Created 11/03/15 15:28:08 UTC
- [ARIA Envisat InSAR](#)
Tohoku-oki EQ Envisat wrapped interferogram from descending track 189 (west), 347 (middle), and 74 (east)
- [Ages of the Ocean Floor](#)
from nachon.free.fr/GE/Welcome.html
- [Tectonic Plates \(simplified boundaries\)](#)
Tectonic Plates of the world (US Geological Survey).
 - [Plates](#)
Deep beneath California, the Pacific and North American Plates relentlessly grind past one another, straining or
 - [Text 3D](#)
 - [Arrows 3D](#)
 - [Plates Legend](#)
 - [USGS Logo](#)
- [Temporary Places](#)



Plate Boundaries

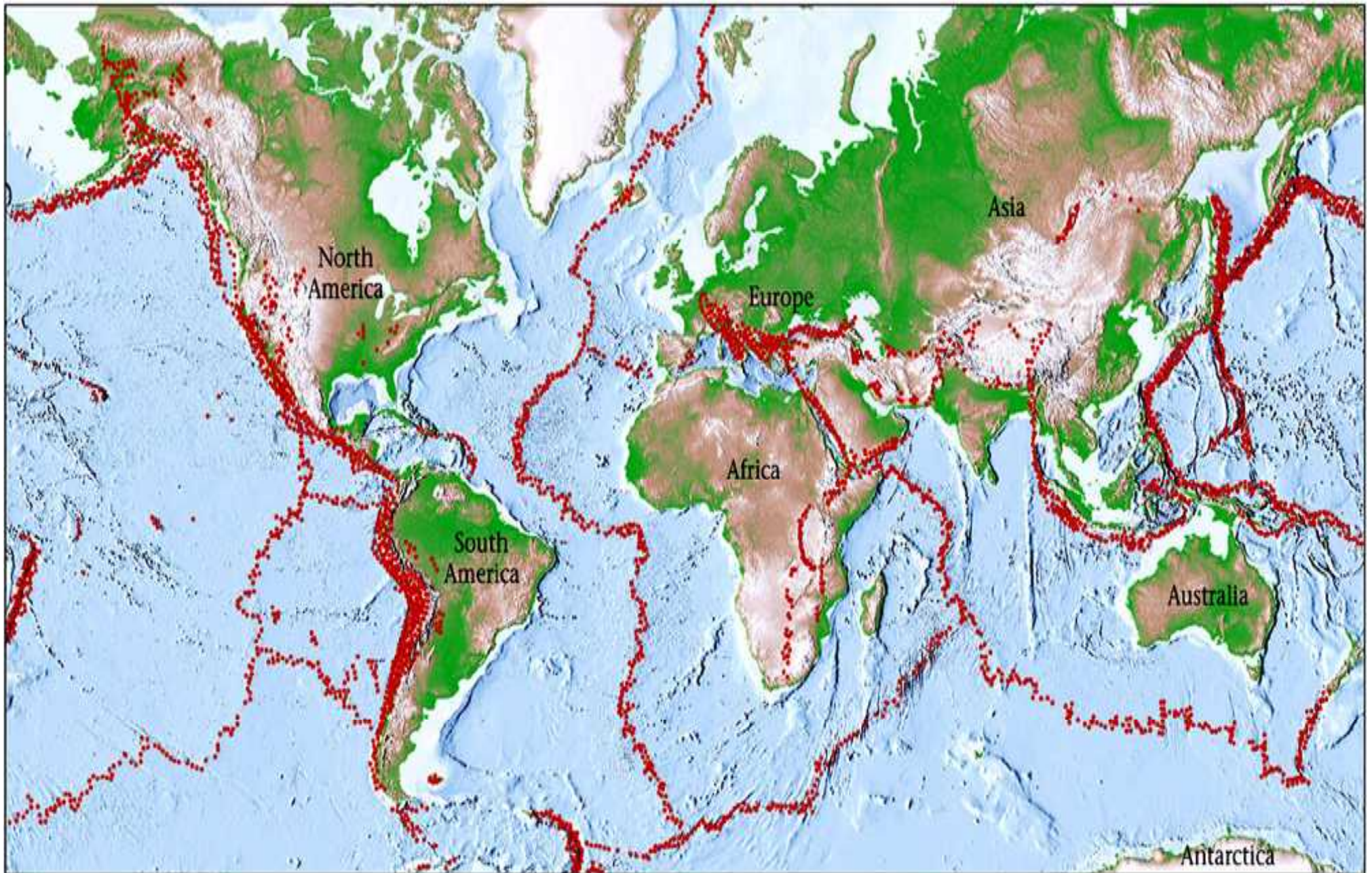
- Divergent
- Transform
- Convergent
- Undefined



Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image IBCAO

Google Earth: Learn_about_Plate_Tectonics.kmz

Plattengrenzen erkennen: Seismizität



Plattengrenzen erkennen: Vulkanismus



Island arc



Continental arc



Rift



Hot spot



Mid-ocean ridge

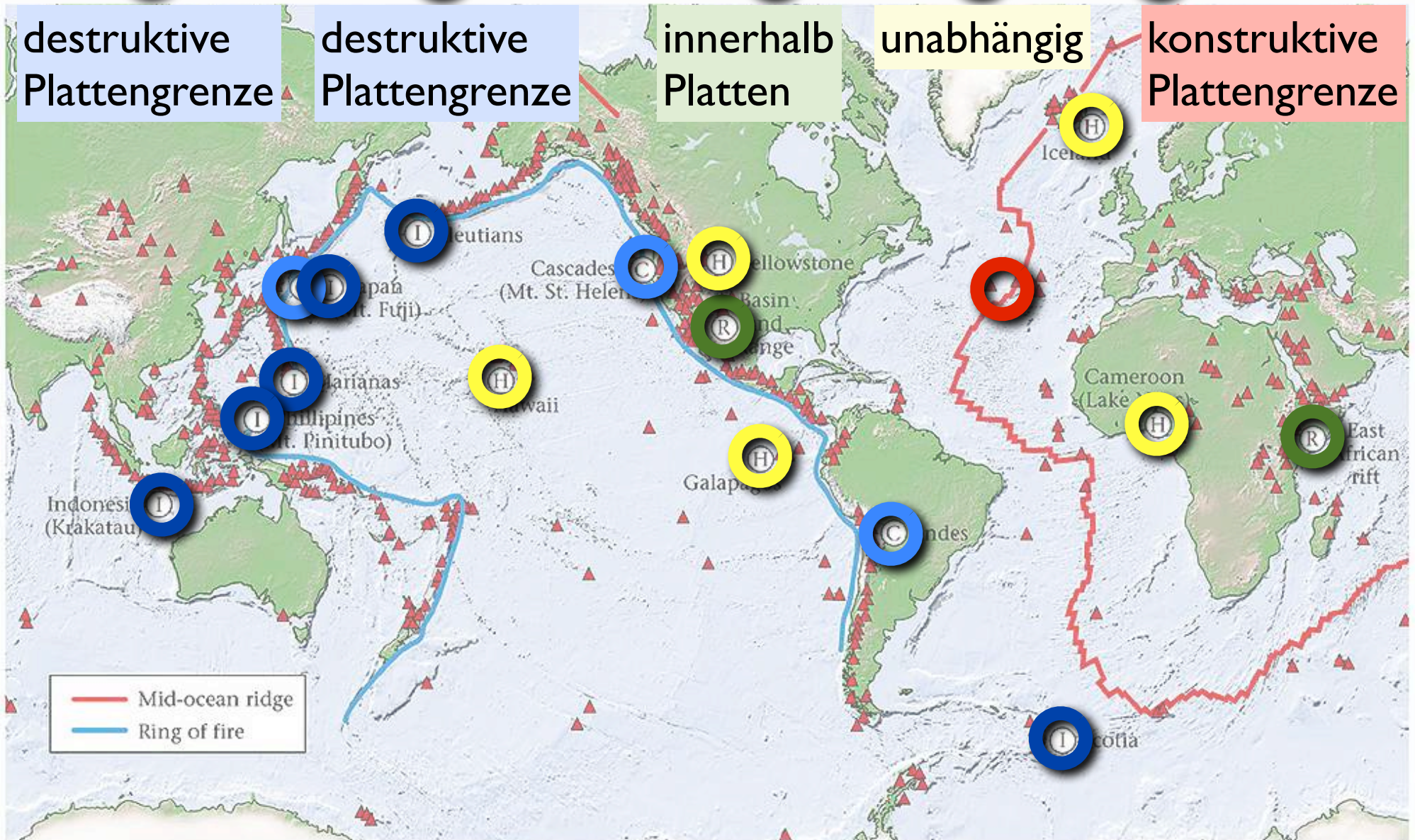
destruktive Plattengrenze

destruktive Plattengrenze

innerhalb Platten

unabhängig

konstruktive Plattengrenze



3 Typen von Plattengrenzen

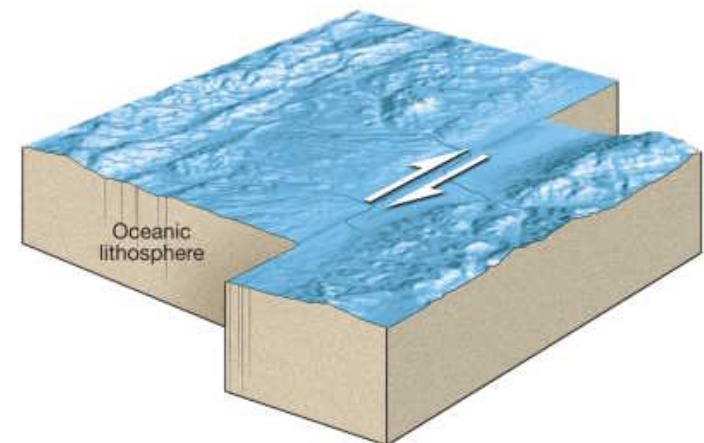
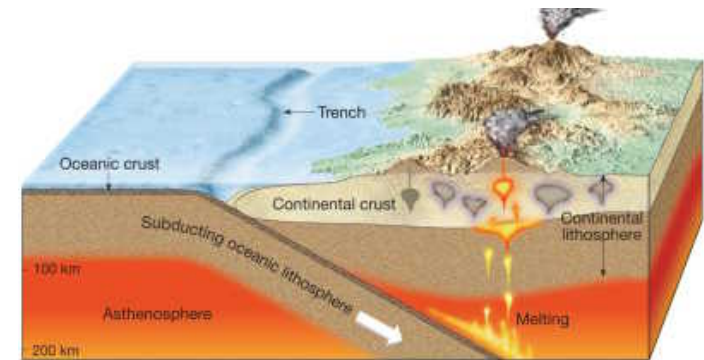
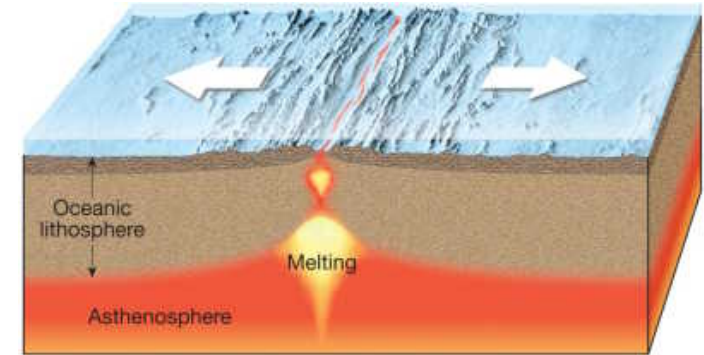
Erdoberfläche: **Bewegungssinn:**

konstruktive = distensive

destruktive = kompressive

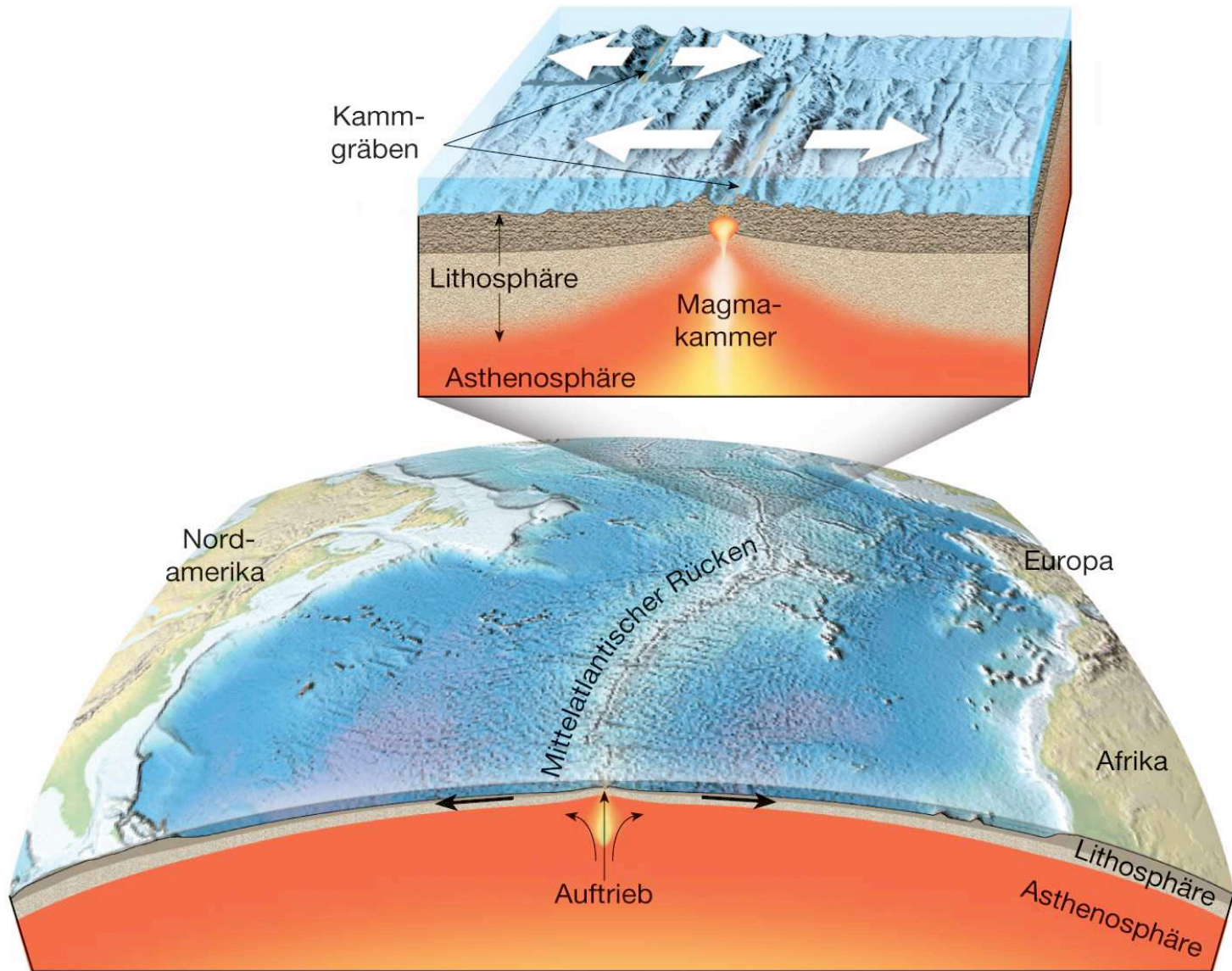
konservative = Transform-

... und Untergrenze



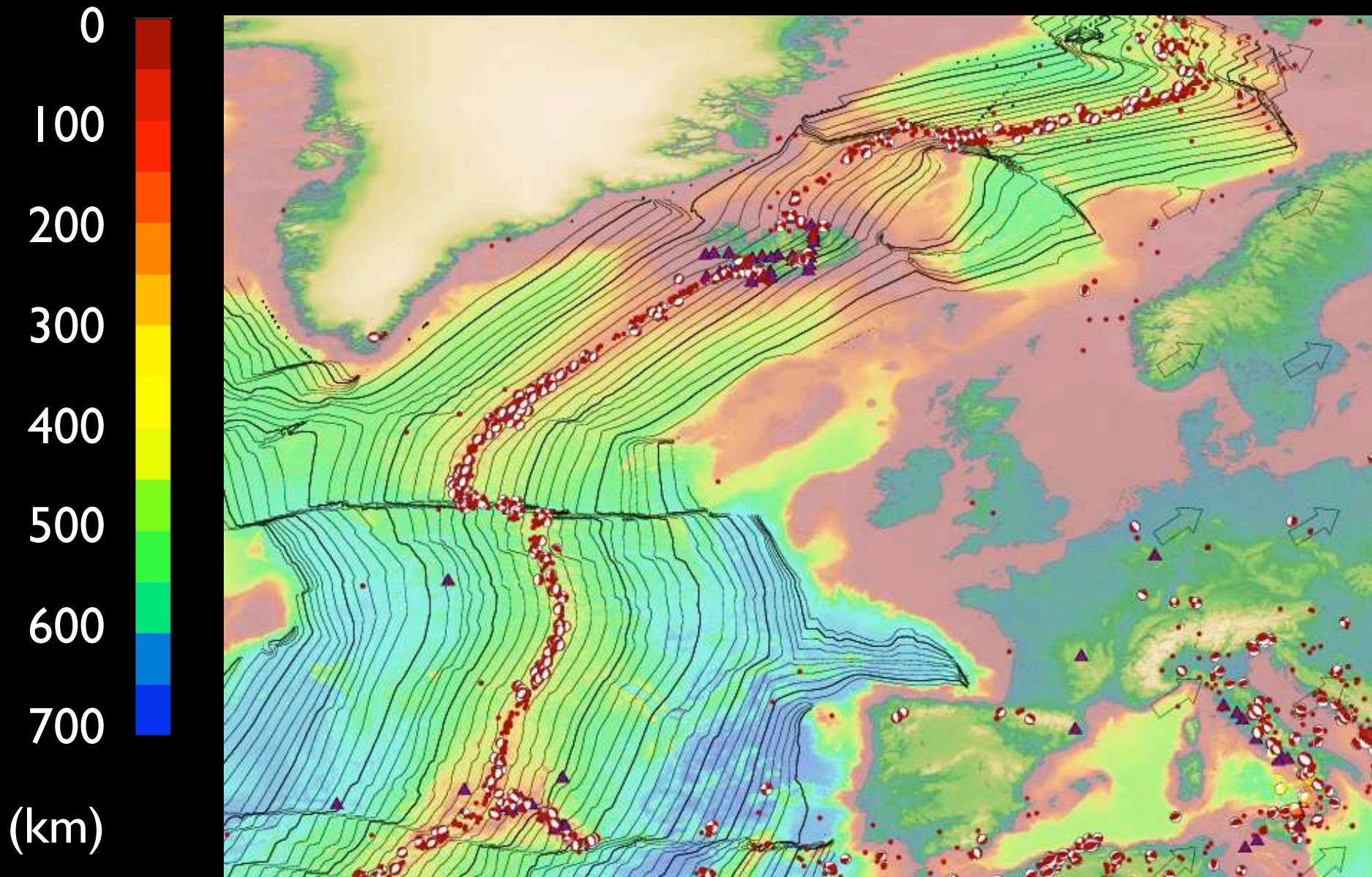
Konstruktive Plattengrenzen

(I) Konstruktive Plattengrenzen

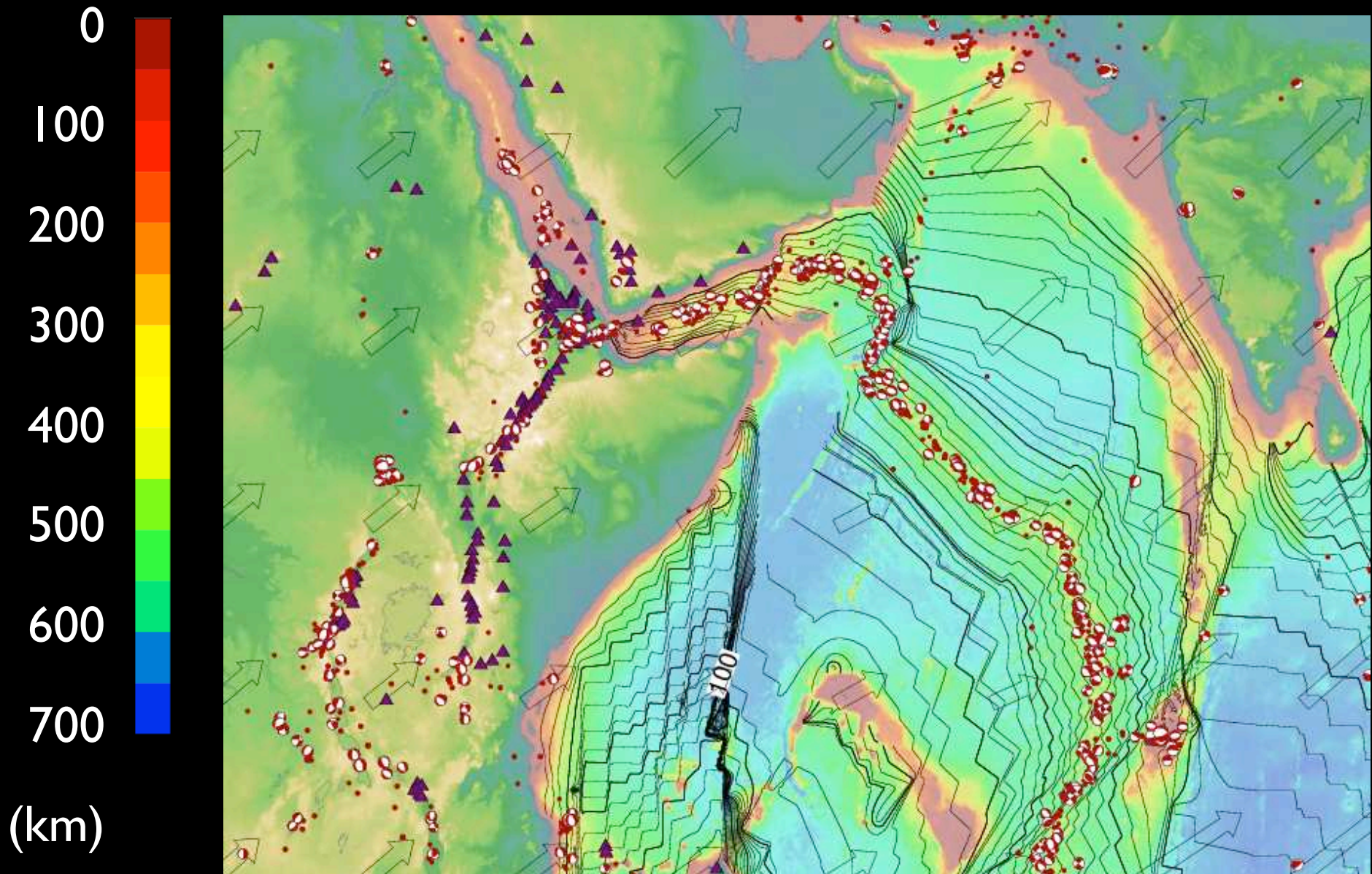


konstruktiv
=
divergent
=
distensiv

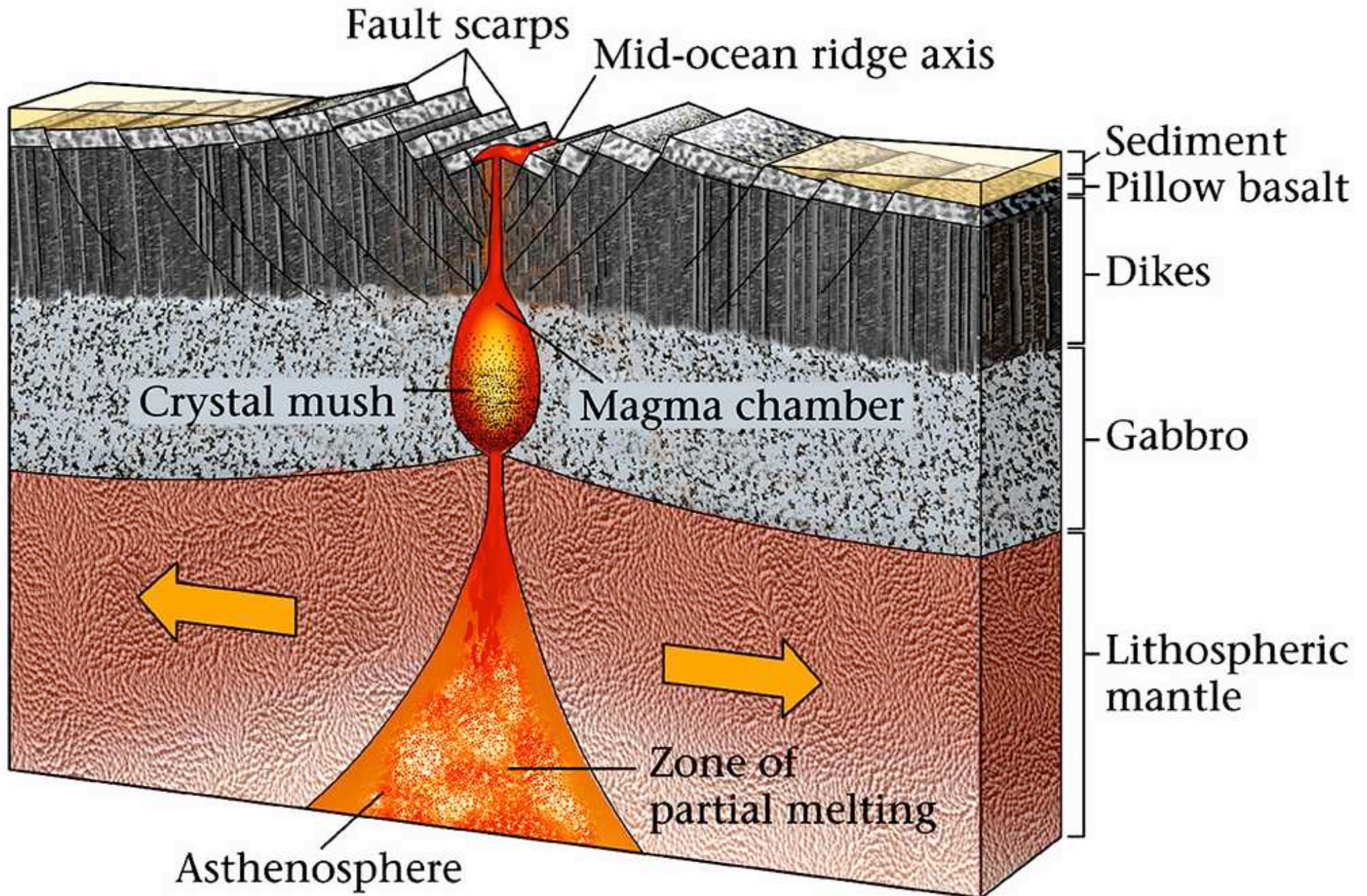
(I) konstruktive Plattengrenzen



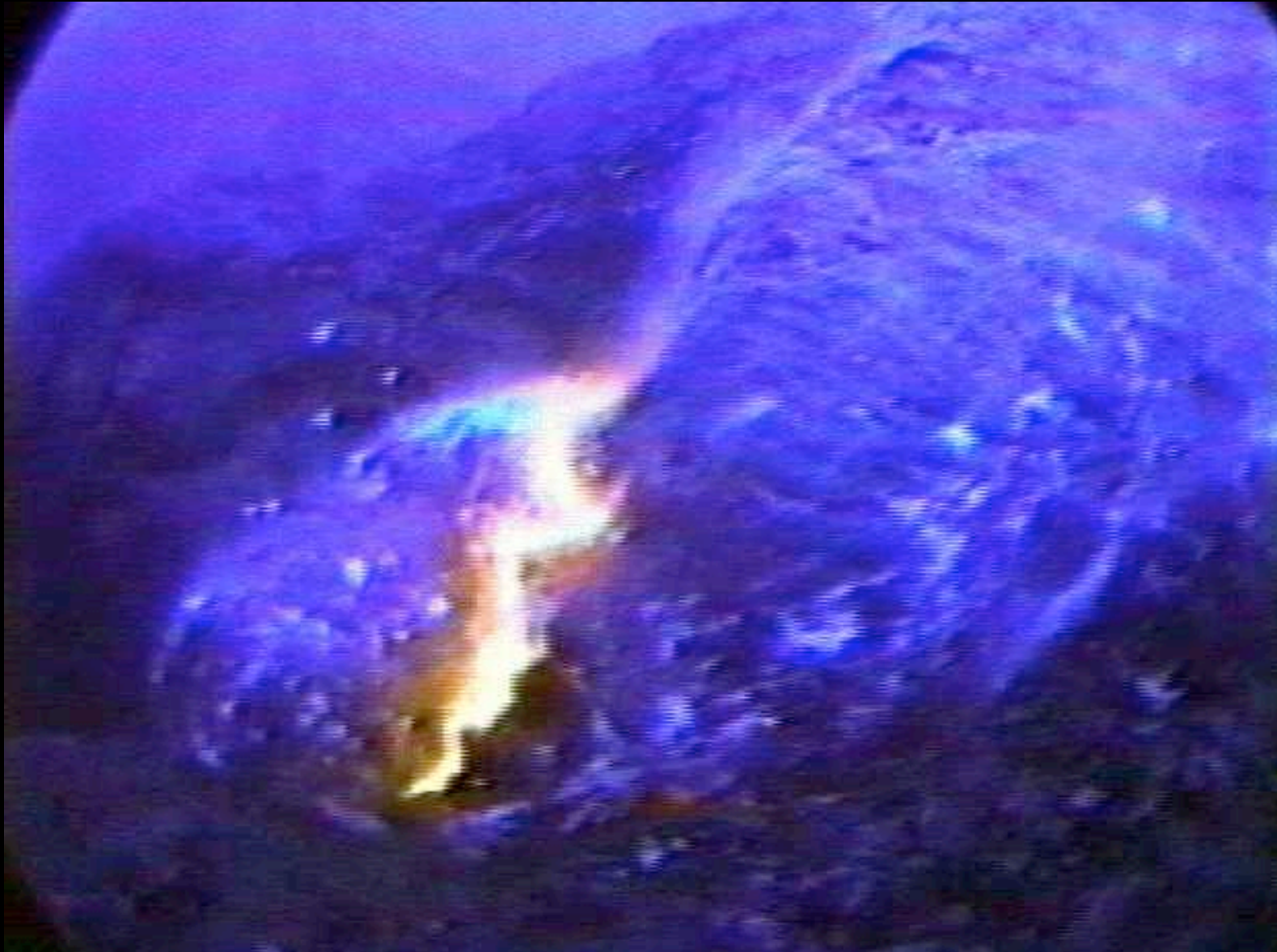
(I) konstruktive Plattengrenzen



Bildung ozeanischer Kruste



Bildung von Kissenlava (pillow lava)



pillows

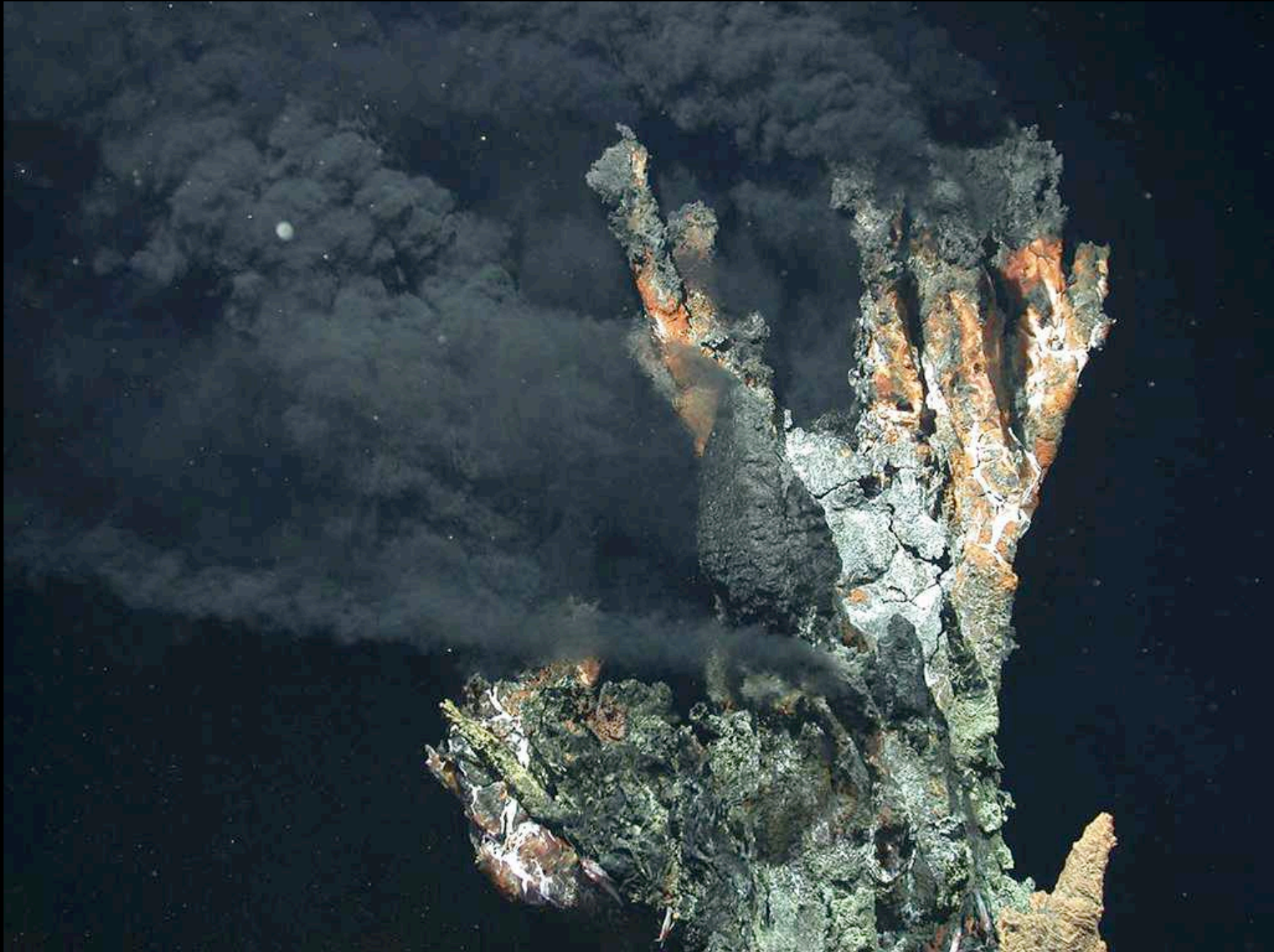


"Ozean im Gebirge"

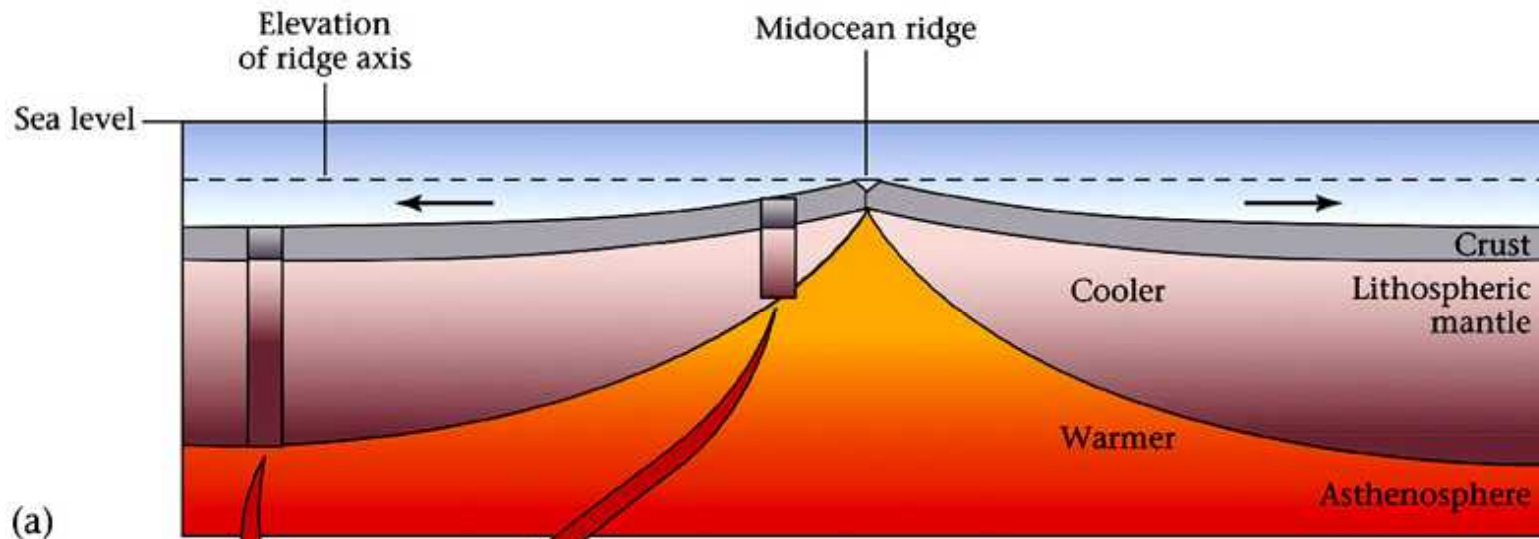


Pillow-Lava am Marmorera Staudamm

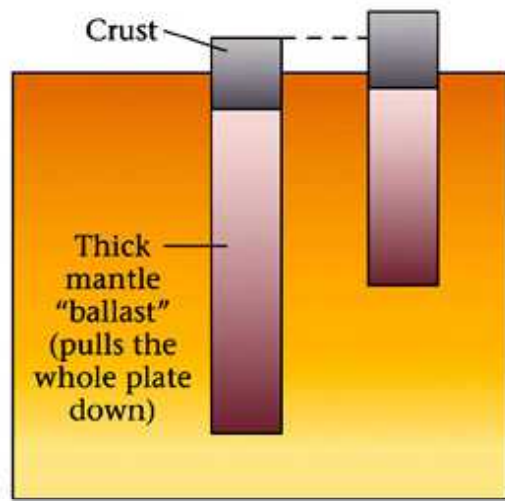
Black smoker



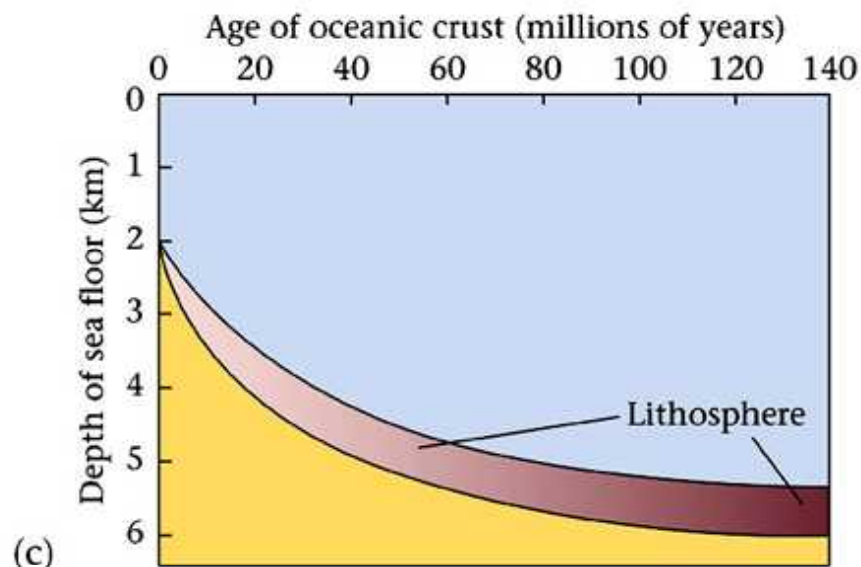
älter ... kälter ... dichter ... tiefer



(a)

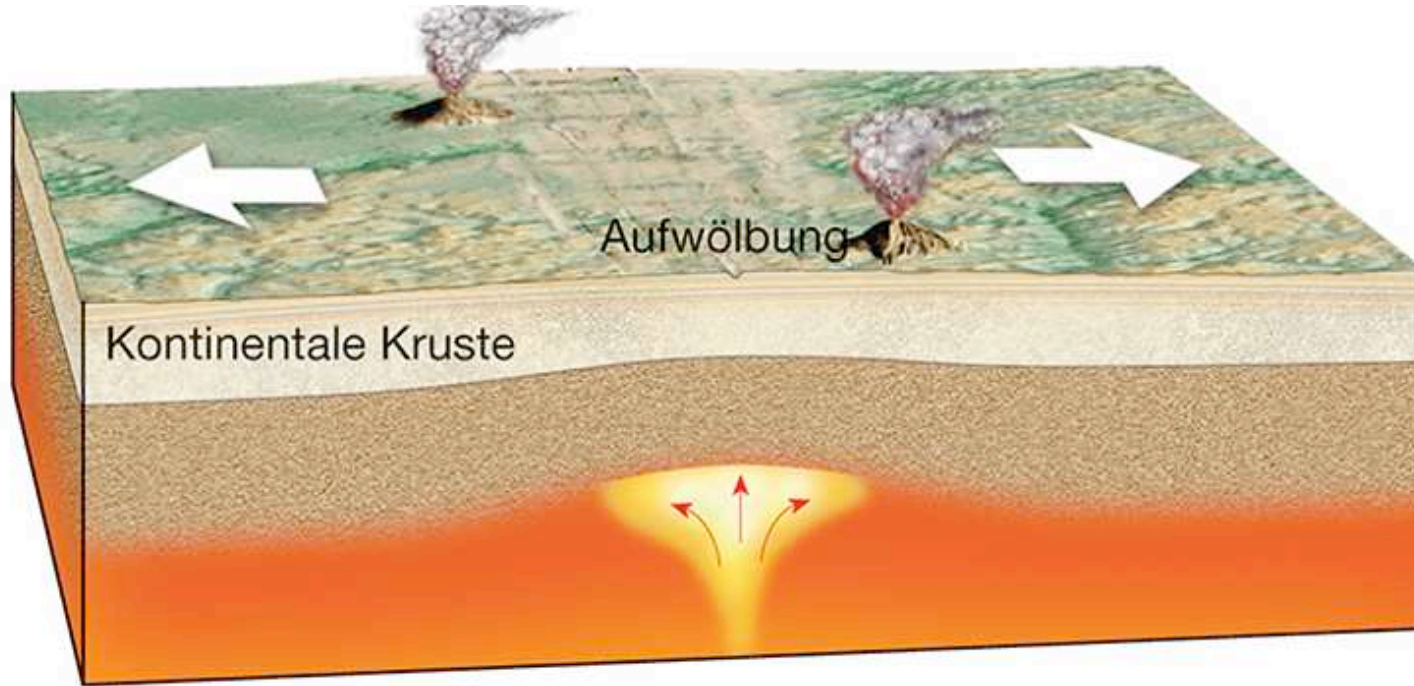


(b)

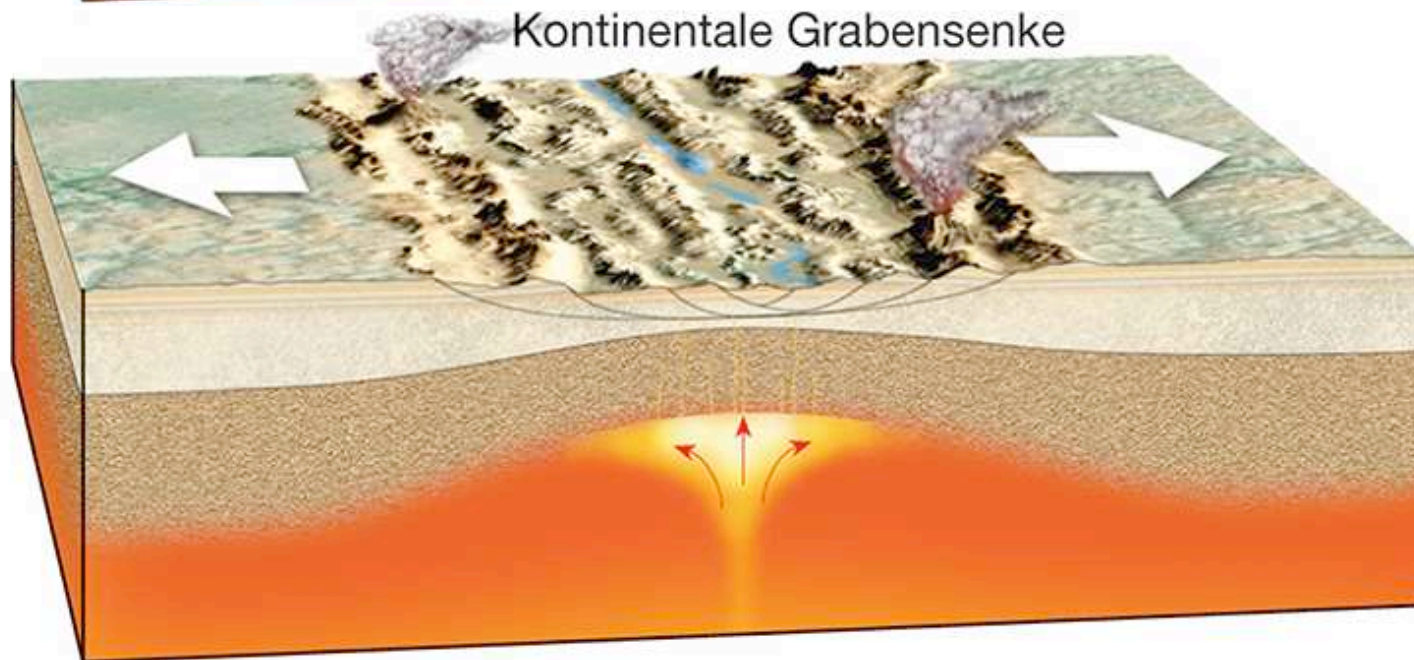


(c)

Vom kontinentalen Grabenbruch ...

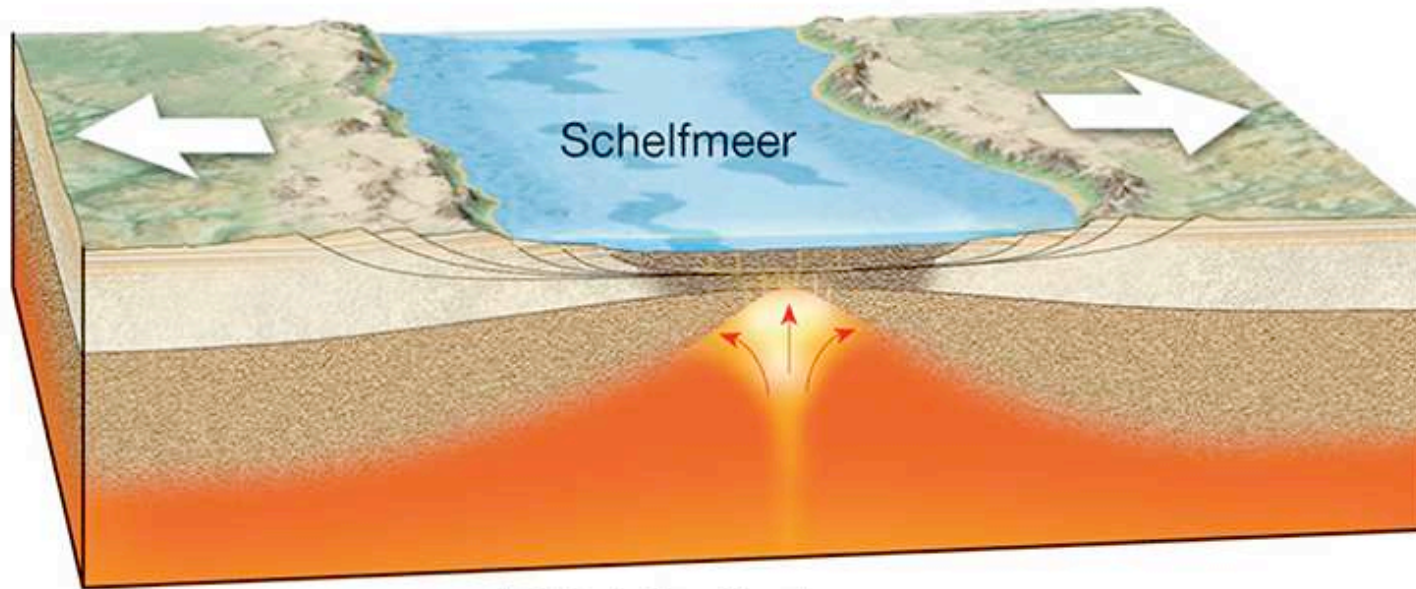


A.

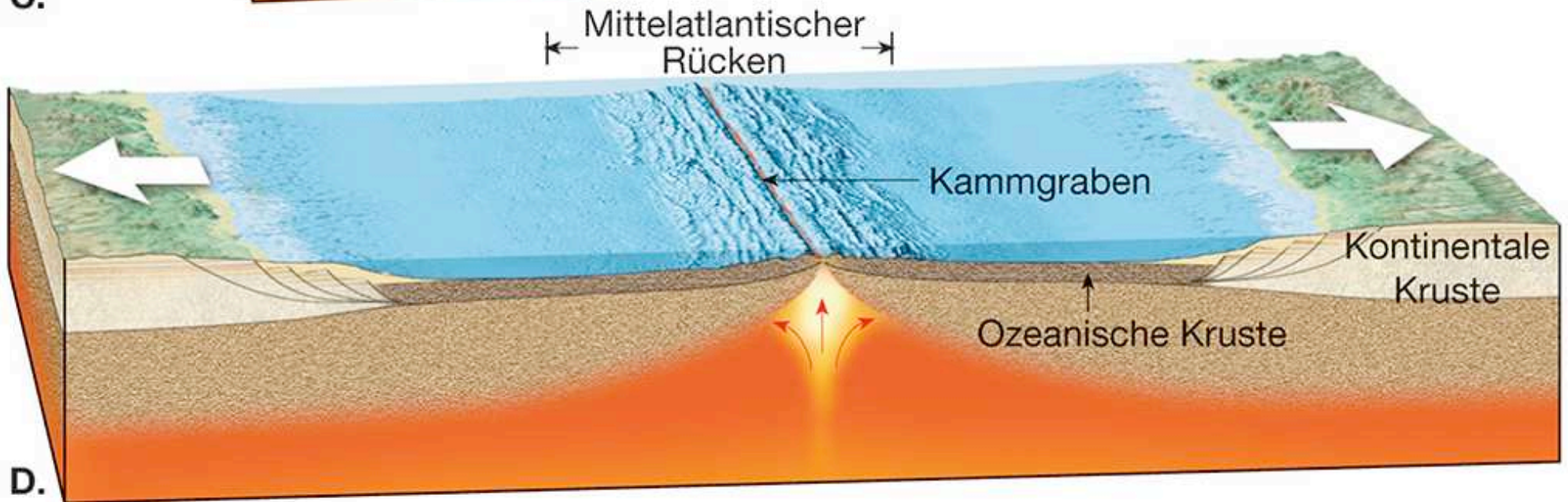


B.

... zum Ozeanbecken

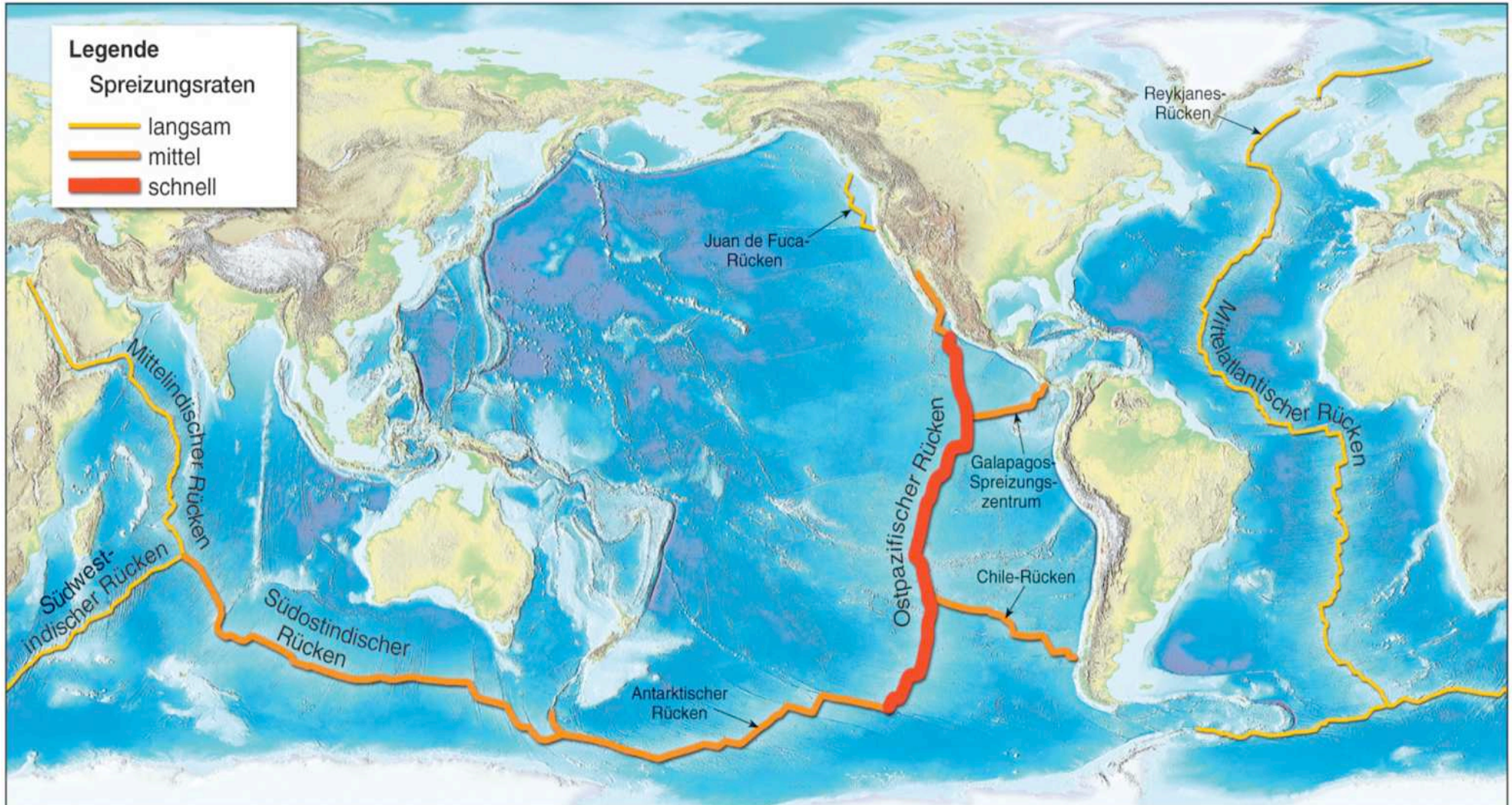


C.



D.

Spreizungsraten



Search

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 [USGS Real-time Earthquakes](#)

M 1+, past 7 days. Earthquakes update every 5 minutes.

 [ShakeMap: b0006bqc](#) [Historic Earthquakes](#)

M 3+, past 90 days; M 4+, past year; M 5+, past 5 years; M 6+, since 1970. Earthquakes are updated once per day.

 [Global Topography V14.1](#)

Global Topography V14.1 SEAFLOOR DEPTH - Colors and 500m contours represent variations in seafloor depth

 [Largest Earthquakes in the World Since 1900](#)

Created 11/03/15 15:28:08 UTC

 [ARIA Envisat InSAR](#)

Tohoku-oki EQ Envisat wrapped interferogram from descending track 189 (west), 347 (middle), and 74 (east)

 [Ages of the Ocean Floor](#)

from nachon.free.fr/GE/Welcome.html

 [Tectonic Plates \(simplified boundaries\)](#)

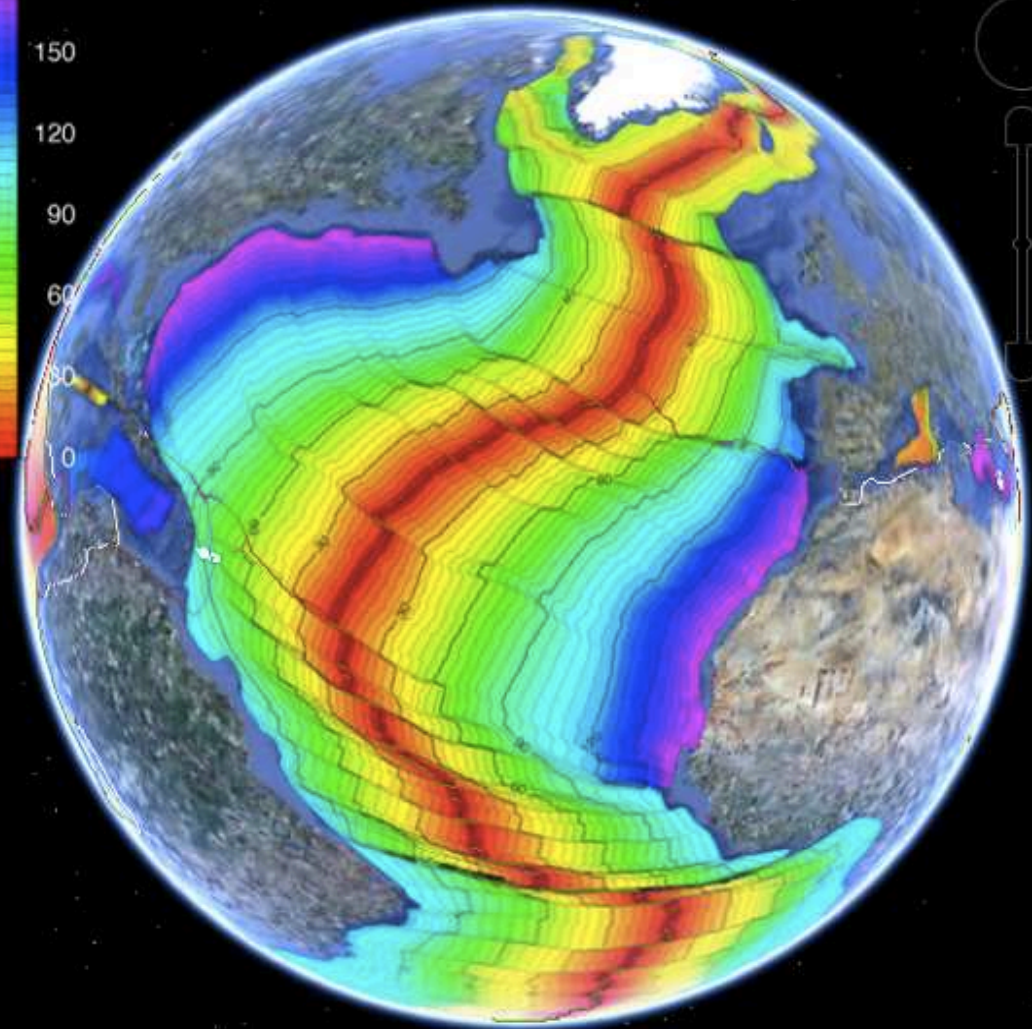
Tectonic Plates of the world (US Geological Survey).

 [Plates](#)

Deep beneath California, the Pacific and North American Plates relentlessly grind past one another, straining or

 [Text 3D](#) [Arrows 3D](#) [Plates Legend](#) [USGS Logo](#) [Temporary Places](#)

AGE OF OCEAN FLOOR Millions Years before present

270
240
180
150
120
90
60
30
0Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Cnes/Spot Image

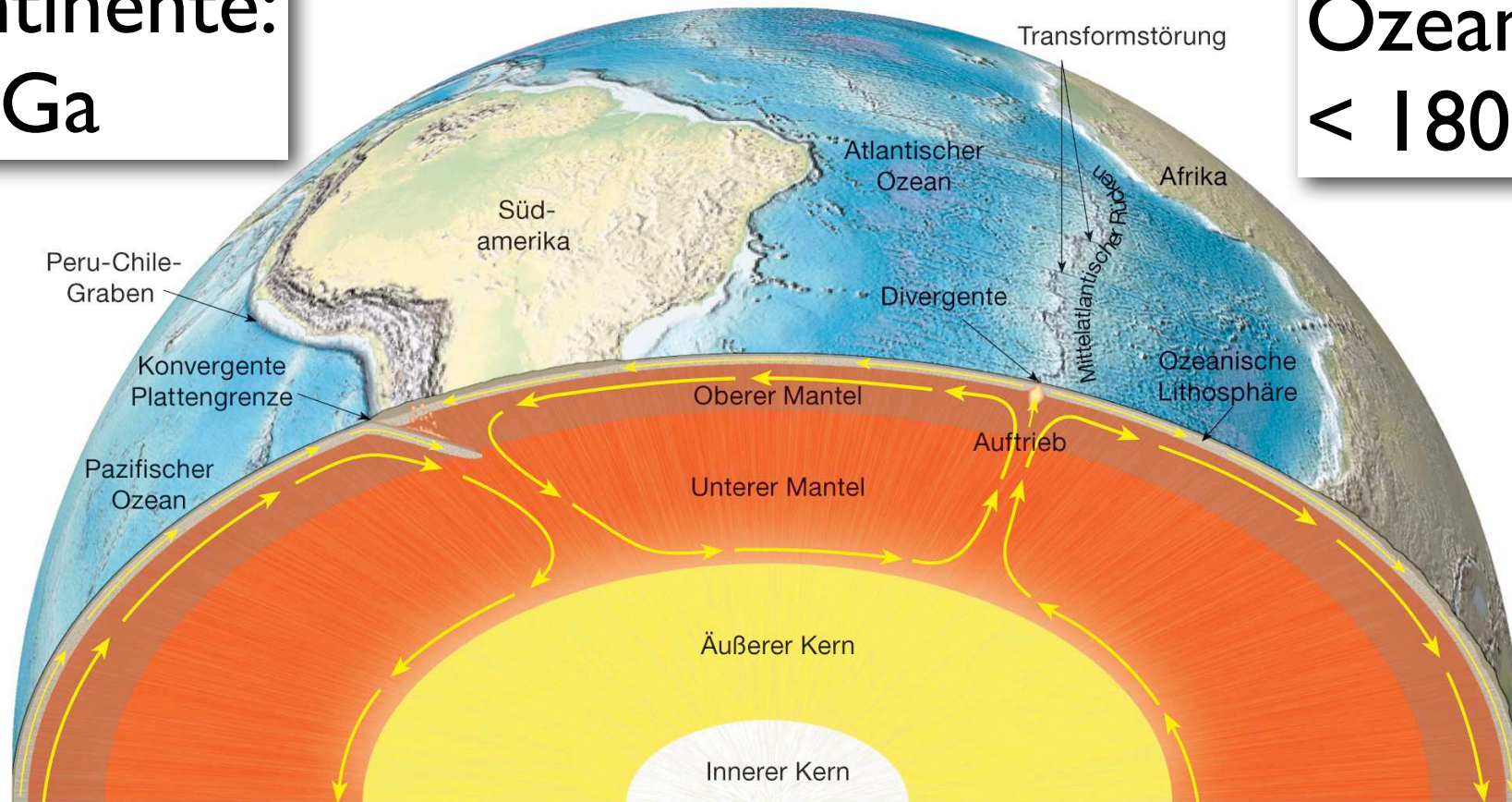
Google Earth: Ages of the Ocean Floor

Destruktive Plattengrenzen

(2) destruktive Plattengrenzen

Kontinente:
4.5 Ga

Ozeane :
< 180 Ma



Mittelozeanischer Rücken produzieren
(ausschliesslich ozeanische) Lithosphäre
....wohin damit ?!

Plattengrenzen: 3 Typen

(1) konstruktive distensive

(2) destruktive kompressive

(3) konservative Transform-

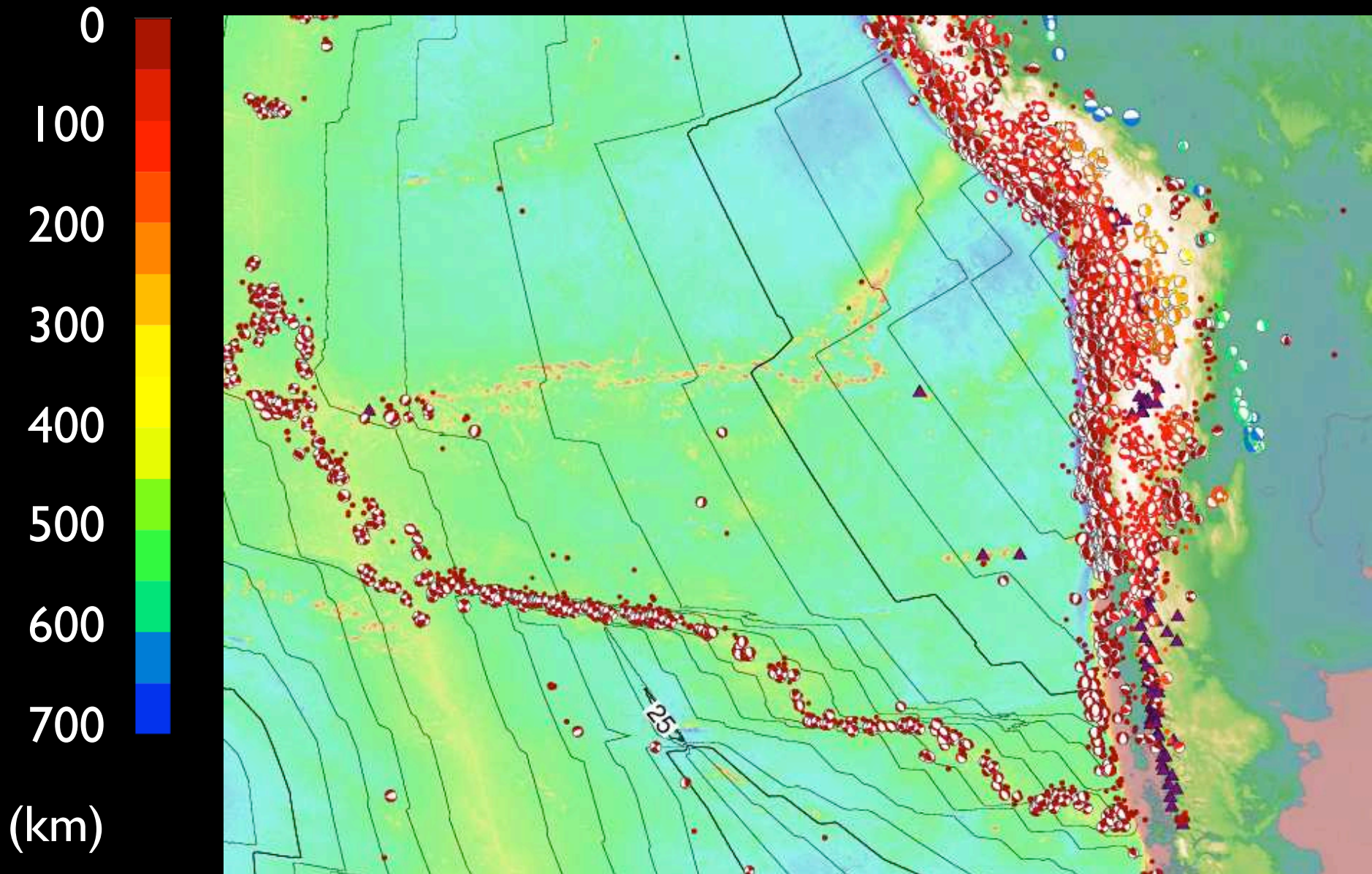
destruktive Plattengrenzen: 3 Typen

(a) Ozean Ozean

(b) Ozean Kontinent

(c) Kontinent Kontinent

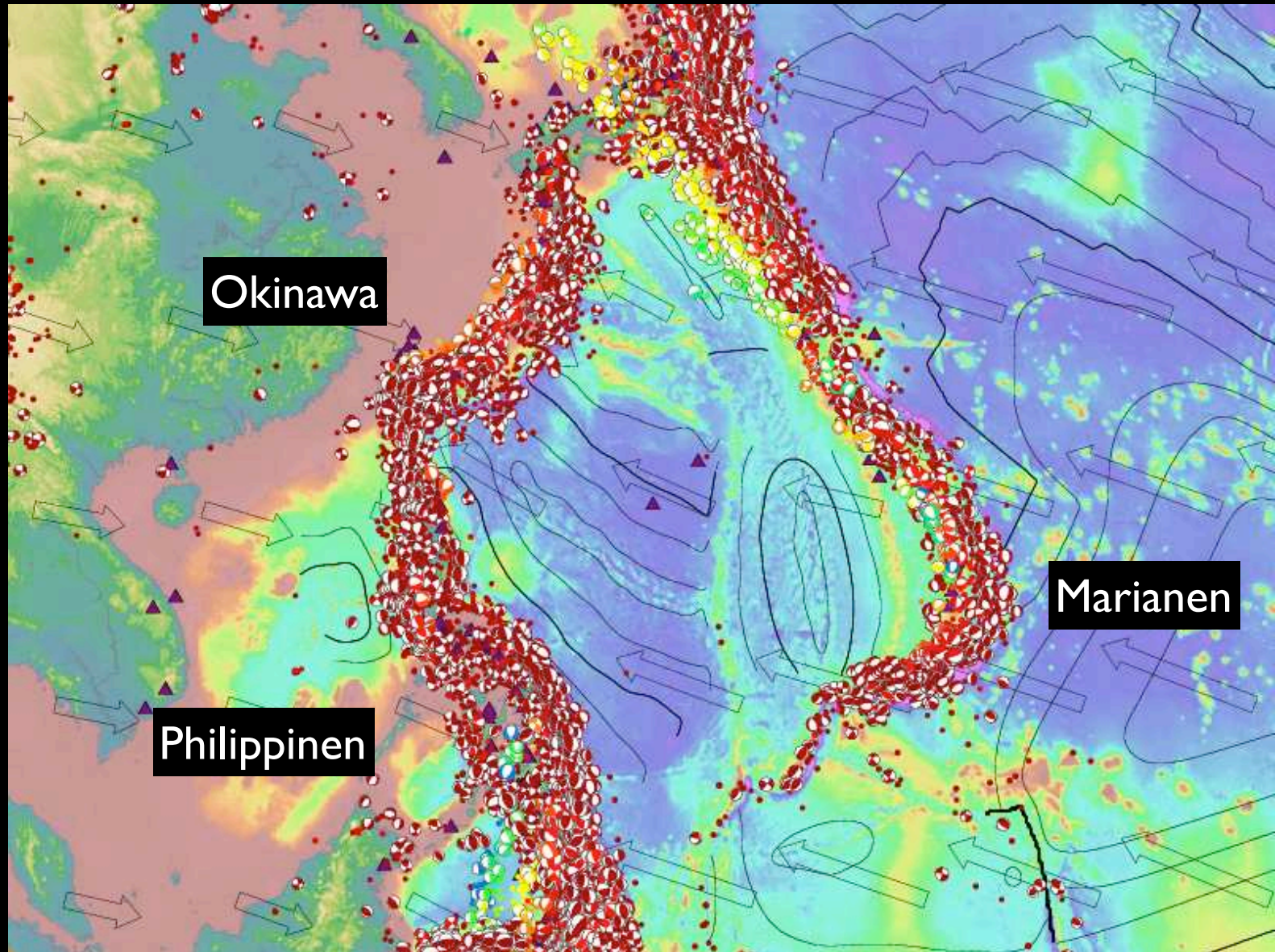
(2a) Ozean - Kontinent



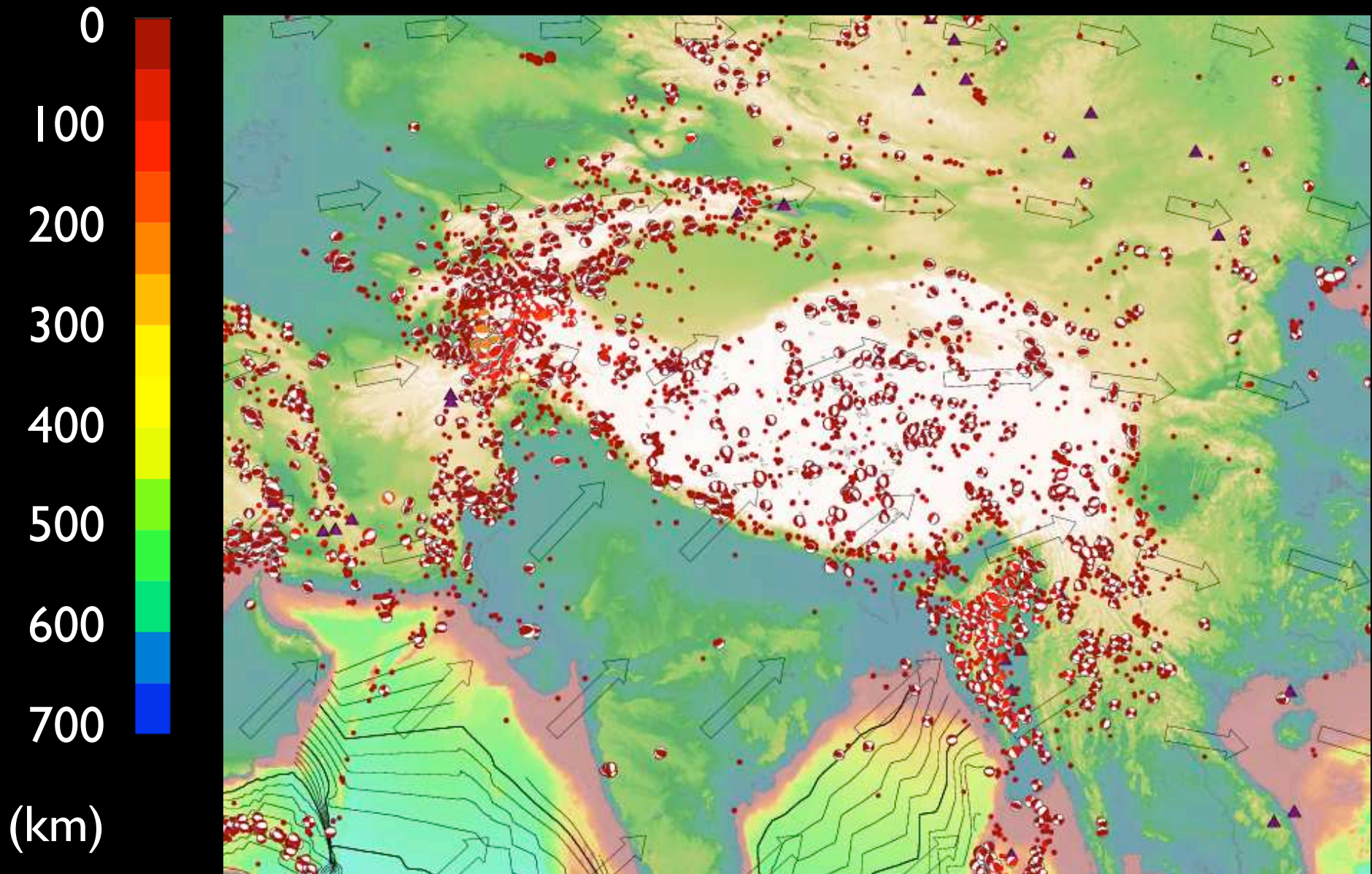
(2b) Ozean - Ozean

Mt Fuji

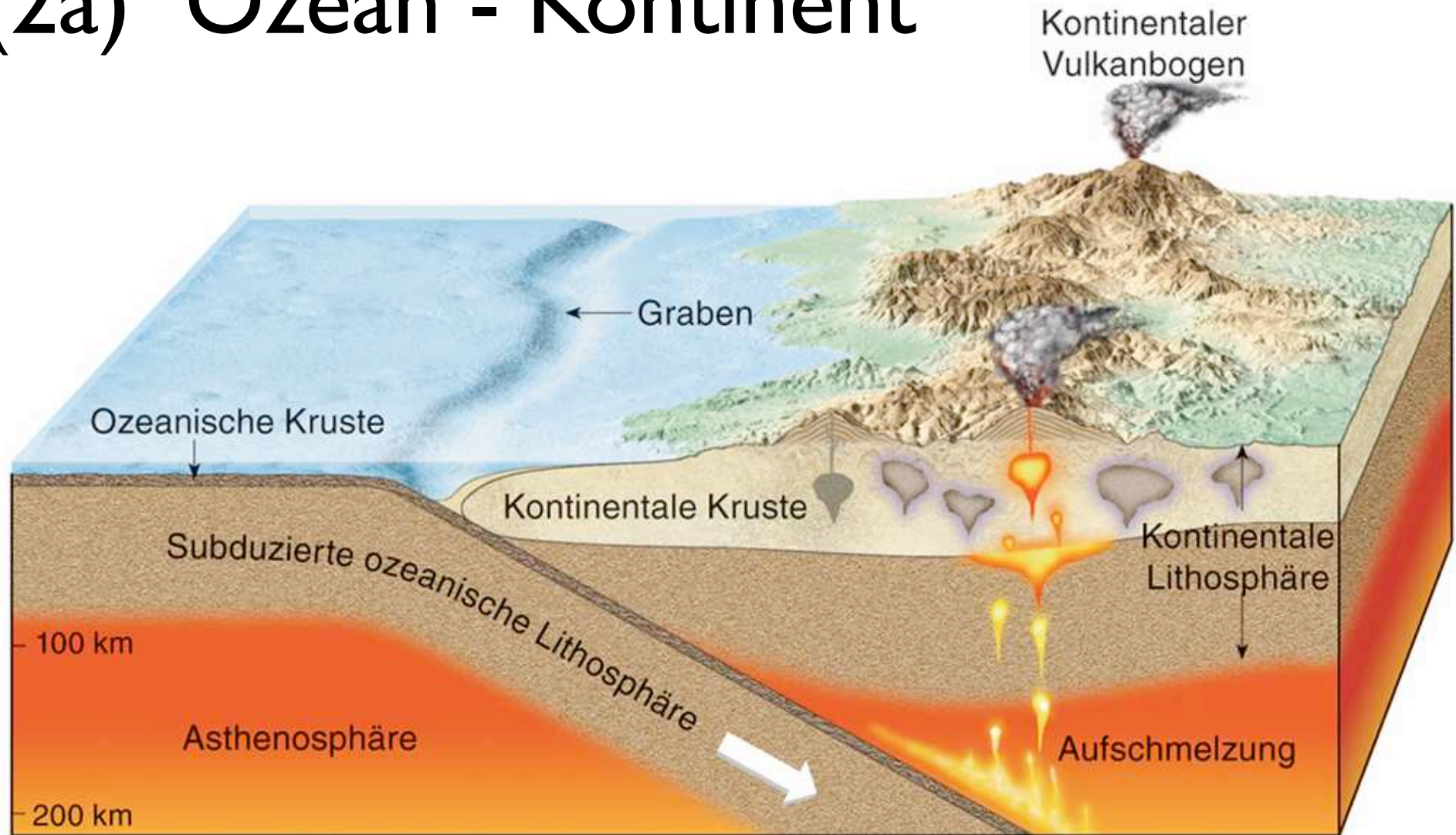
0
100
200
300
400
500
600
700
(km)



(2c) Kontinent - Kontinent

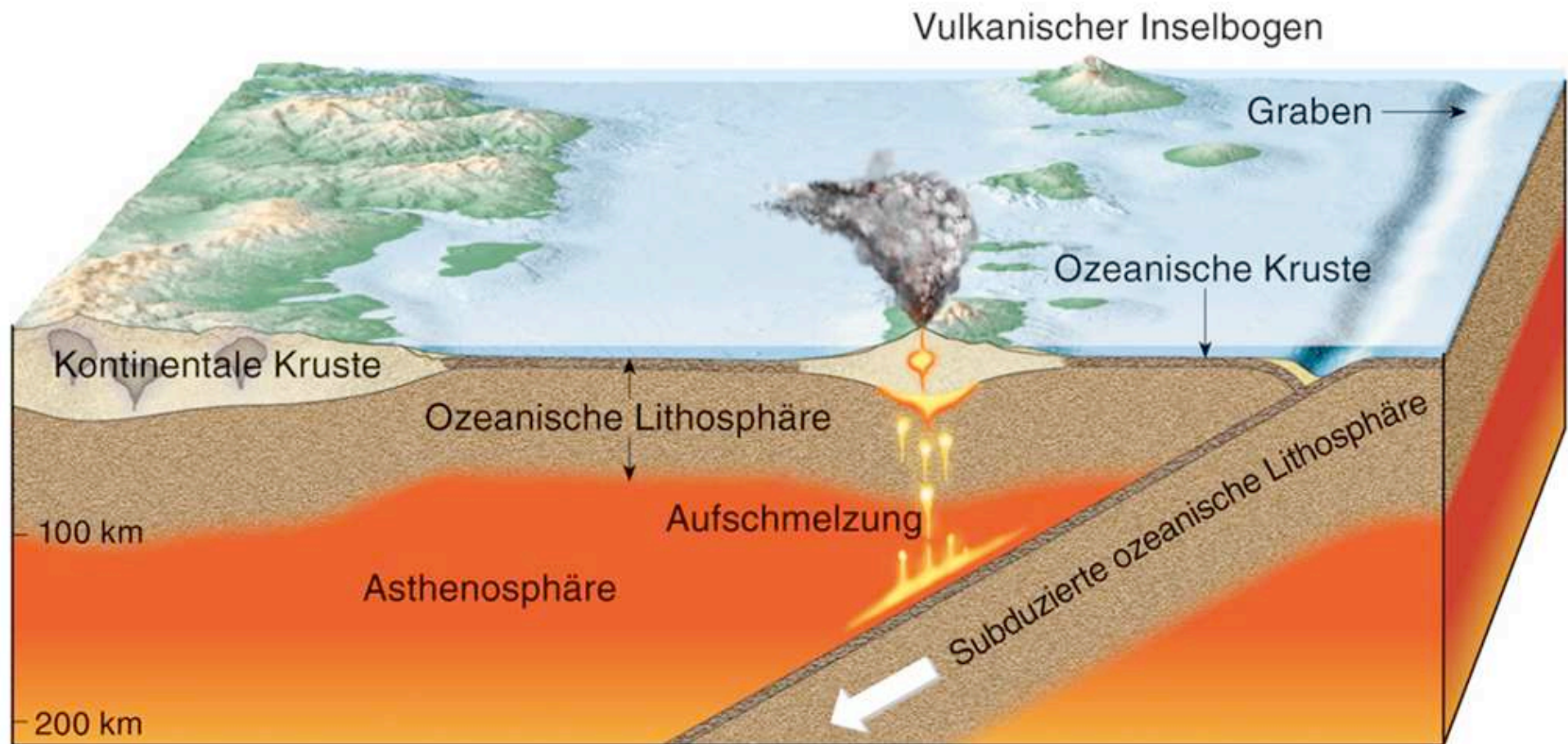


(2a) Ozean - Kontinent



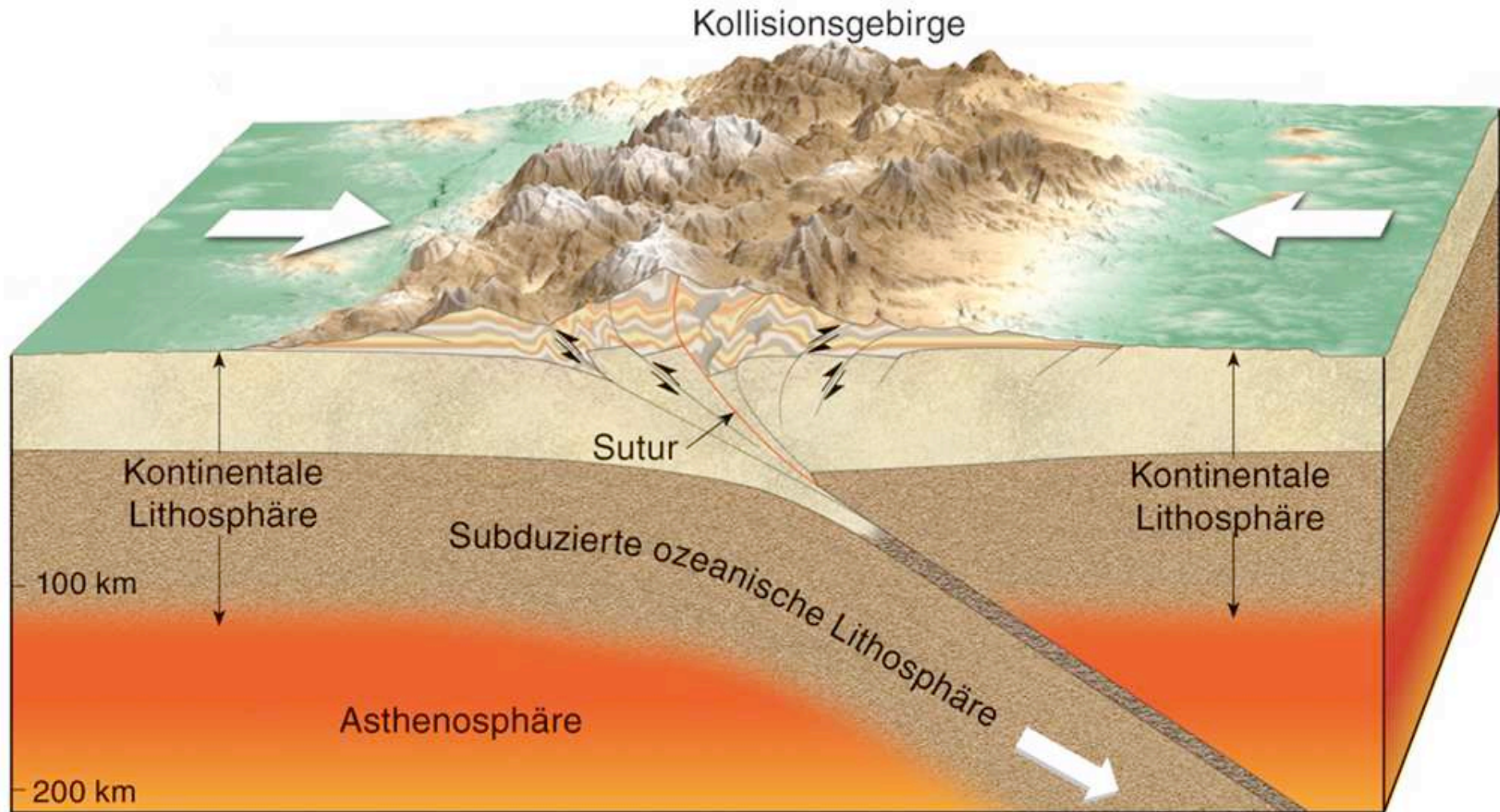
dichtere Platte (= ozeanische) sinkt hinunter
Aufschmelzung in überschobener Platte
Kontinentale Vulkanbögen: Anden, Cascades (USA)

(2b) Ozean - Ozean



dichtere Platte sinkt hinunter
Vulkanismus am Ozeanboden
Vulkanische Inselbögen: Japan, Aleuten, Tonga

(2c) Kontinent - Kontinent

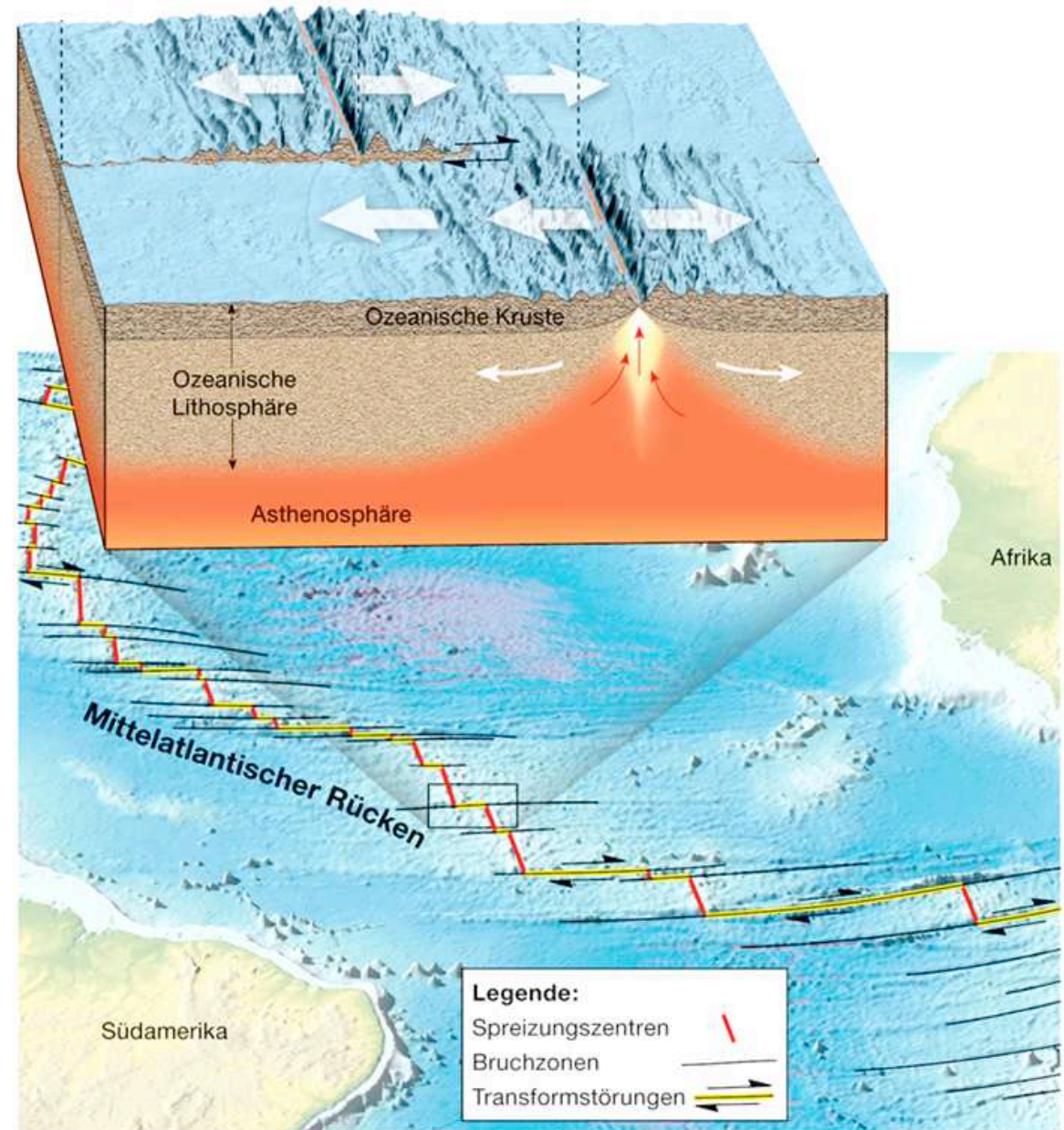


Fortgesetzte Subduktion → kontinentale Kollision
dichtere Platte wird subduziert
Kollisionsgebirge: Himalaya, Alpen, Appalachen

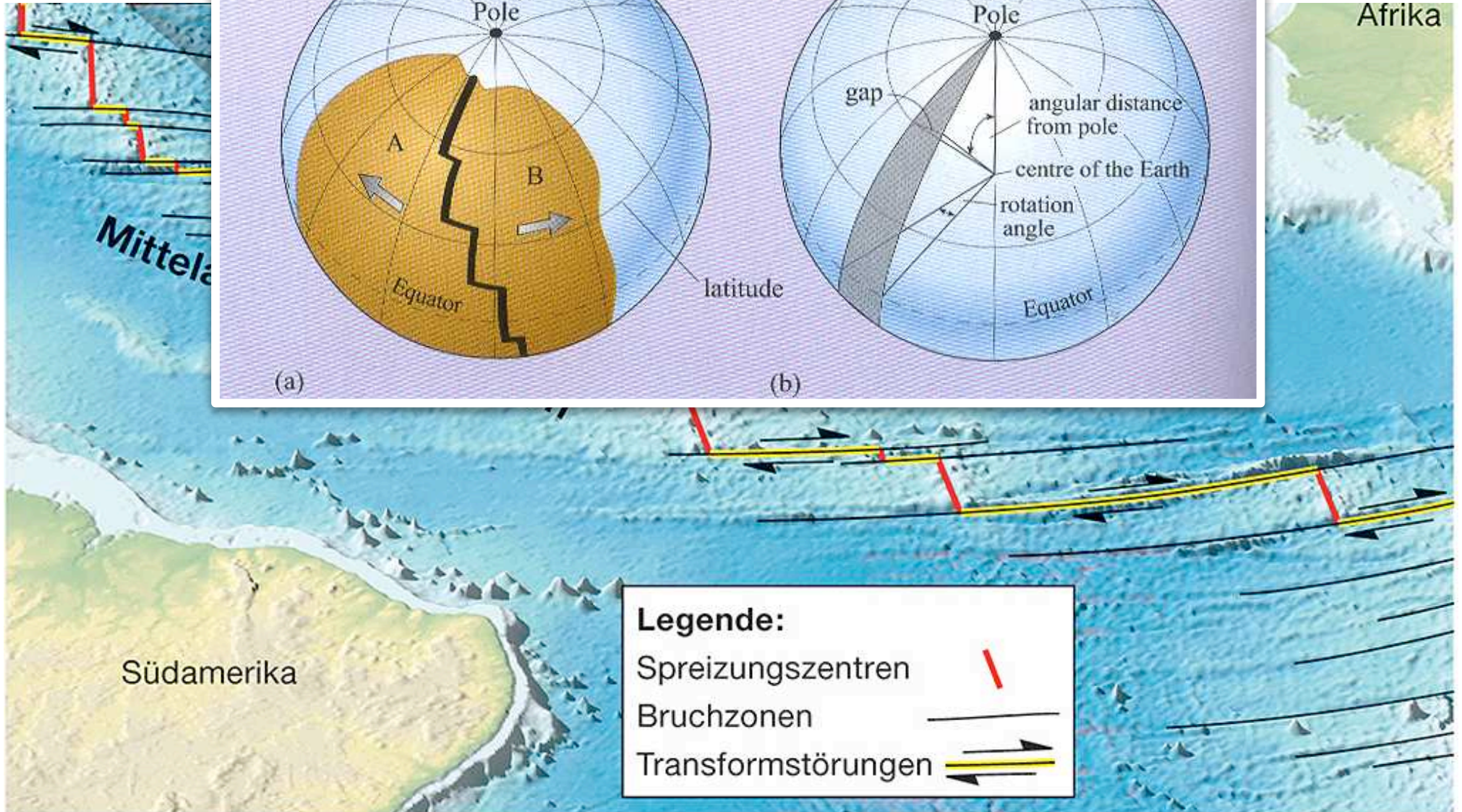
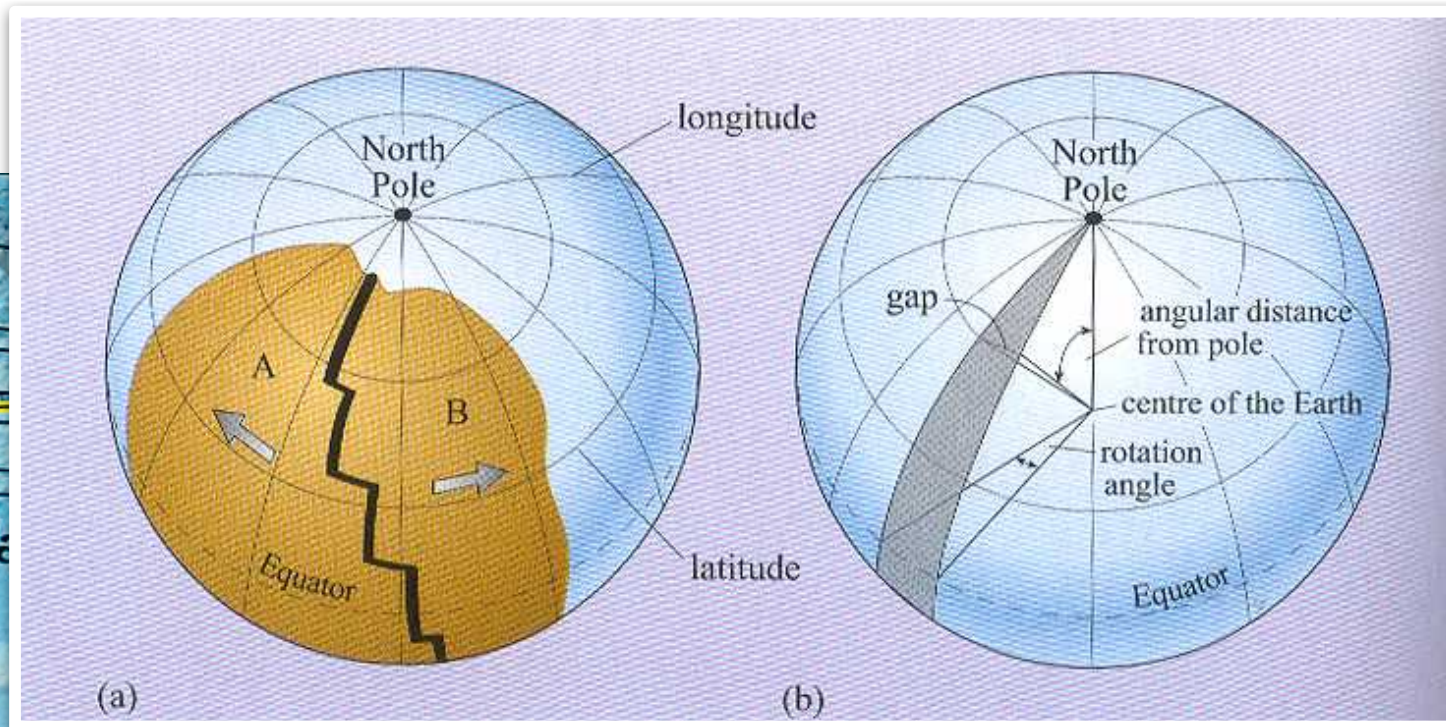
Konservative Plattengrenzen

(3) Konservative Plattengrenzen

Transformbrüche
Transformstörungen

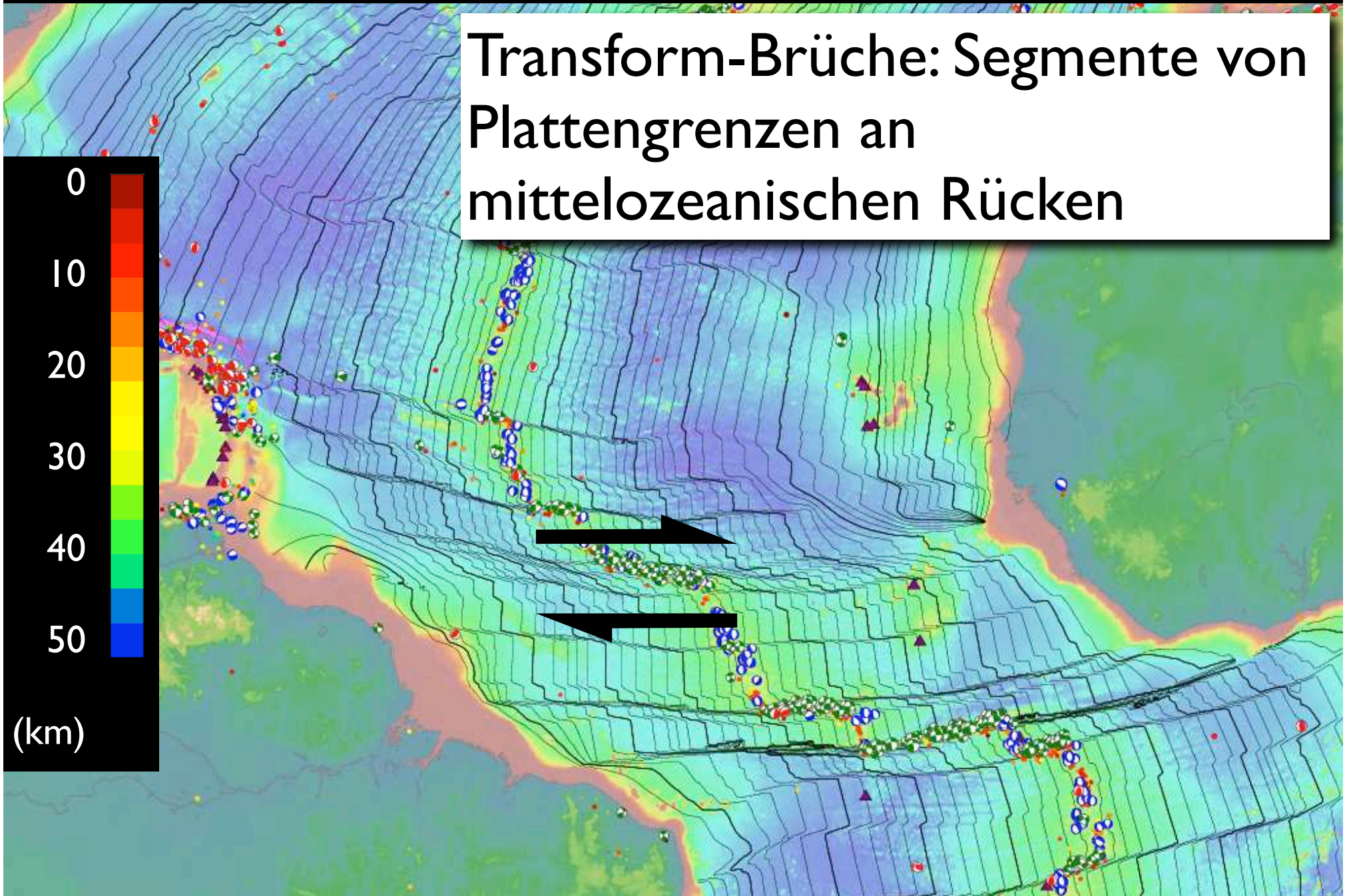


Transformstörungen

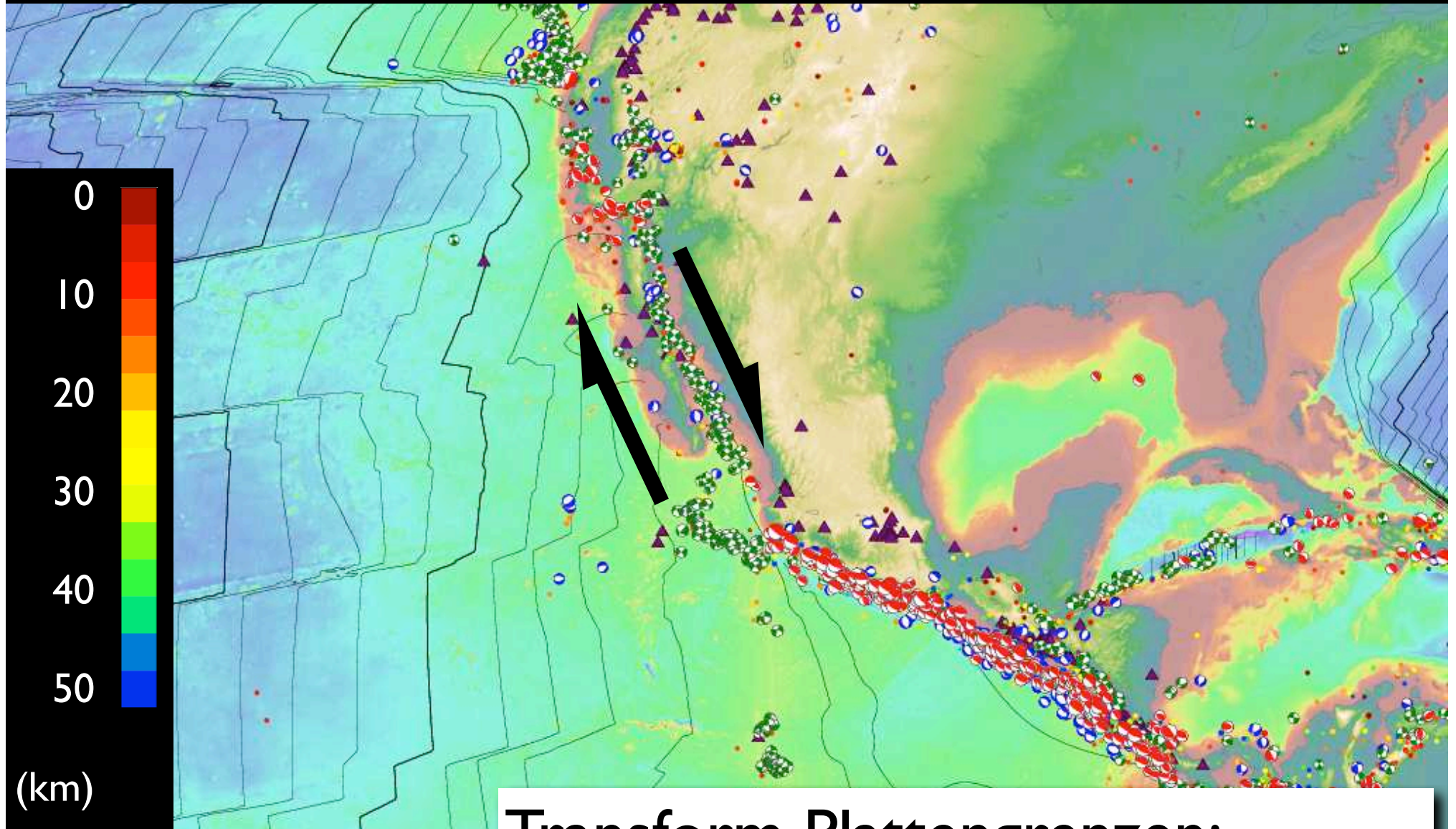


(3a) konservative Plattengrenze

Transform-Brüche: Segmente von Plattengrenzen an mittelozeanischen Rücken

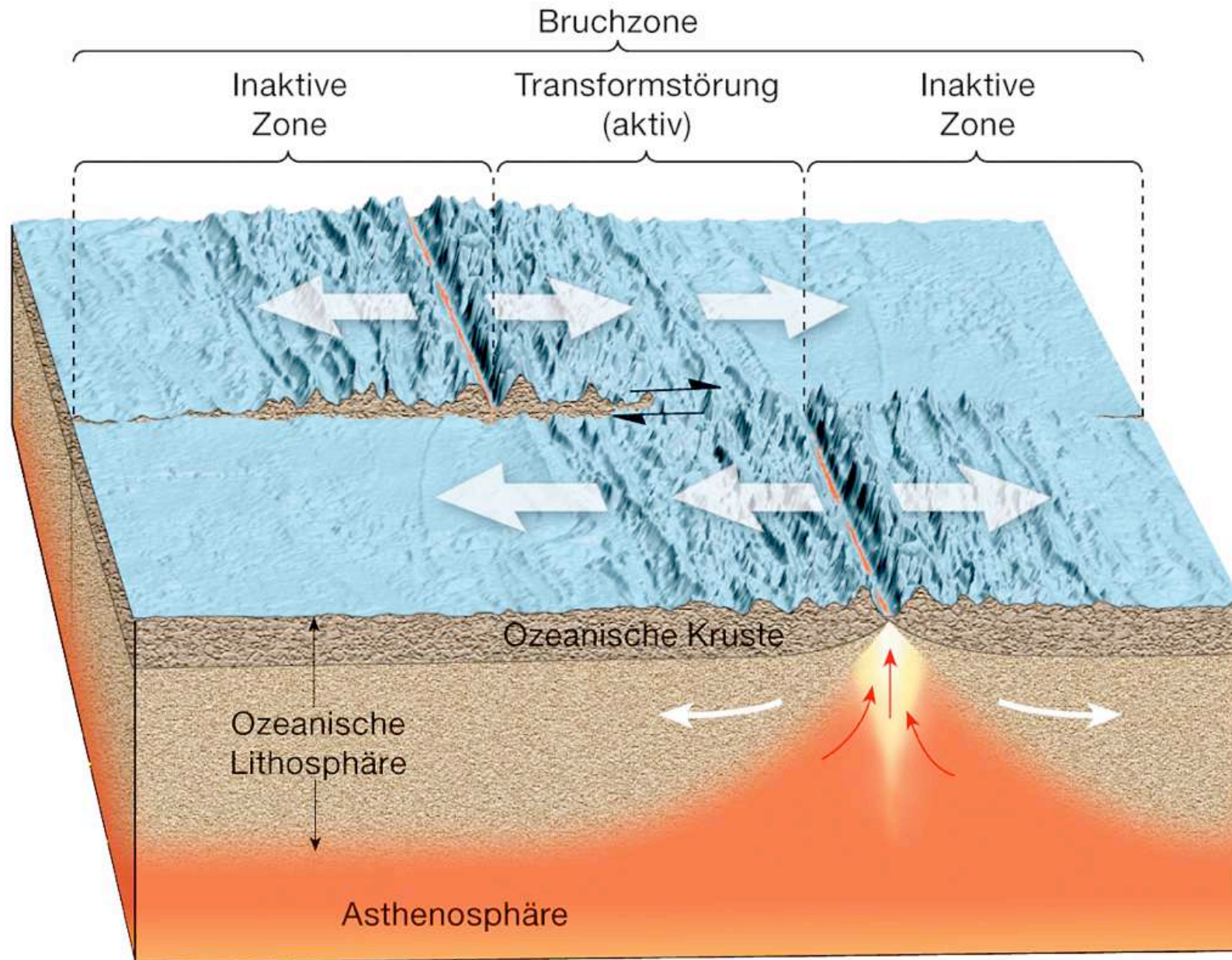


(3b) konservative Plattengrenze



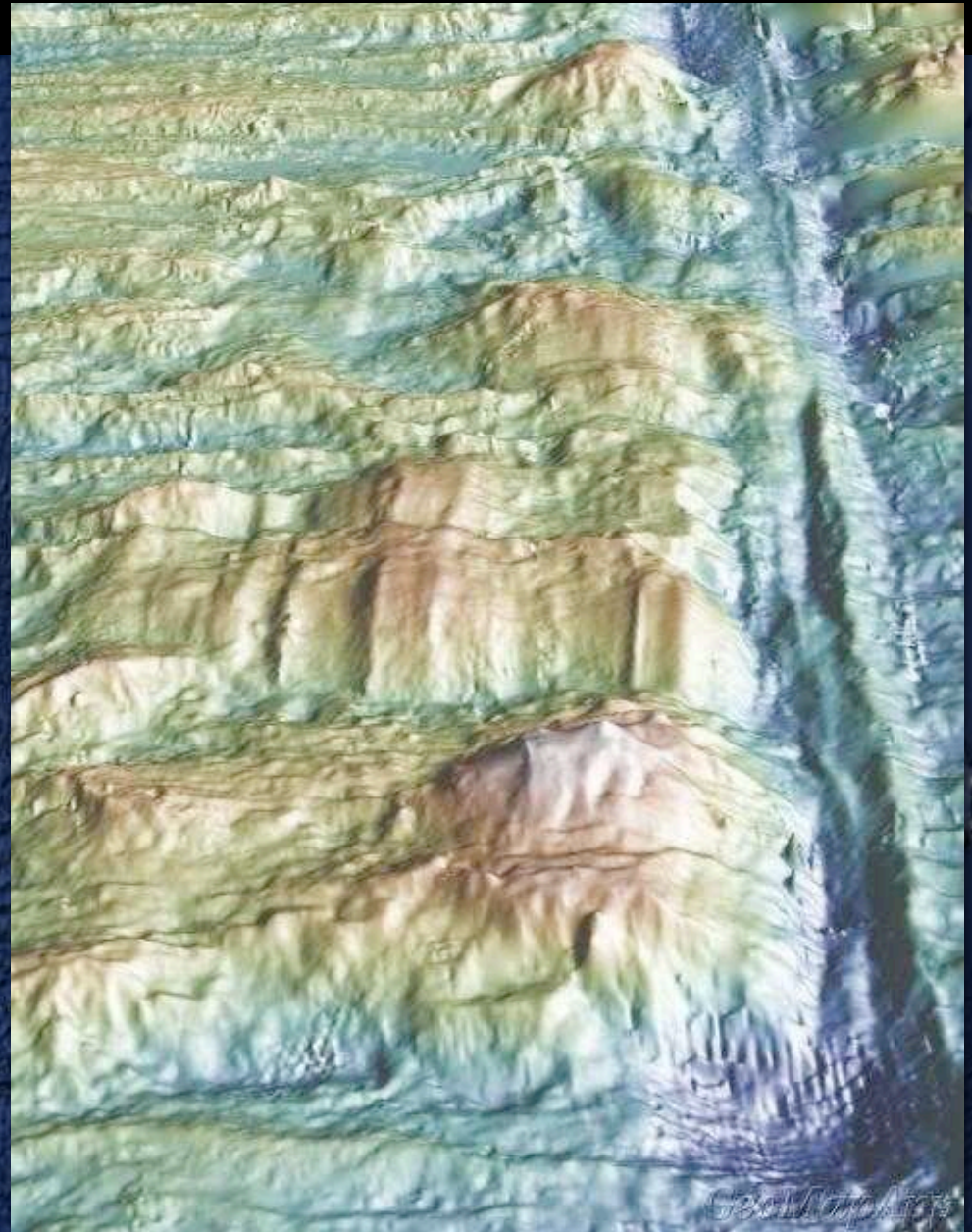
Transform Plattengrenzen:
Beispiel Kalifornien

Transformstörungen



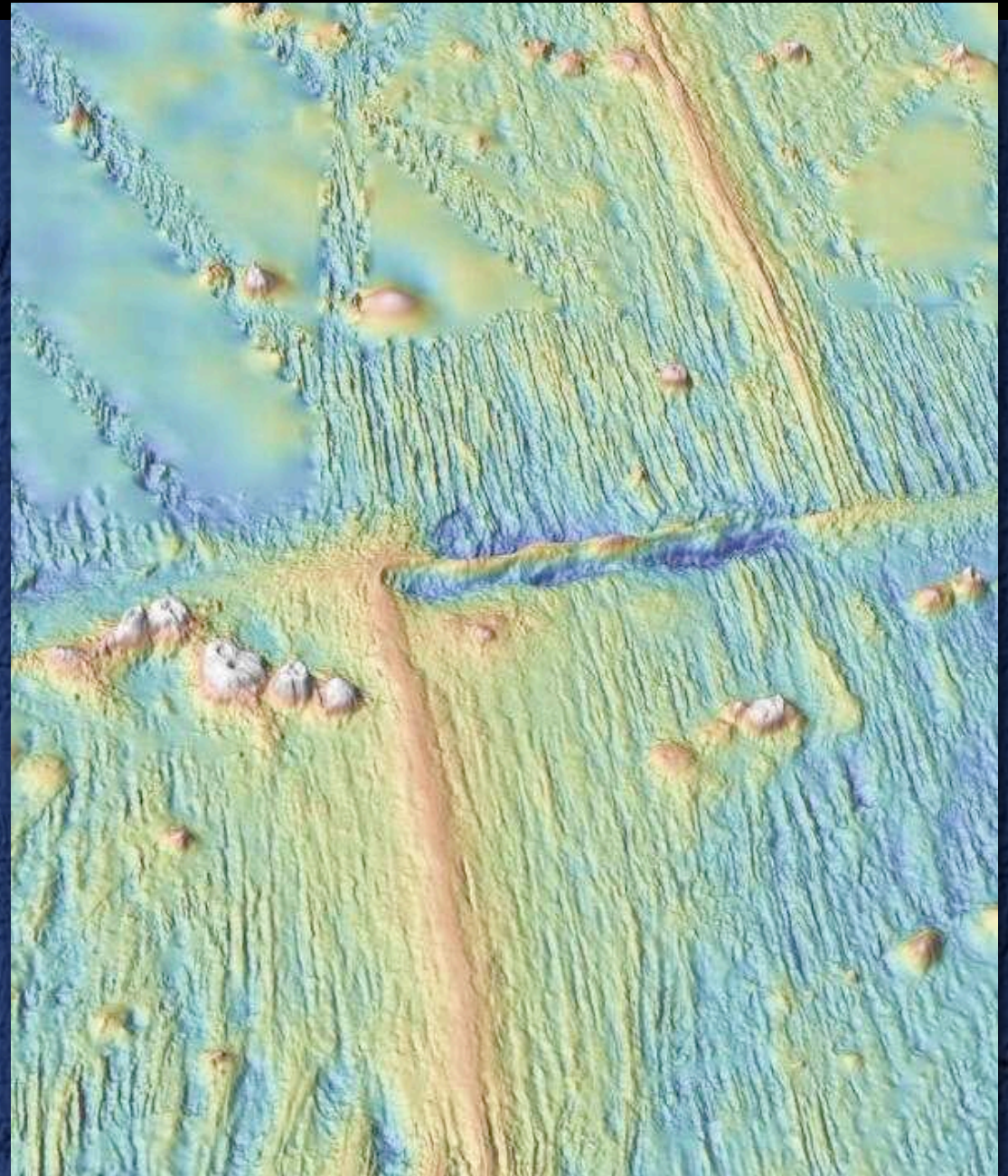
Transformbruch

Kane Fracture
Zone (MAR)



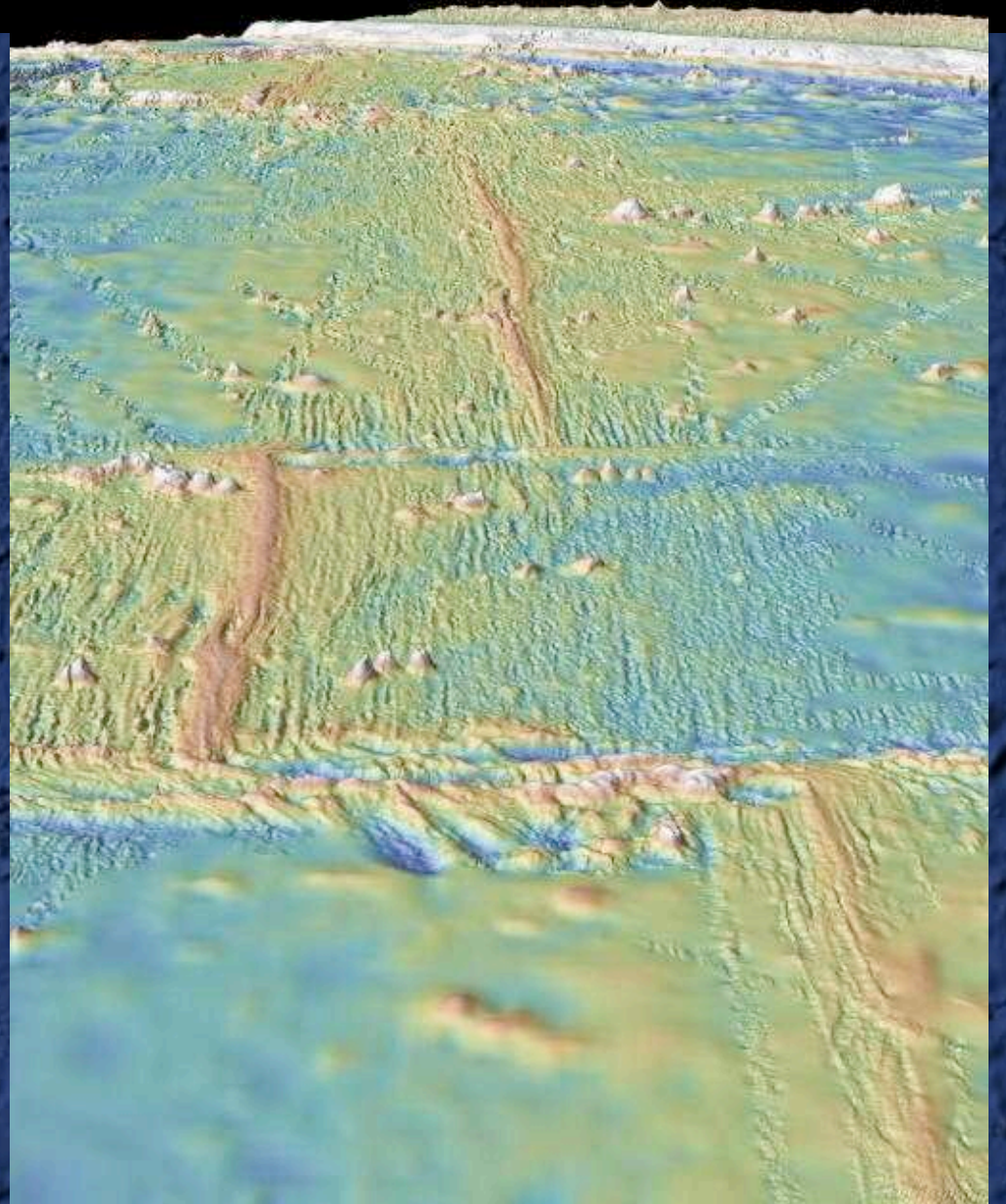
Transformbruch

East Pacific Rise



Transformbruch

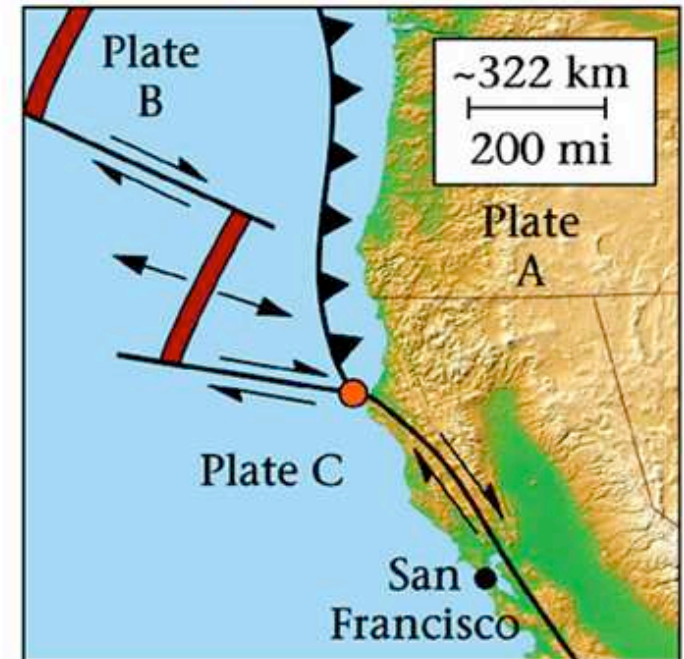
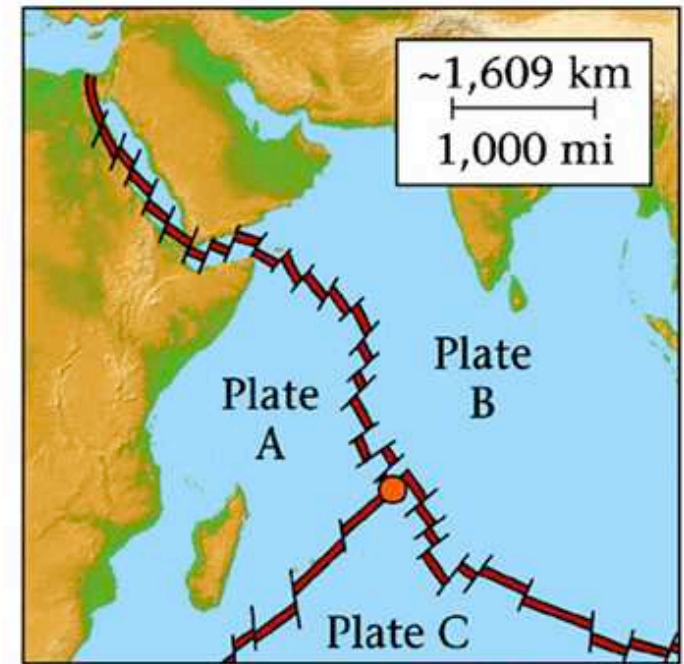
East Pacific Rise



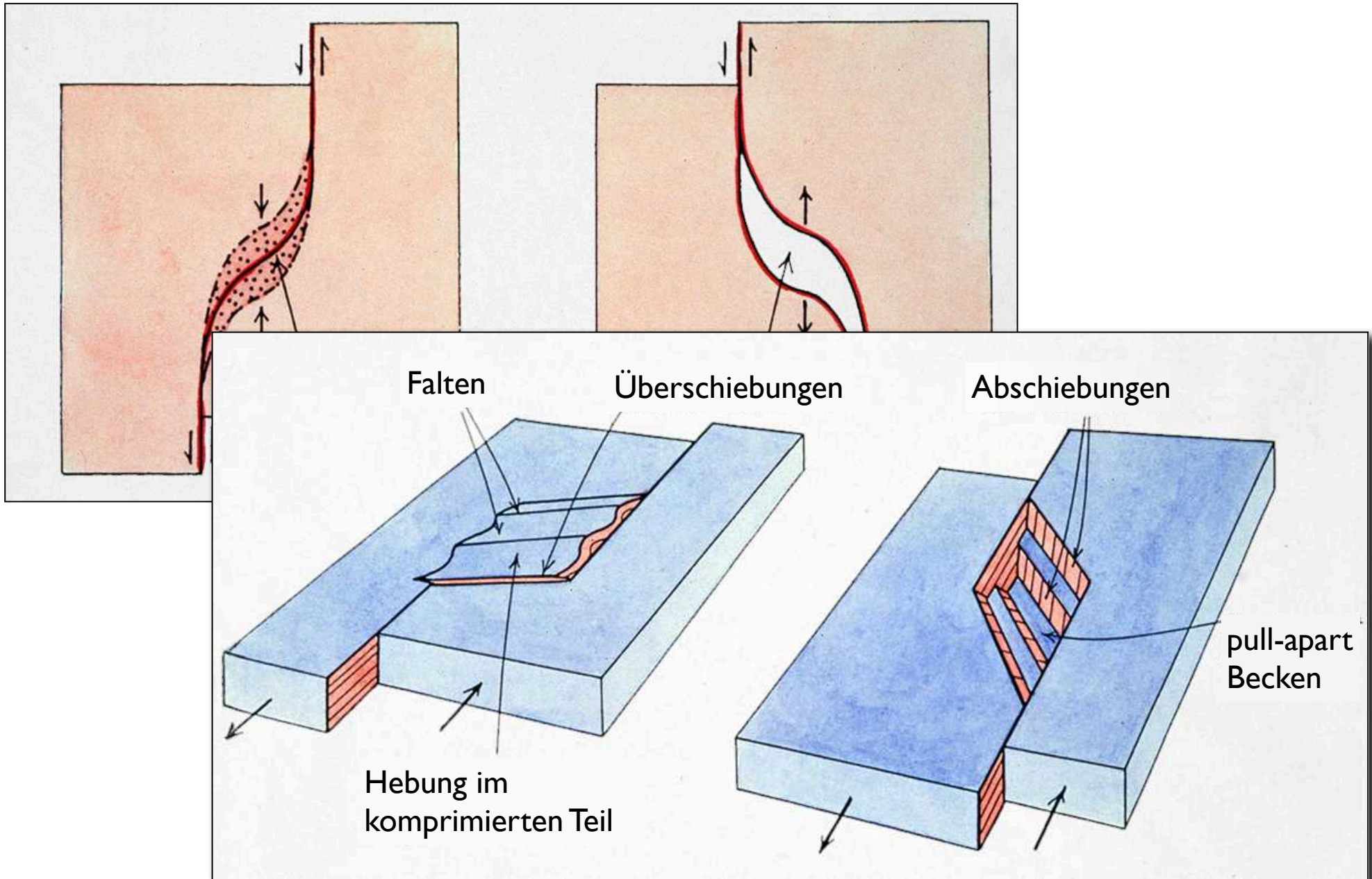
Transform Plattengrenze



Transform - Plattengrenzen



Transpression - Transtension



San Andreas Fault, California



San Andreas Fault, California

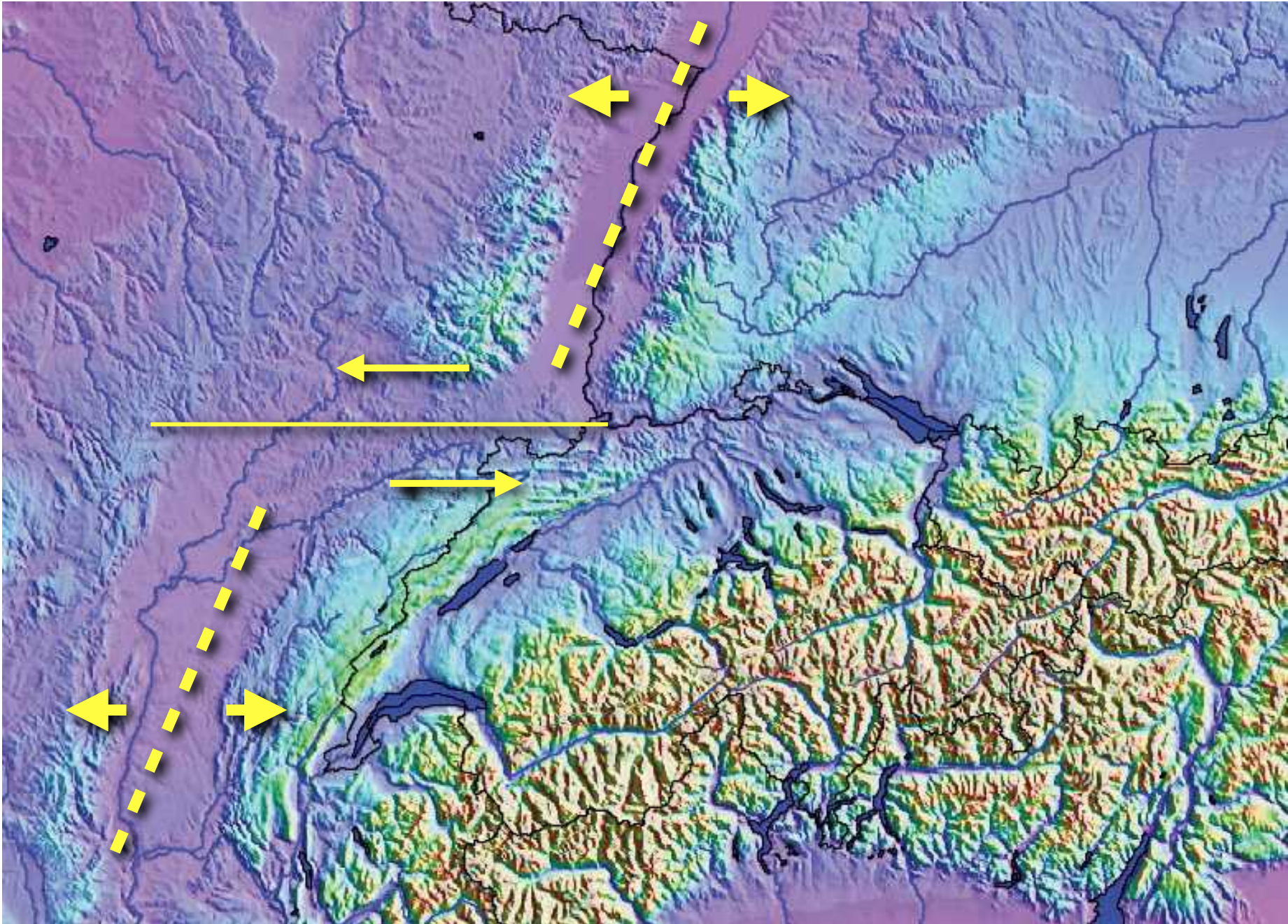


San Andreas Fault, California



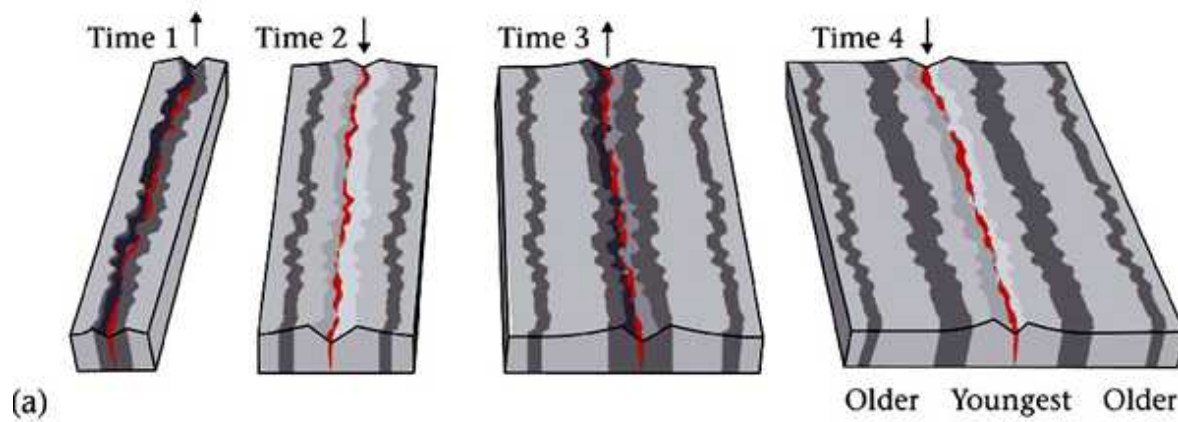
3x überhöht

Transform Rhein- Bresse- Graben

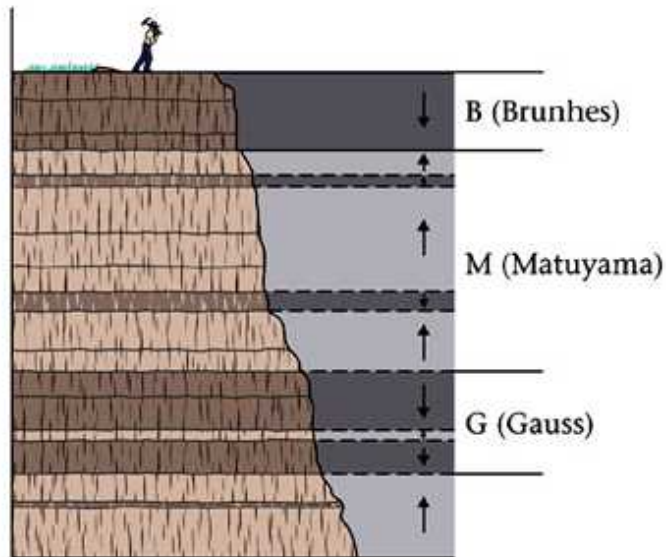


Platten- bewegungen

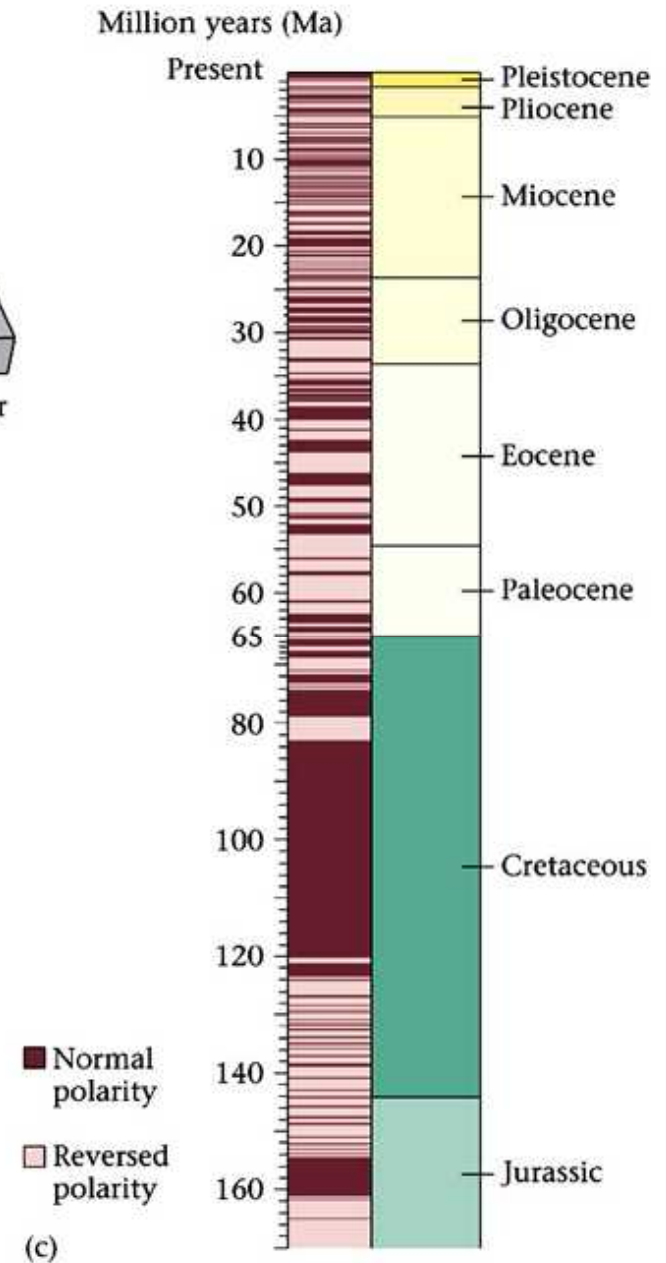
Magnetische Lineationen



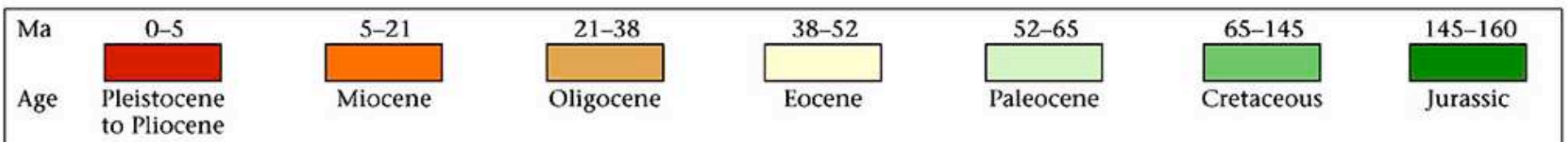
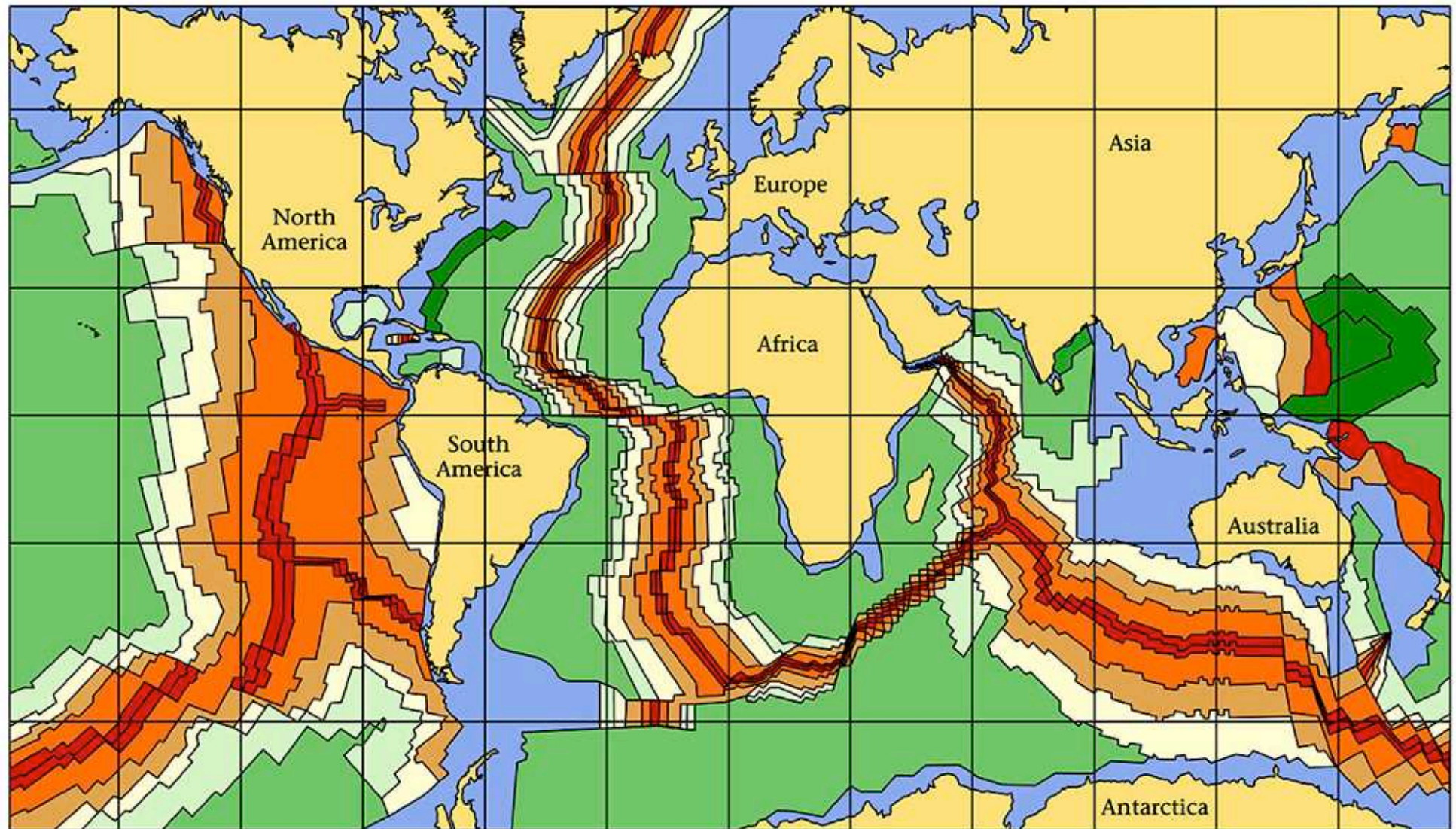
(a)



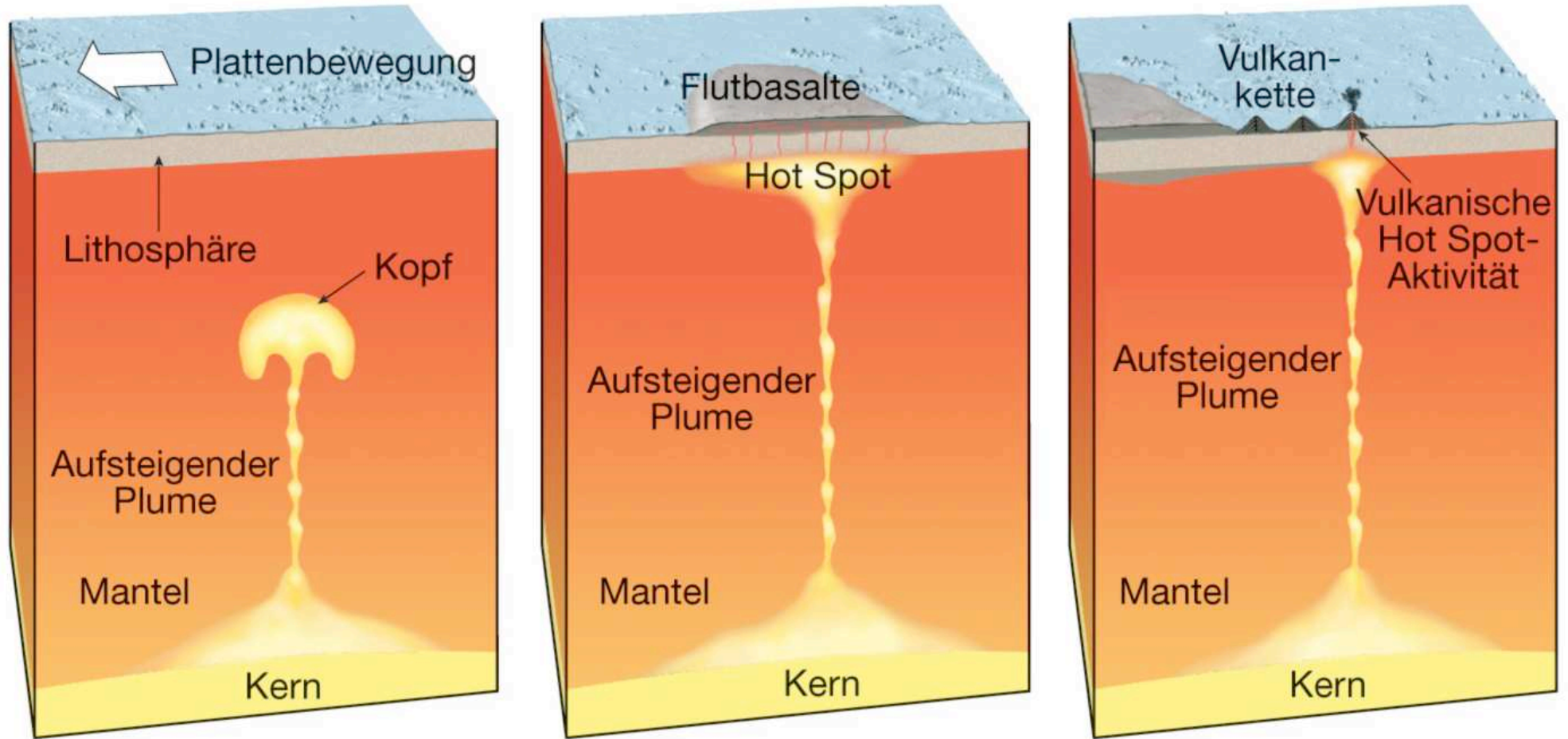
(b) Vertical sequence of basalt flows on continent



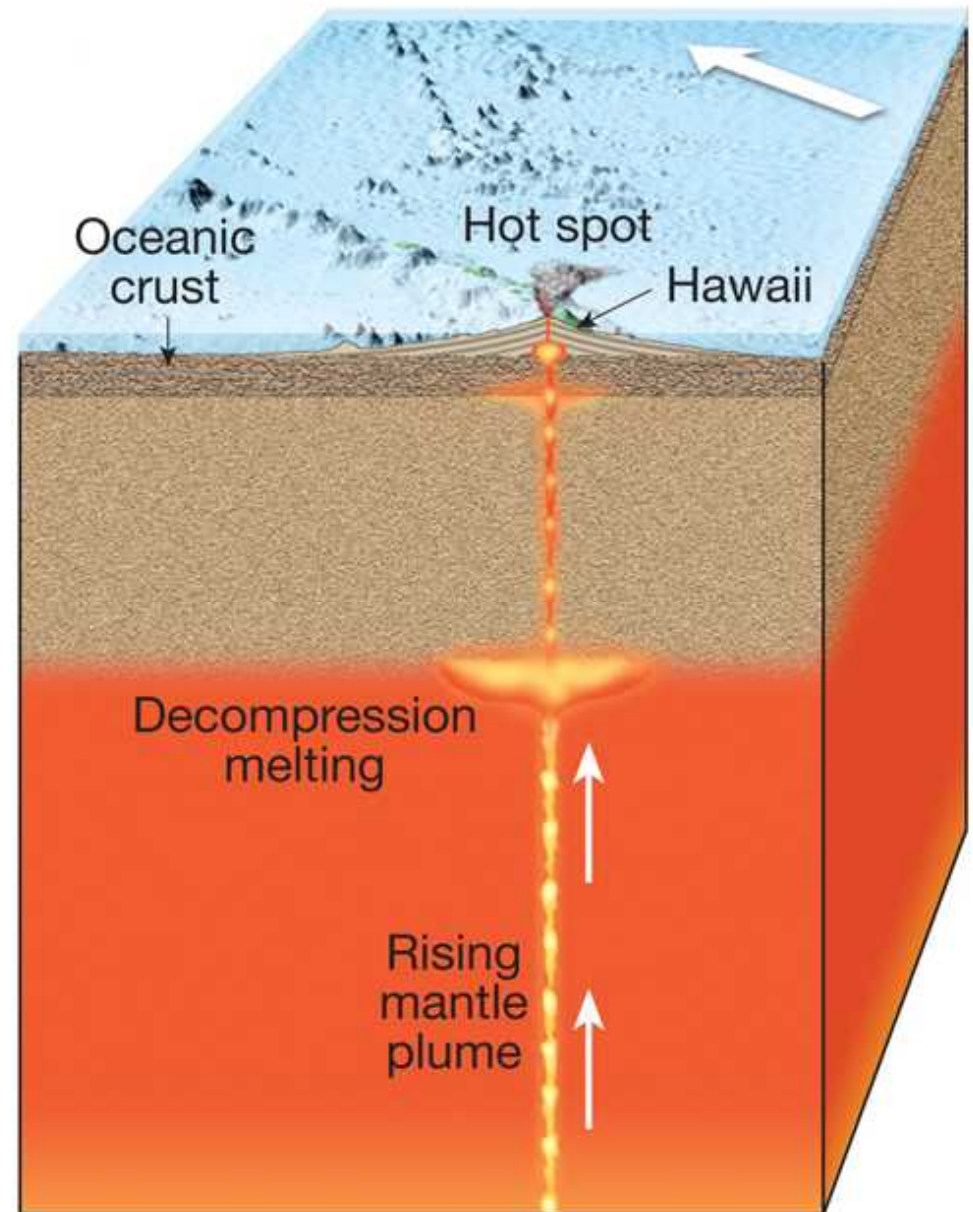
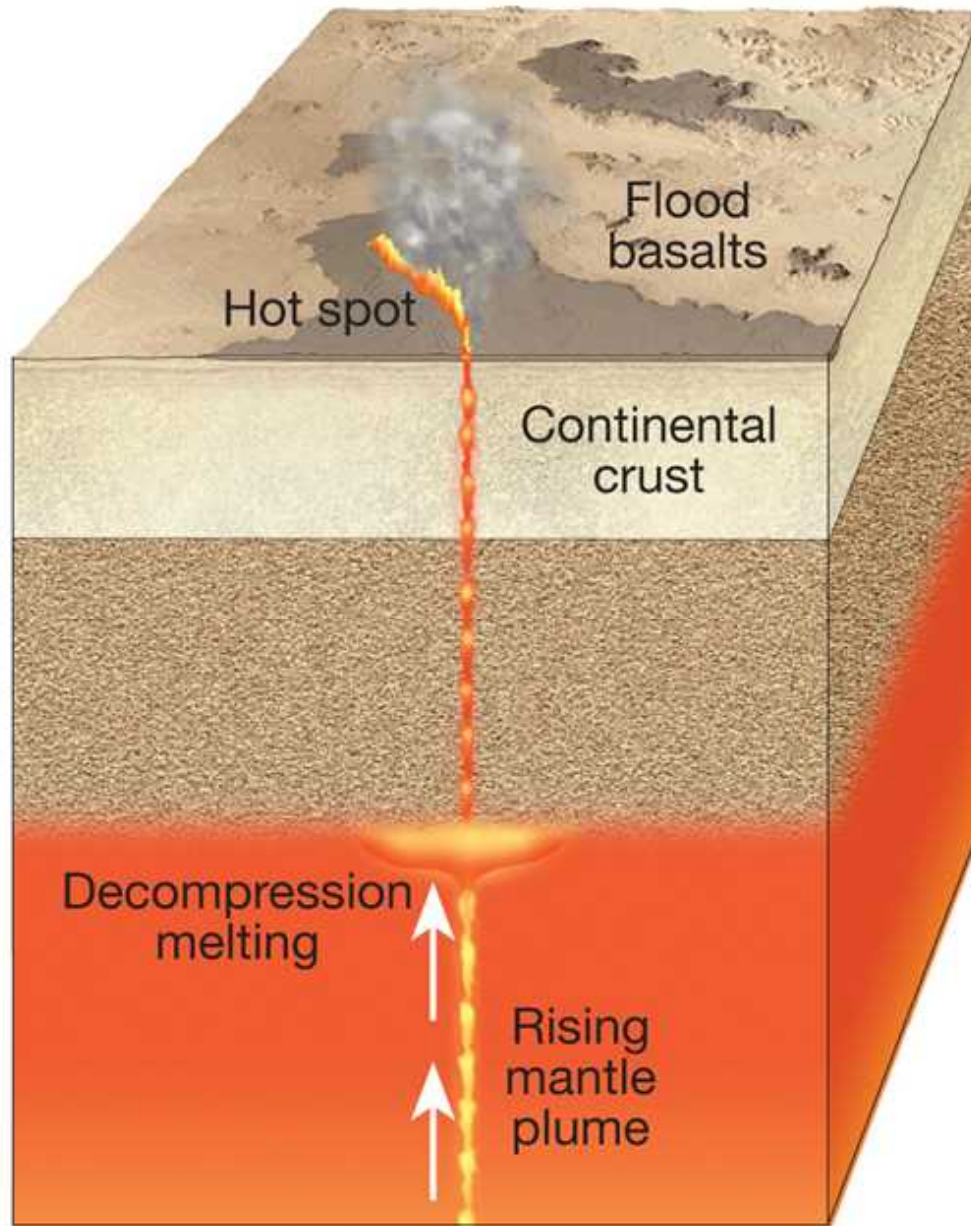
Plattengeschwindigkeiten



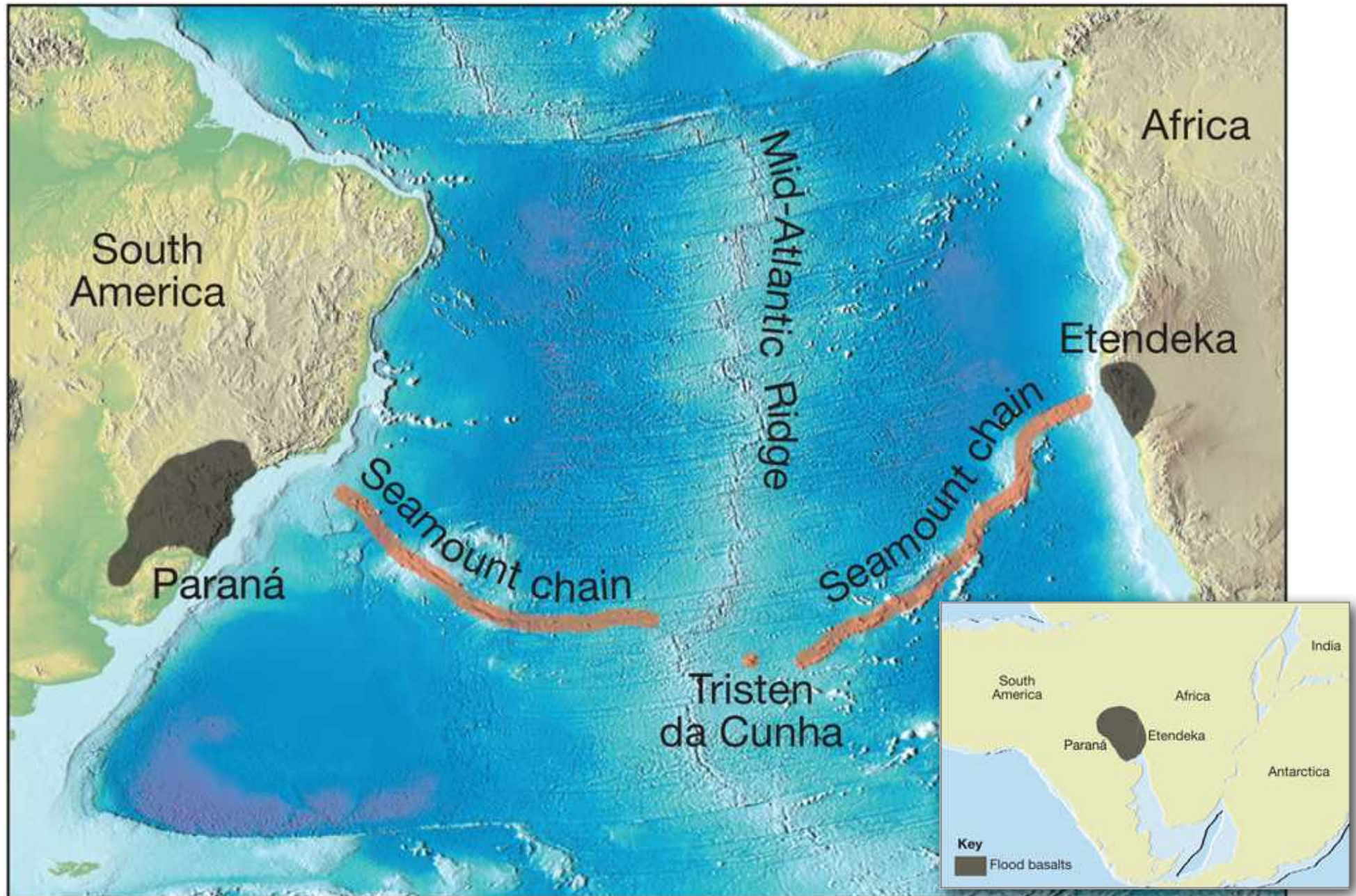
Hot Spots & Mantle Plumes



Hot Spots - Flutbasalte

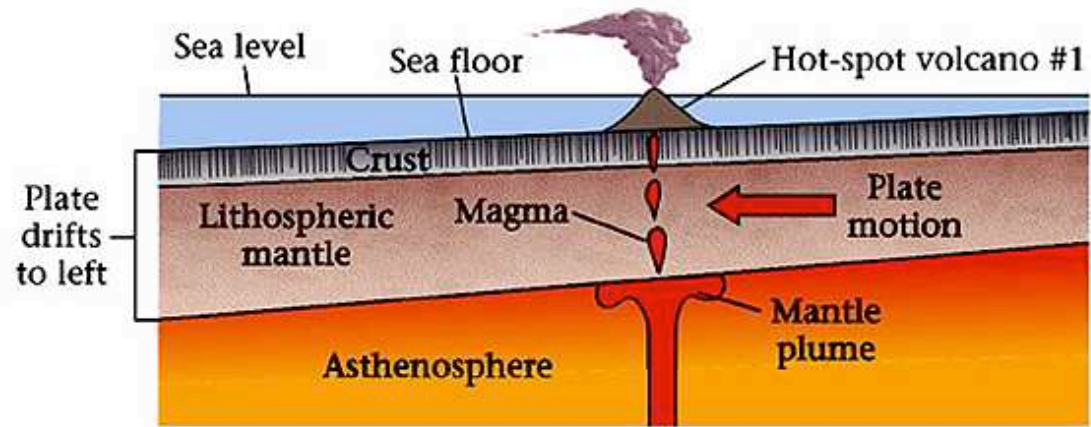


Hot Spot am Beginn der Grabenbildung

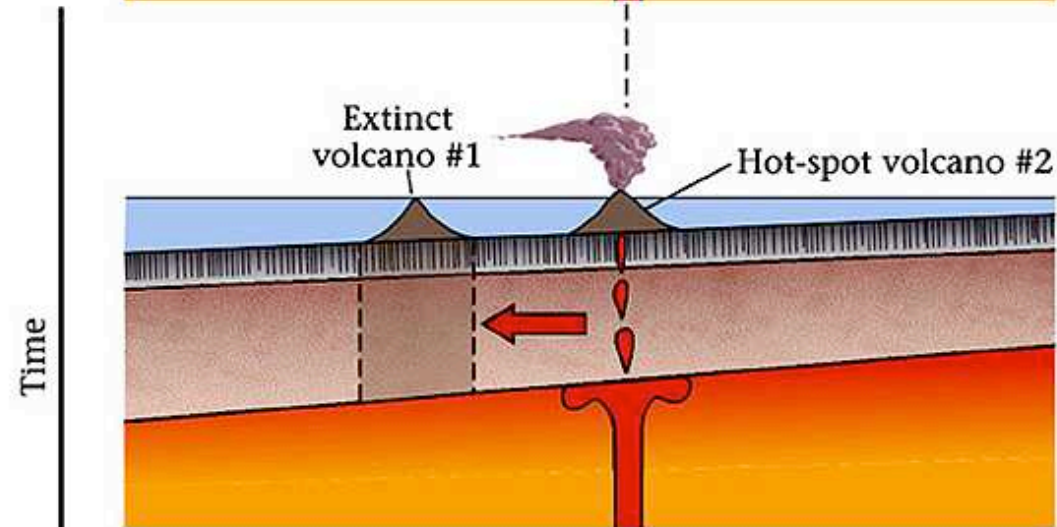


Hot spot

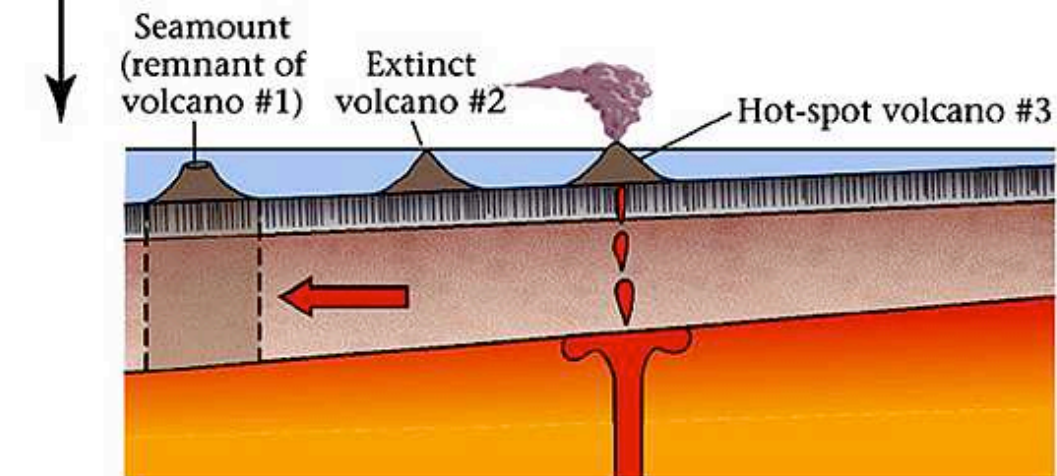
Zeit 1



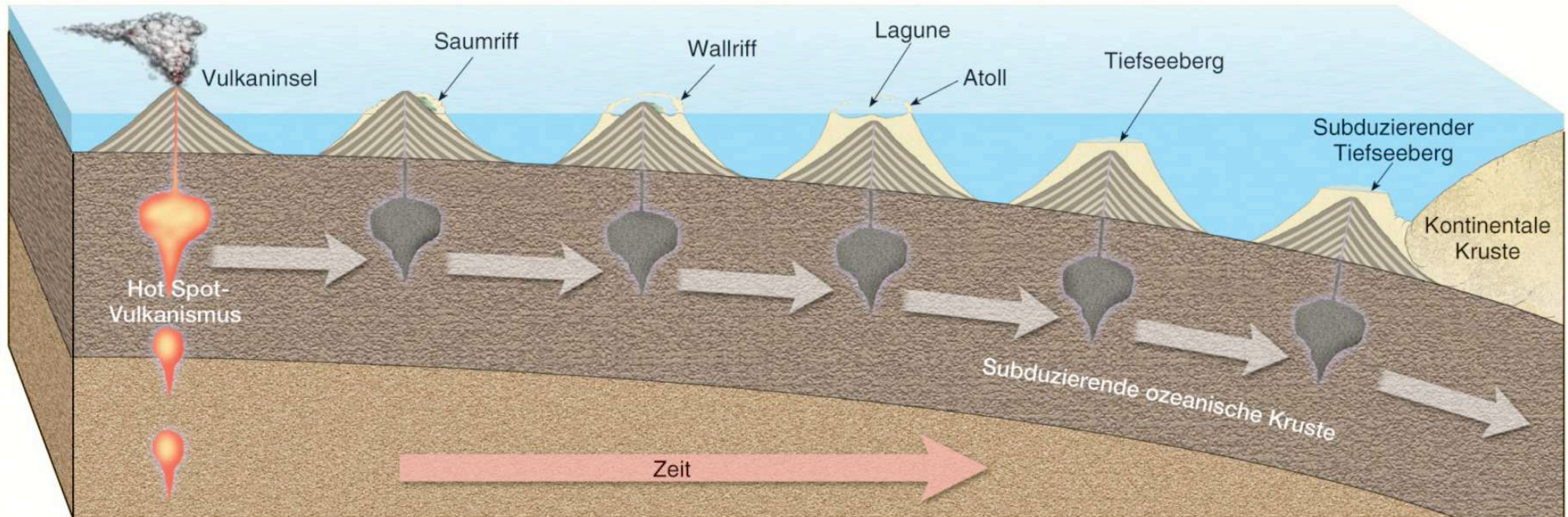
Zeit 2



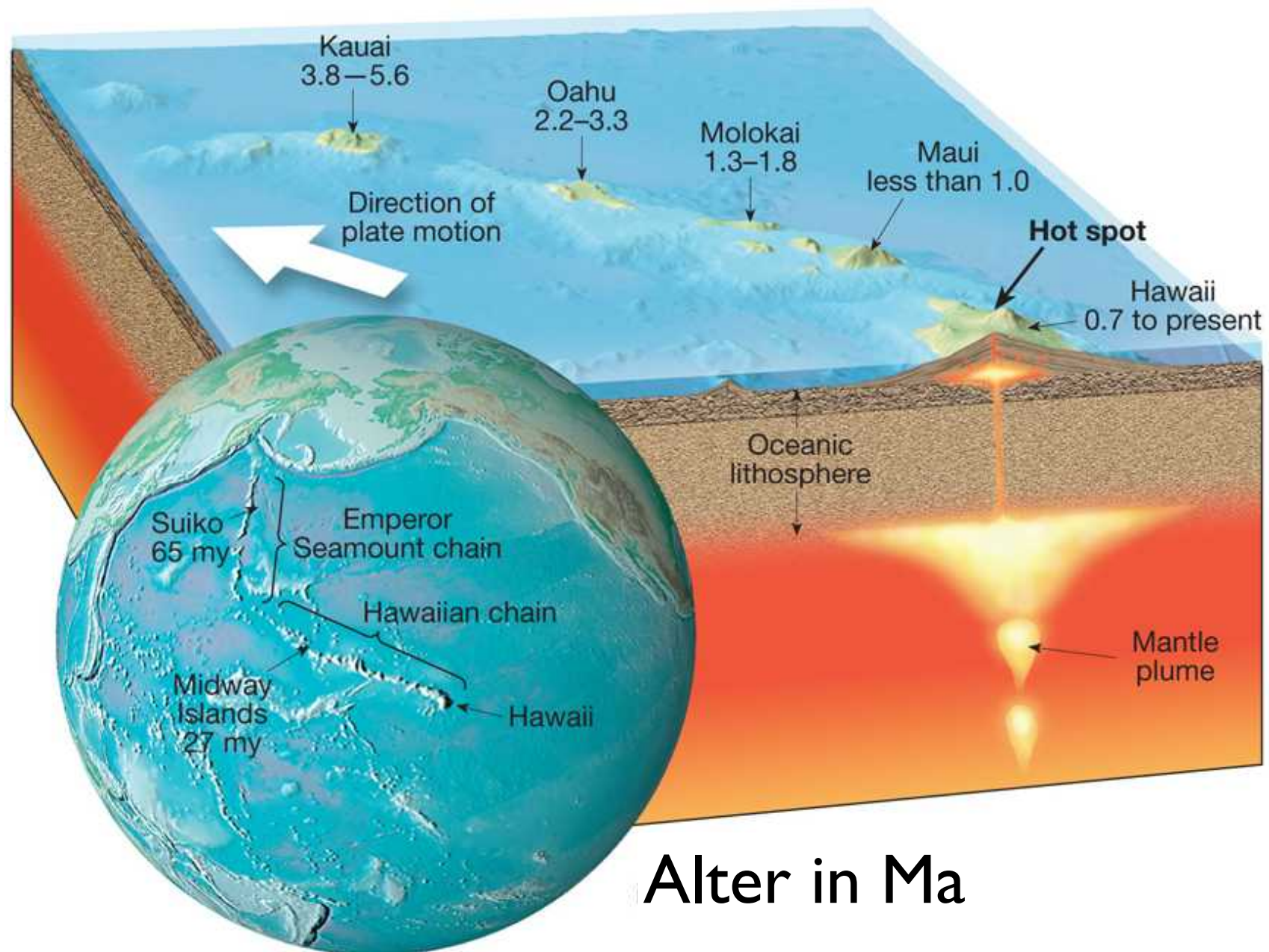
Zeit 3



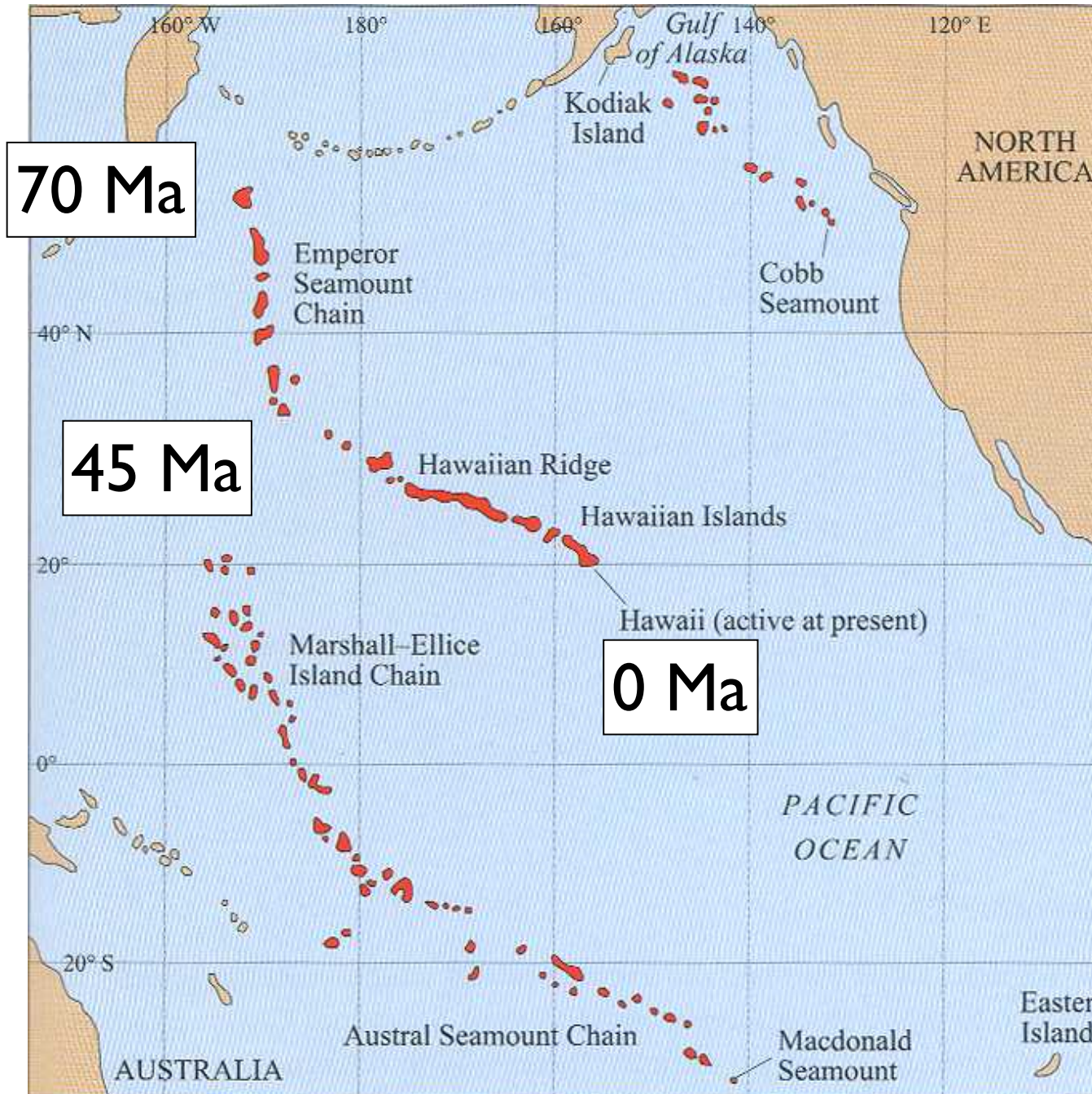
Hot Spot - Atoll - Tiefseeberg



The Hawaiian Islands



Absolute Plattenbewegung



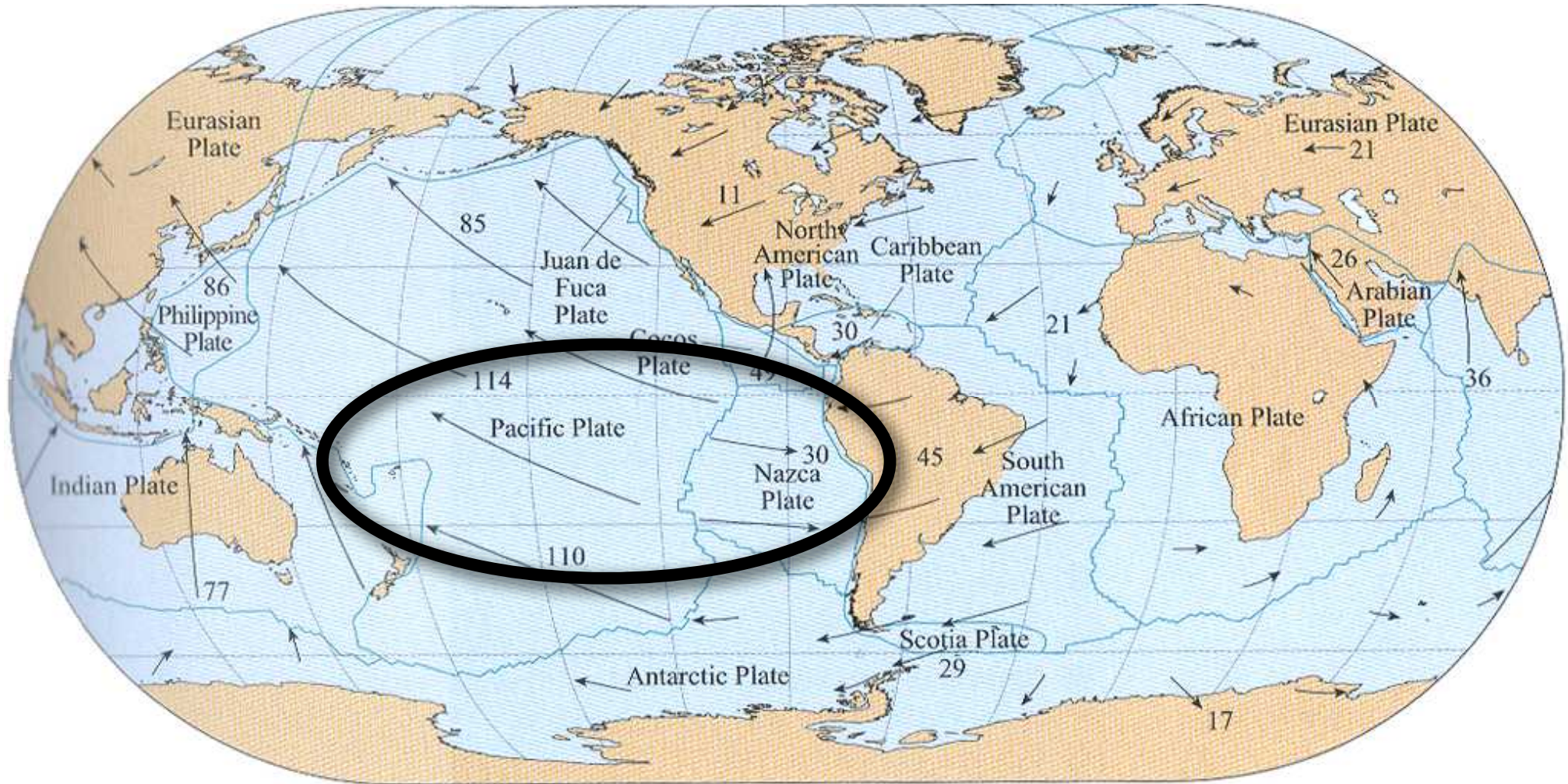
Hawaii -
Emperor
Seamount
Chain

Länge 6000km

Zeit: 70 Ma

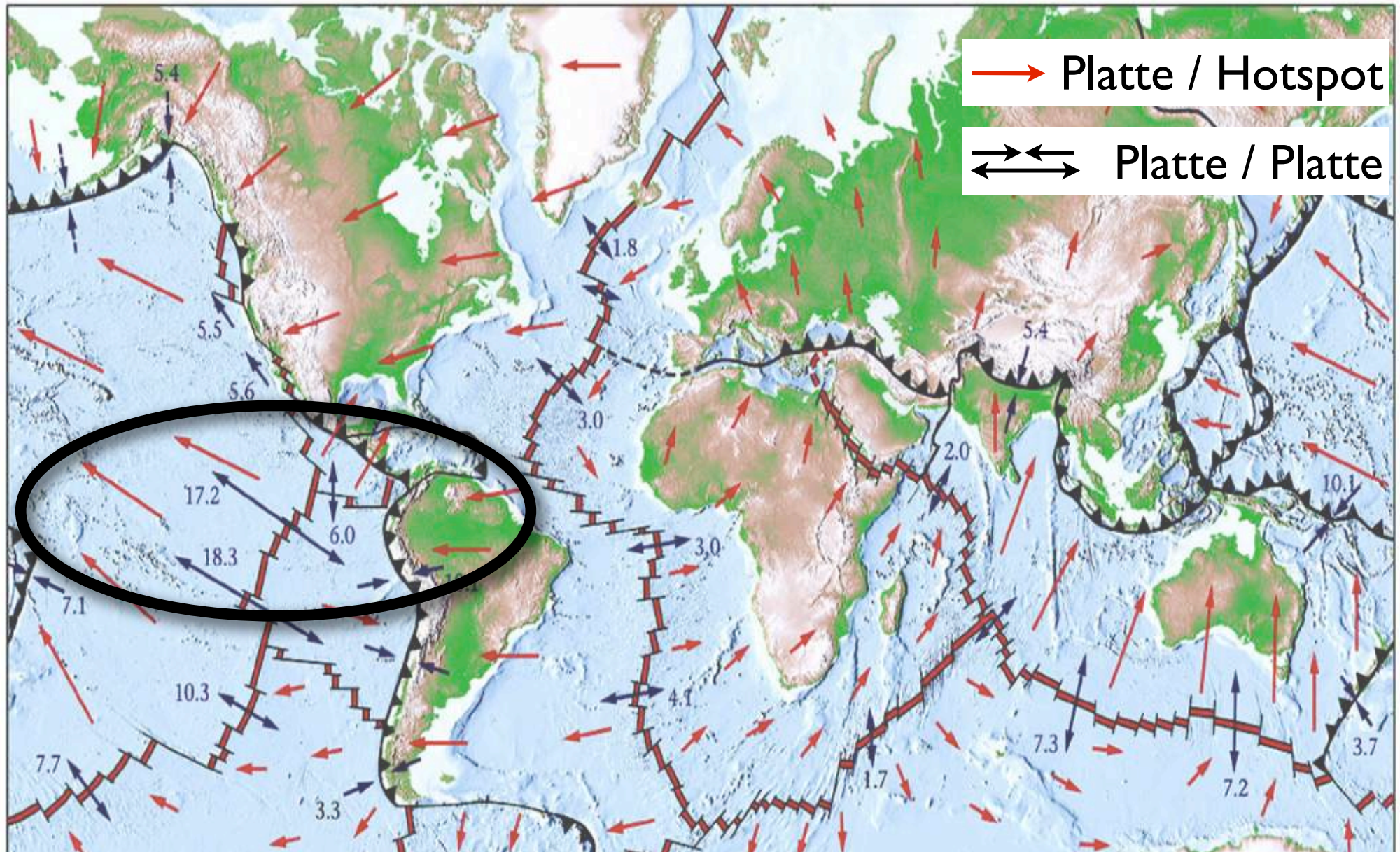
≈ 9 cm / Jahr

Absolute Plattenbewegung



bezüglich Hot Spots (mm a⁻¹)

Plattengeschwindigkeiten



▲▲▲ destruktive — konstruktive — Transform