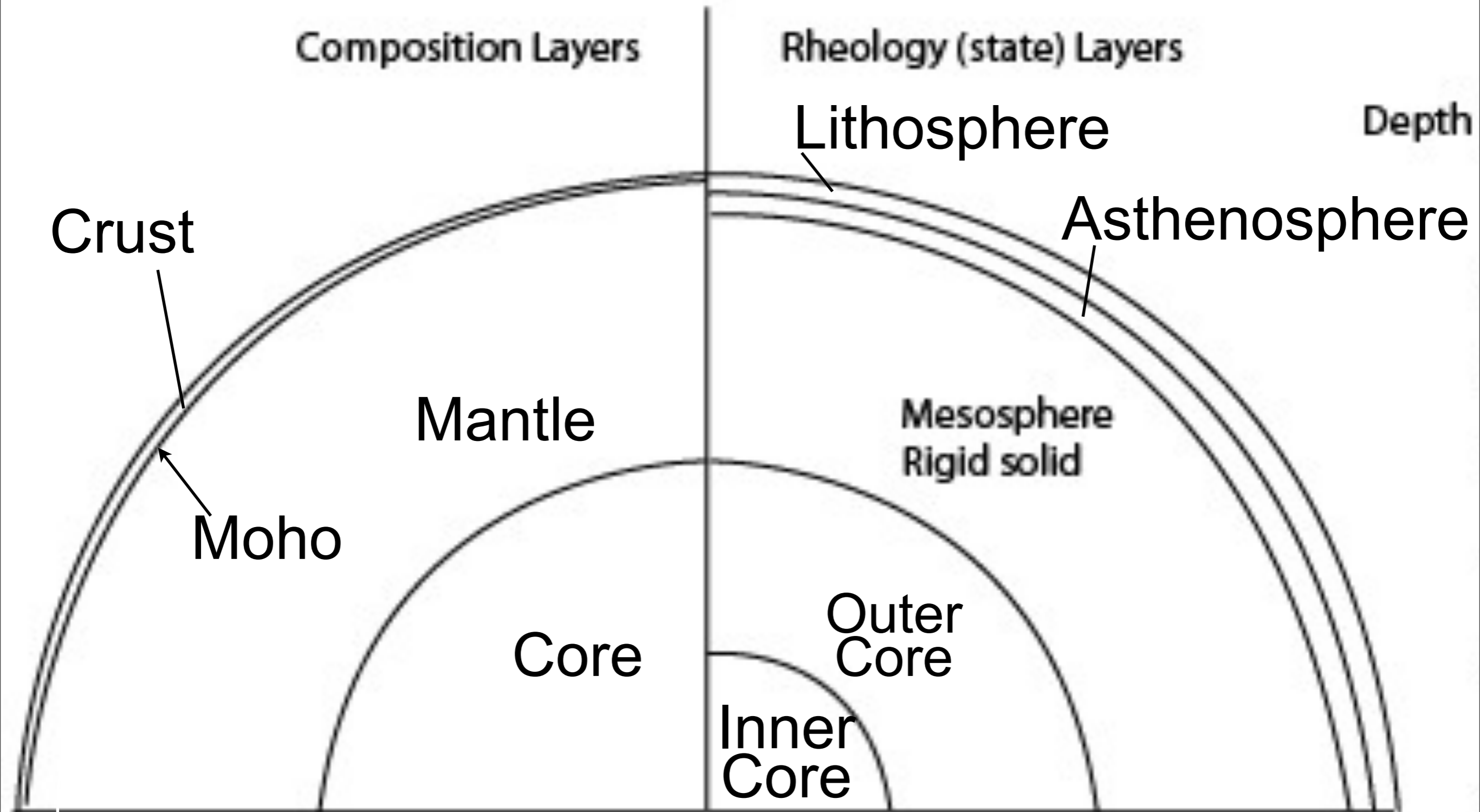


In your groups, discuss Homework Questions.
I will start calling on individuals to answer questions
and develop class discussion starting at ~10:00 am

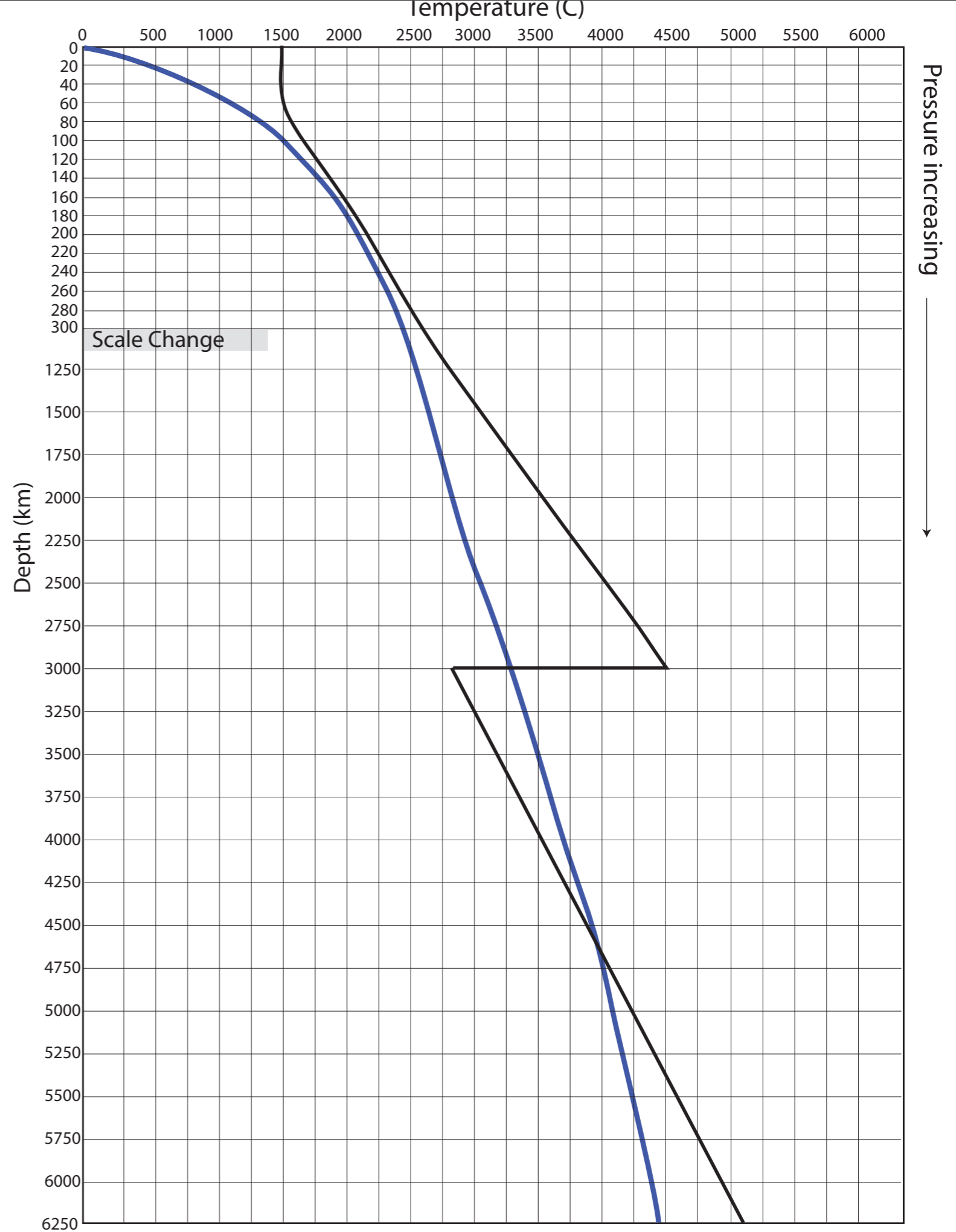
The Earth's Magnetic Field

“The origin of the Earth's Magnetic Field is one of the
great unsolved problems facing physicists”
-Albert Einstein (ca. 1905)

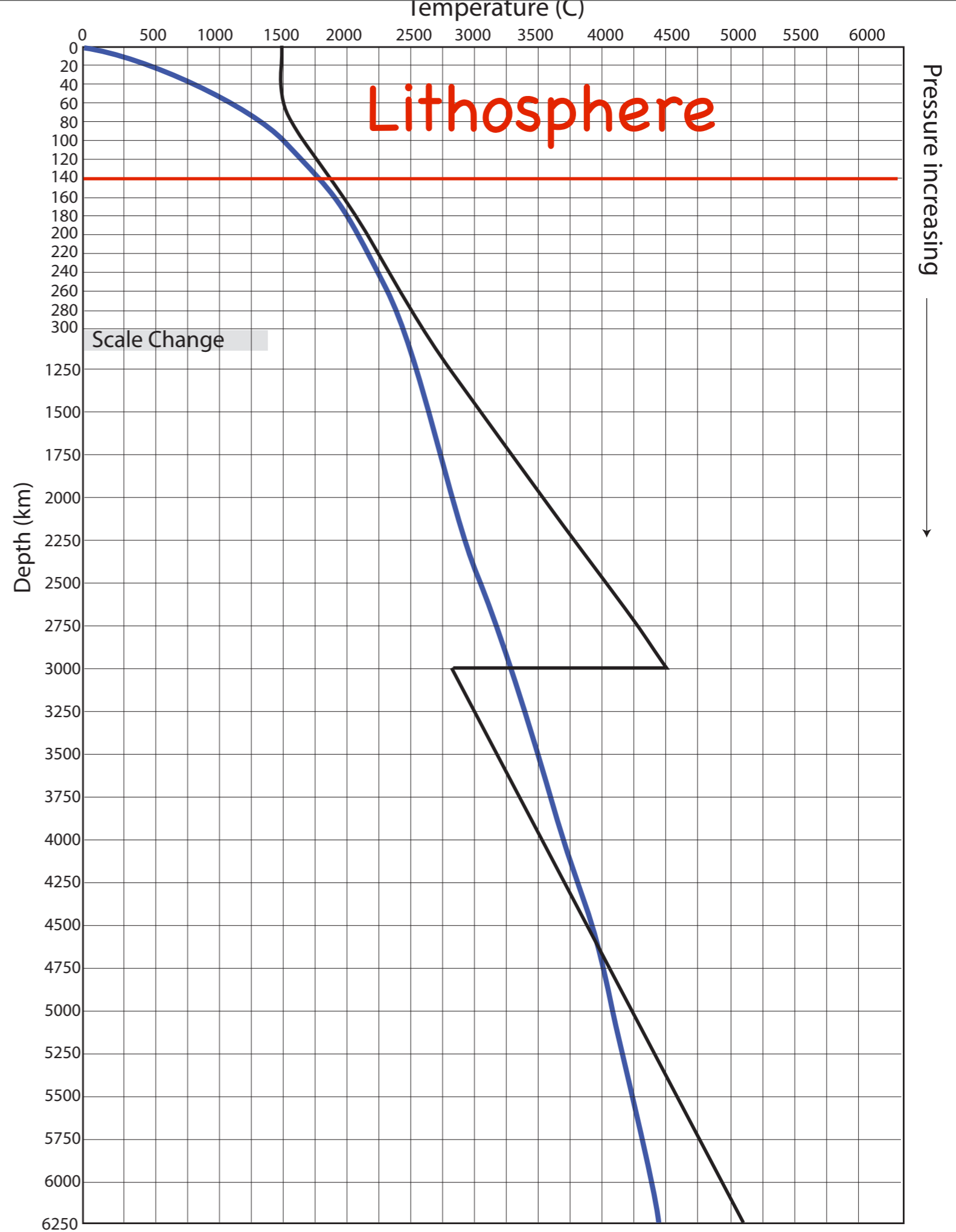
Earth's Structure



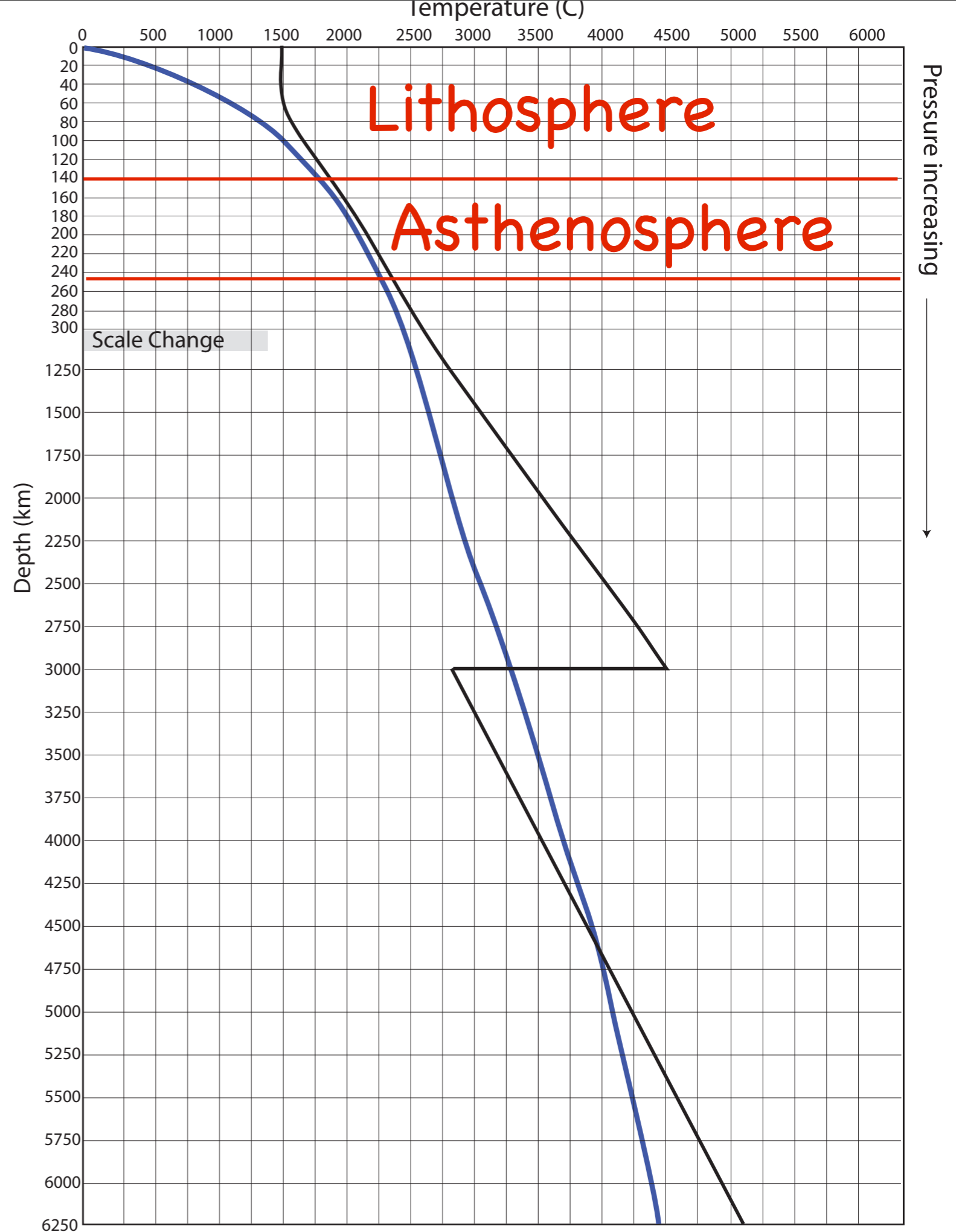
The Earth's Rheology



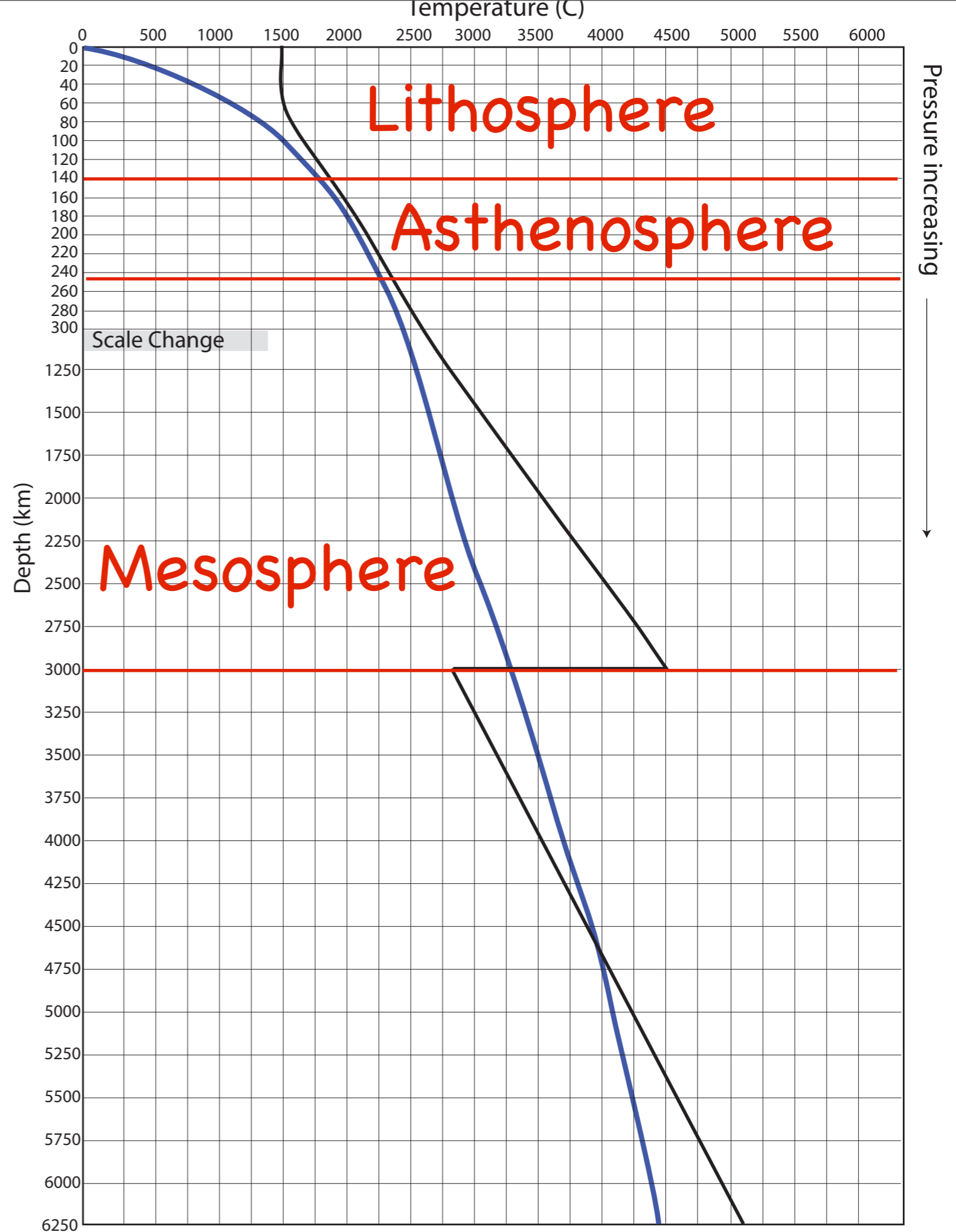
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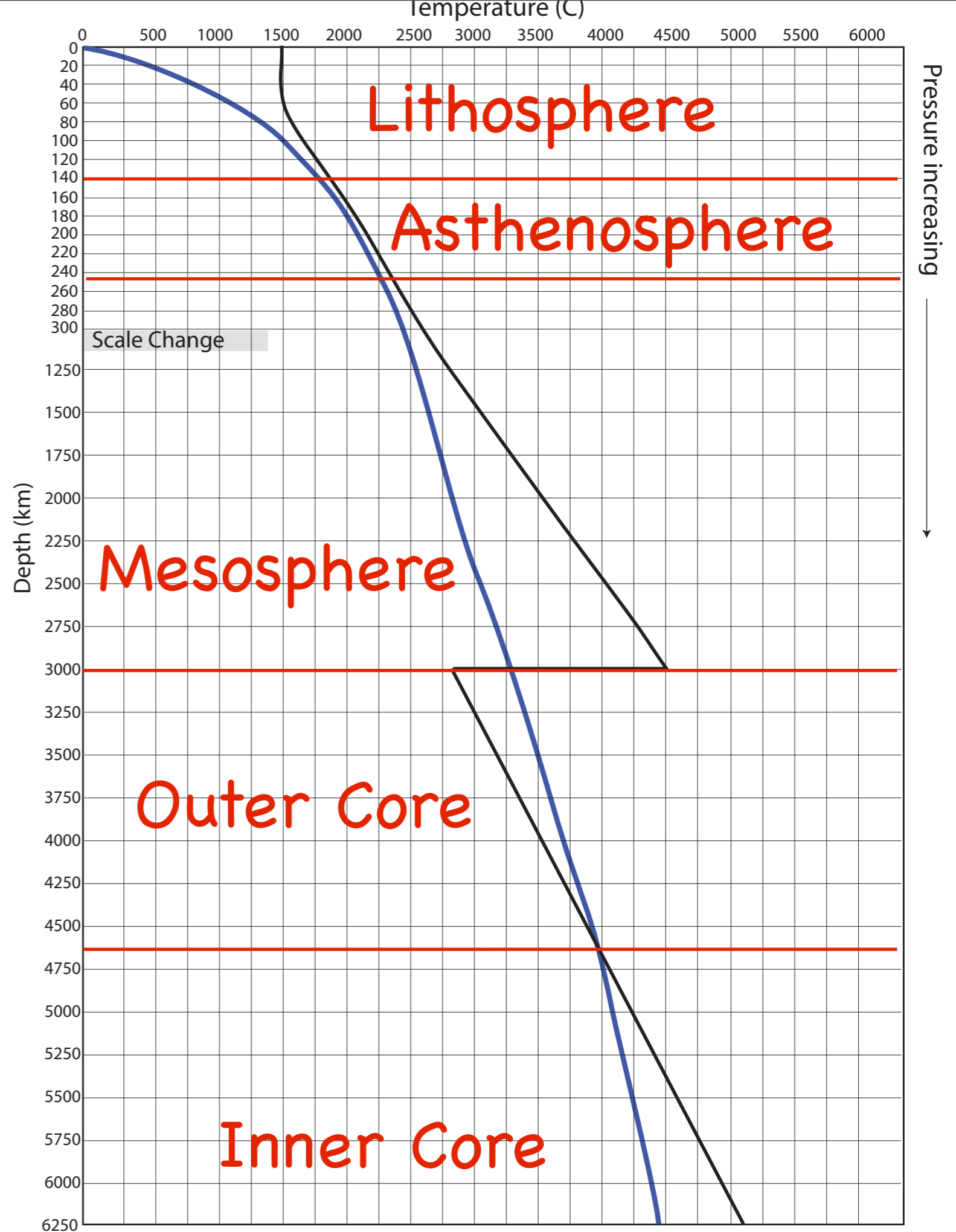
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The Earth's Rheology



The Earth's Rheology



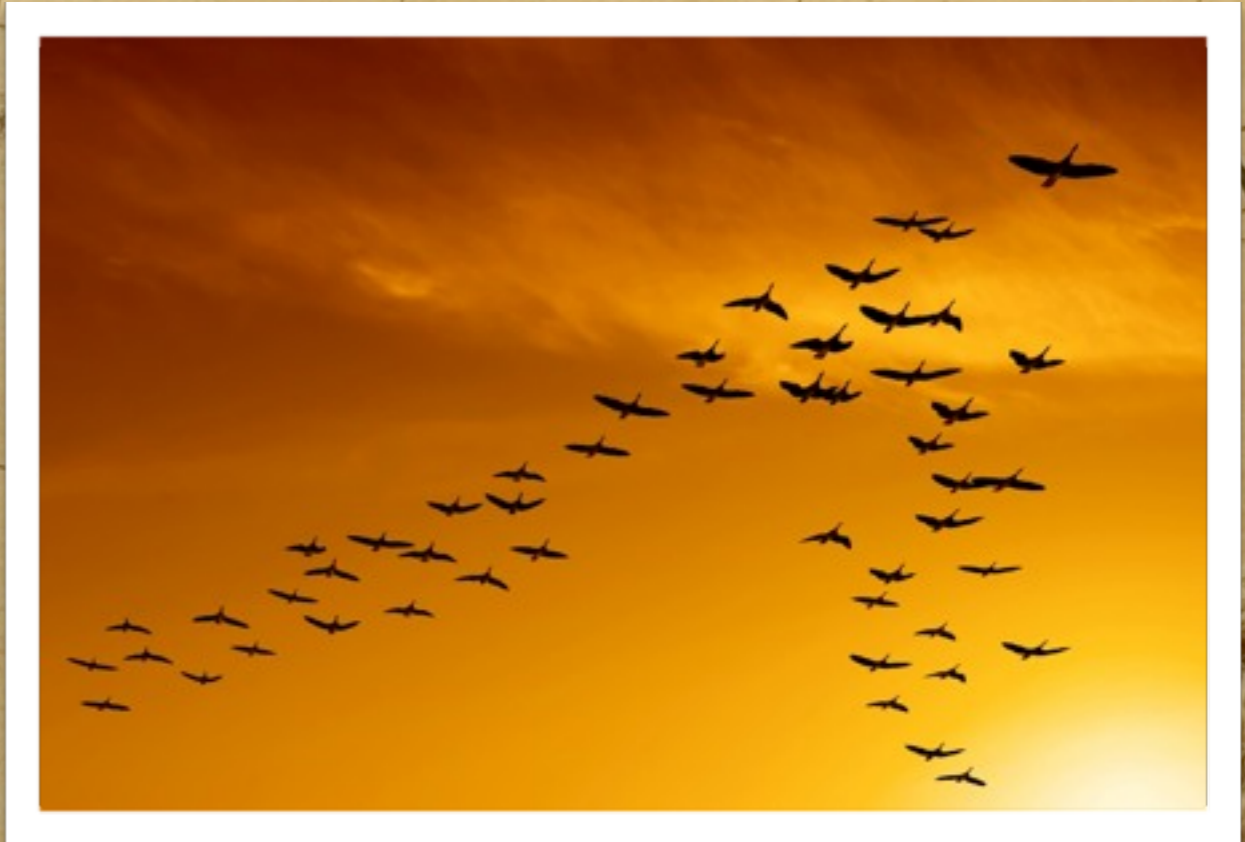


The Earth's Magnetic Field

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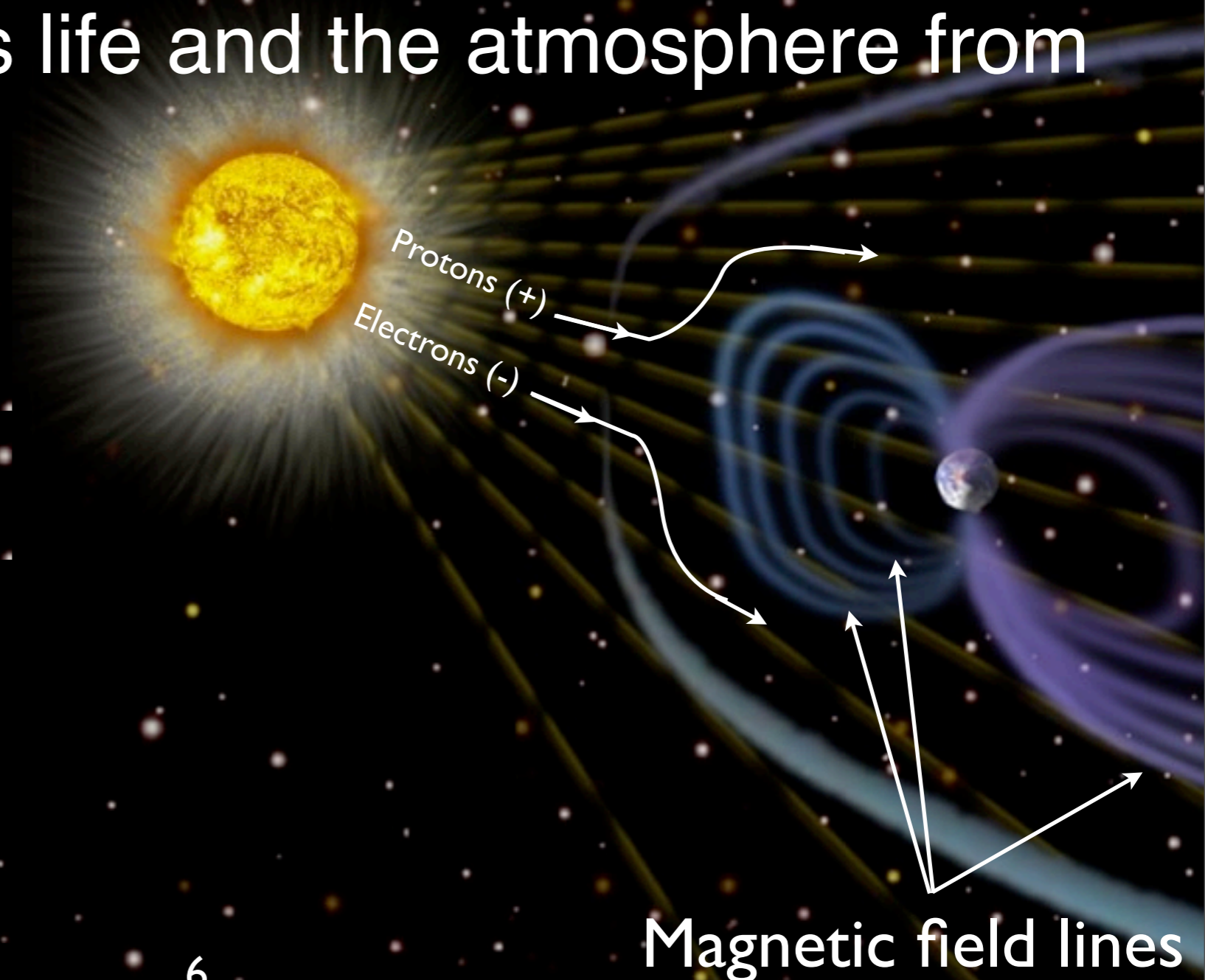
Why do we care about the Earth's Magnetic Field?

1) Humans and animals use the EMF for navigation.



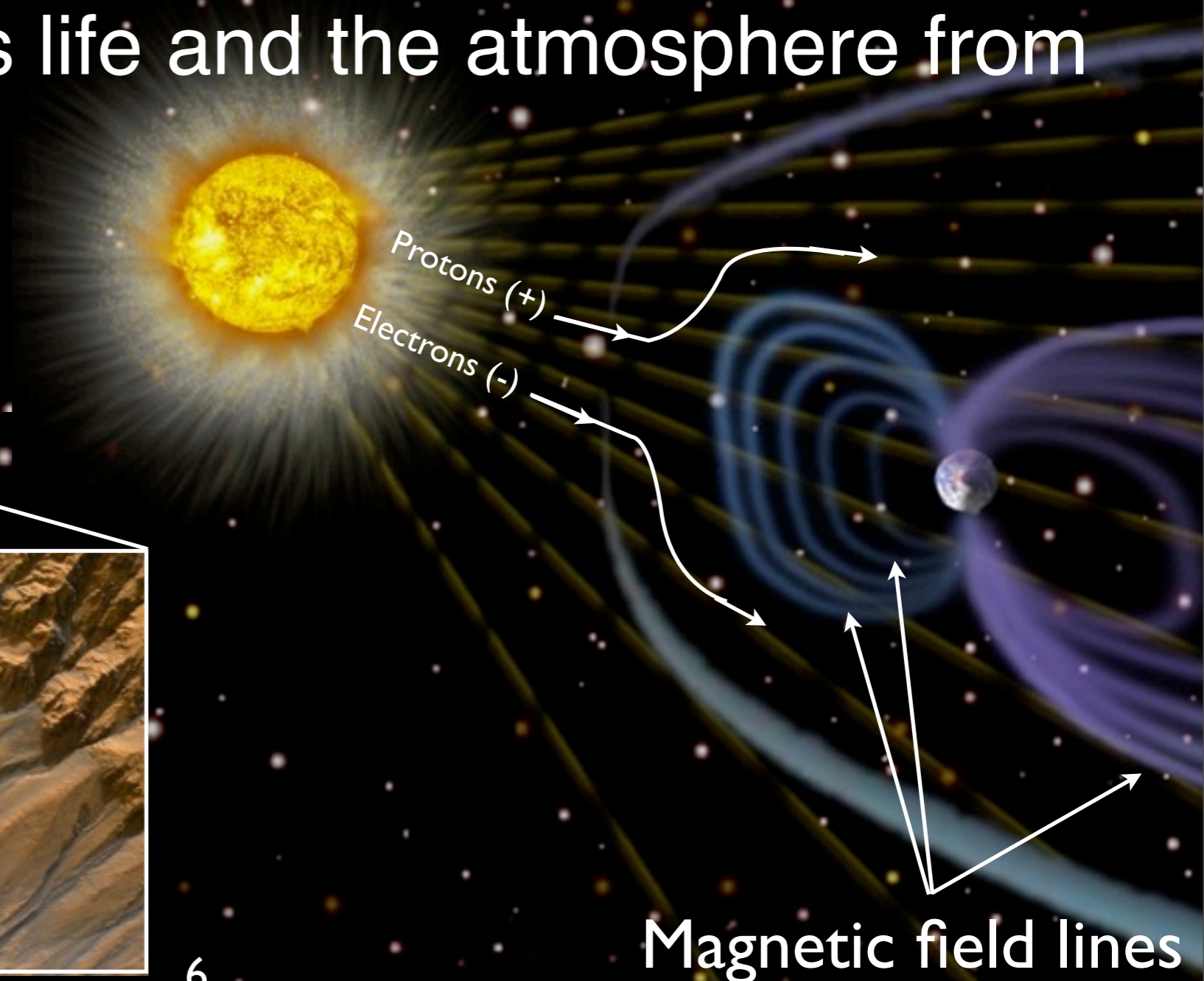
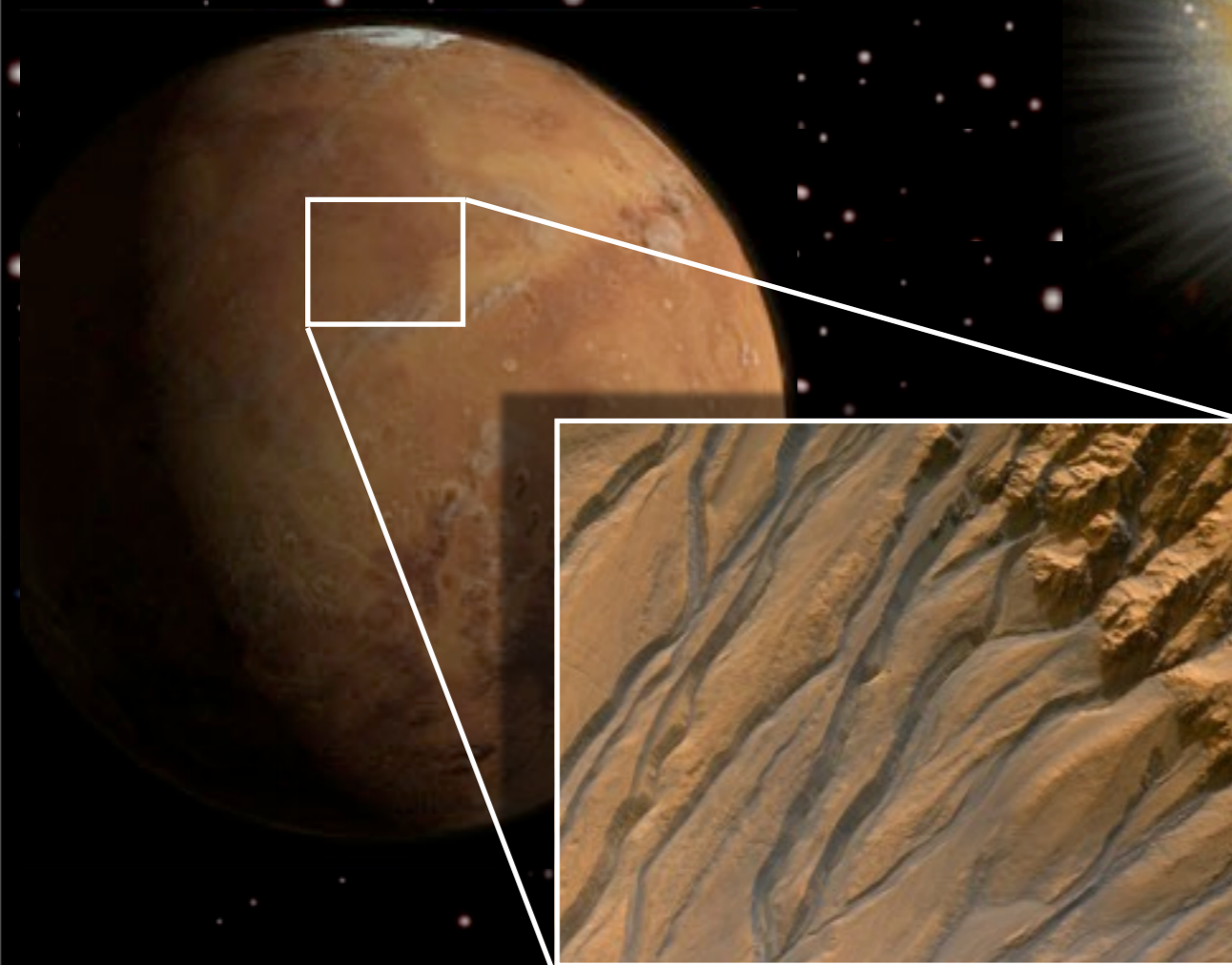
Why do we care about the Earth's Magnetic Field?

- 1) Humans and animals use the EMF for navigation.
- 2) The EMF protects life and the atmosphere from the Solar Wind.



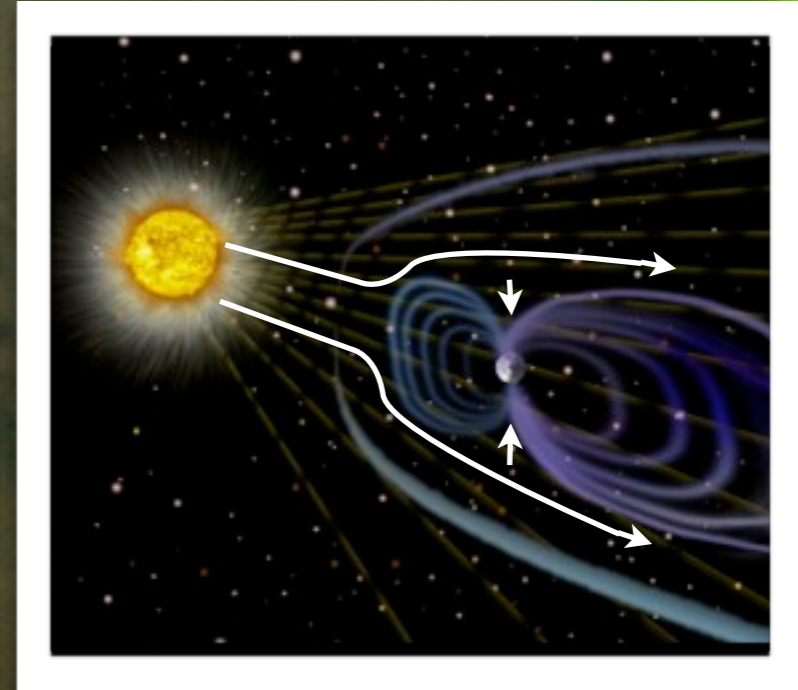
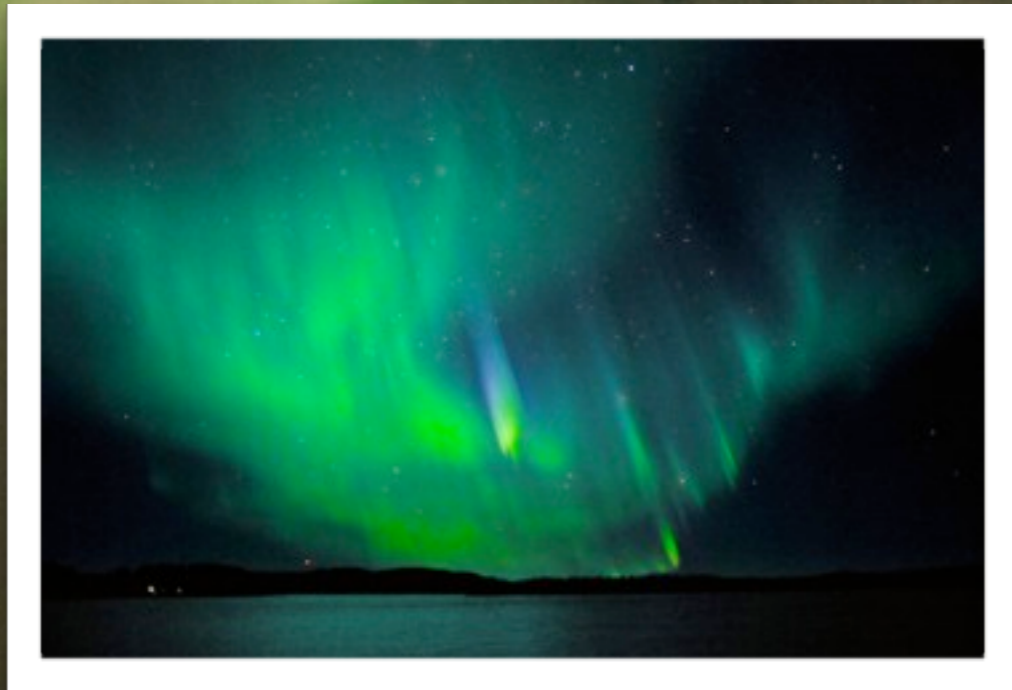
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- 1) Humans and animals use the EMF for navigation.
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- 3) The Northern and Southern light are the result of the interaction between the EMF and the solar wind.



Why do we care about the Earth's Magnetic Field?

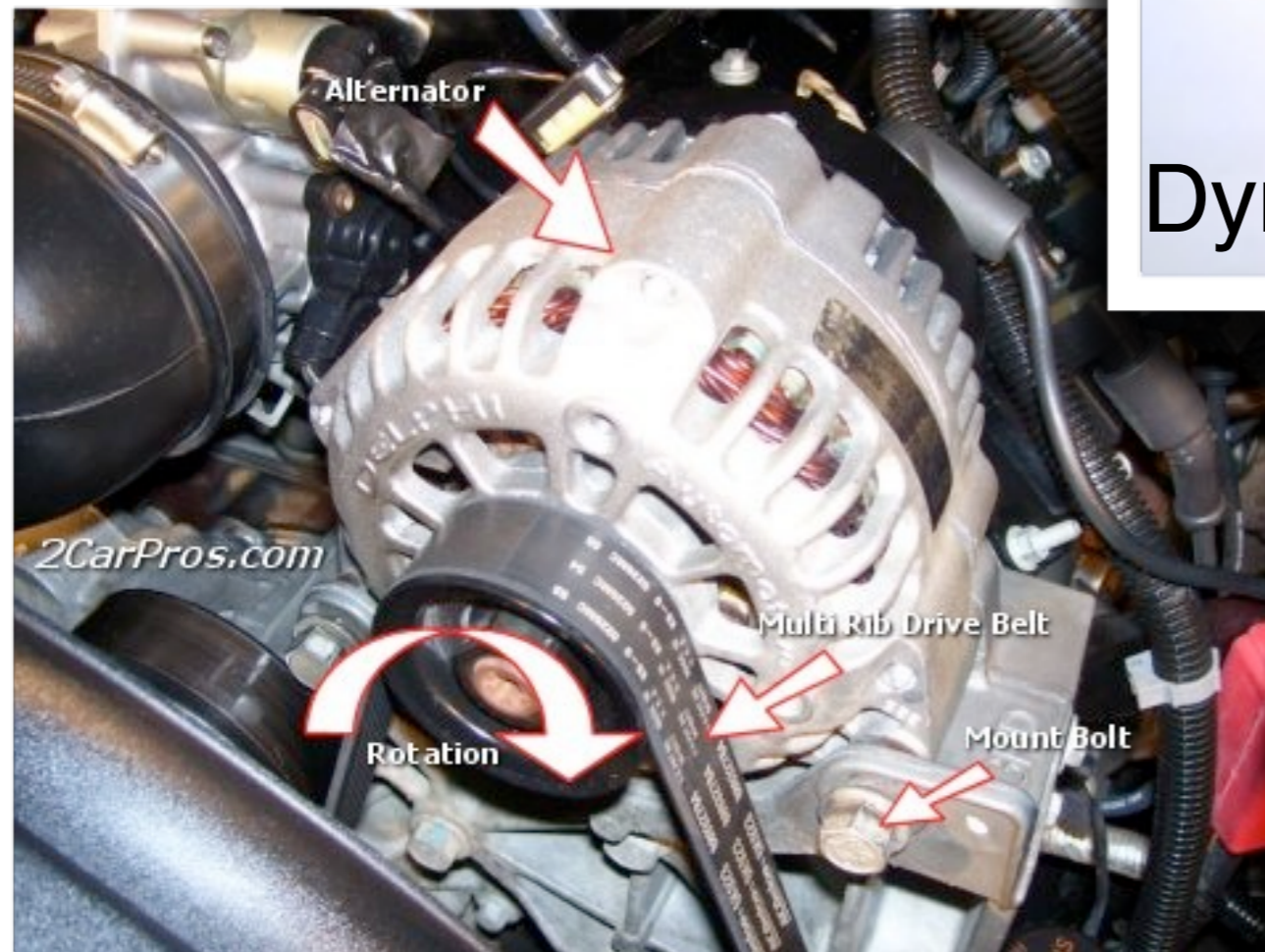
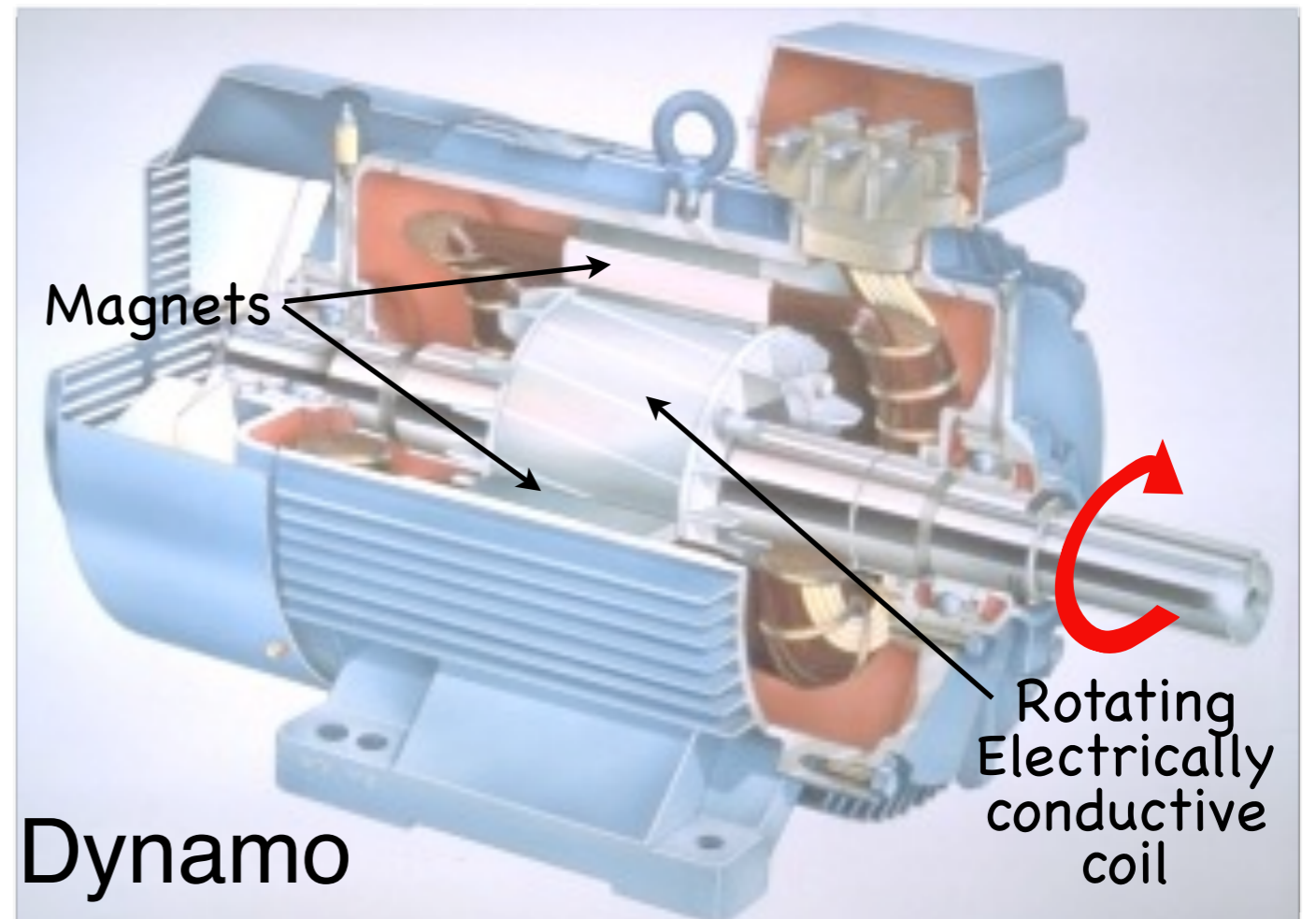
- 1) Humans and animals use the **EMF** for navigation.
- 2) The EMF protects life and the atmosphere from the Solar Wind.
- 3) The Northern and Southern light are the result of the interaction between the **EMF** and the solar wind.
- 4) Variations in the **EMF** are preserved in the rock record and were instrumental to the development of **Plate Tectonic Theory**.

Some Basic Physics of Magnetic Fields

1) A fluctuating magnetic field creates electrical current and electrical current moving in a conductive material creates a magnetic field.

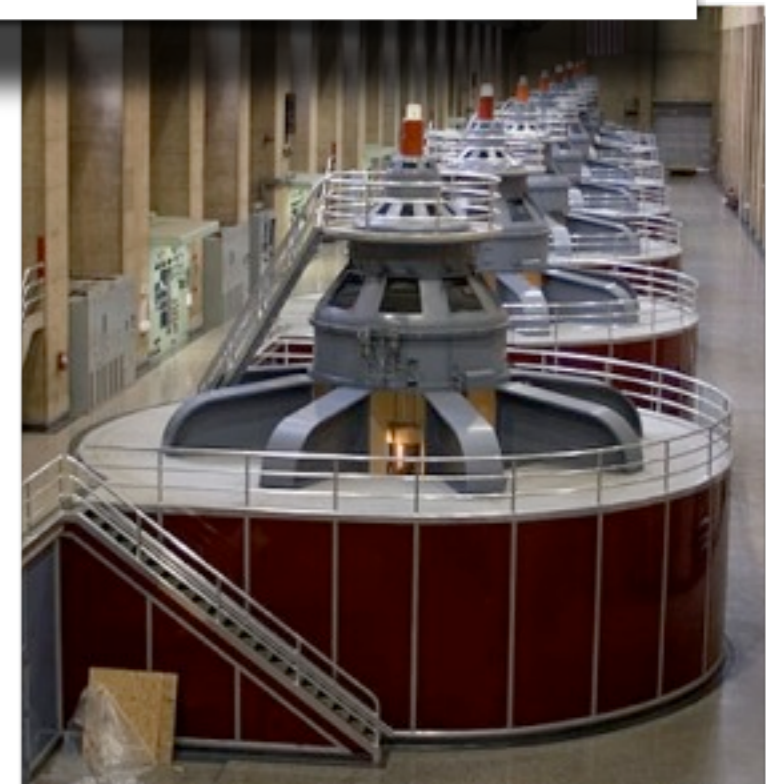
Some Basic Physics of Mag

1) A fluctuating magnetic current and electrical conductive material cr



Automobile alternator

Hoover
Dam
electrical
generators



Some Basic Physics of Magnetic Fields

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Some Basic Physics of Magnetic Fields

1) A fluctuating magnetic field creates electrical current and electrical current moving in a **conductive material** creates a magnetic field.

2) Electrically conductive (shaded green) and magnetic elemental compounds (yellow box):

- Iron (Fe)
- Nickel (Ni)
- Copper (Cu)
- Cobalt (Co)

The image shows a periodic table of elements. Elements are color-coded: green for electrically conductive and yellow for magnetic. A yellow box highlights the transition metals Fe, Co, Ni, and Cu. A blue box highlights the lanthanide and actinide series (57-71 and 89-103). A sidebar on the right lists various physical and chemical properties for the selected elements, including Series, State at 273 K, Melting Point, Boiling Point, Electronegativity, Electron Affinity, Valence, Ionization, Radius, Hardness, Modulus, Density, Electric Conductivity, Heat, Abundance, and Discovered.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H Hydrogen																	2 He Helium
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium											13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Caesium	56 Ba Barium	57-71 Lanthanides	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89-103 Actinides	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Uut Ununtrium	114 Uuq Ununquadium	115 Uup Ununpentium	116 Uuh Ununhexium	117 Uus Ununseptium	118 Uuo Ununoctium

As you know from your reading the outer core is responsible for Earth's Magnetic Field. Why might this be?

As you know from your reading the outer core is responsible for Earth's Magnetic Field. Why might this be?

A) Because the outer core is the only layer of Earth that is composed of electrically conductive material.

B) Because the outer core is the only layer that is composed of electrically conductive material and is in motion due to conduction.

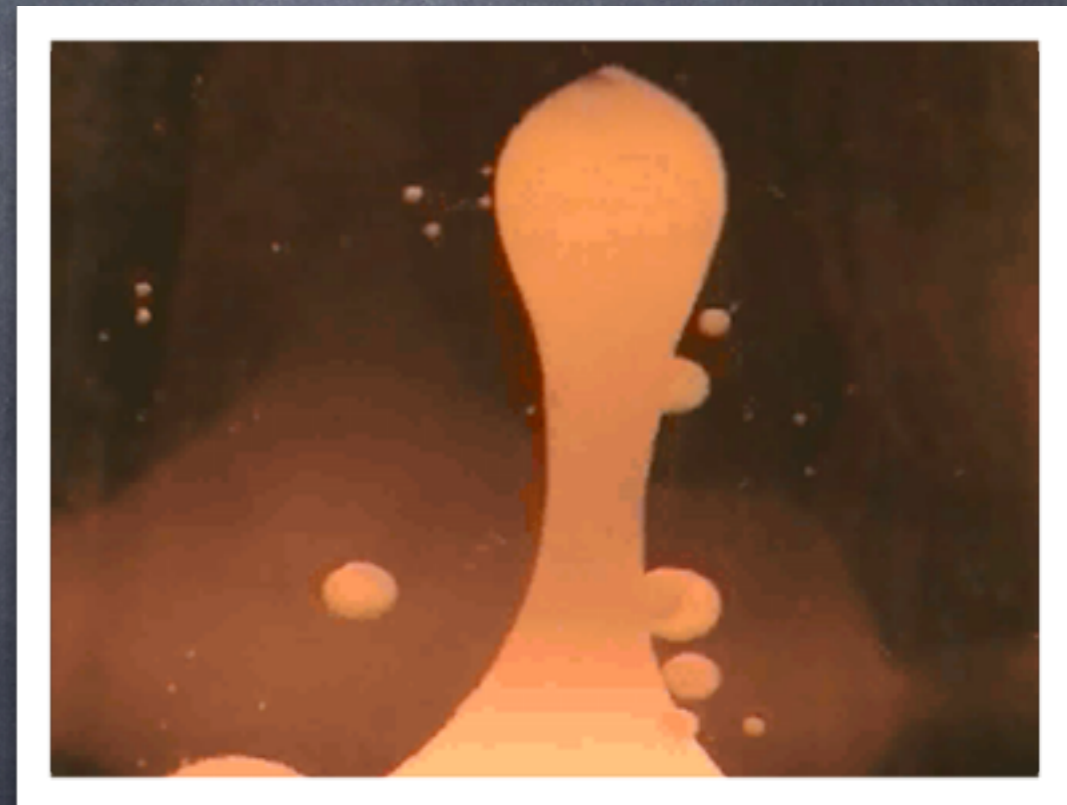
C) Because the outer core is the only layer that is composed of electrically conductive material and is in motion due to convection.

As you know from your reading the outer core is responsible for Earth's Magnetic Field. Why might this be?

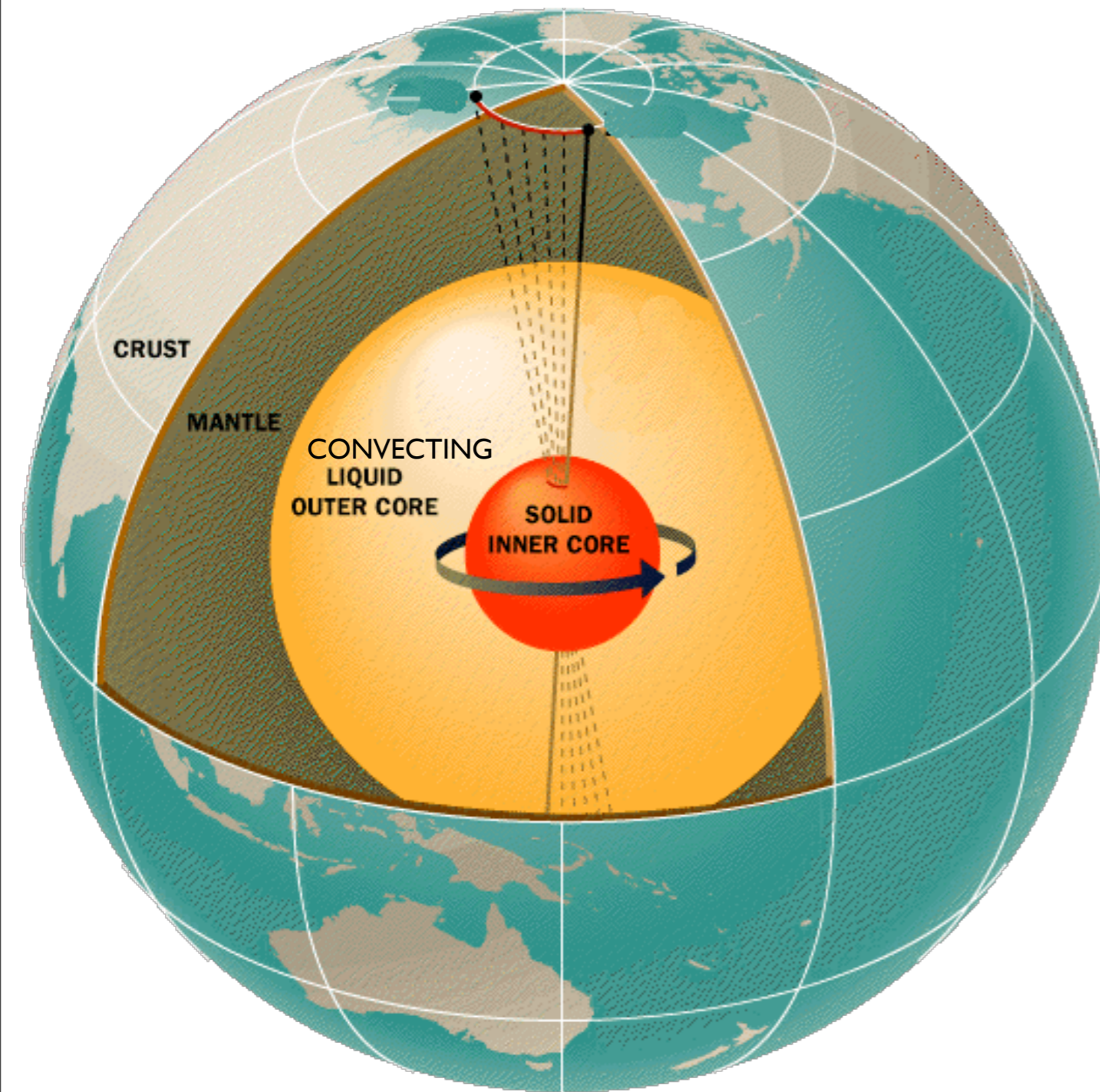
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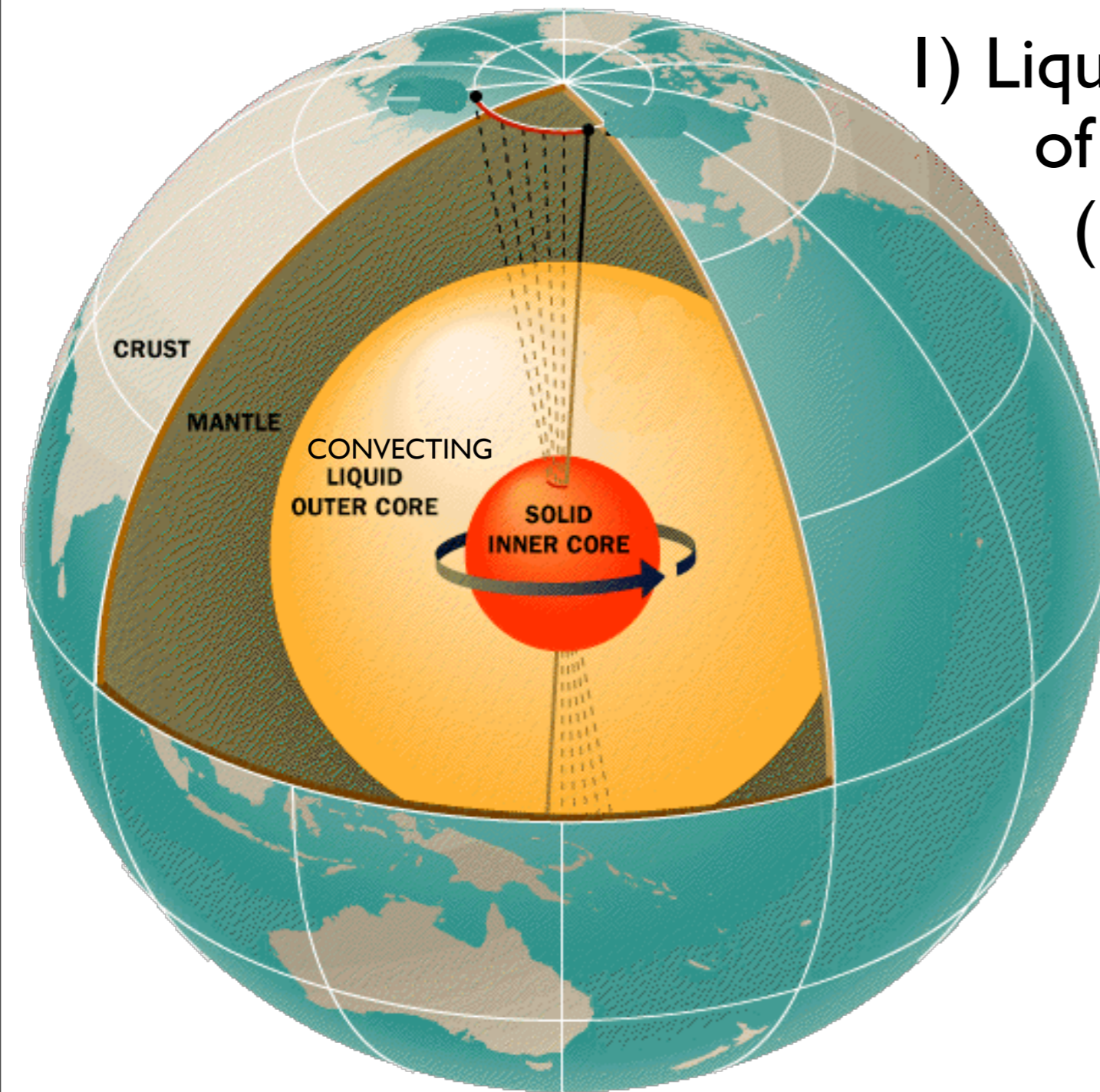


Geodynamo: the Driving Force behind Earth's Magnetic Field:

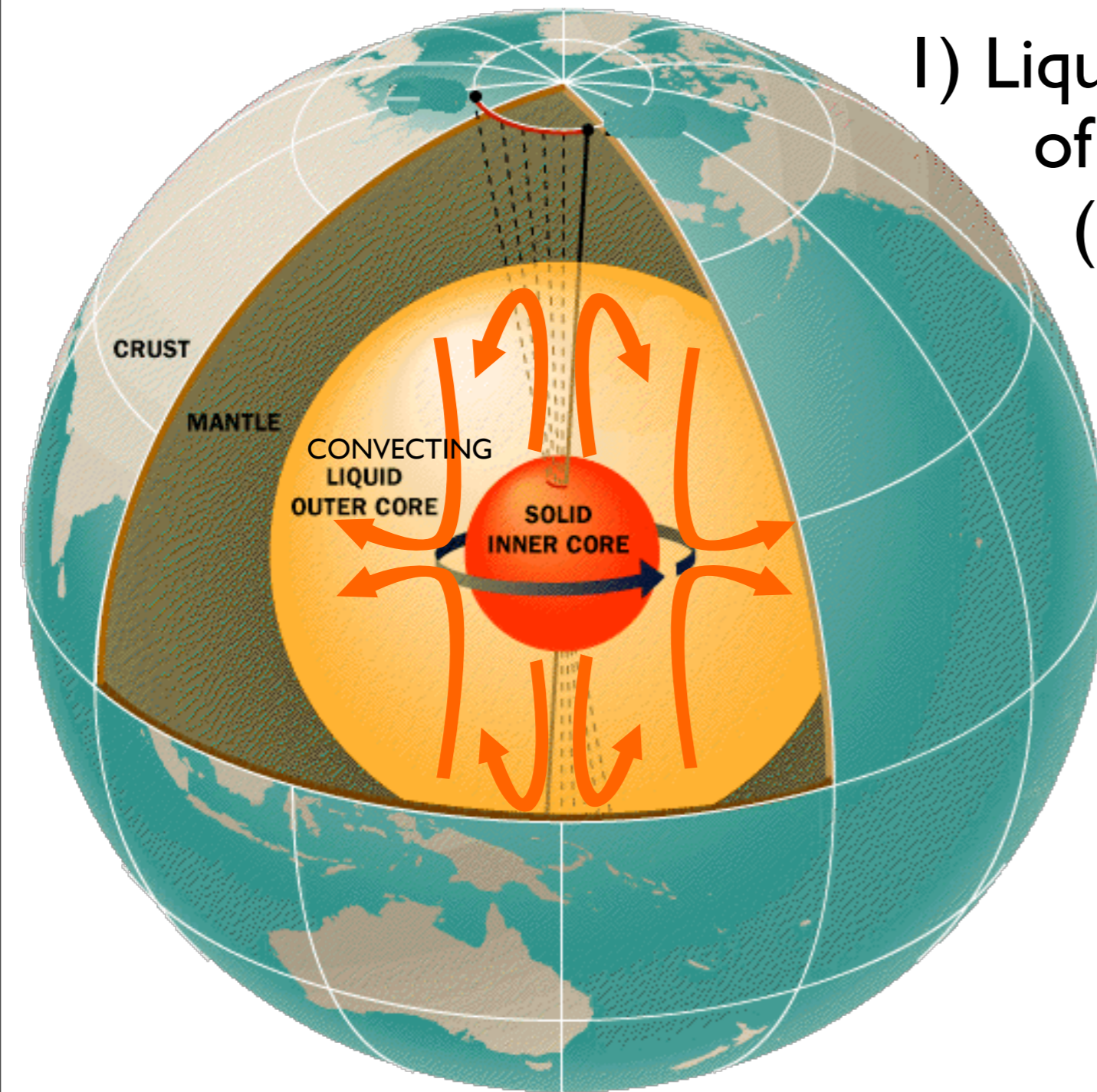


Geodynamo: the Driving Force behind Earth's Magnetic Field:

I) Liquid outer core composed of electrically conductive metal (Nickel and Iron)



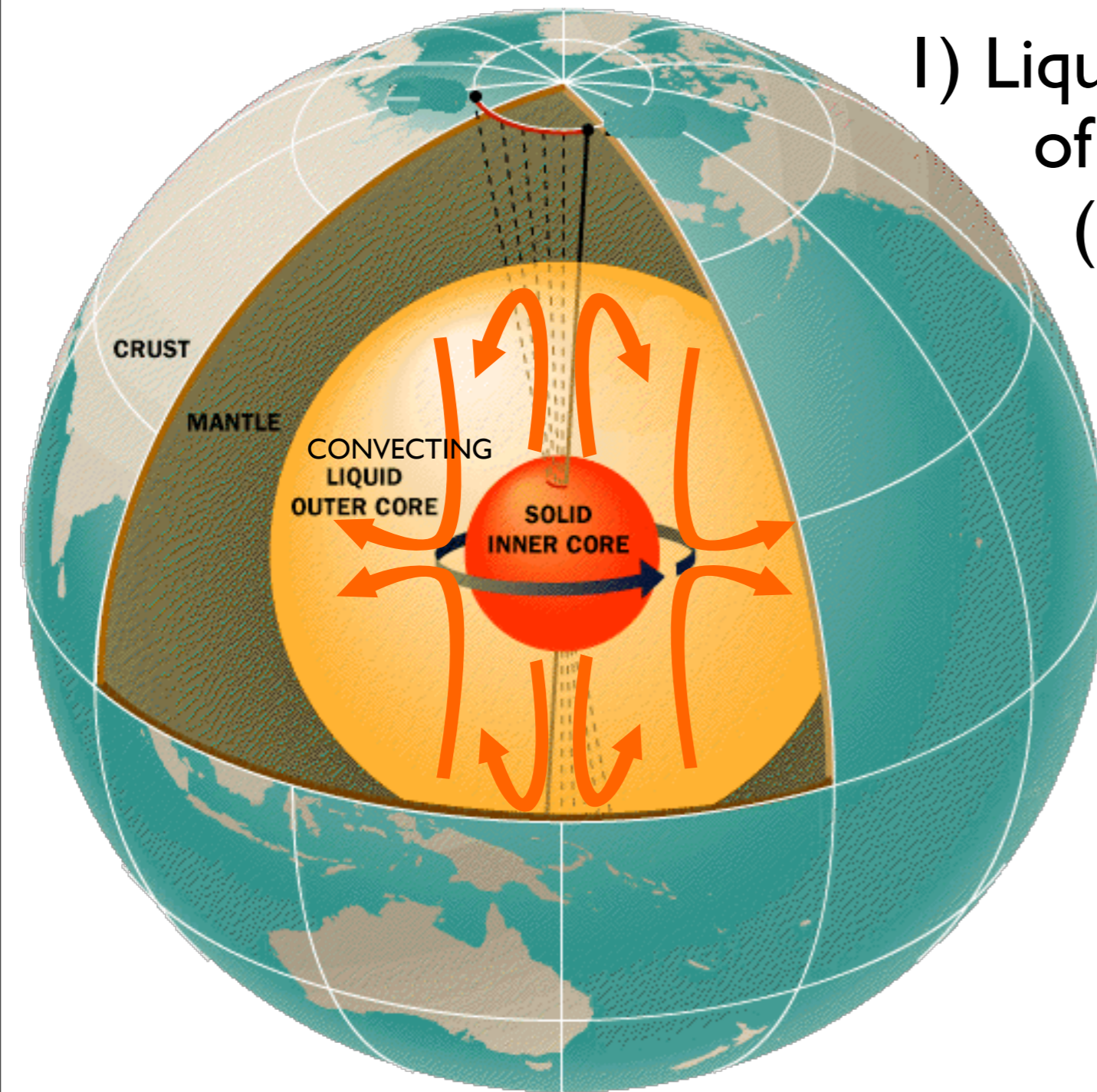
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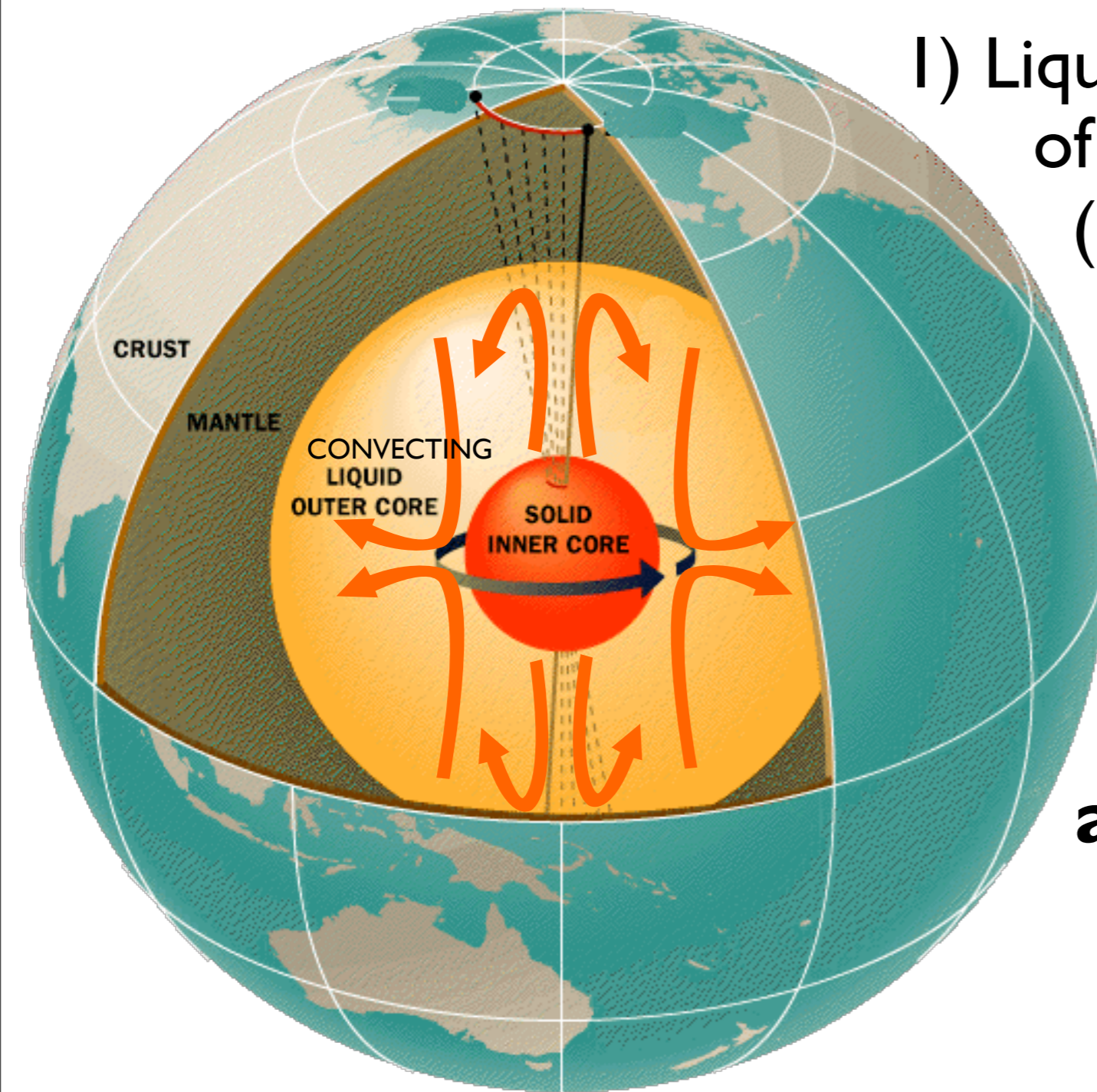


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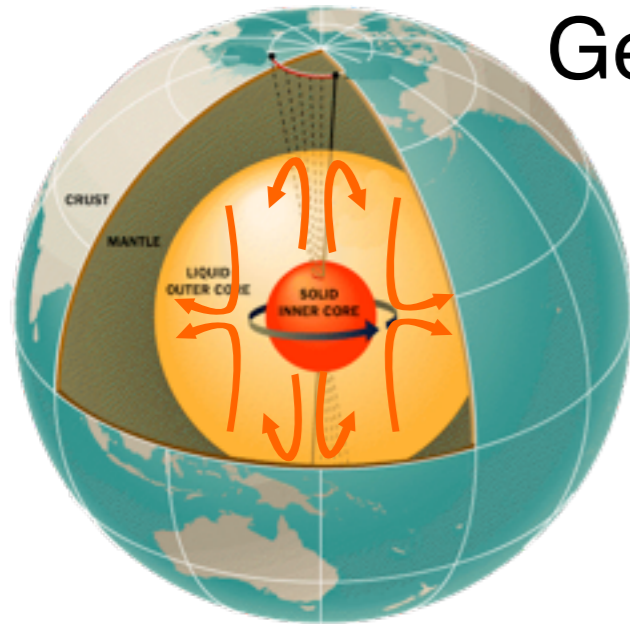
together create an electrical current in the outer core

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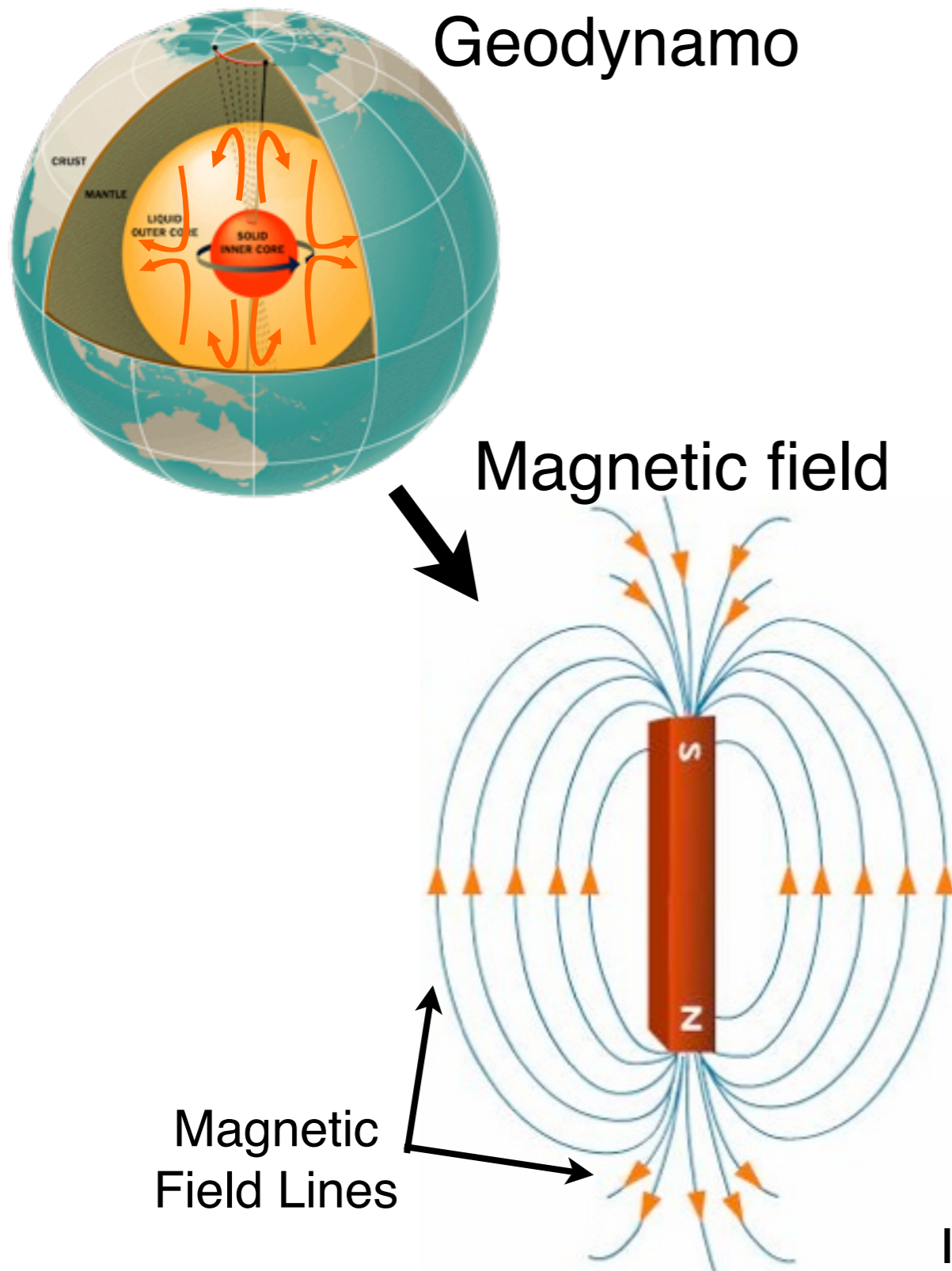
The Geodynamo

Summary of the Cause of the Earth Magnetic Field

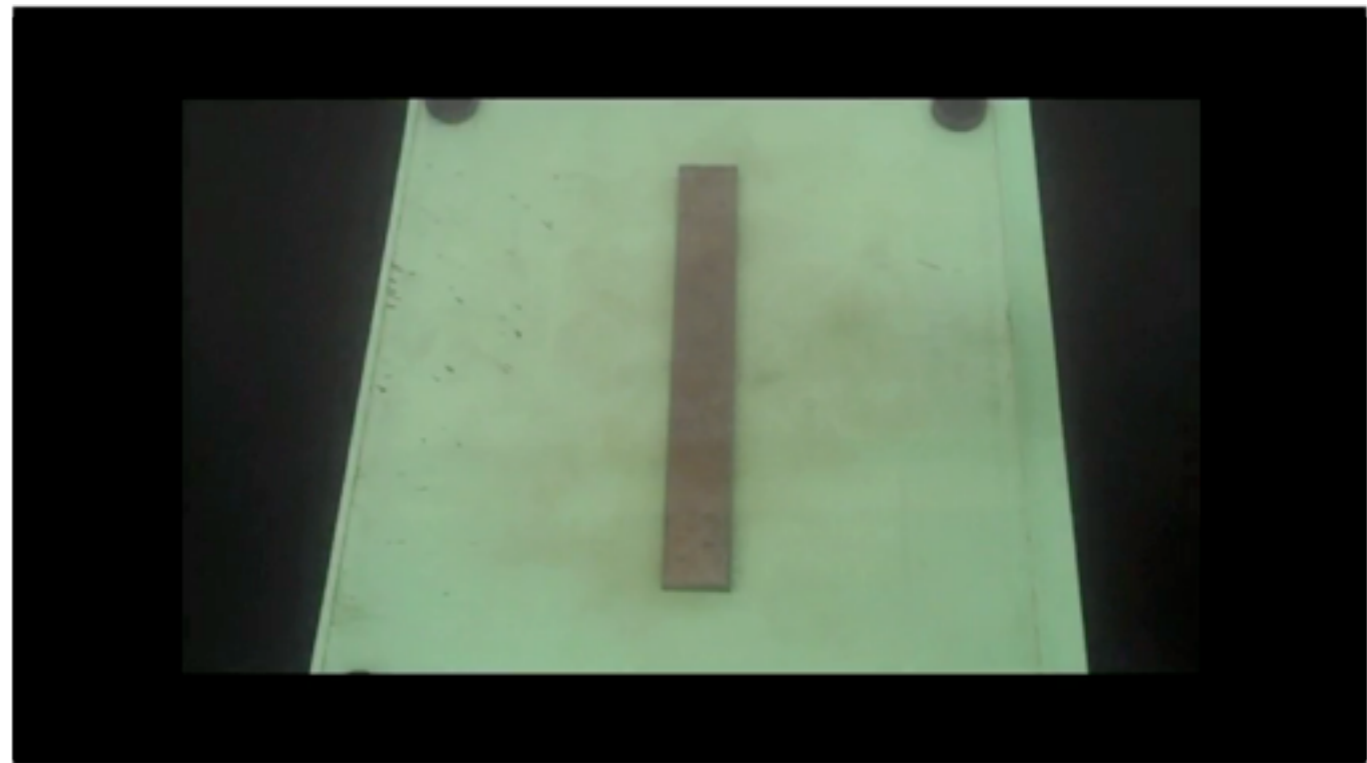
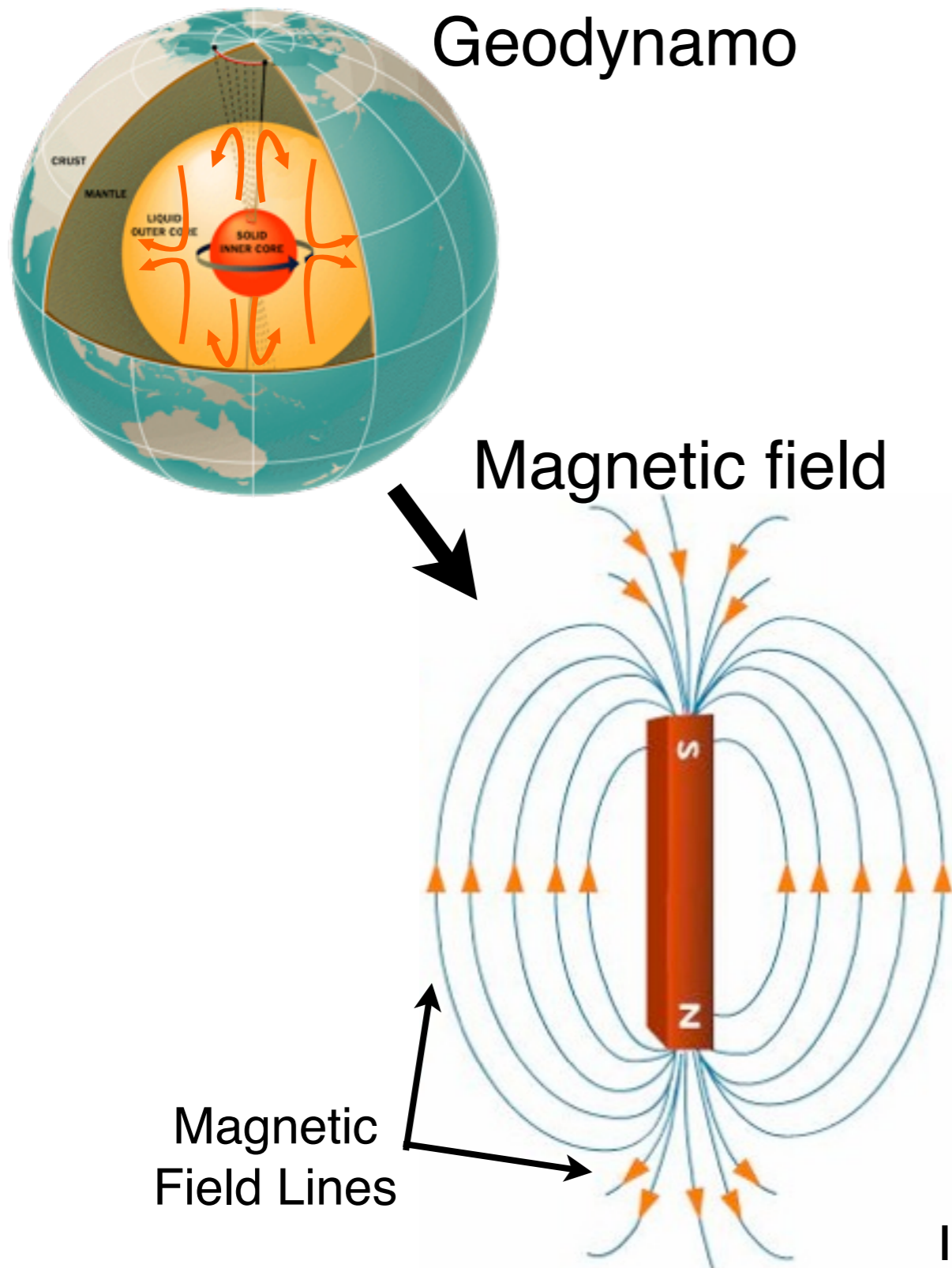
Geodynamo



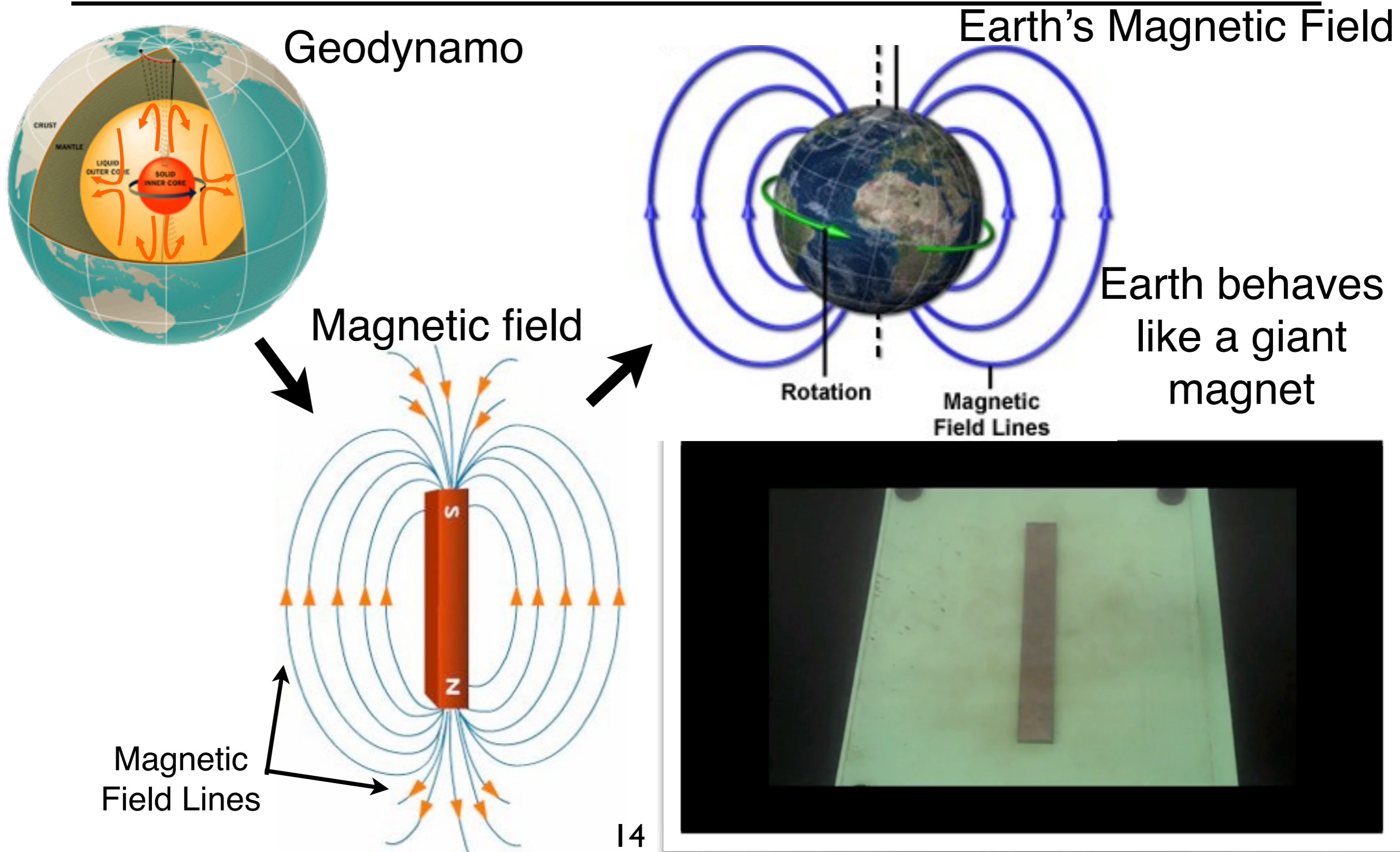
Summary of the Cause of the Earth Magnetic Field



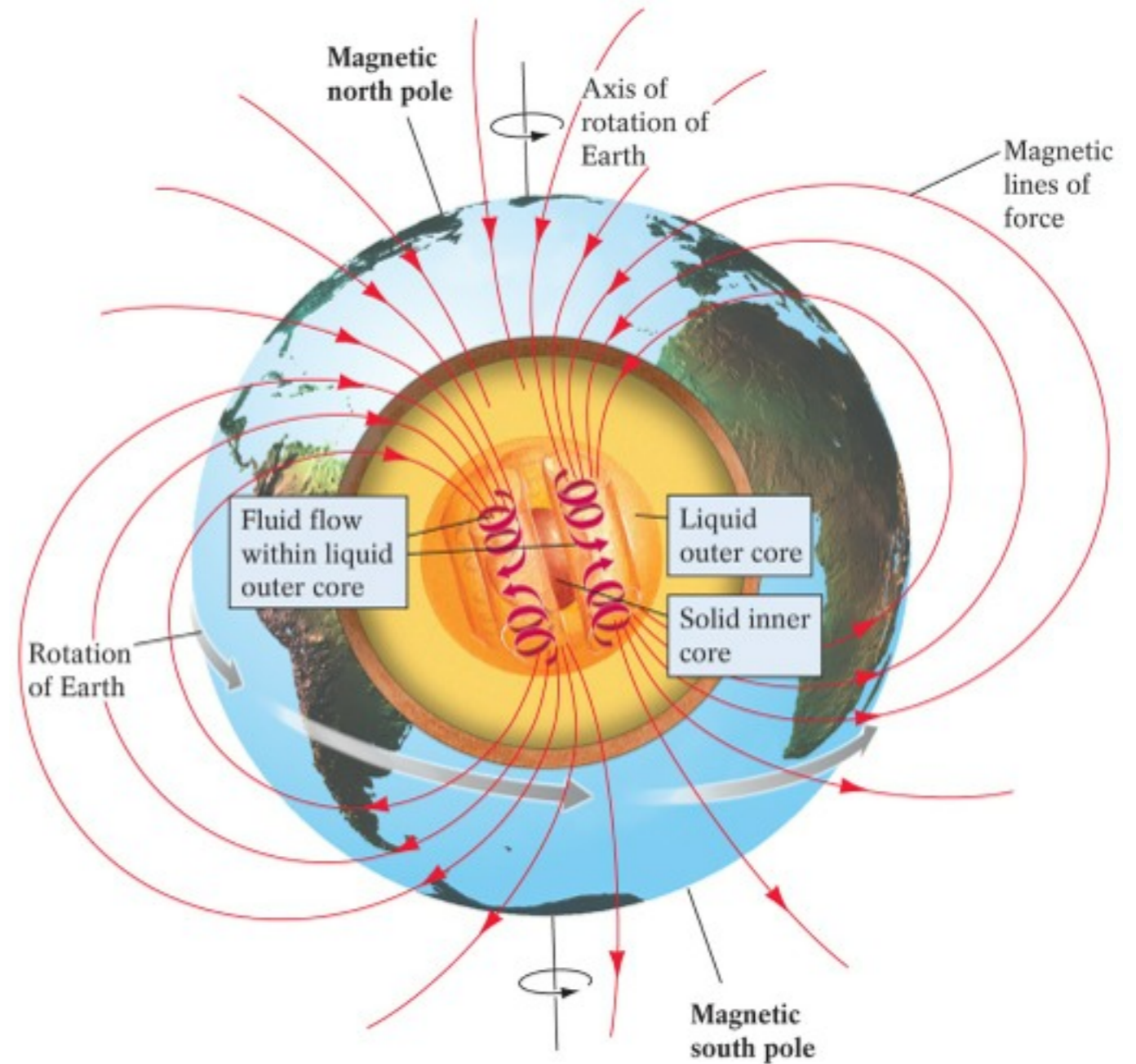
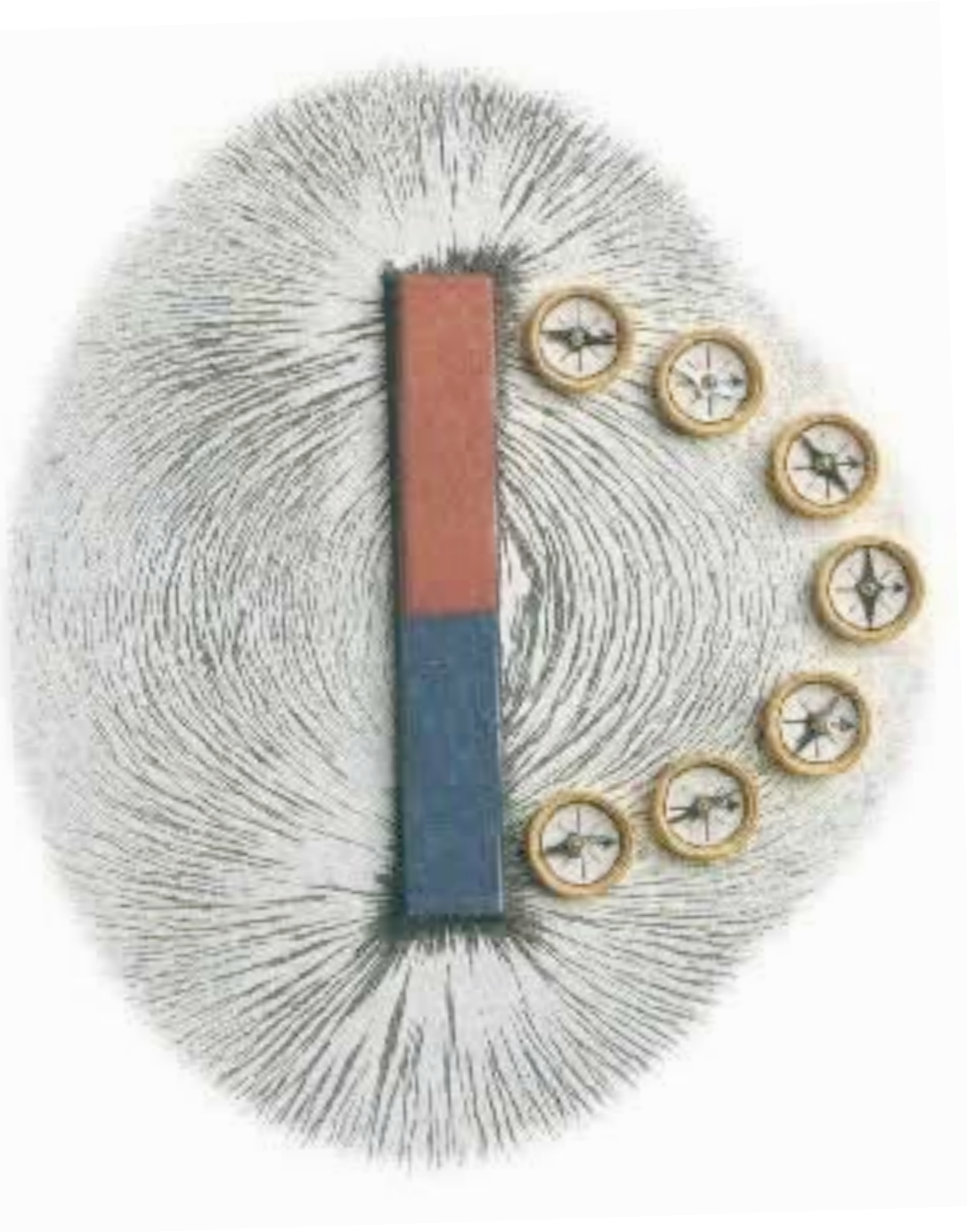
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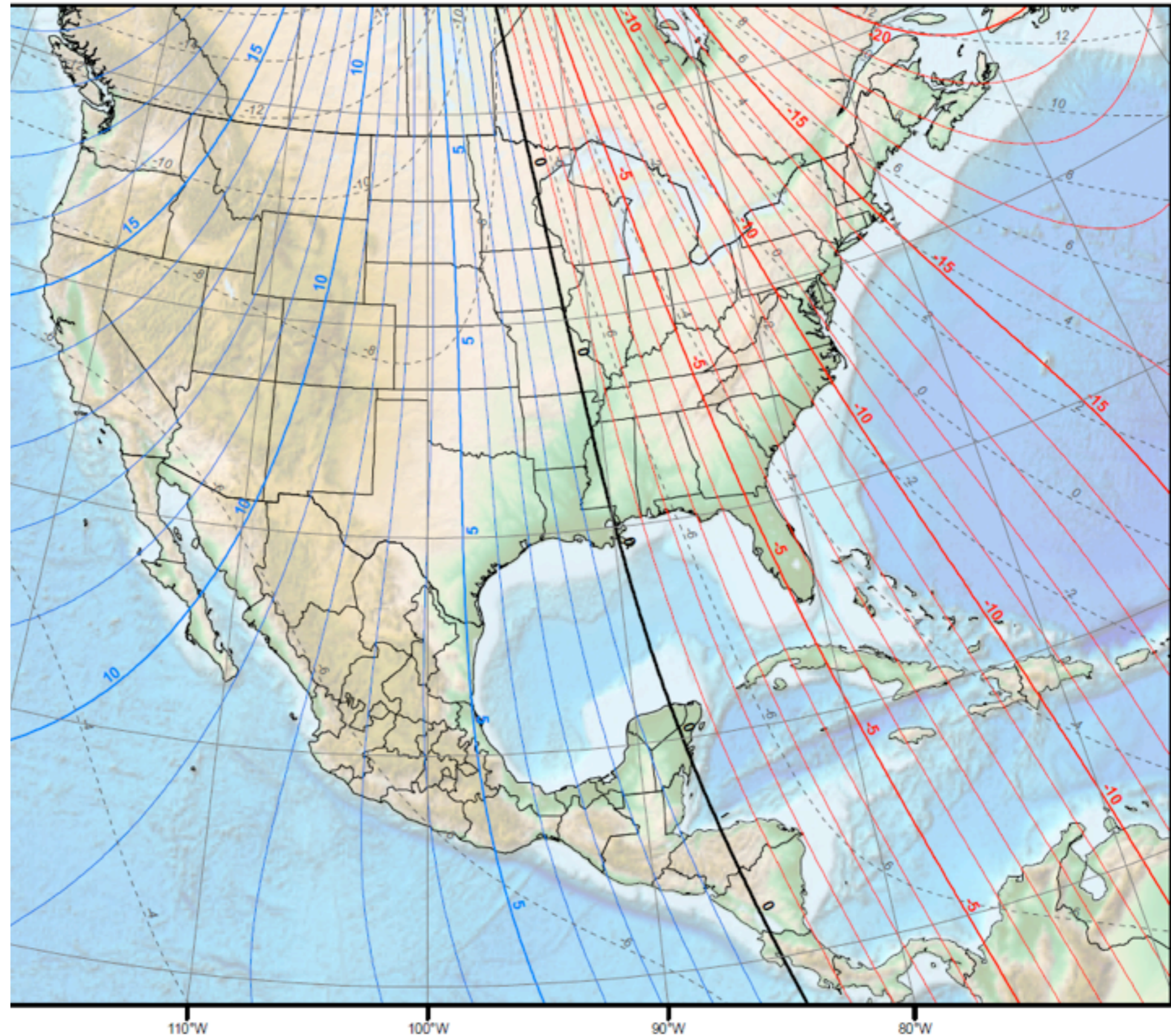


Magnetism and Geomagnetism

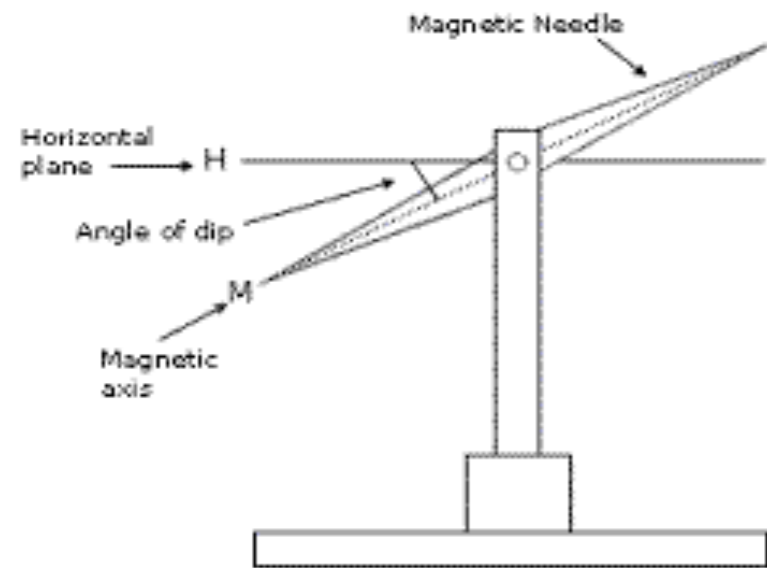


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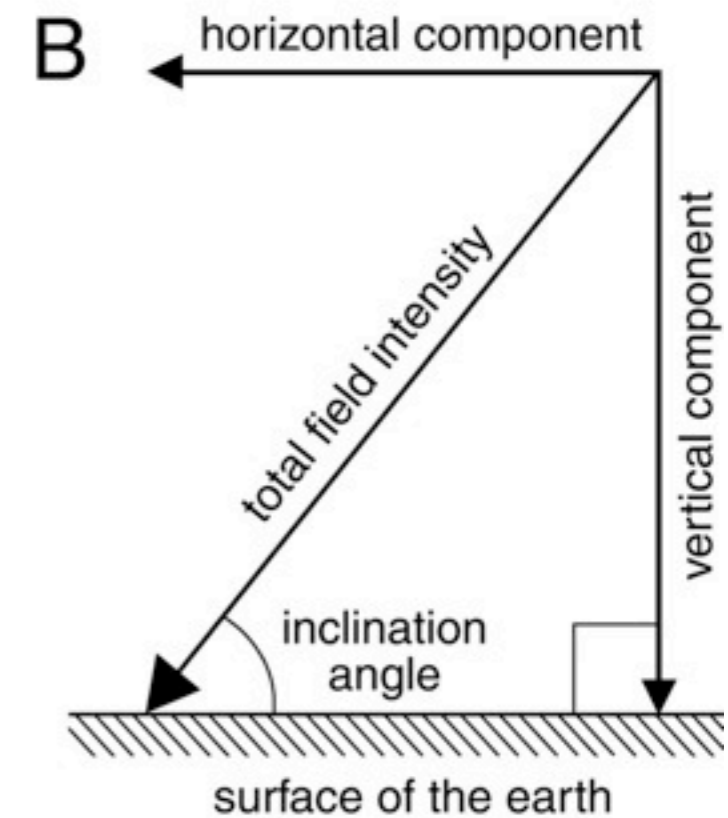
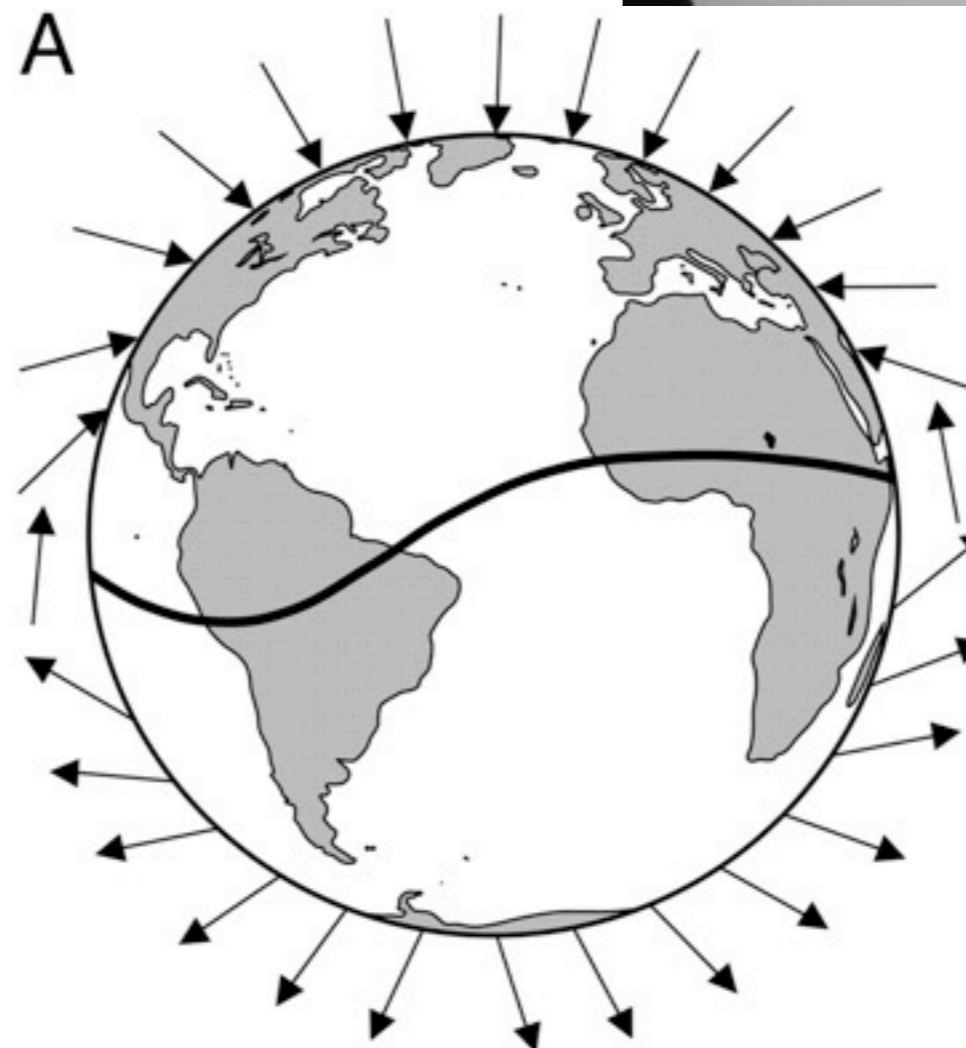
Magnetic Declination



Magnetic Inclination

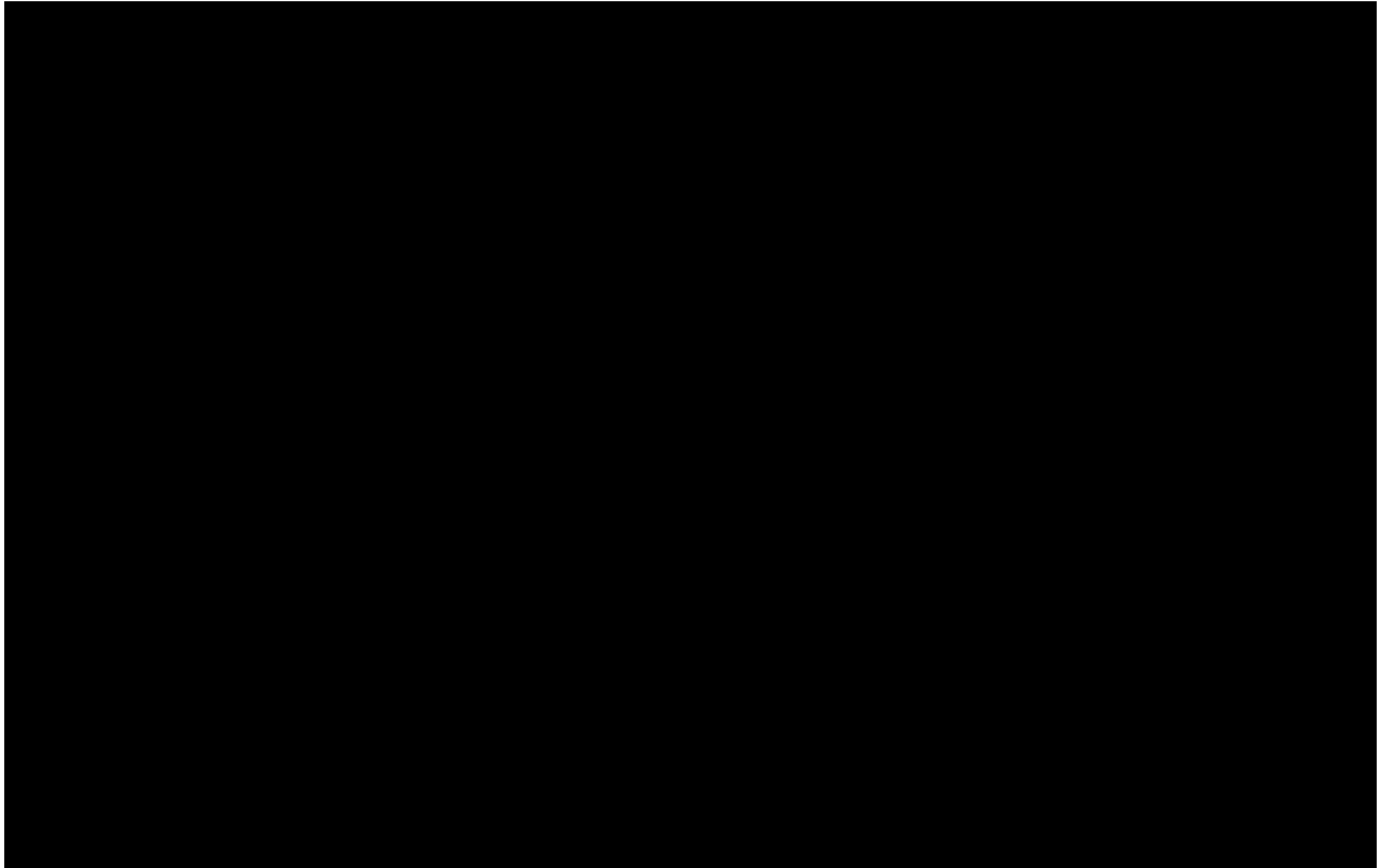


The angle HOM between the horizontal plane HO and the axis of freely suspended magnetic needle MO is Angle of Dip or Inclination

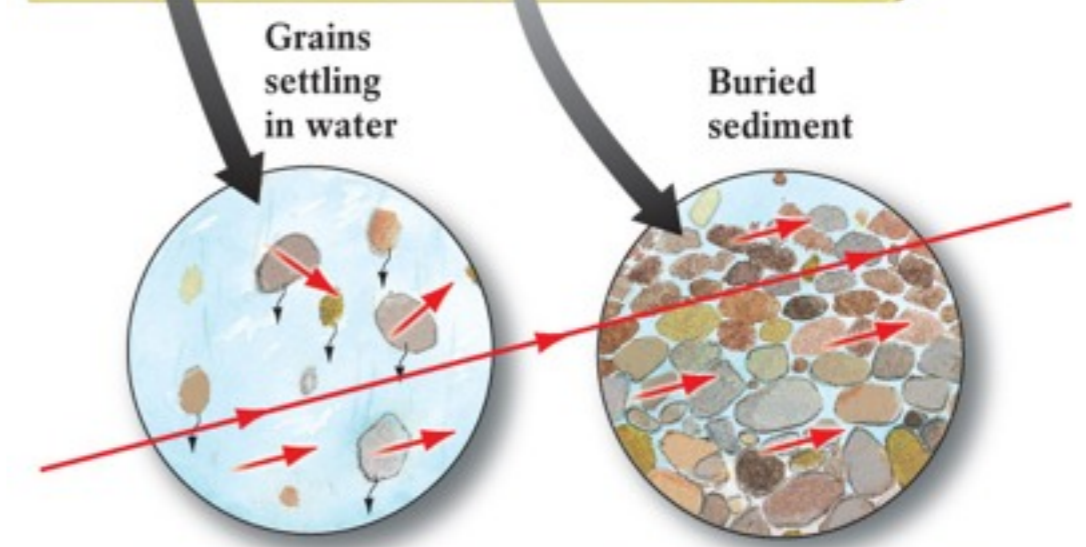
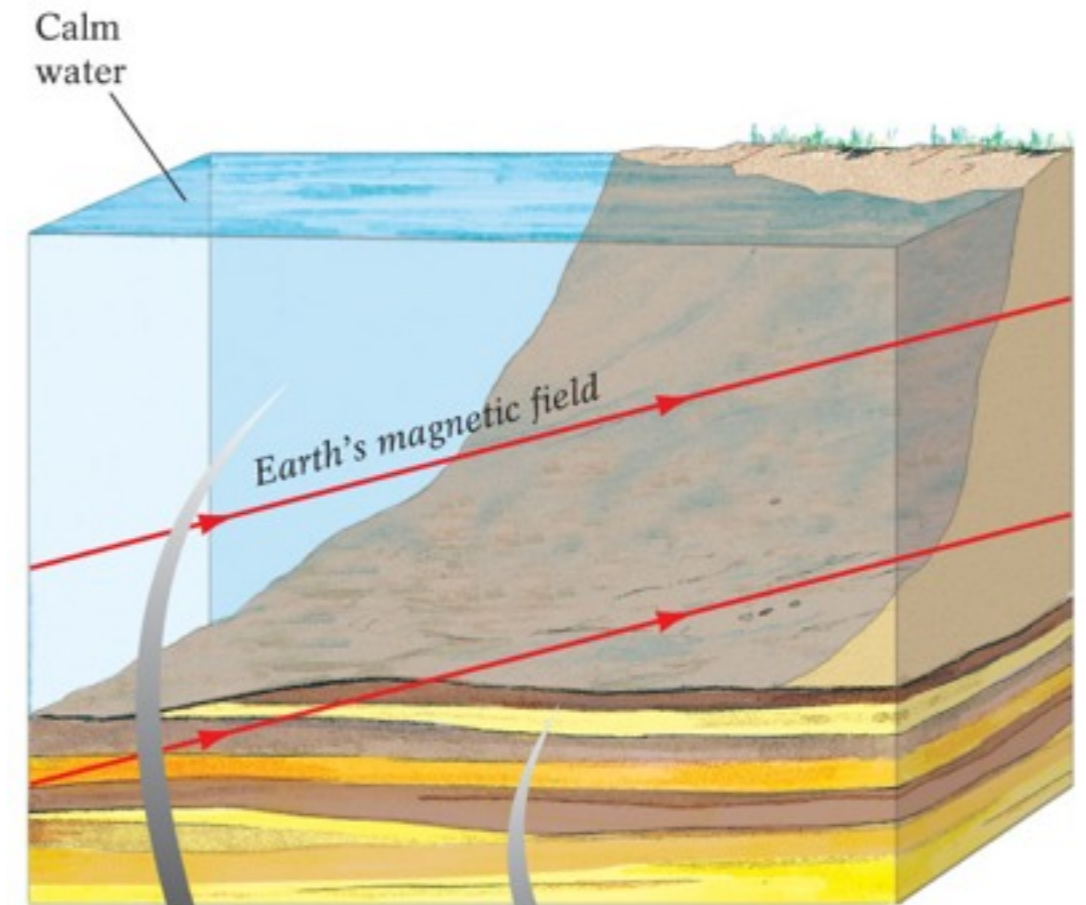
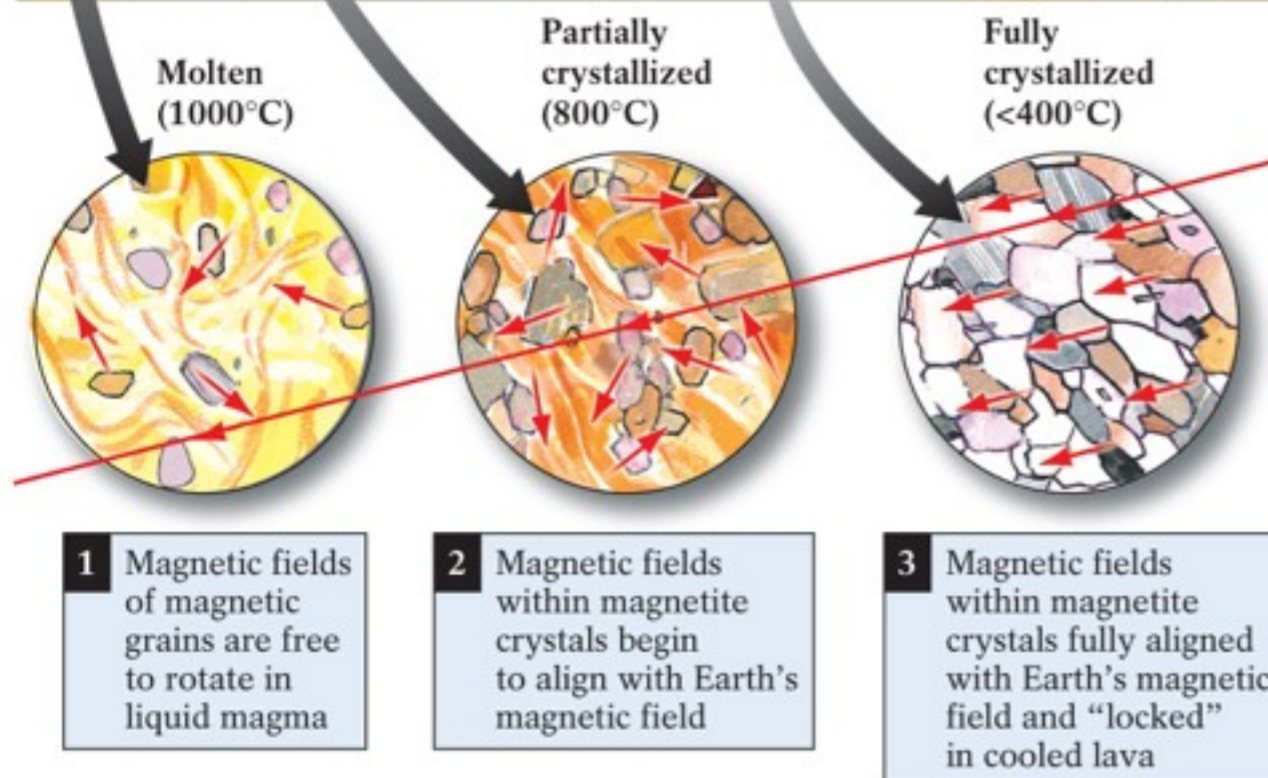
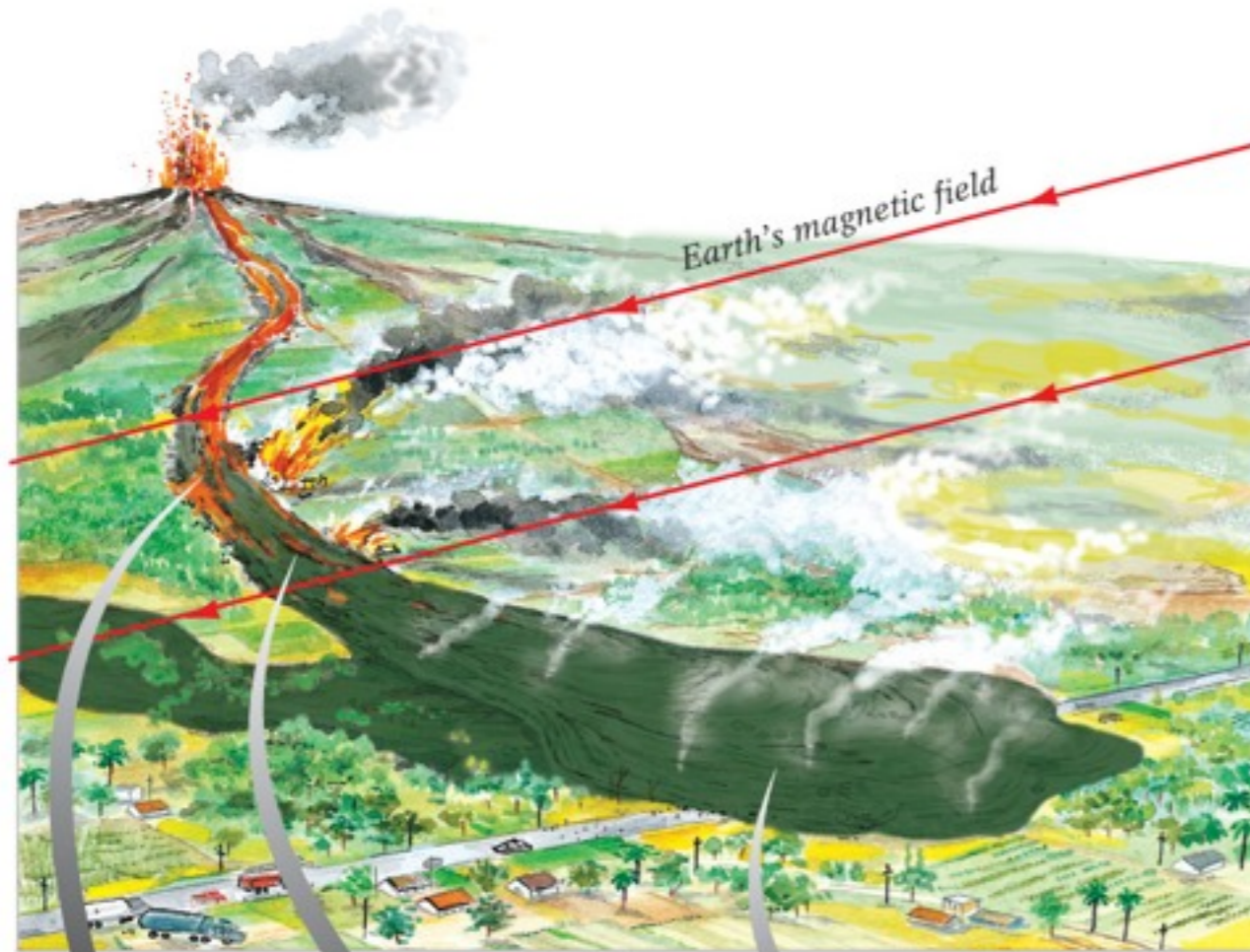


Magnetic Reversal

Magnetic Reversal

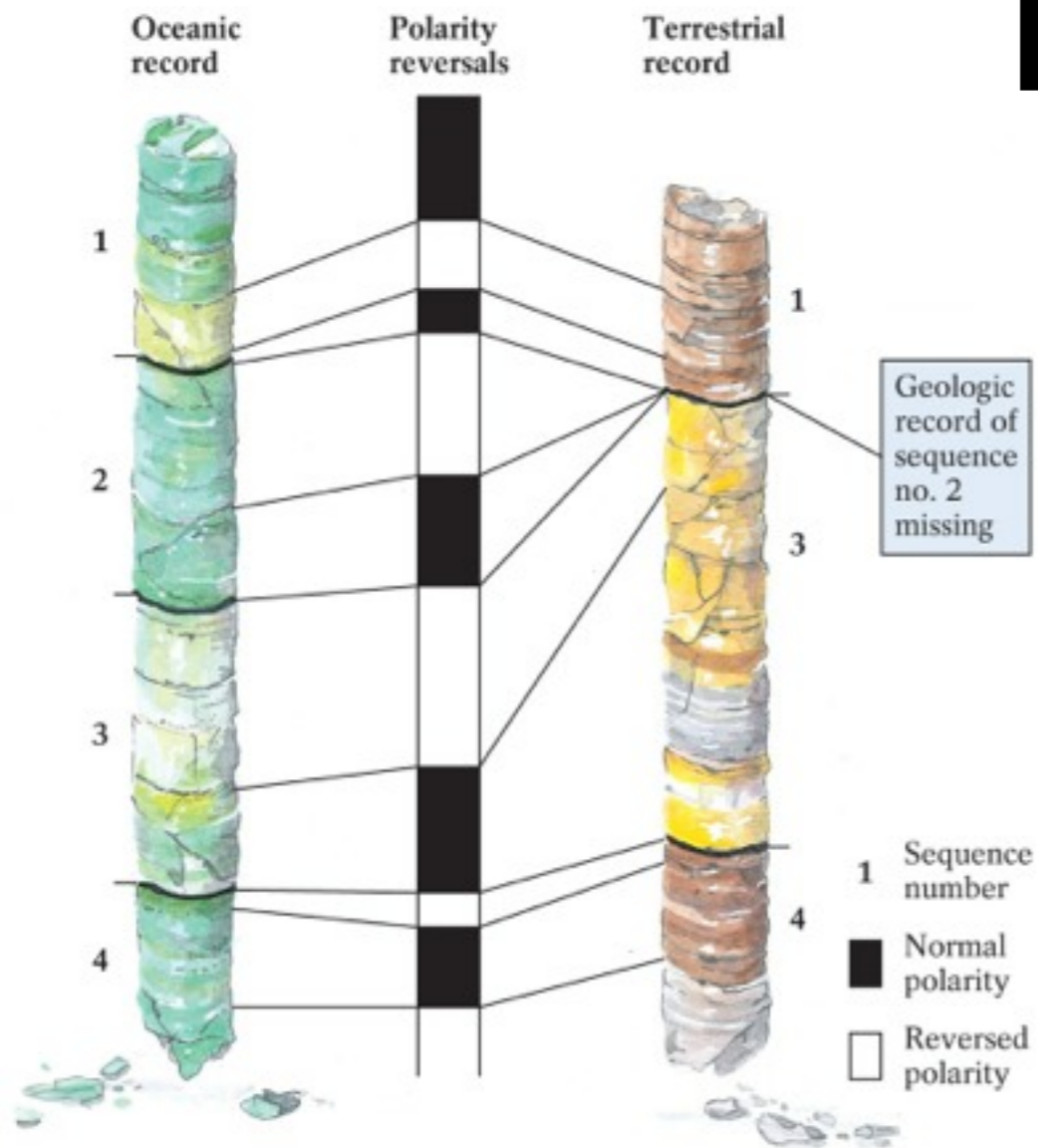


Paleomagnetism



- 1 Magnetic grains rotate freely as they settle through calm water, and start to align with Earth's magnetic field
- 2 Magnetic grains in sediment are fully aligned with Earth's magnetic field, and "locked" in compacted sediment

Paleomagnetism



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From what you have learned about the driving force of a planet's magnetic field, what can you infer about changes in the internal workings of Mars?

- A) the planet has cooled down.
- B) the core of the planet has completely crystallized.
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- D) All of the above
- E) None of the above

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