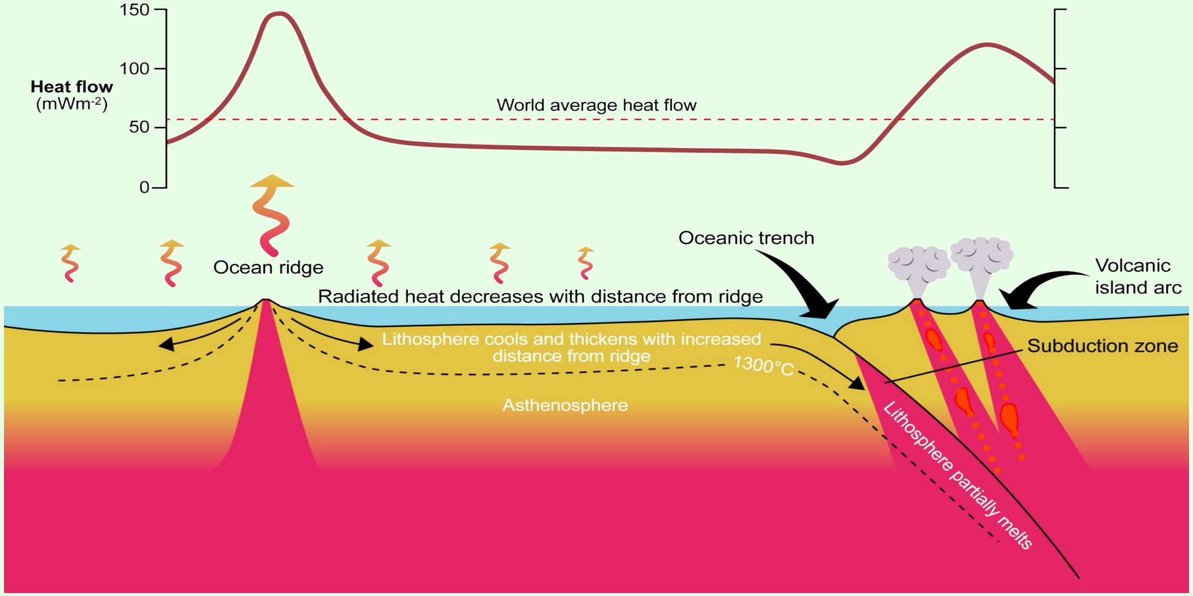
The plate tectonic story – online
Part 2

Earth Science for science and geography – video workshop



Developed from the Earth Science Education Unit 'The plate tectonic story' workshop, with permission

www.earthlearningidea.com
Earth Learning Idea
Innovative, Earth-related teaching ideas

Teaching Earthlearningideas

The plate tectonic story

- **Divergent margins**

Go to: https://www.earthlearningidea.com/Video/V29_Divergent_margins1.html hyperlink

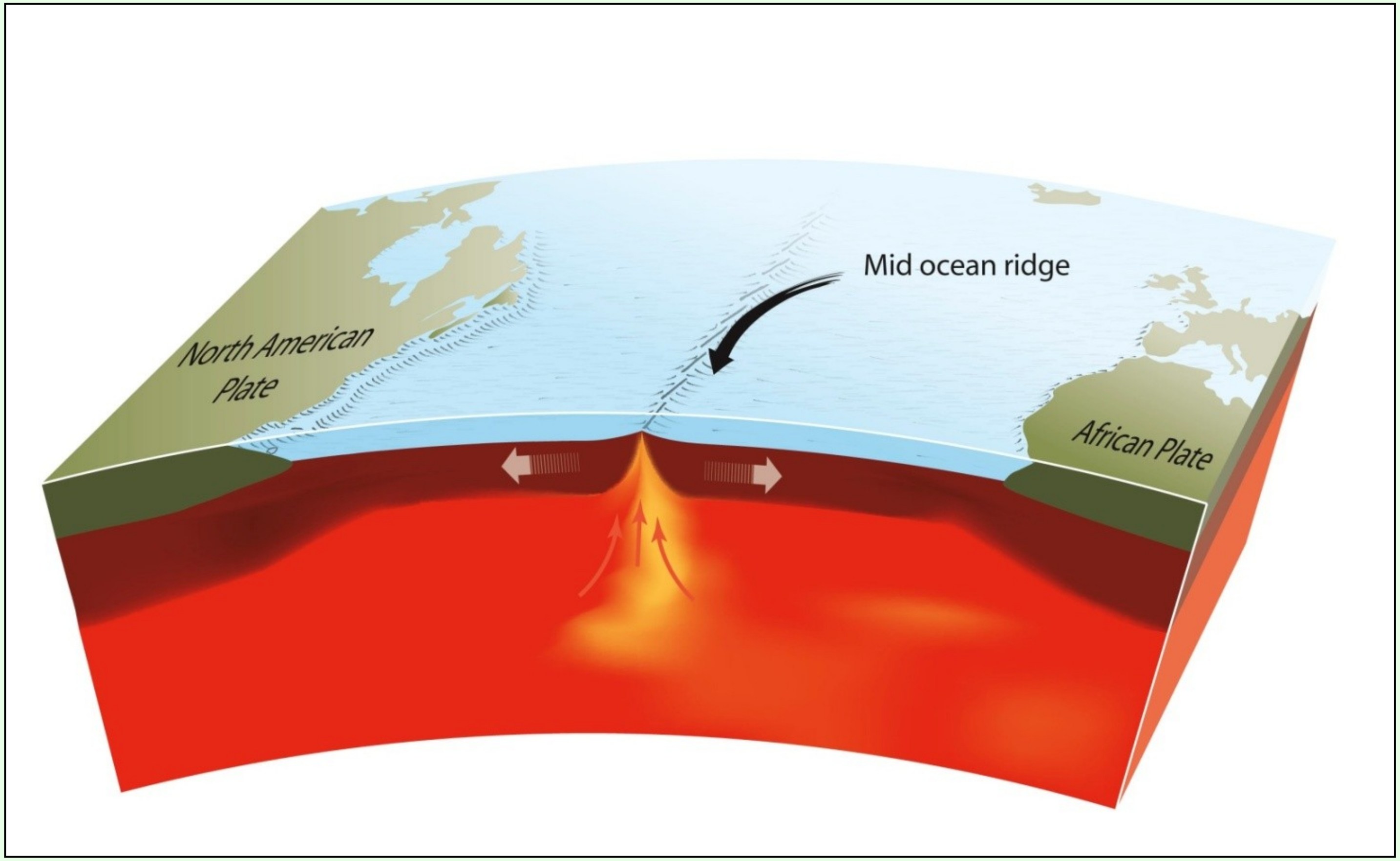
The plate tectonic story

Divergent plate margins -
adding new plate material

Underwater basalt lava at a divergent margin in the public domain by Vintei

The plate tectonic story

Activity at an oceanic ridge – a divergent plate margin



An oceanic ridge © Press & Siever, redrawn by ESEU

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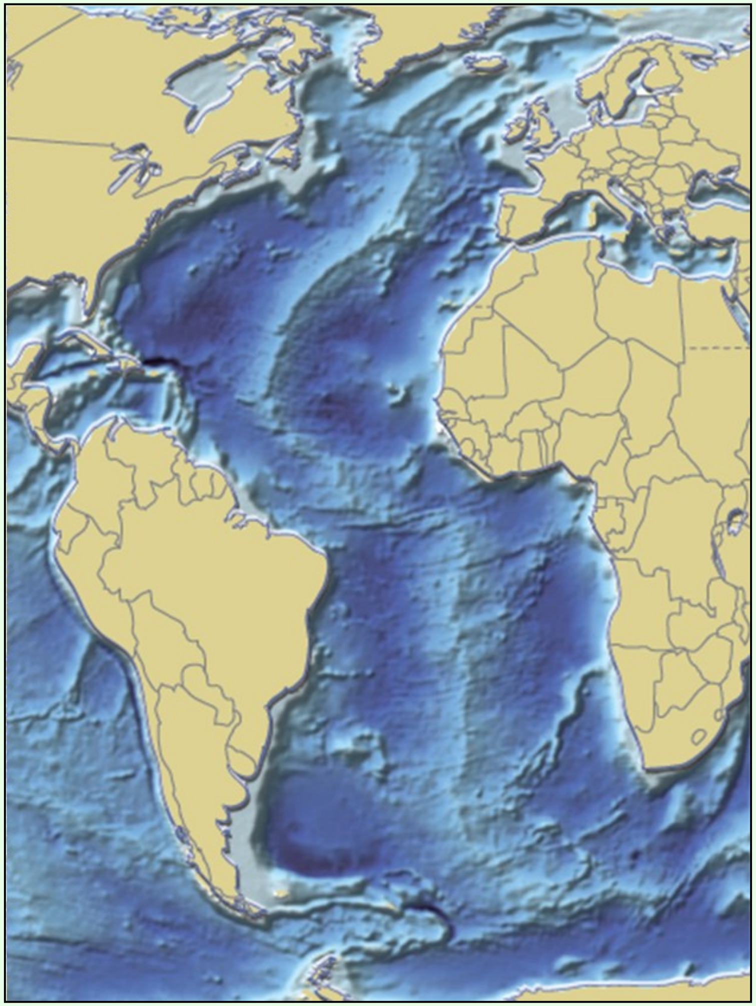
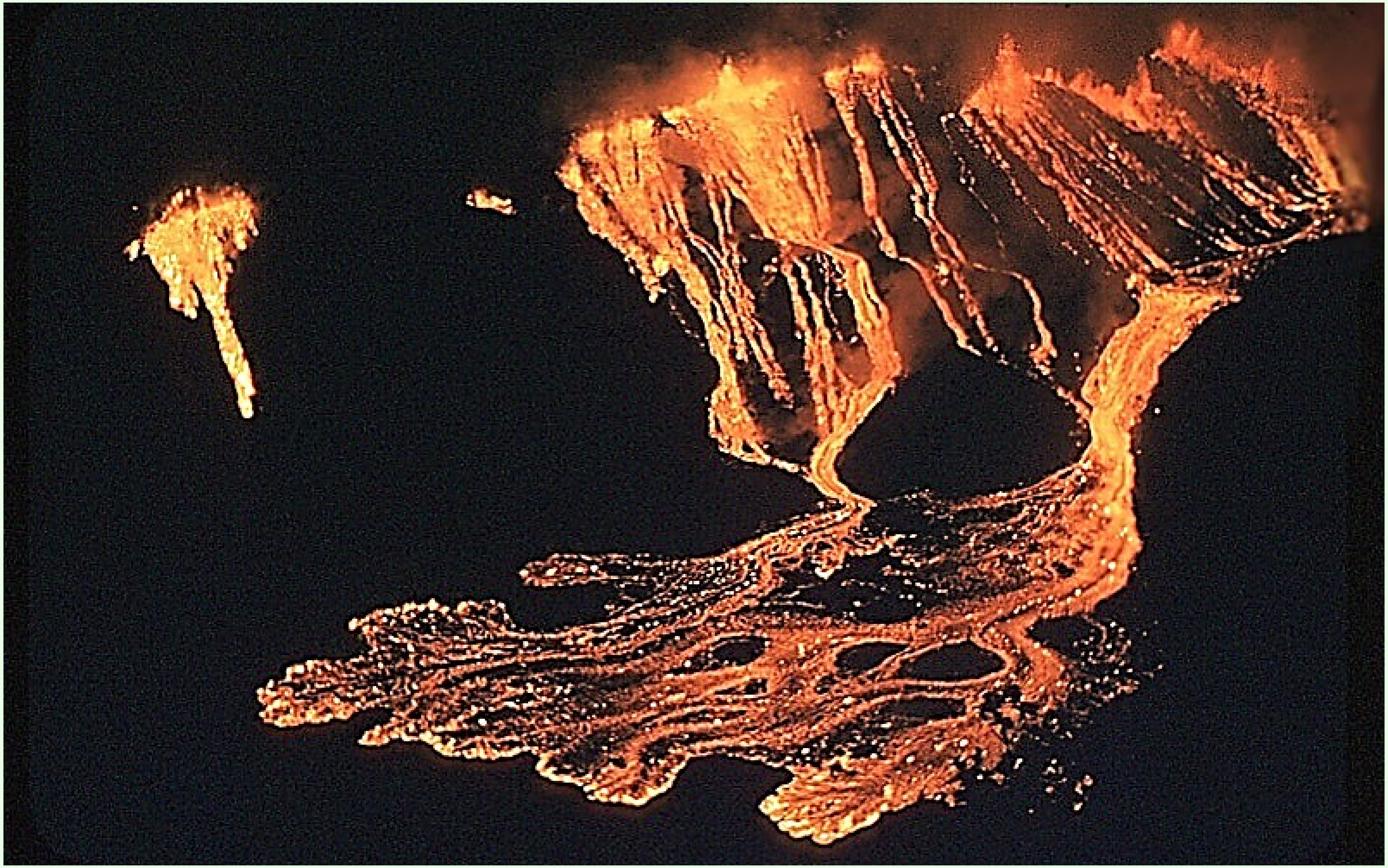
Mid-Atlantic ridge



http://maps.grida.no/go/graphic/world-ocean-bathymetric-map
(Hugo Ahlenius, UNEP/GRID-Arendal)

The plate tectonic story

Icelandic-type eruption



Icelandic-type eruption - reproduced with kind permission of U.S. Department of Interior, USGS

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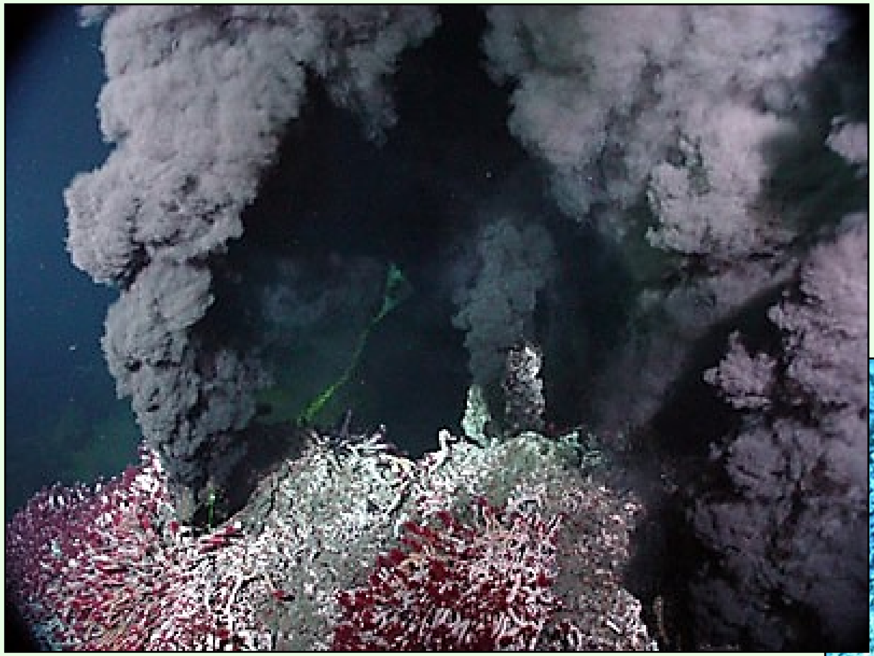
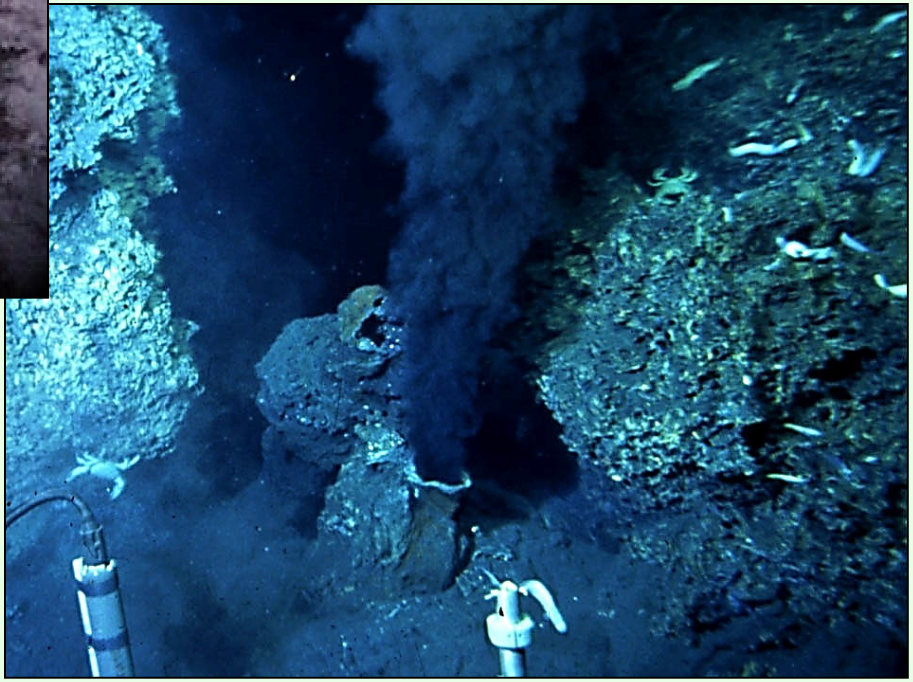
Ancient pillow lavas

Ancient Pillow lavas © Peter Kennett

The plate tectonic story

Black smoker activity





Black Smoker' by US National Oceanic & Atmospheric Administration (public domain)

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The plate tectonic story

- **Faults in a Mars™ bar**

Go to: https://www.earthlearningidea.com/Video/V29_Divergent_margins2.html
hyperlink

The plate tectonic story

Faults in a Mars™ Bar
Modelling a divergent plate margin

Gap between the North American and Eurasian continental plates © Randomskk

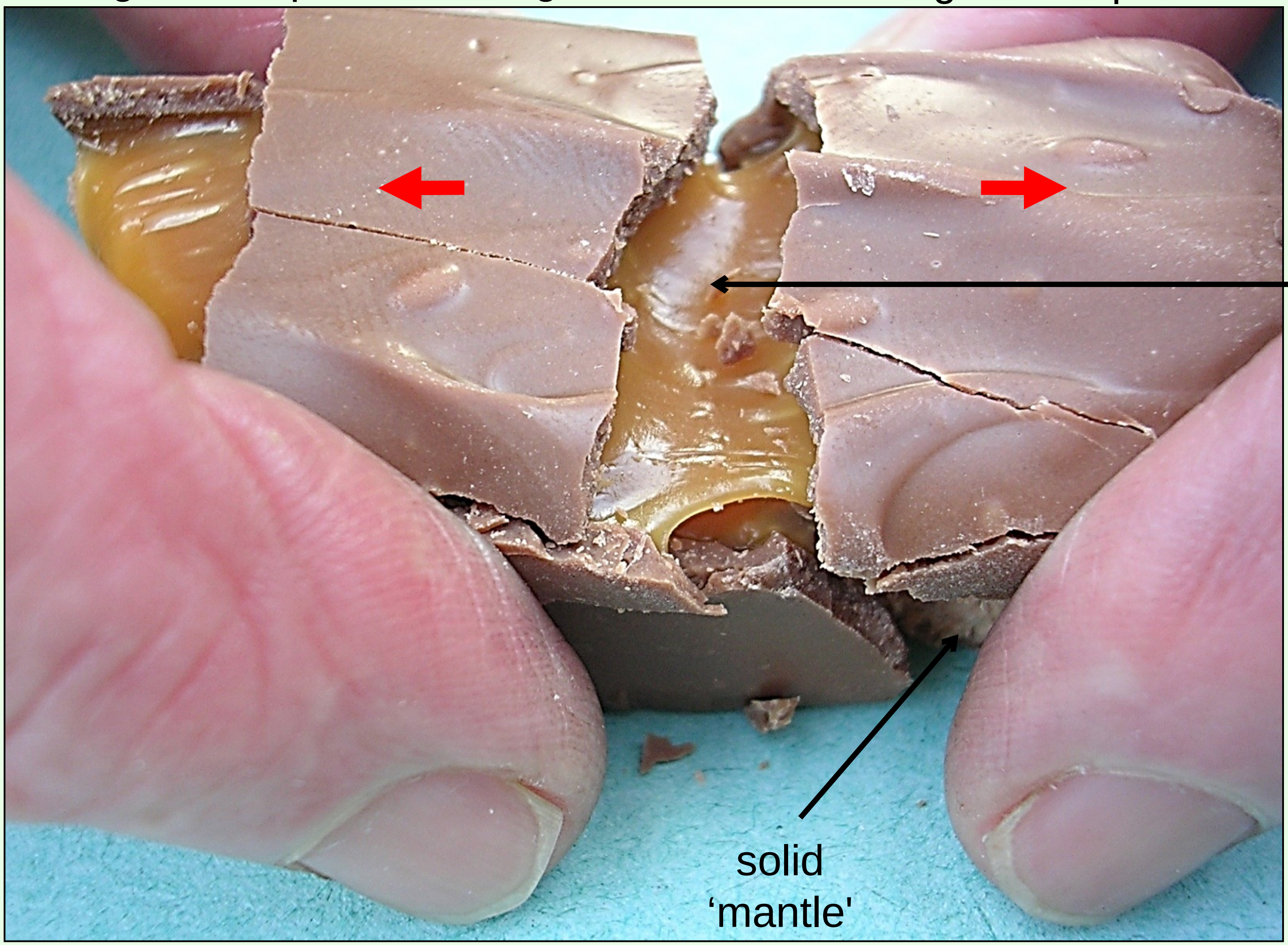
The plate tectonic story

Faults in a Mars™ Bar

Faults in a Mars™ Bar (A rift valley) © Peter Kennett

The plate tectonic story

Faults in a Mars™ Bar



Faults in a Mars™ Bar (A rift valley)

The plate tectonic story

A divergent margin rift valley on land
Iceland

Gap between the North American and Eurasian continental plates © Randomskk

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The plate tectonic story

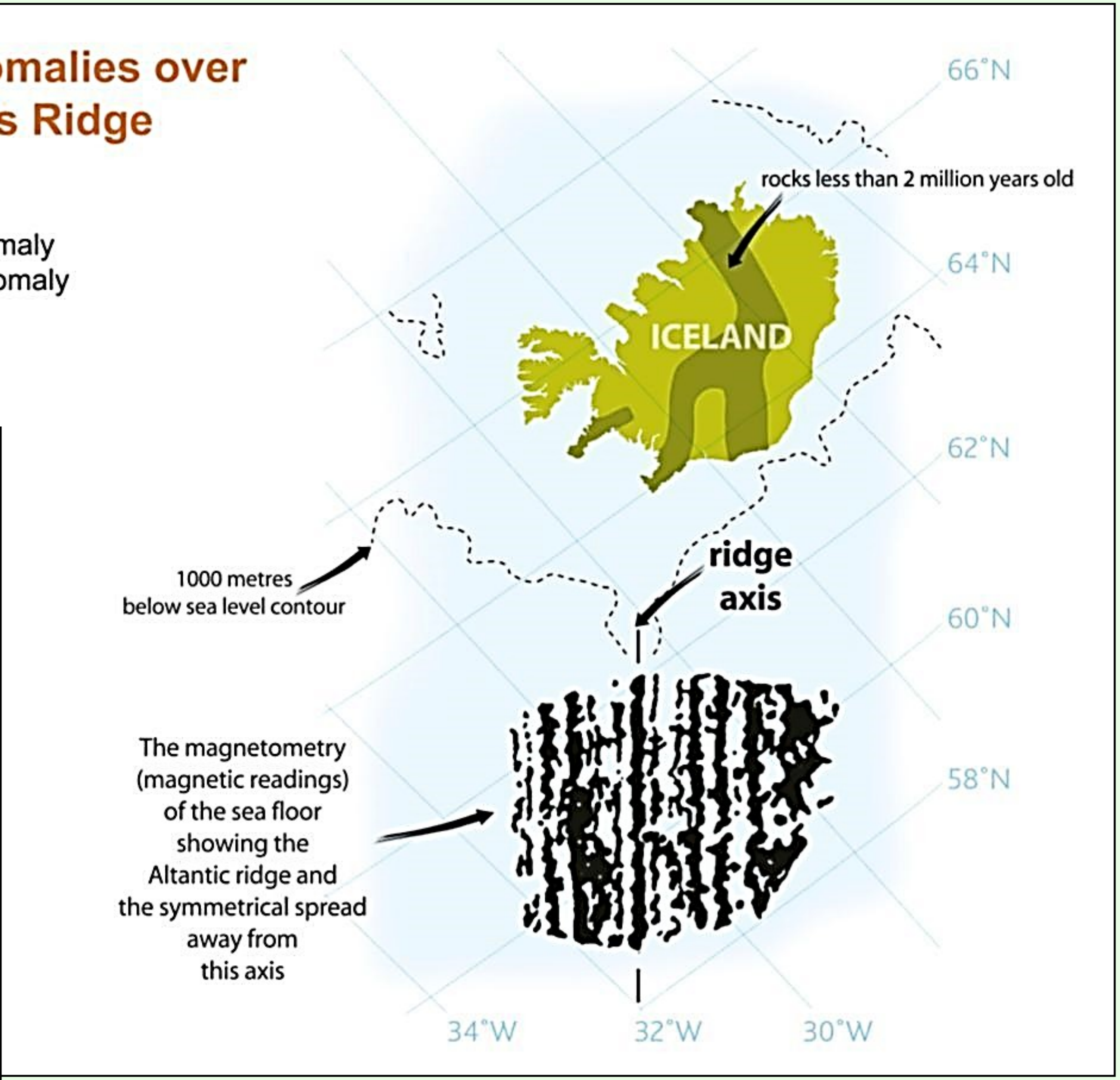
- **Magnetic stripes**

Go to: https://www.earthlearningidea.com/Video/V30_Magnetic_stripes.html hyperlink

The plate tectonic story

The magnetic stripes evidence

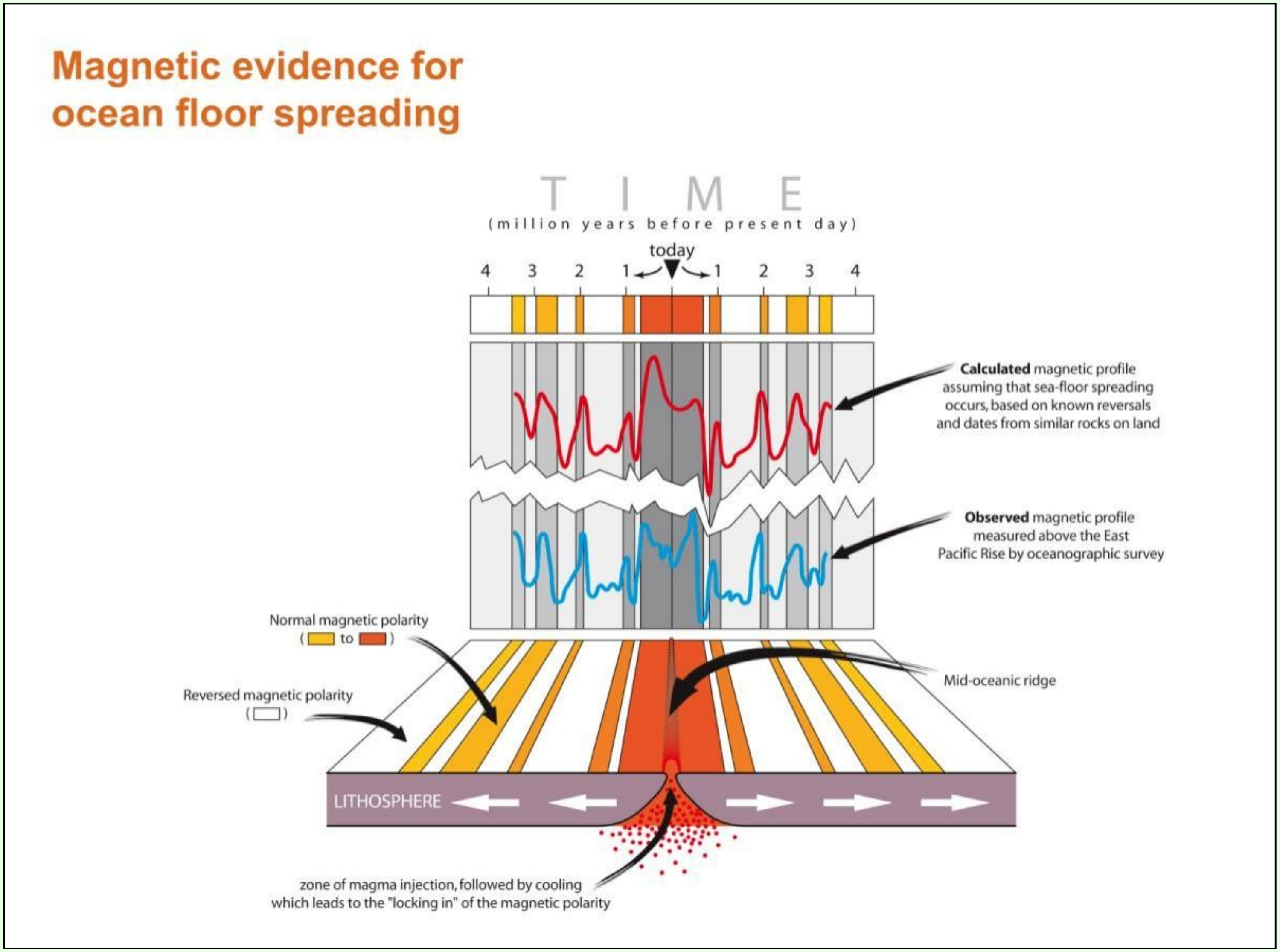
The plate tectonic story



The equipment used to show magnetic anomalies © Peter Kennett

Magnetic anomalies over the Reykjanes Ridge © Geoscience, redrawn by ESEU

The plate tectonic story



Magnetic evidence for ocean floor spreading © This Dynamic Earth: the Story of Plate Tectonics, USGS, redrawn by ESEU

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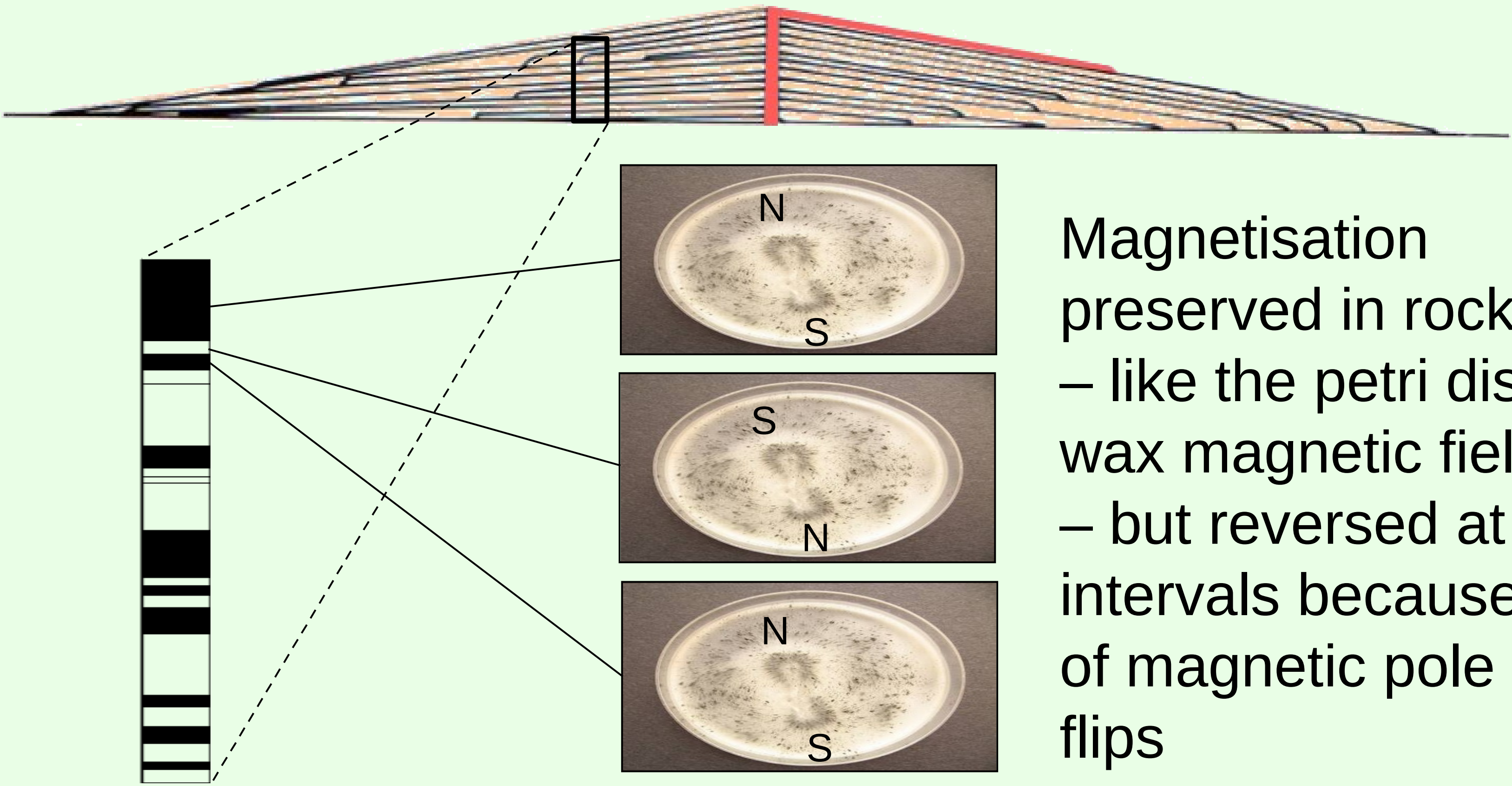
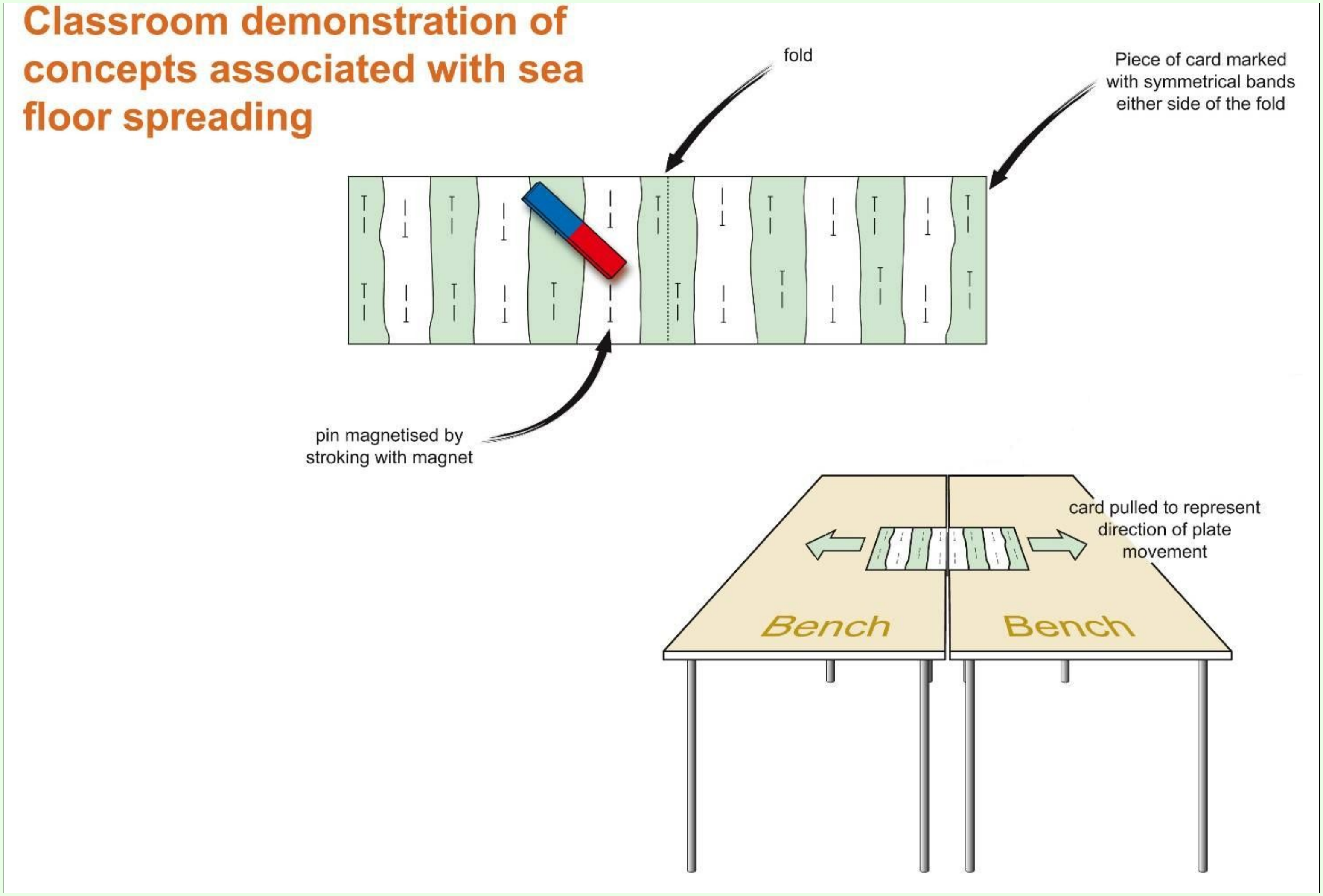
Meanwhile, it had been found from sequences of volcanic lava flows that the Earth’s magnetic field had ‘flipped’ many times in the geological past



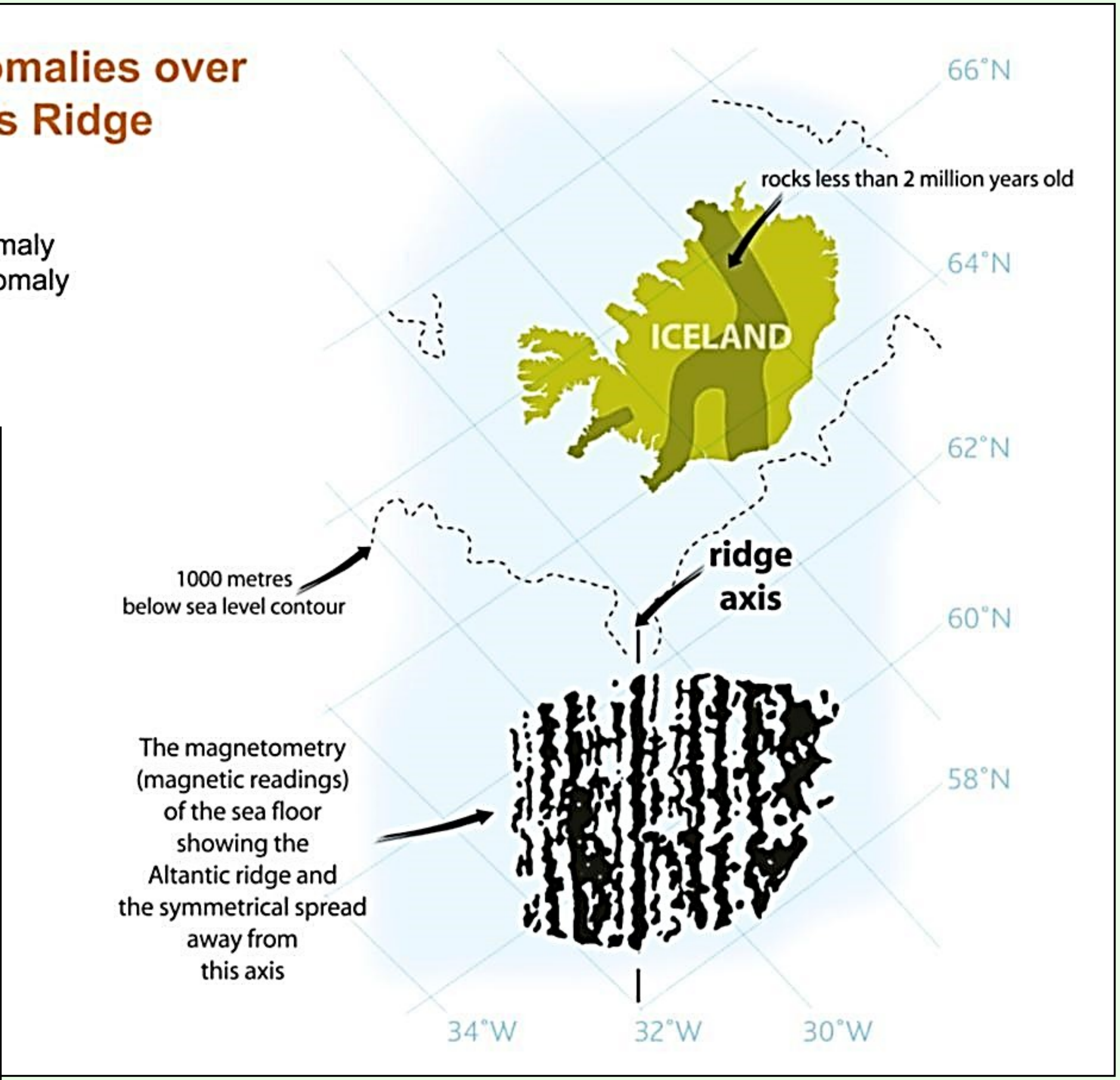
Magnetisation preserved in rocks – like the petri dish wax magnetic field – but reversed at intervals because of magnetic pole flips

The plate tectonic story



Classroom demonstration of concepts associated with sea floor spreading © ESTA redrawn by ESEU

The plate tectonic story

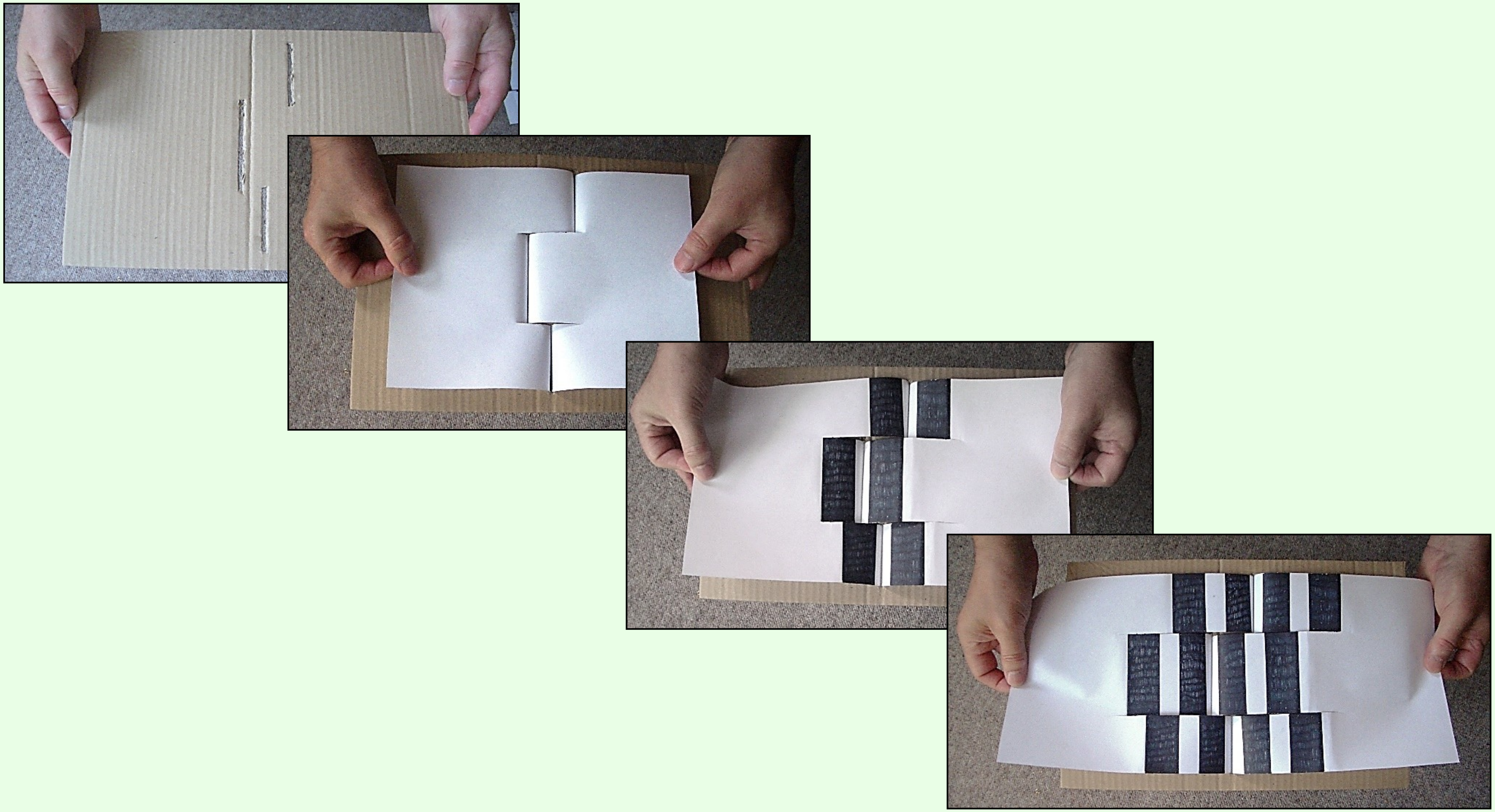


The equipment used to show magnetic anomalies © Peter Kennett

Magnetic anomalies over the Reykjanes Ridge © Geoscience, redrawn by ESEU

The plate tectonic story

The magnetic stripes are offset by transform faults – conservative or sliding plate margins



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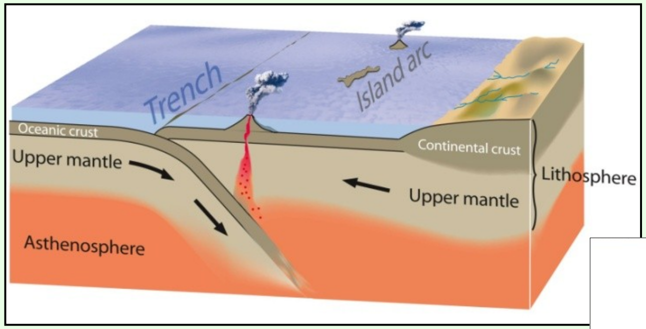
The plate tectonic story

- **Convergent margins**

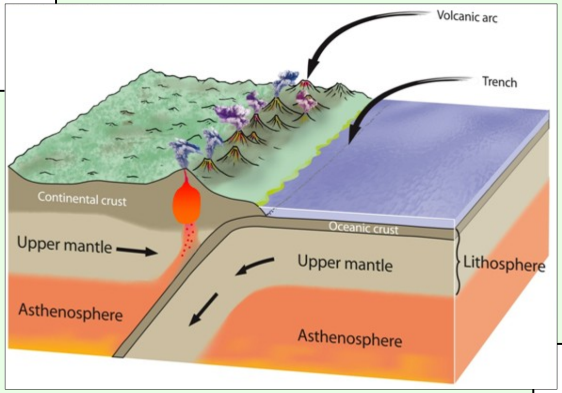
Go to: https://www.earthlearningidea.com/Video/V31_Convergent_margins.html
hyperlink

The plate tectonic story

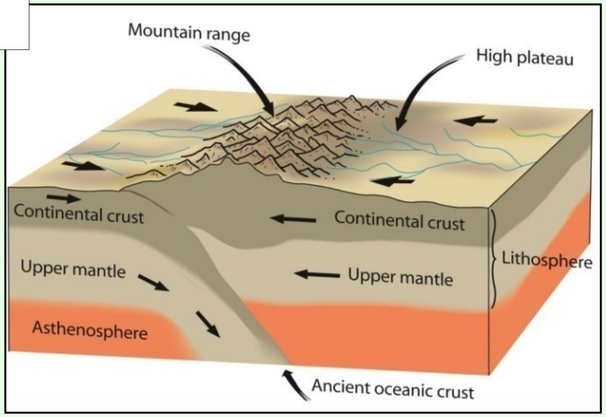
Convergent plate margins - recycling material



Continental plate collision zone. Reproduced with kind permission of USGS, redrawn by ESEU



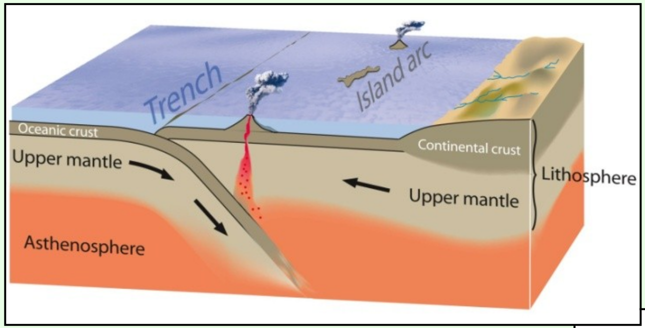
Subduction zone ('partially melts and volcanoes are produced' 'molten rock cools down below the surface') - reproduced with kind permission of USGS, redrawn by ESEU



Continental plate collision zone. Reproduced with kind permission of USGS, redrawn by ESEU

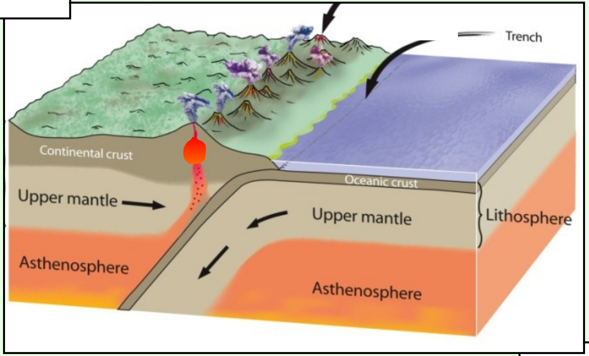
The plate tectonic story

Convergent plate margins - recycling material

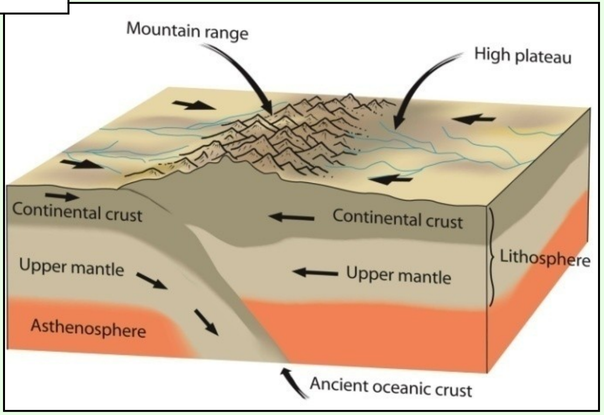


Ocean v ocean convergent plate margin
– one oceanic plate subducted beneath another

Ocean v continent convergent plate margin
– an oceanic plate subducted beneath a continental plate



Continent v continent convergent plate margin
– two continental plates colliding



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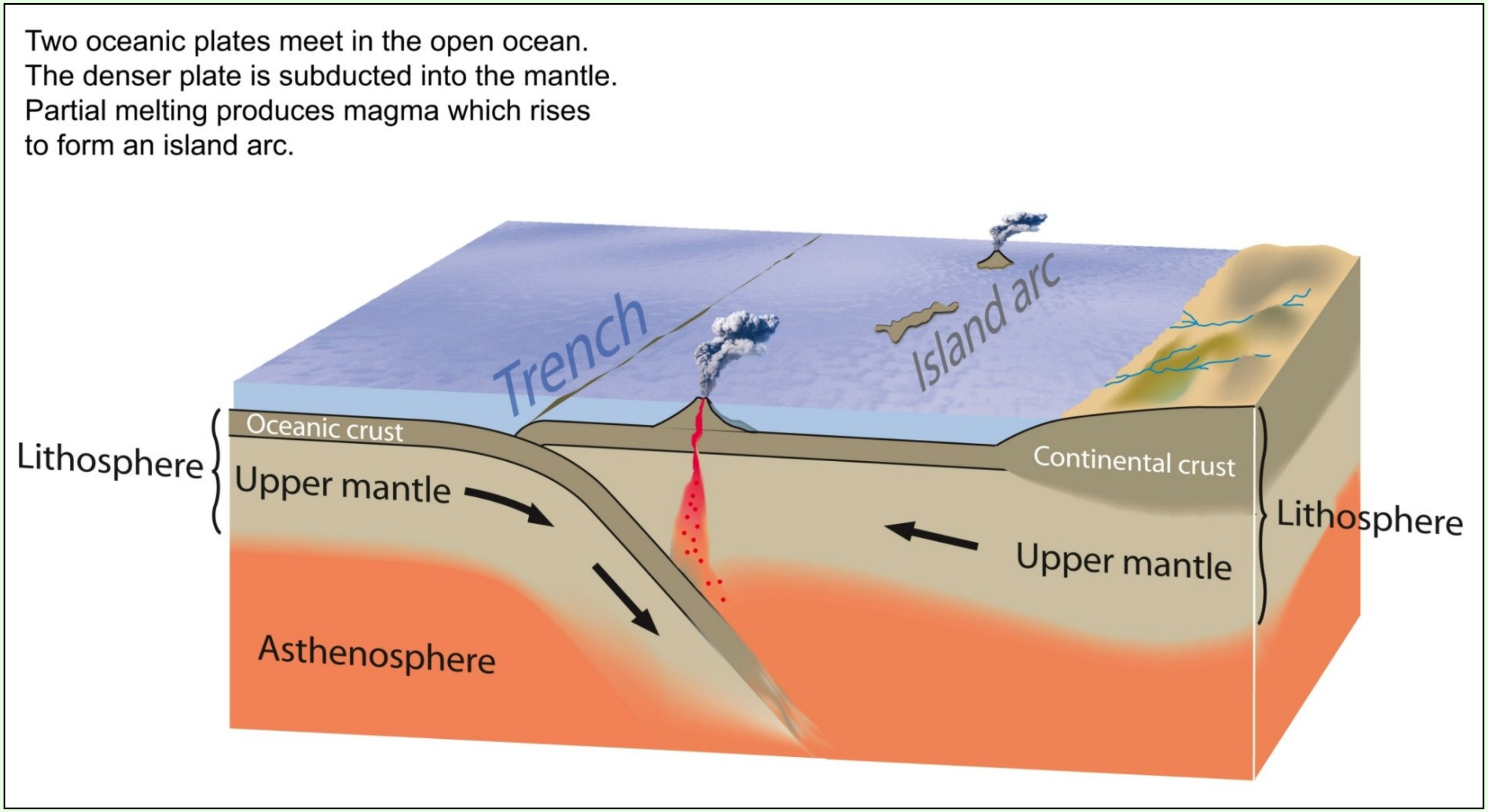
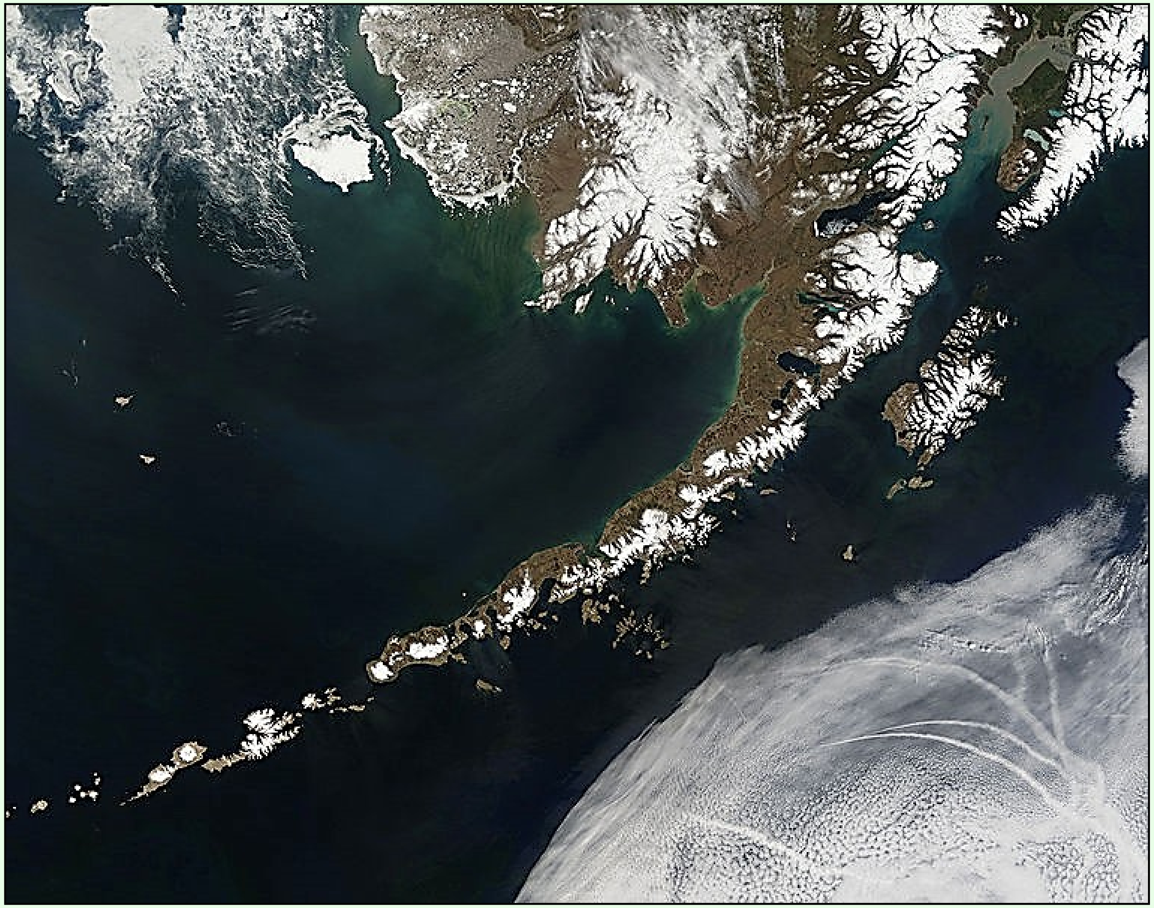
Ocean-ocean convergence



Continental plate collision zone. Reproduced with kind permission of USGS, redrawn by ESEU

The plate tectonic story

Convergent plate margins:
where plate material is recycled



‘A satellite view of the Aleutian Islands, Pacific Ocean’ by NASA (public domain)

The plate tectonic story

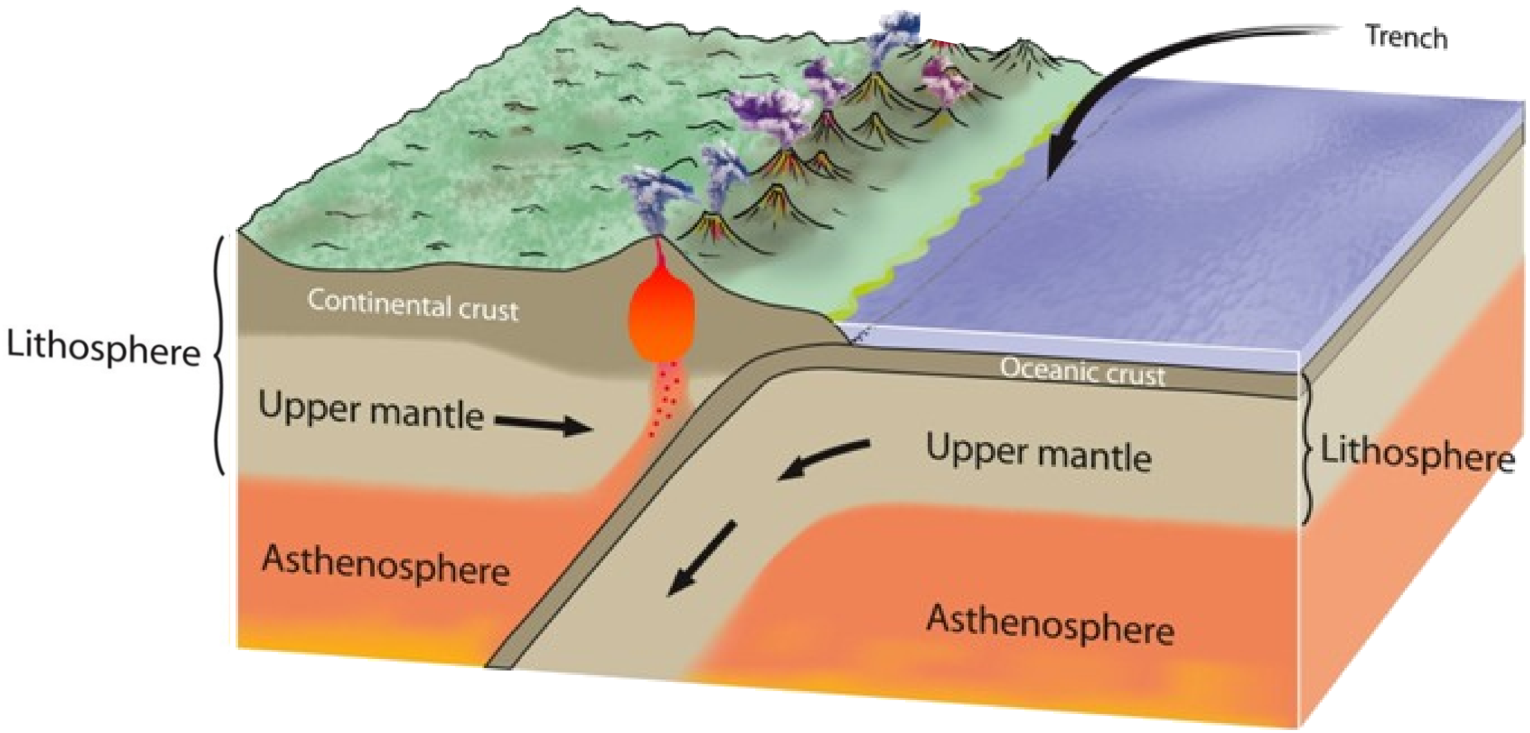
Island arc volcanism

Zavodovski Island, South Sandwich Island, South Atlantic (Peter Kennett)

The plate tectonic story

Ocean-continent convergence

The dense oceanic plate descends below the lighter continental one. Partial melting of the basaltic rocks of the ocean floors produces magma which rises. It is richer in silica than basalt and erupts in a more violent way.



Subduction zone (‘partially melts and volcanoes are produced’ ‘molten rock cools down below the surface’)
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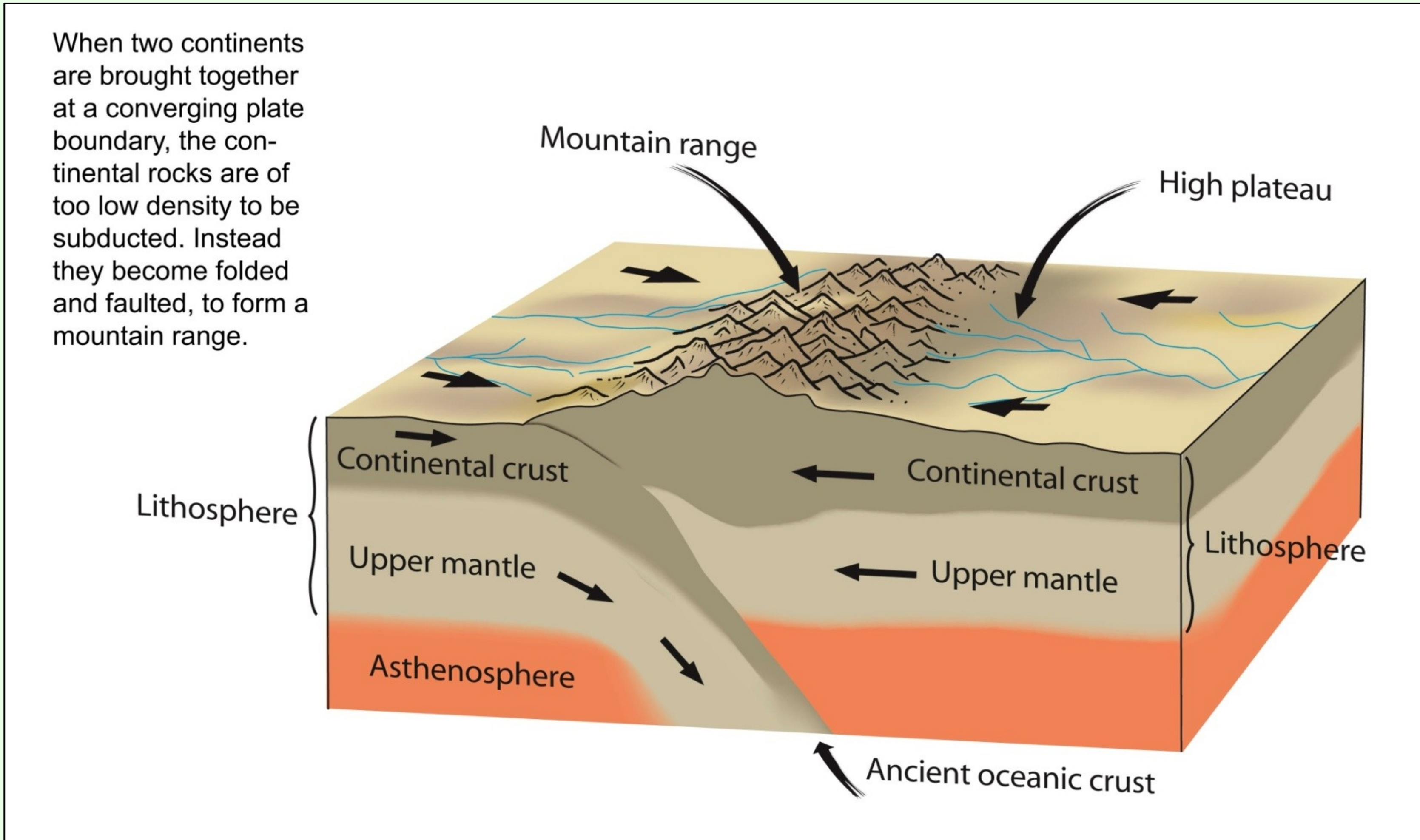
The plate tectonic story

Ocean-continent convergence: Mount St Helens

Mount St Helens © USGS/Cascades Volcano Observatory

The plate tectonic story

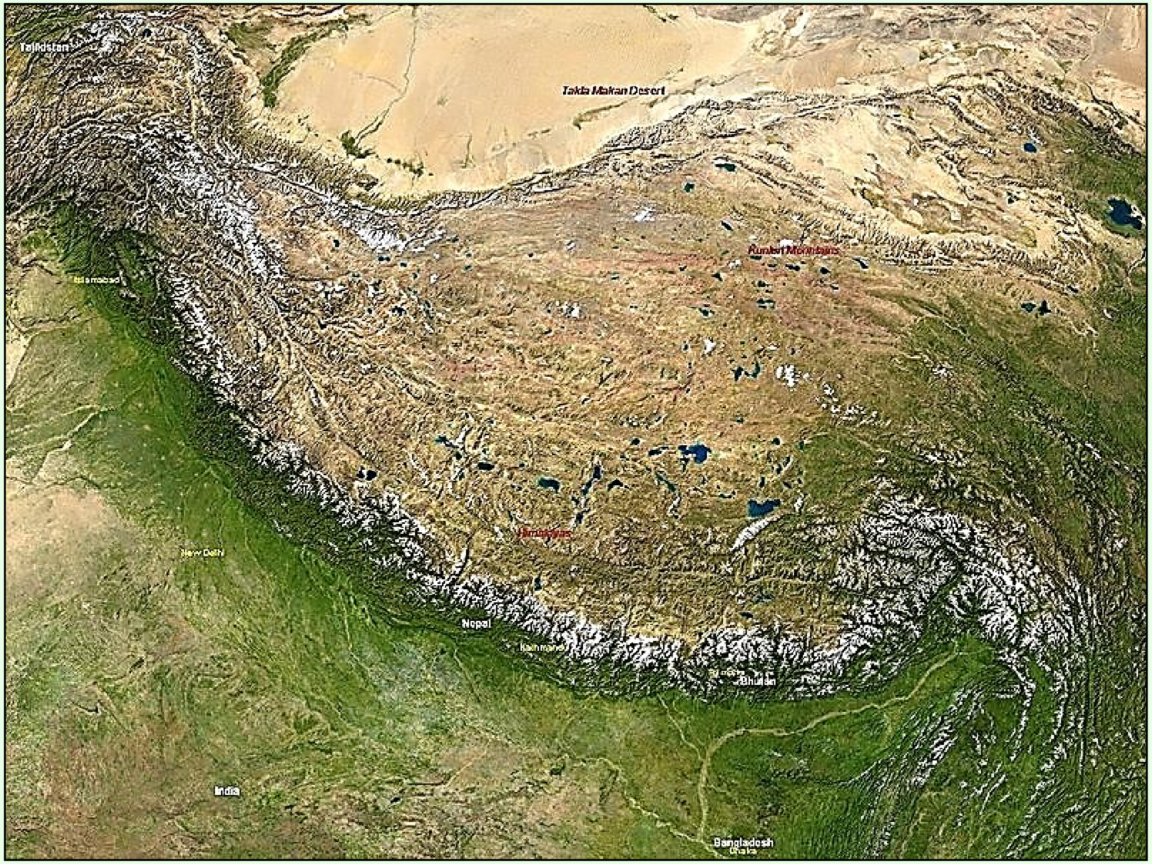
Continent-continent convergence



Continental plate collision zone. Reproduced with kind permission of USGS, redrawn by ESEU

The plate tectonic story

Plates in motion – cardboard replica
A working model of how colliding continents produce mountain chains – like this one



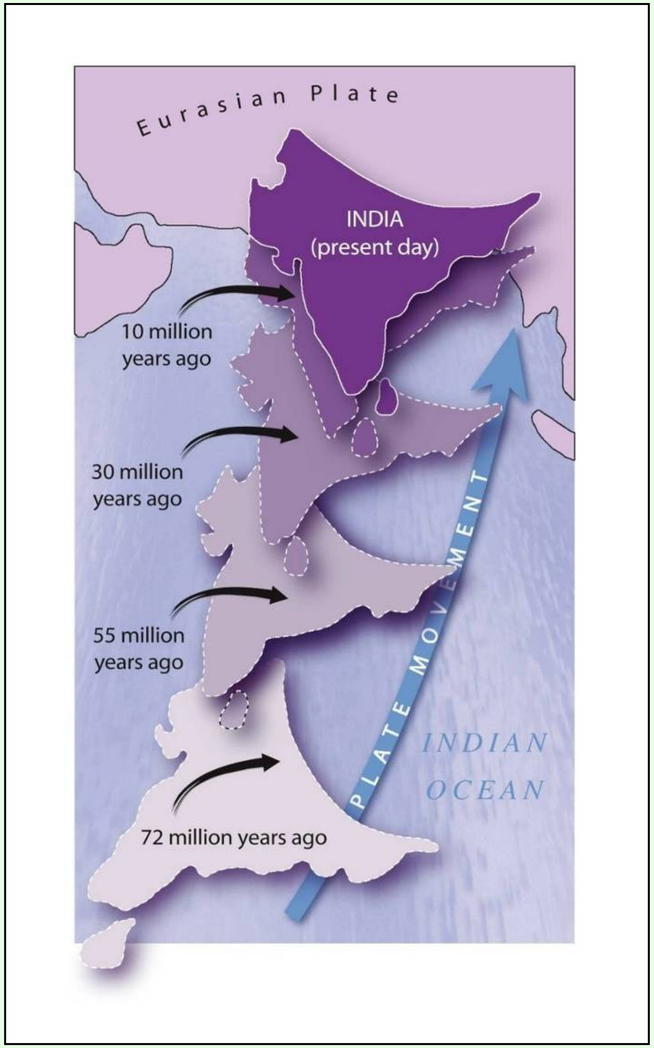
'The Tibetan Plateau, Himalayas' by NASA – image in the public domain 'The Tibetan Plateau, Himalayas' by NASA (public domain)

The plate tectonic story

Continent-continent convergence

The rapid northward drift of the Indian plate (at 15-40cm per year) produced the Himalayas and Tibetan Plateau when it collided with the Eurasian plate.

Folds at Lhotse (Himalayas) by Michael Searle © University of Oxford



Eurasian Plate (India's movement) © This Dynamic Earth: the Story of Plate Tectonics, USGS, redrawn by ESEU

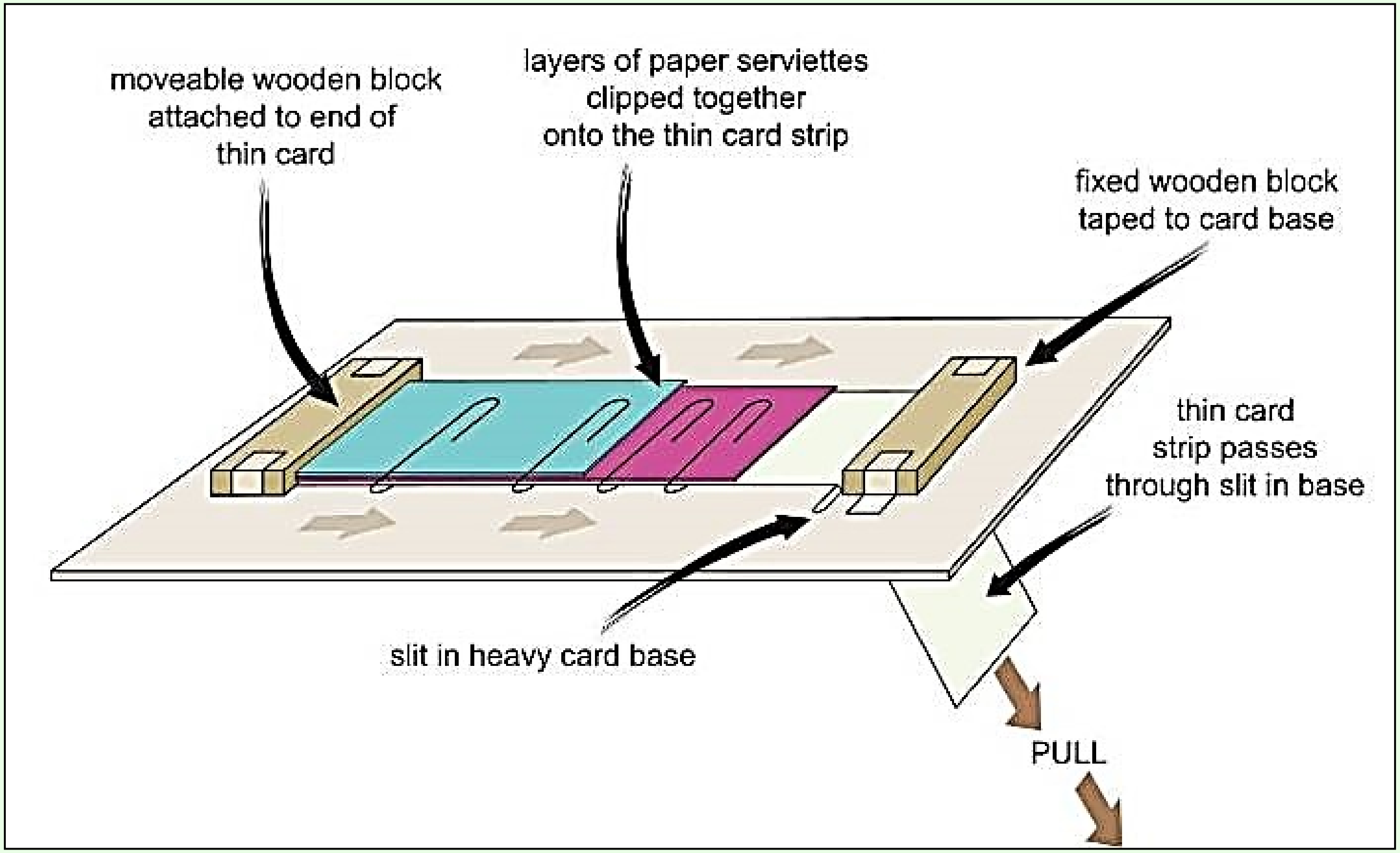
The plate tectonic story

Plates in motion: cardboard replica plates in motion

Cardboard replica of plates in motion (photograph) © ESEU

The plate tectonic story

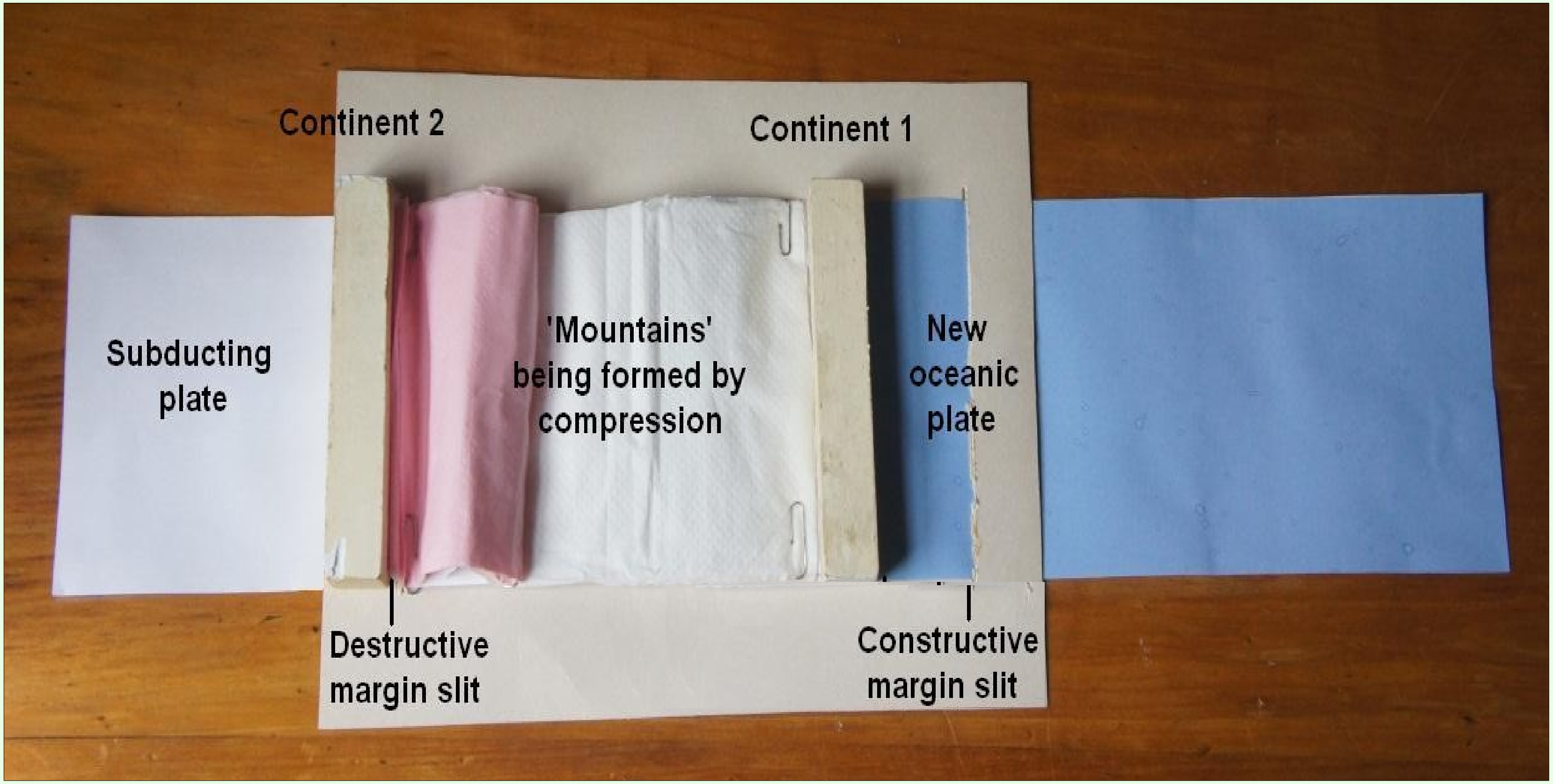
Plates in motion:
cardboard replica plates in motion



Cardboard replica of plates in motion (diagram) © ESTA, redrawn by ESEU

The plate tectonic story

Plates in motion:
cardboard replica plates in motion



Photograph of plates in motion © Chris King

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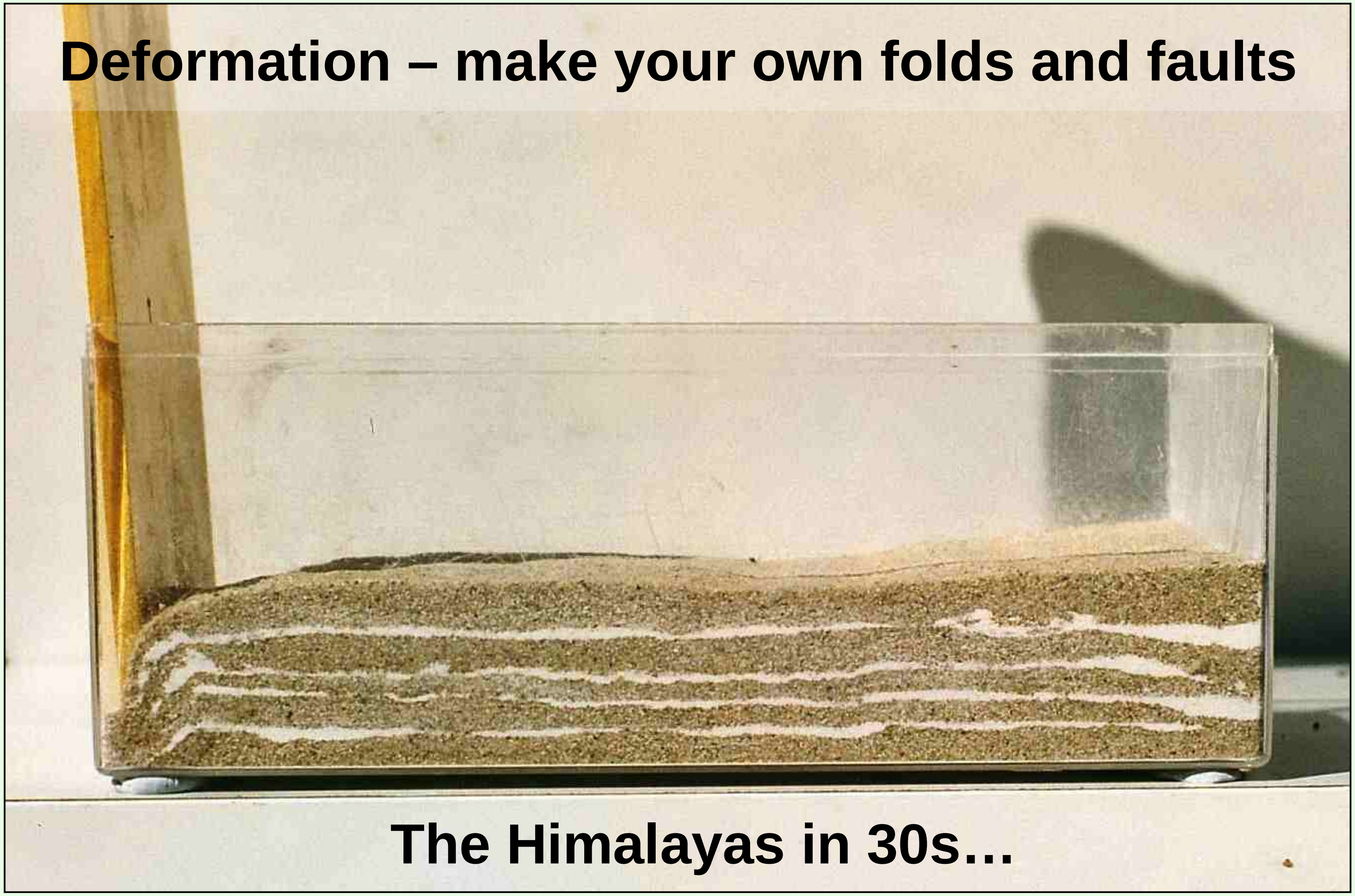
The plate tectonic story

- **Deformation**

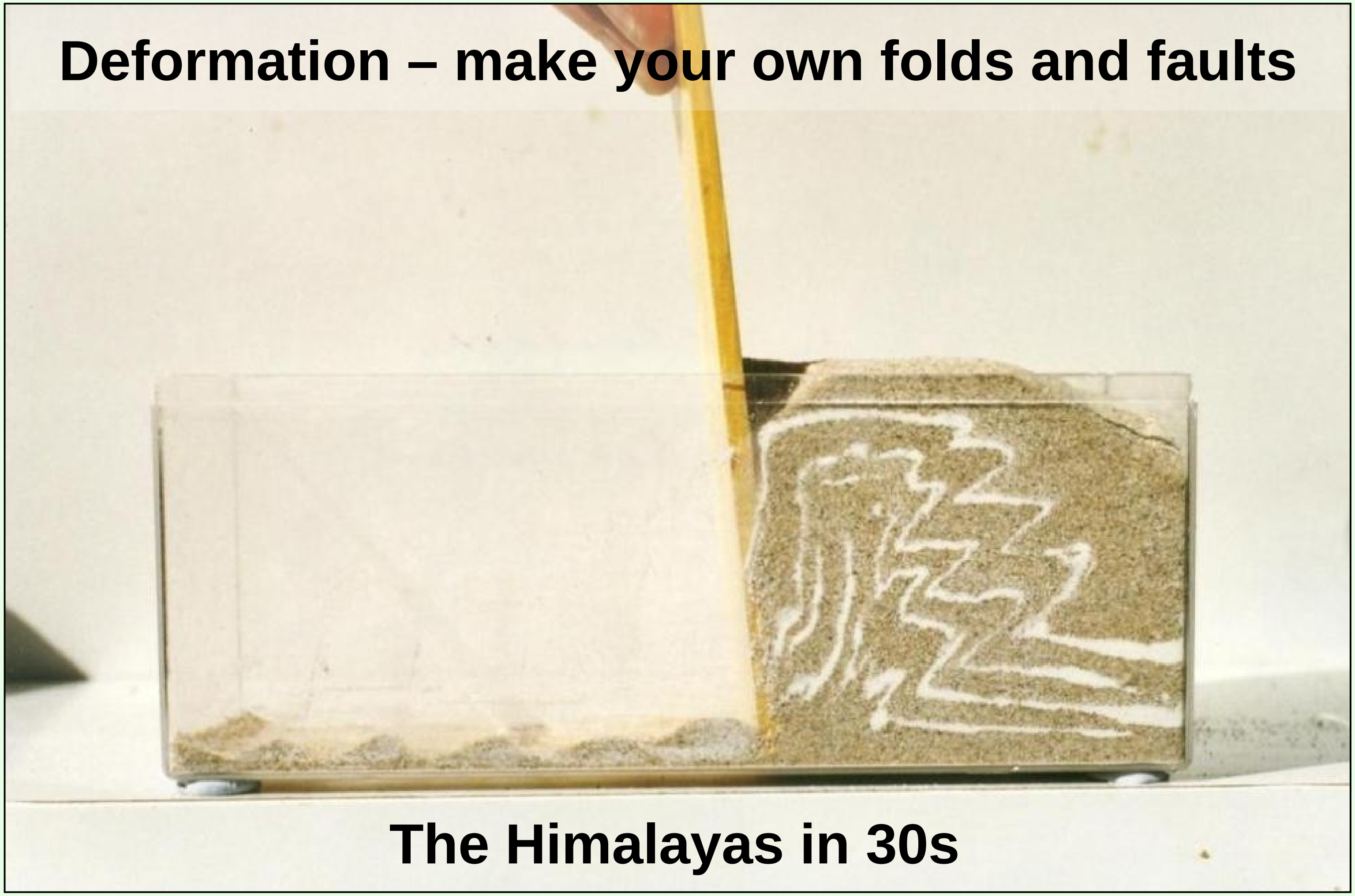
Go to: https://www.earthlearningidea.com/Video/V31_Deformation2.html hyperlink

The plate tectonic story



The plate tectonic story

Deformation – make your own folds and faults



The Himalayas in 30s

The plate tectonic story

Deformation – make your own folds and faults

The Himalayas in 30s

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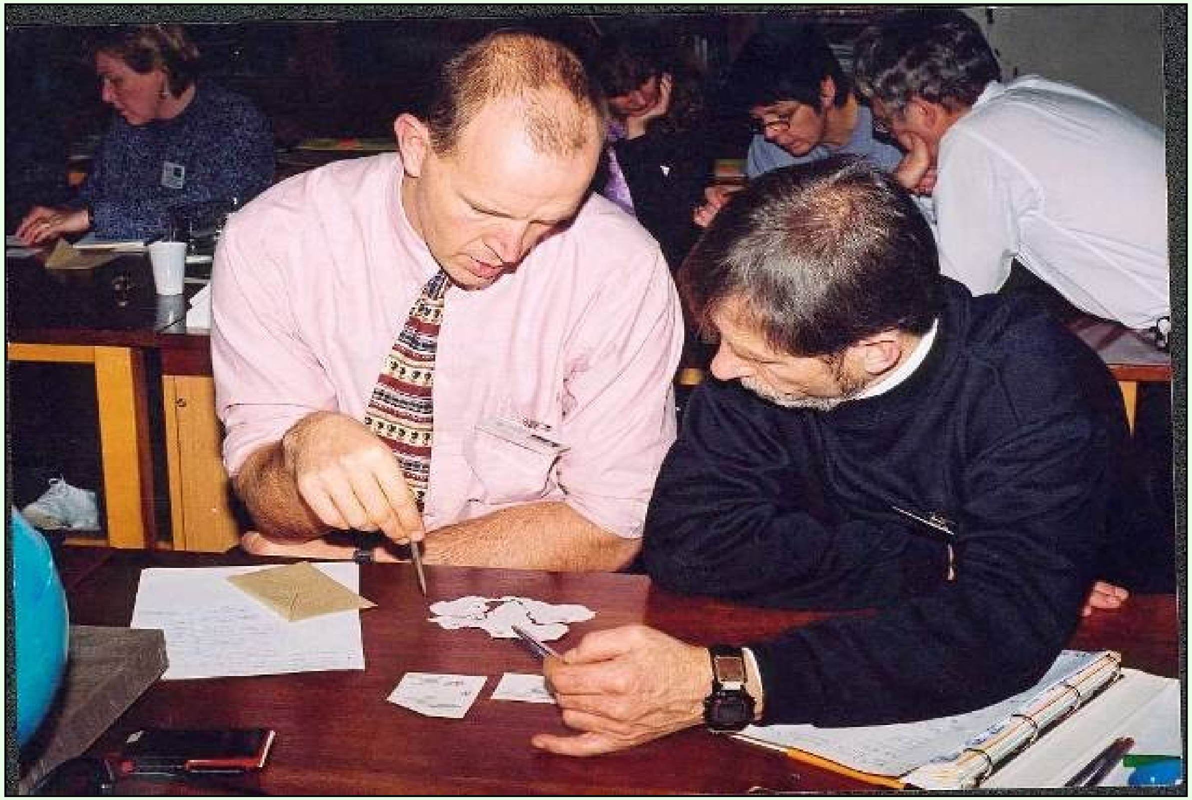
The plate tectonic story

- **Continental jigsaw puzzles**

Go to: https://www.earthlearningidea.com/Video/V32_Jigsaw_puzzles.html hyperlink

The plate tectonic story

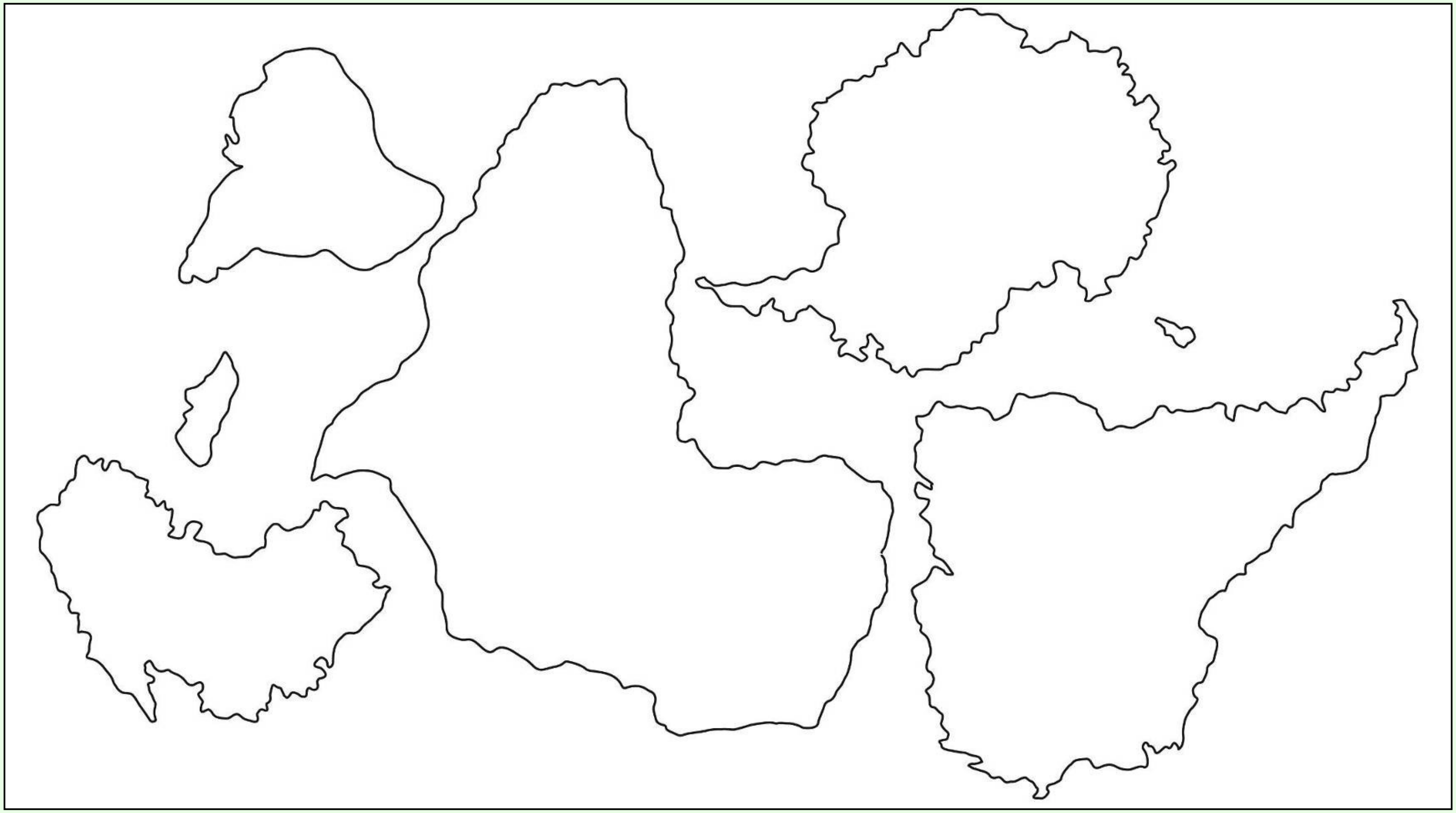
Continental jigsaw puzzles - the ‘matching’ evidence



Debating the reconstruction of the supercontinent of ‘Gondwana’ © Peter Kennett

The plate tectonic story

The continental jigsaw puzzles (the outlines of the Gondwana continents)



The continental jigsaw puzzle (the outlines of the Gondwana continents) © Author/origin unknown – redraw by Peter Kennett

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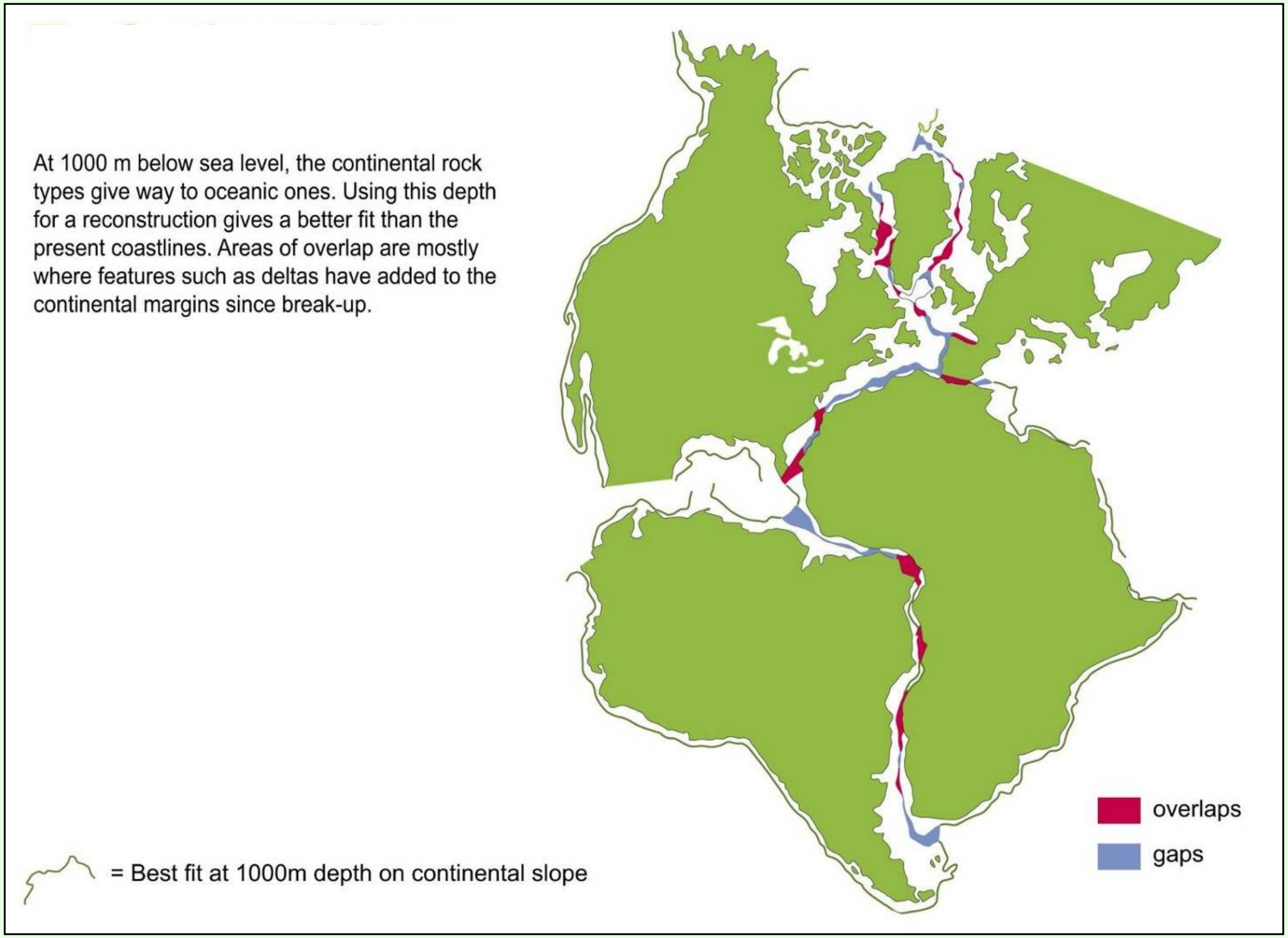
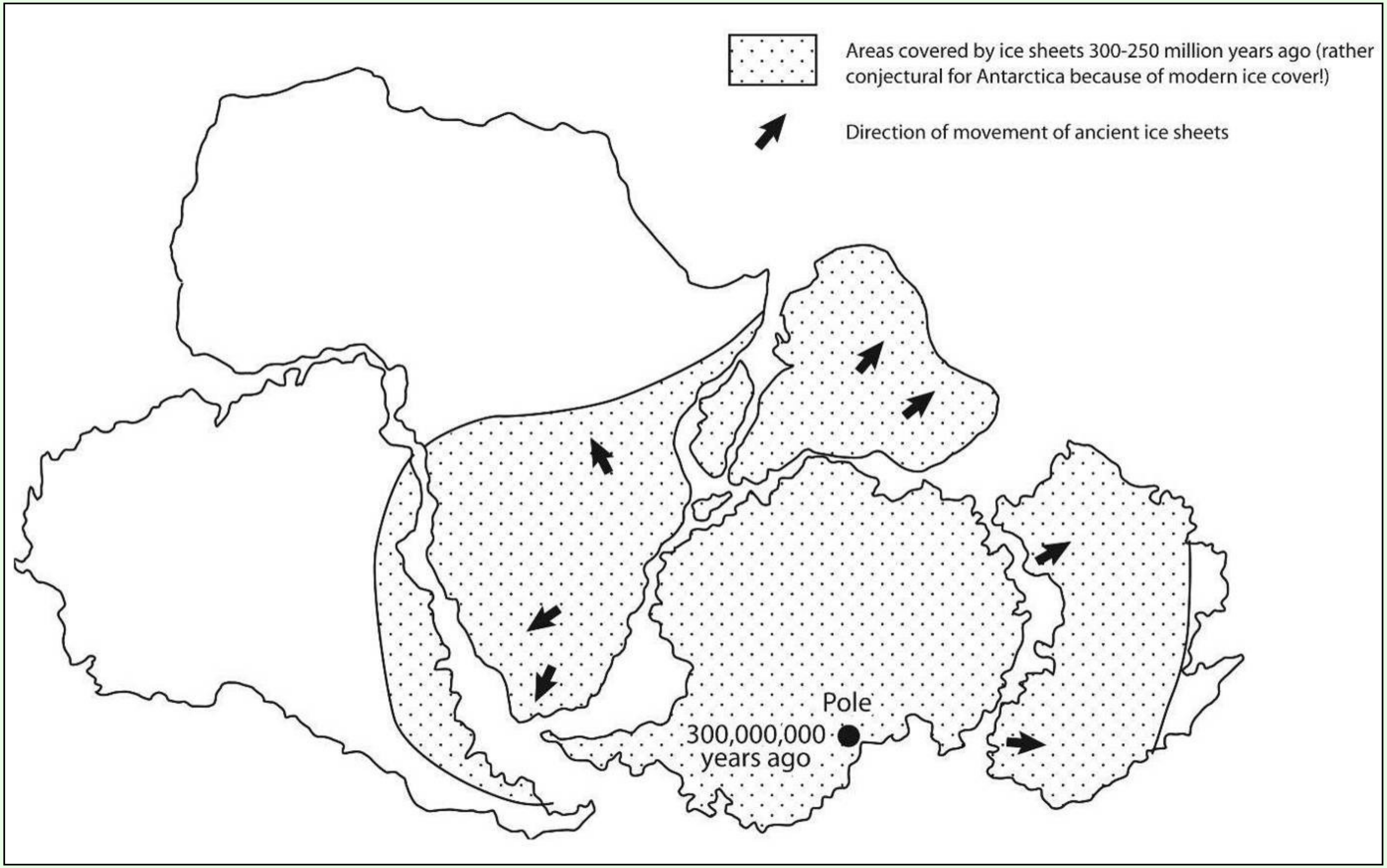
The continental jigsaw puzzles (continental shelf match at 1000m depth below sea level)



The continental jigsaw puzzle, continental shelf (best fit at 1000m) © Andrew McLeish in 'Geological Science'

The plate tectonic story

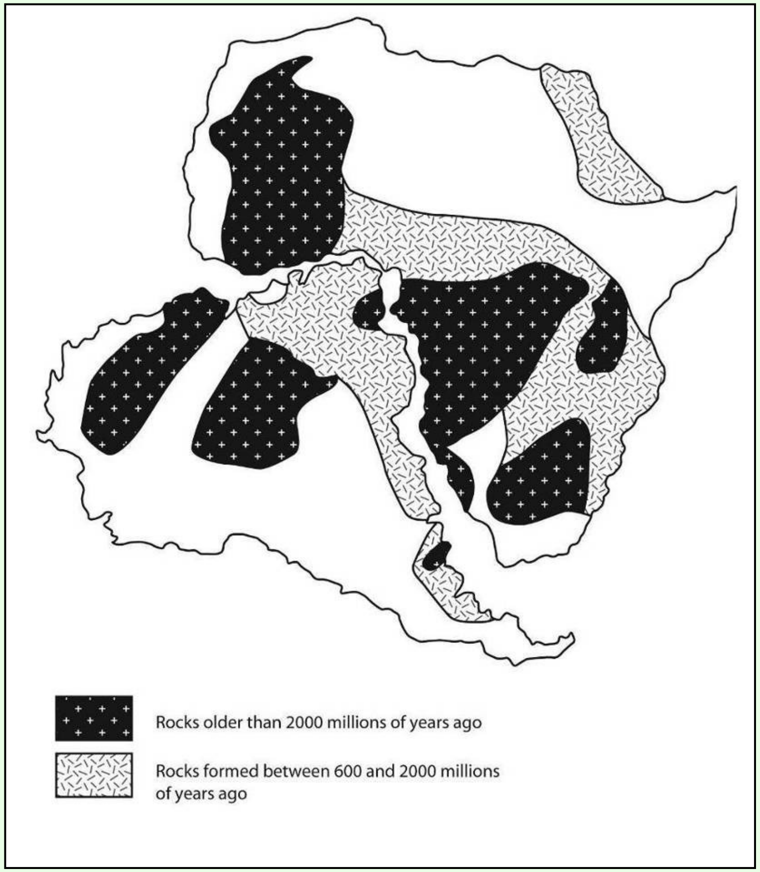
The continental jigsaw puzzles (former distribution of ice across the Gondwana continents



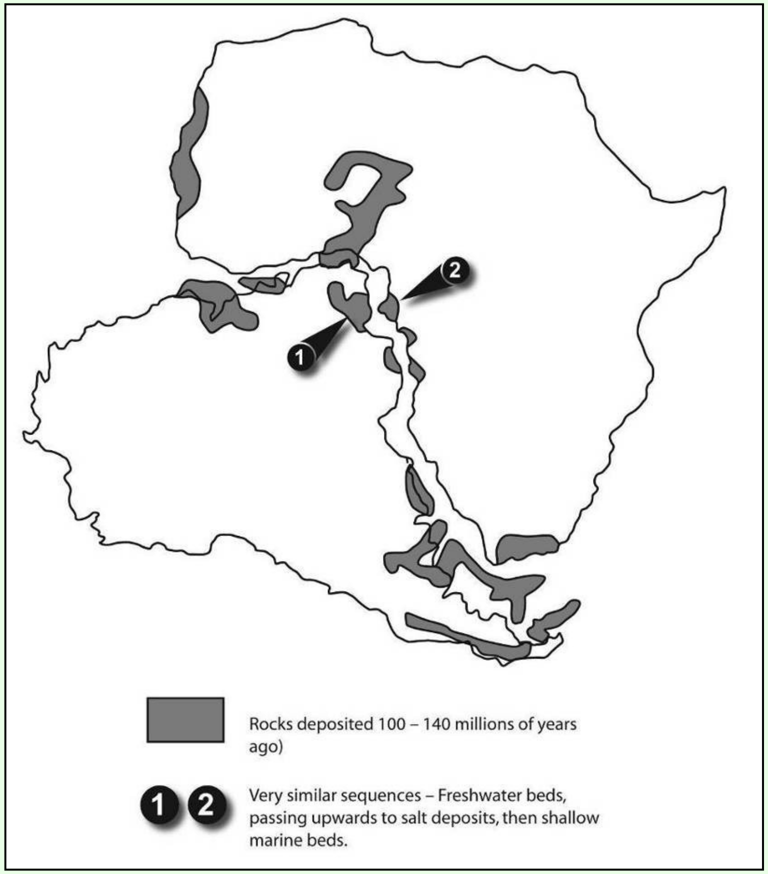
The continental jigsaw puzzles (former distribution of ice across the Gondwana continents) © Andrew McLeish in 'Geological Science'

The plate tectonic story

The continental jigsaw puzzles (matching ancient rock distributions)



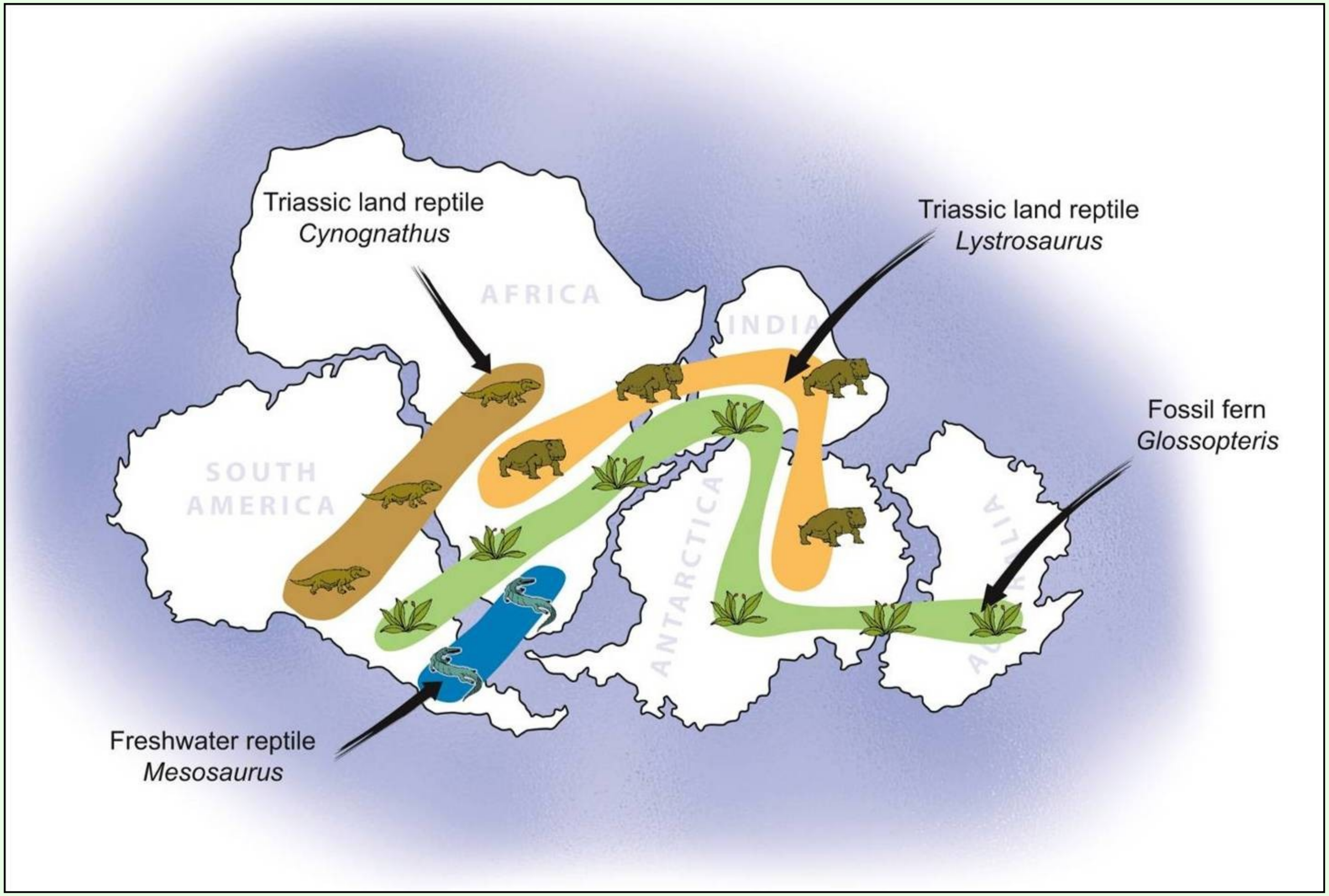
The distribution of ancient rocks across South America and Africa
© Andrew McLeish in 'Geological Science'



The distribution of younger rocks across South America and Africa up to the beginning of the continental split. Source unknown, redrawn by ESEU

The plate tectonic story

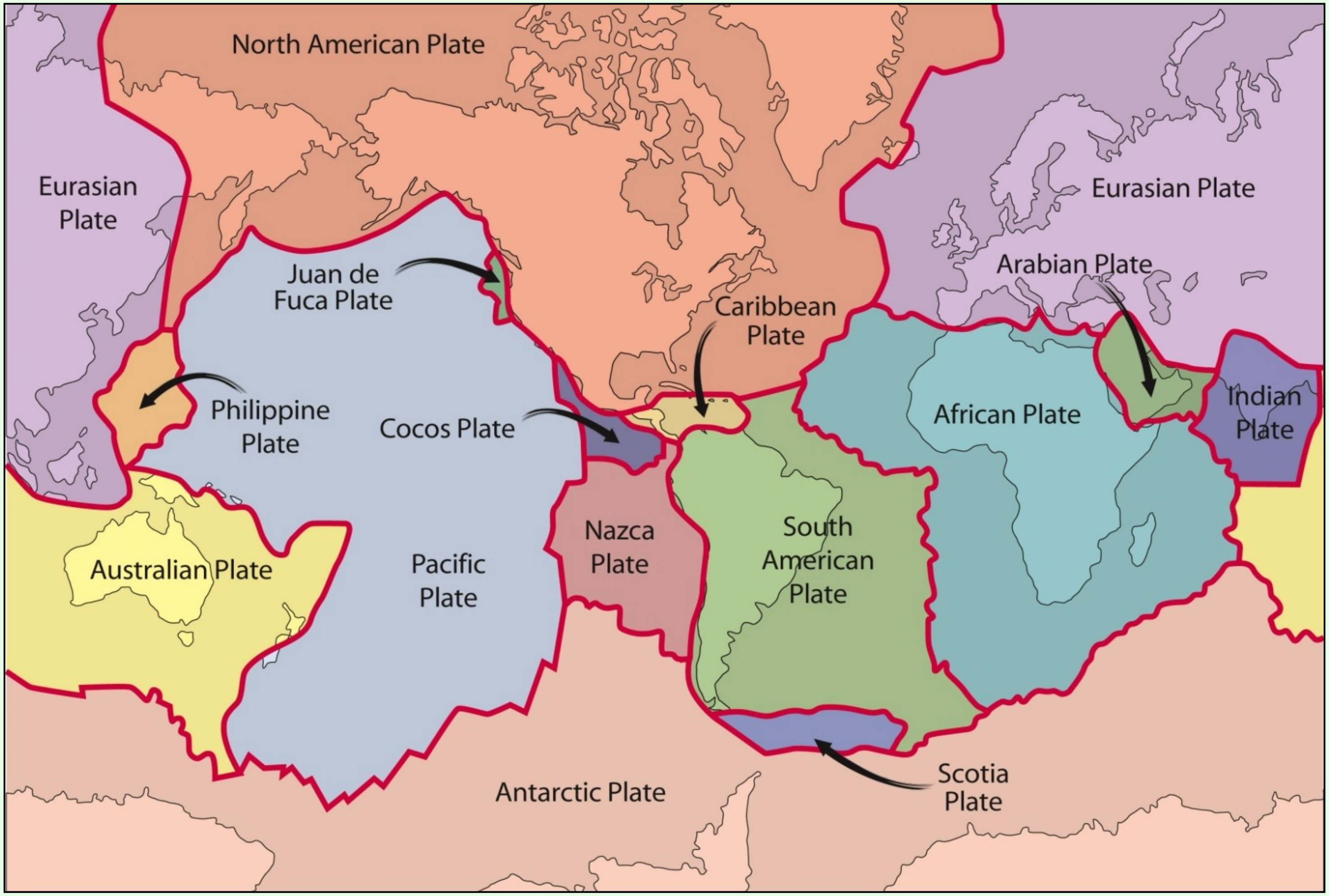
The continental jigsaw puzzles (distribution of land/freshwater animals and plants in the continents of 'Gondwana')



The continental jigsaw puzzles fossil distribution evidence, reproduced with kind permission of USGS

The plate tectonic story

Map of plates and continental distributions today



Map of plates © This Dynamic Earth: the Story of Plate Tectonics, USGS, redrawn by ESEU

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Brickquake

Go to: https://www.earthlearningidea.com/Video/V33_Brickquake.html hyperlink

The plate tectonic story

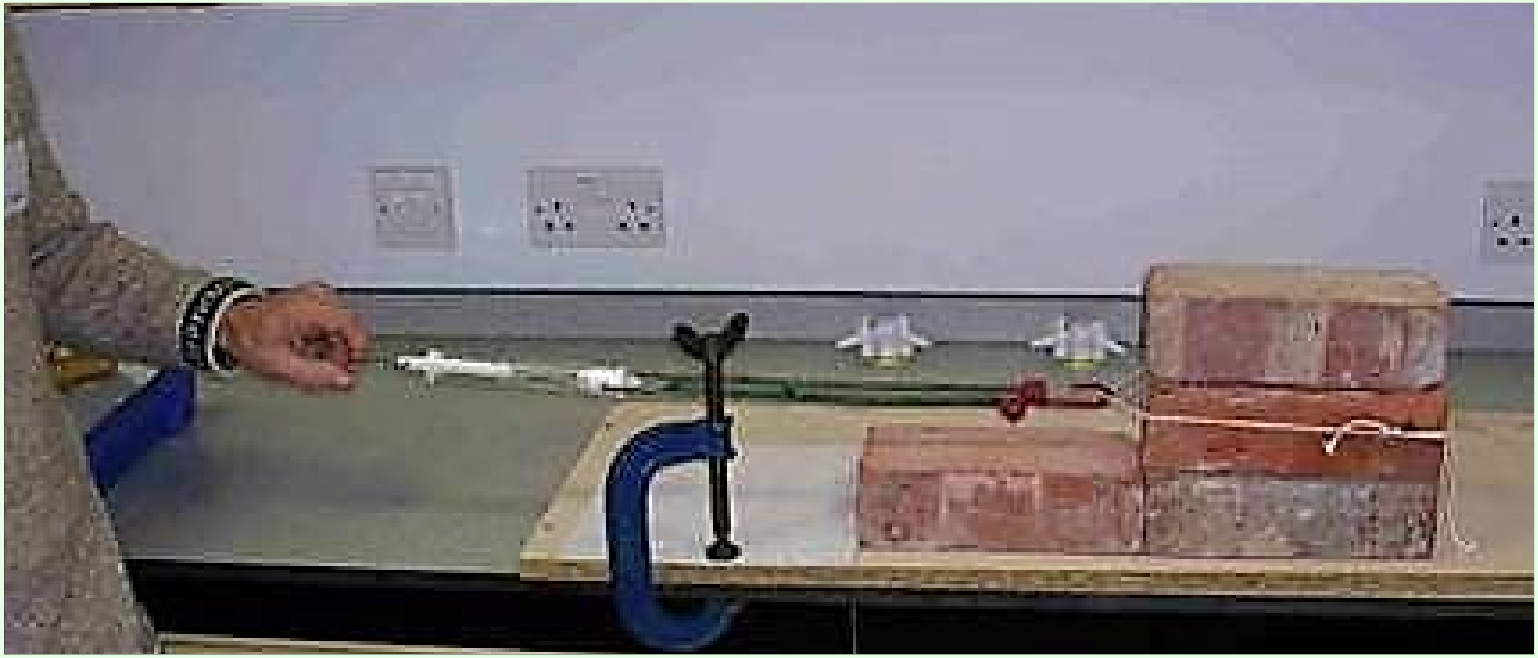
Brickquake – can earthquakes be predicted?
How earthquakes work –
and how difficult they are to predict

Ground deformation after an earthquake © National Geophysical Data Center (NGDC)

Brickquake (ESEU)

The plate tectonic story

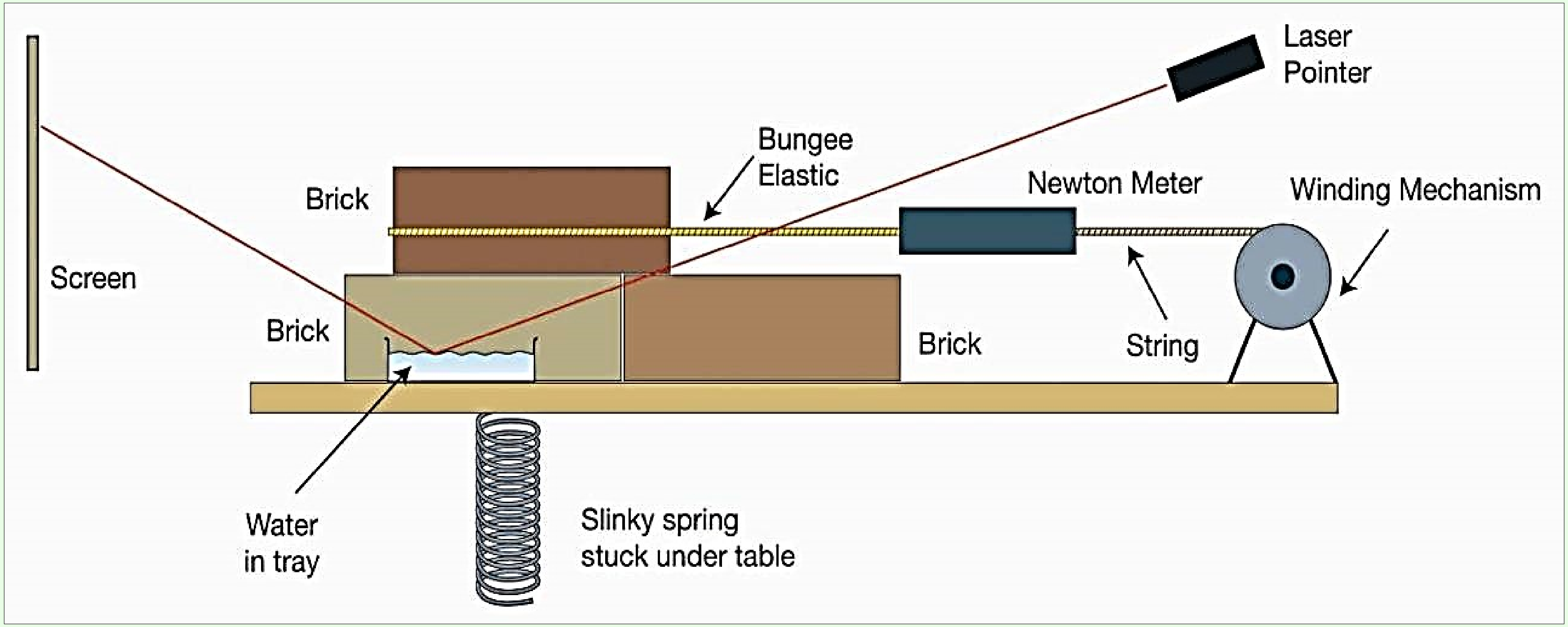
Brickquake – can earthquakes be predicted?
How earthquakes work –
and how difficult they are to predict



Brickquake (ESEU)

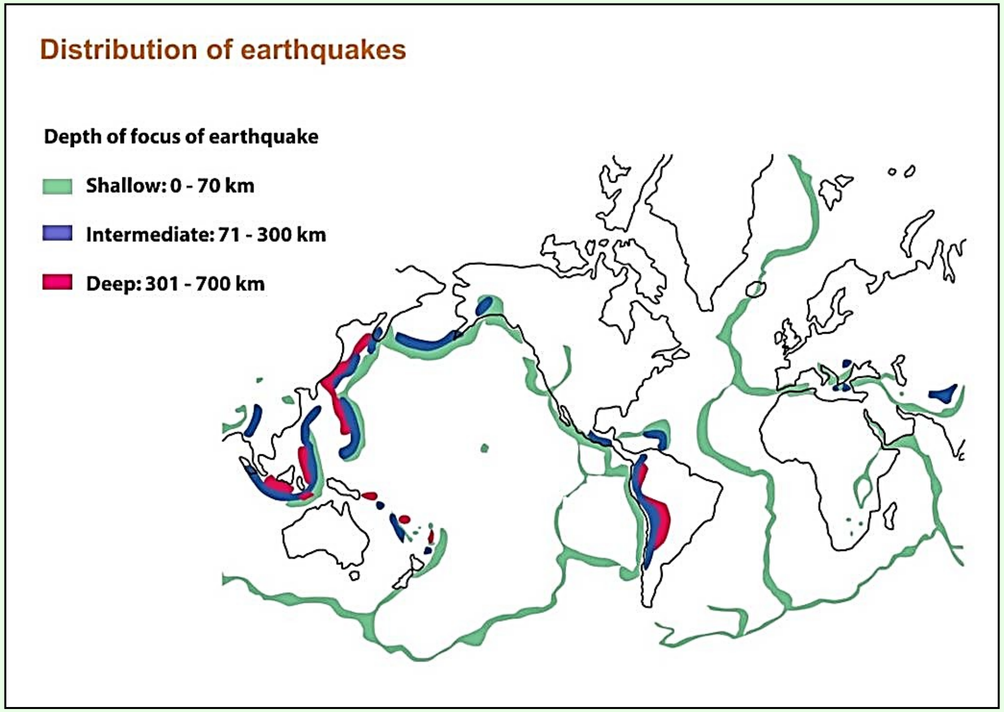
The plate tectonic story

Brickquake – can earthquakes be predicted?
How earthquakes work –
and how difficult they are to predict



Brickquake – can earthquakes be predicted (diagram) © ESEU

The plate tectonic story



Distribution of earthquakes – source unknown, redrawn by ESEU

‘Brickquake’ results		
Distance moved (cm)	Force (Newtons)	Relative energy released
2	15	30
7.5	45	337.5
3.5	35	122.5
4	25	100

‘Brickquake’ – can earthquakes be predicted?

Brickquake (ESEU)

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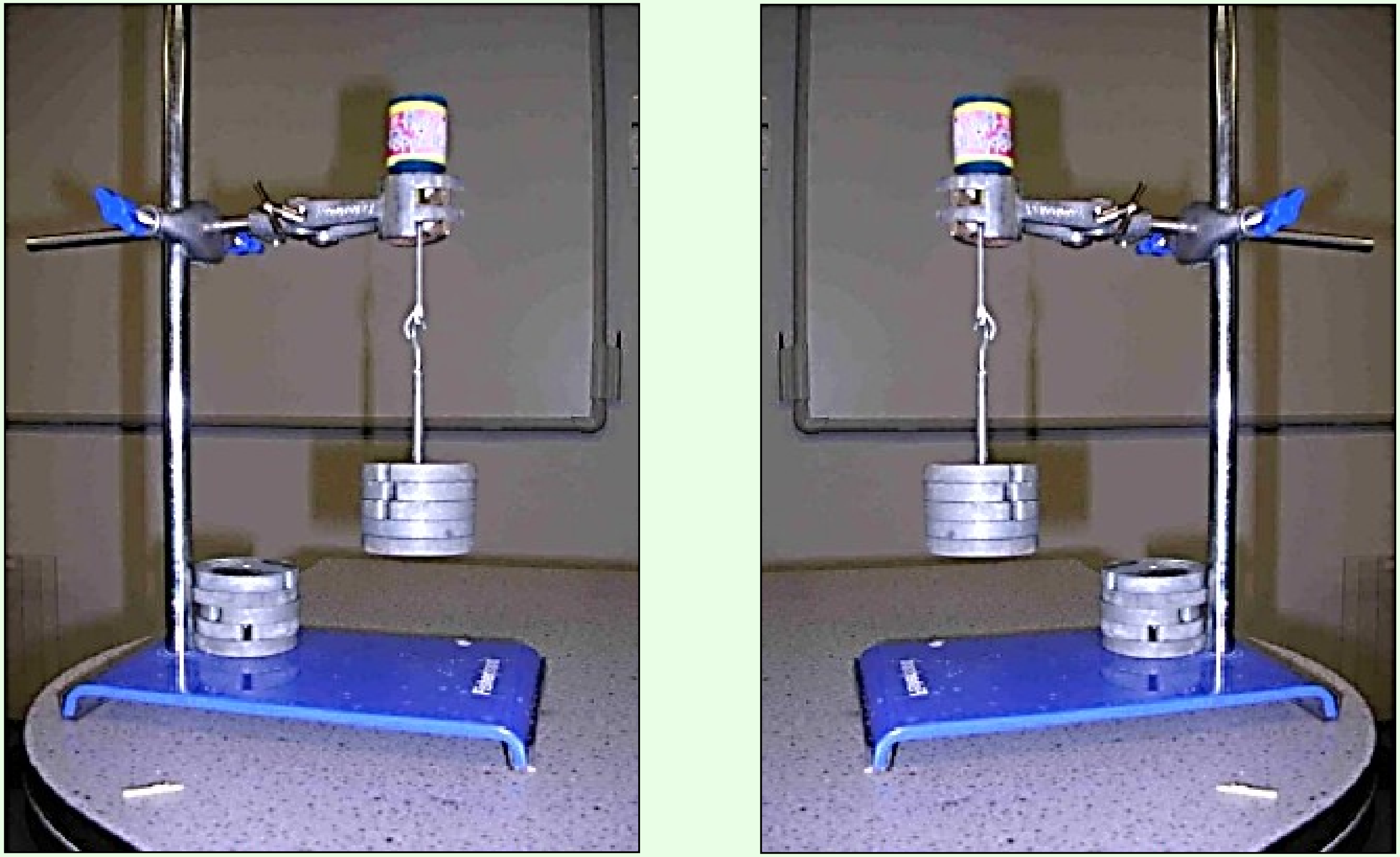
Party popper eruption

Go to: https://www.earthlearningidea.com/Video/V34_Party_poppers.html hyperlink

The plate tectonic story

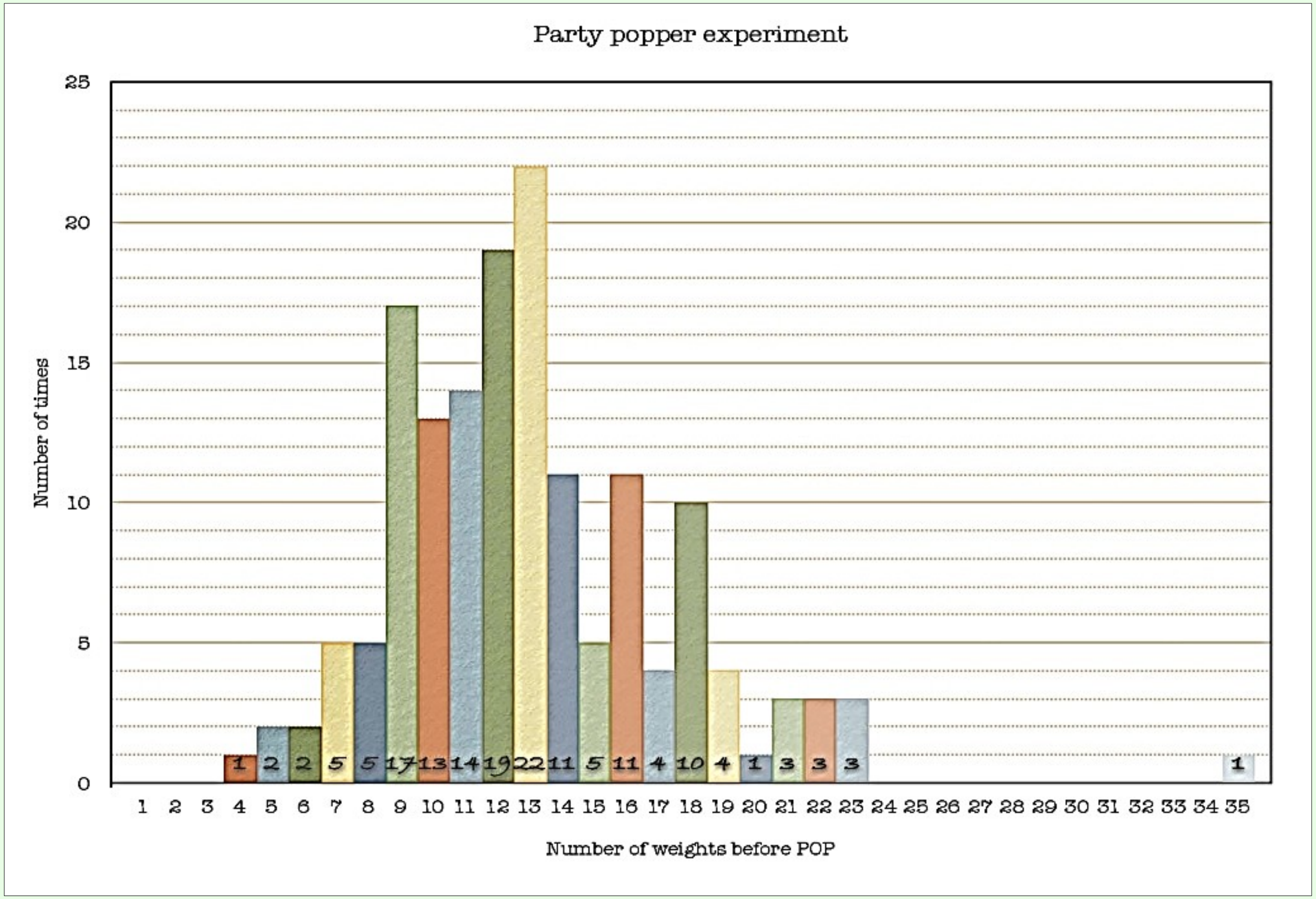
How predictable are volcanic eruptions?
– party popper simulation



Set-up for the party popper activity © Peter Kennett, ESEU

The plate tectonic story

How predictable are volcanic eruptions? – party popper simulation – the result of 156 attempts



The plate tectonic story

How predictable are volcanic eruptions?
– party popper simulation

Party popper eruption 'chance' cards

Volcano alert 'Chance cards' © David Turner

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The plate tectonic story

- **Plate plenary**

Go to: https://www.earthlearningidea.com/Video/V35_Plate_plenary.html hyperlink

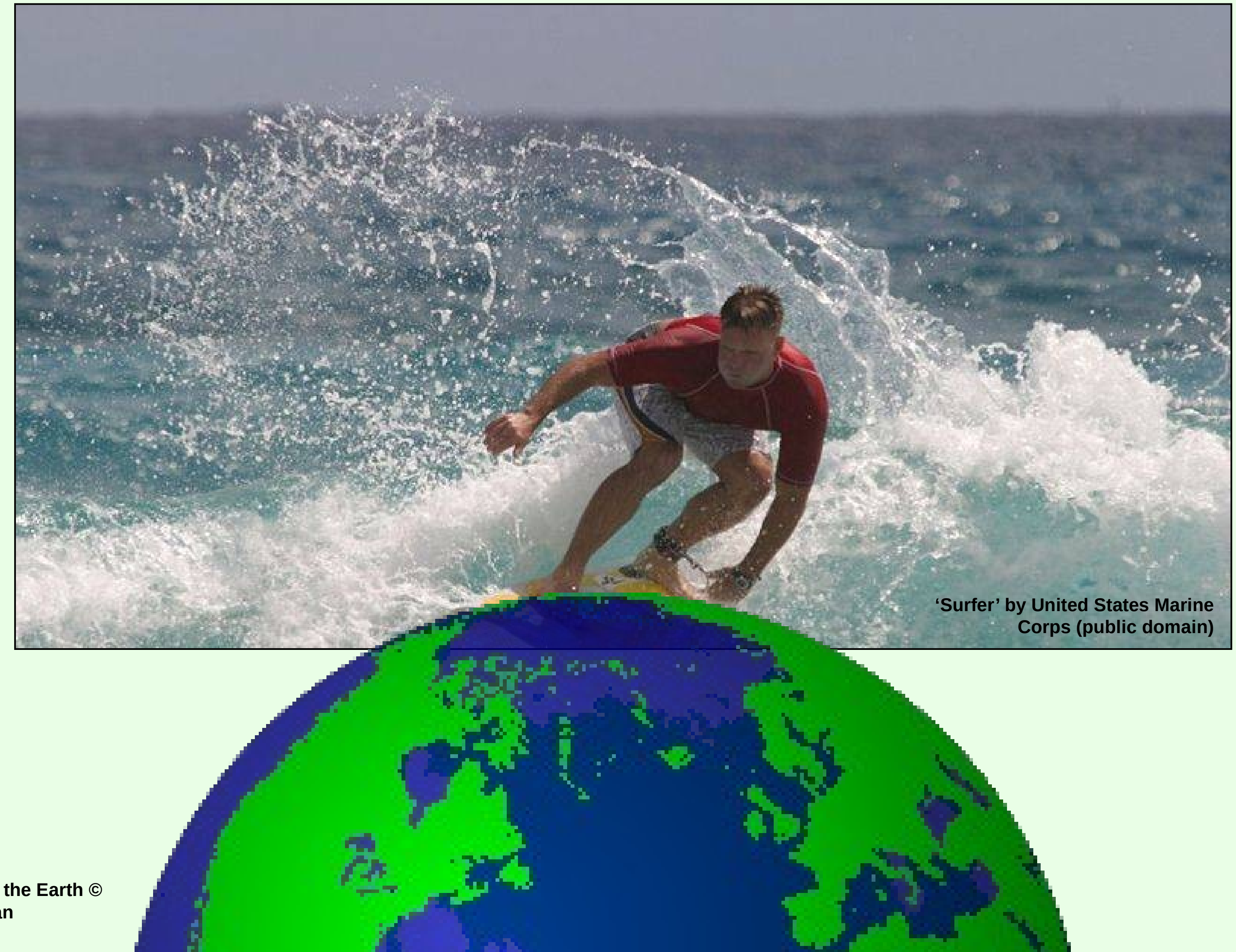
The plate tectonic story

What am I doing?

Published by Jim Henderson under the Creative Commons CC0 1.0 Universal Public Domain Dedication as File:30th St hiline balancing on rails jeh.jpg

The plate tectonic story

Plate-riding



'Surfer' by United States Marine Corps (public domain)

Image of the Earth © Noldoaran

The plate tectonic story

Plate-riding

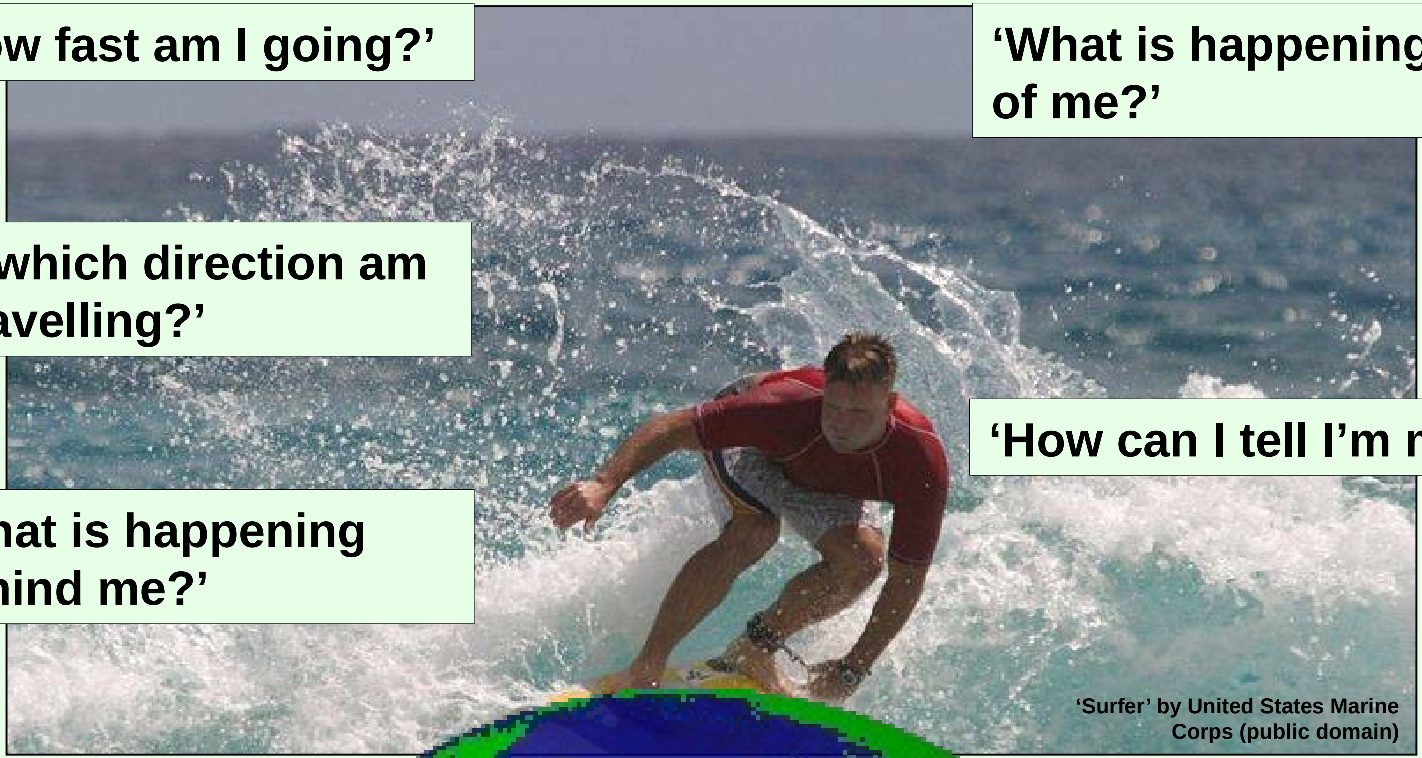
‘How fast am I going?’

‘What is happening in front of me?’

‘In which direction am I travelling?’

‘How can I tell I’m moving?’

‘What is happening behind me?’



‘Surfer’ by United States Marine Corps (public domain)

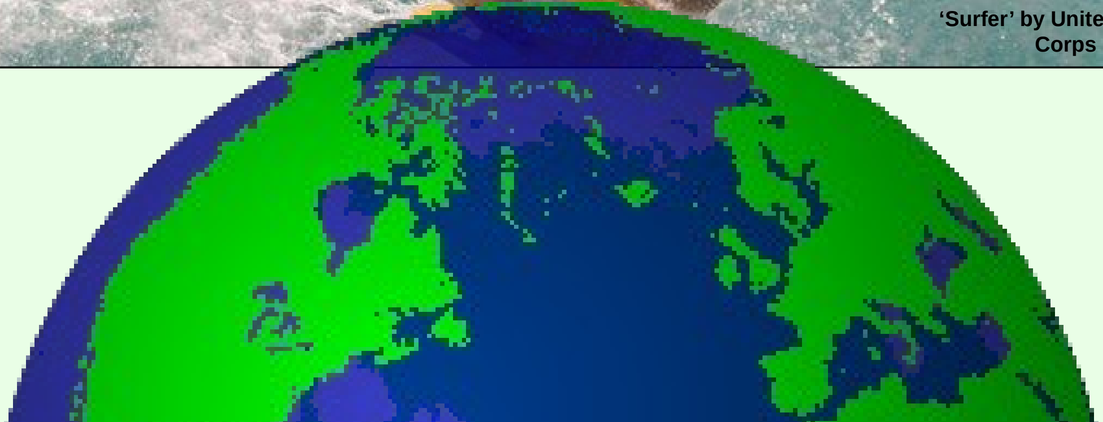
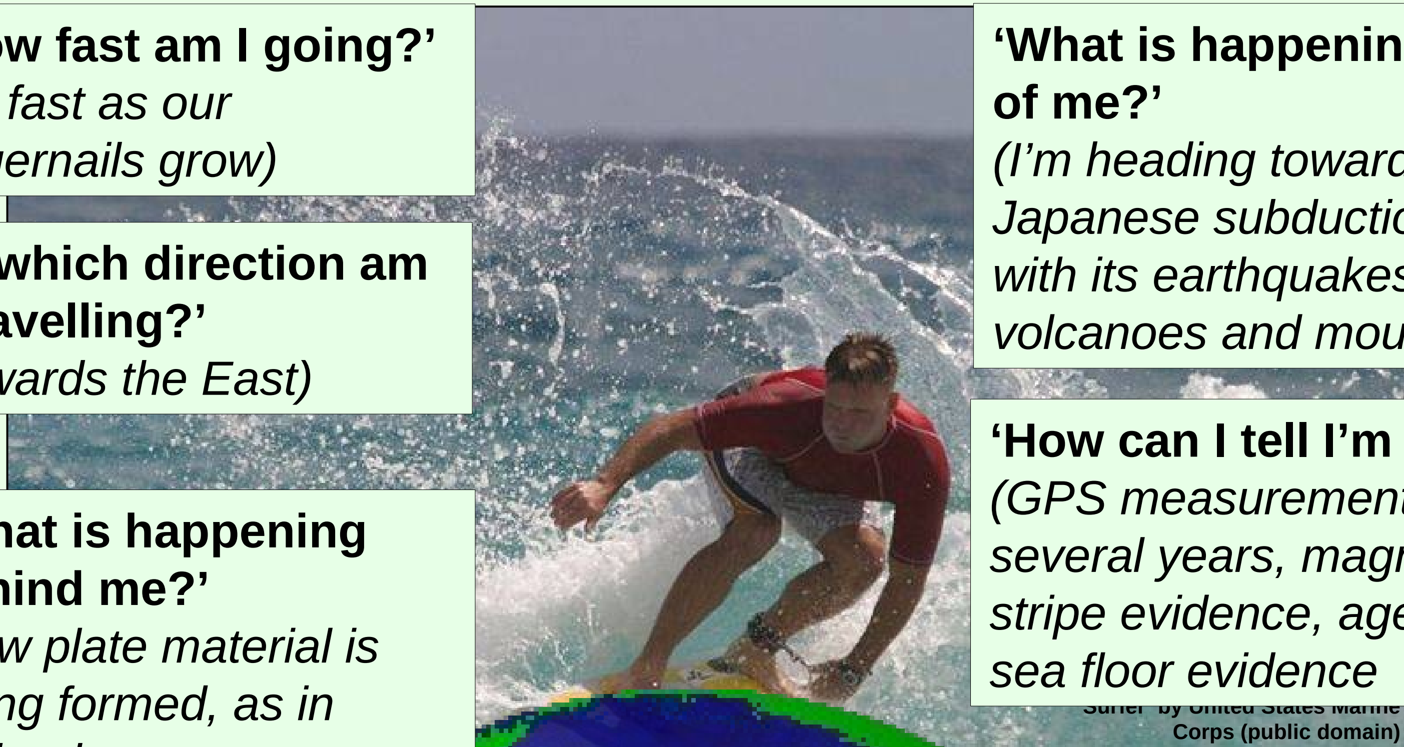


Image of the Earth © Noldoaran

The plate tectonic story

Plate-riding



‘How fast am I going?’
(as fast as our fingernails grow)

‘In which direction am I travelling?’
(towards the East)

‘What is happening behind me?’
(new plate material is being formed, as in Iceland

‘What is happening in front of me?’
(I’m heading towards the Japanese subduction zone, with its earthquakes, volcanoes and mountains

‘How can I tell I’m moving?’
(GPS measurements over several years, magnetic stripe evidence, age of the sea floor evidence

“Surfer” by United States Marine Corps (public domain)

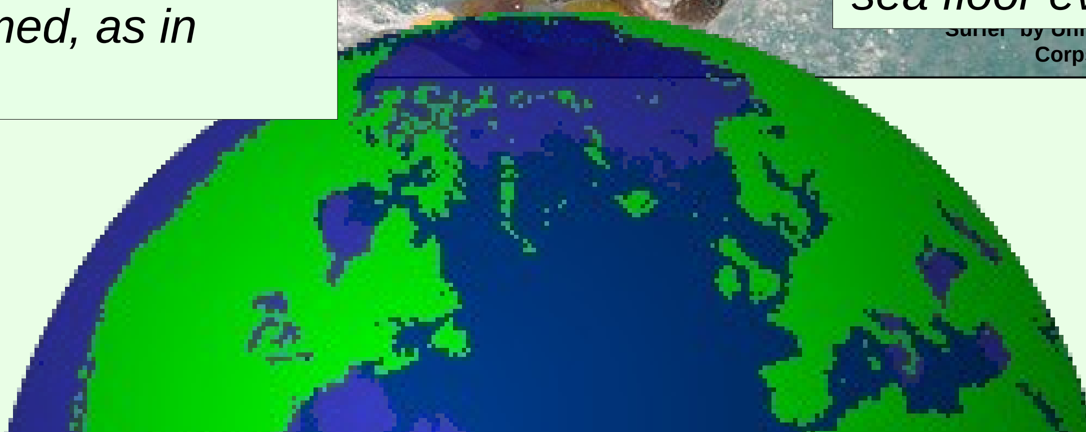
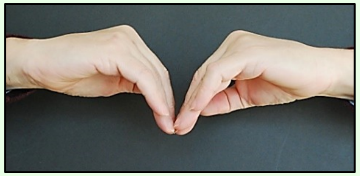


Image of the Earth © Noldoaran

The plate tectonic story

Model the five different types of plate margin with your hands
Possible answers include:

divergent margin



ocean v ocean

ocean v continent

continent v continent

conservative (transform)

The plate tectonic story

Workshop outcomes

The workshop and its activities provide the following outcomes:

- an introduction to plate tectonics;
- distinction between the ‘facts’ of plate tectonics and the evidence used to support plate tectonic theory;
- a survey of some of the evidence supporting plate tectonic theory;
- explanation of some of the hazards caused by plate tectonic processes - earthquakes and eruptions;
- methods of teaching the abstract concepts of plate tectonics, using a wide range of teaching approaches, including practical and electronic simulations;
- approaches to activities designed to develop the thinking and investigational skills of students;
- an integrated overview of the concepts involved in teaching the processes of plate tectonics.

The plate tectonic story

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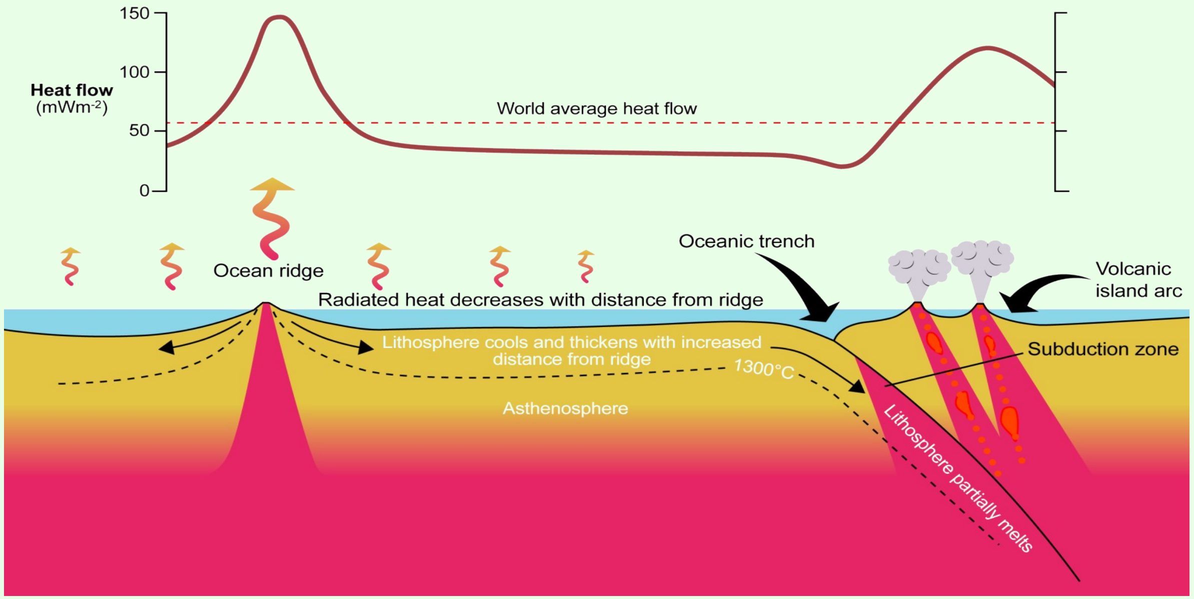
The plate tectonic story – online
Part 2

Earth Science for science and geography – video workshop



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