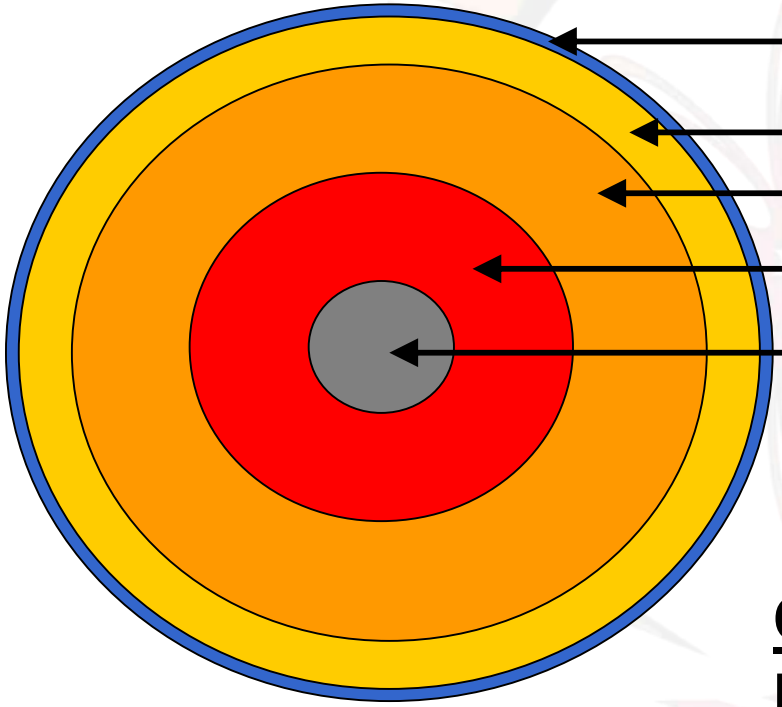
Geothermal Energy

Learning objectives:

1) To describe the principle behind tapping of Geothermal energy
2) To indicate limits and challenges with Geothermal energy usage

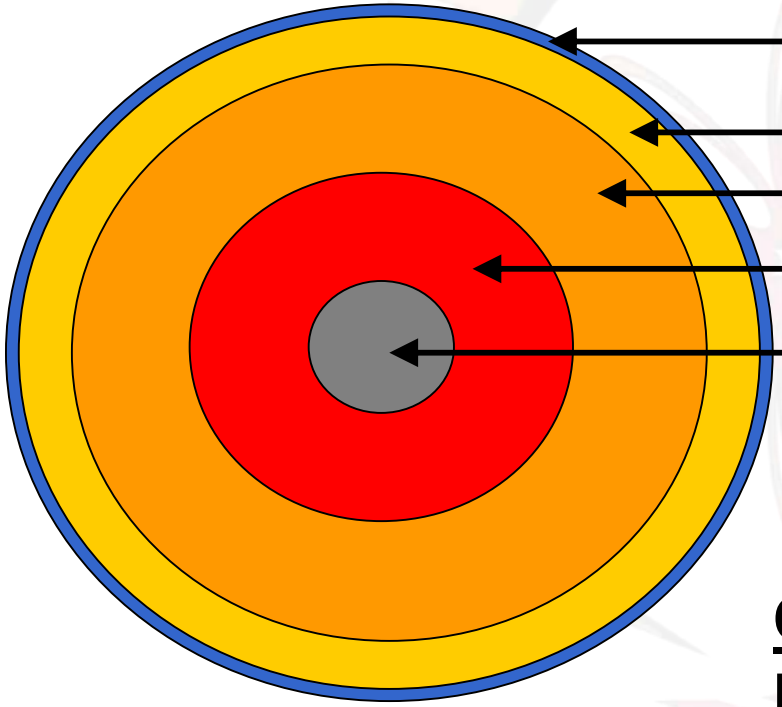
Cross-section of the Earth



	Thickness (km)
Crust	30
Upper Mantle	720
Lower Mantle	2170
Outer Core	2260
Inner Core	1220

Core: Iron, Nickel, noble metals
Mantle: Sulphide and Oxide rich
Crust: Oxides

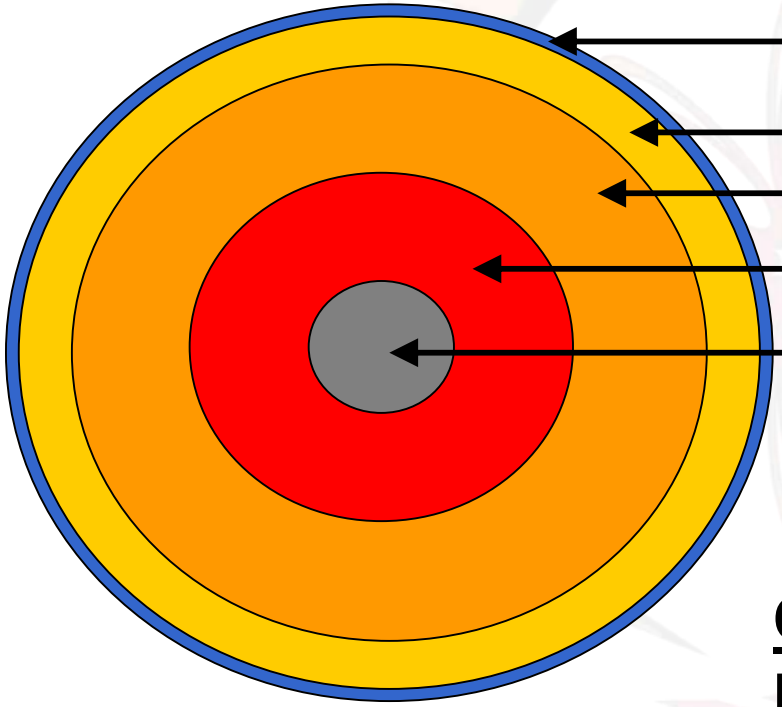
Cross-section of the Earth



	Depth (km)
Crust	30
Upper Mantle	750
Lower Mantle	2920
Outer Core	5180
Inner Core	6400

Core: Iron, Nickel, noble metals
Mantle: Sulphide and Oxide rich
Crust: Oxides

Cross-section of the Earth



	Temperature (ºC)
Crust	0-700
Upper Mantle	1000
Lower Mantle	3500
Outer Core	4000
Inner Core	7000

Core: Iron, Nickel, noble metals
Mantle: Sulphide and Oxide rich
Crust: Oxides

Deepest spot in the oceans:

The Challenger Deep / Mariana's Trench: 11 Km deep
(In the Pacific Ocean, near Japan)
Deeper than the height of Mt Everest 8.9 Km

Deepest spot in the lands:

Drill hole in Soviet peninsula of Kola: 12 Km deep

Composition of Earth determined from:

1) Flow of heat from inside earth

2) Experiments on surface minerals and rocks under high P, T

3) Gravity and magnetic fields of earth

4) Path of earth quake waves travelling through the earth

Principle of Geothermal energy usage:

- Temperature gradient is of the order of 25 ^{o}C to 30 ^{o}C per km
- 20 ^{o}C per km in northern latitudes
- 40 ^{o}C per km closer to equator

Principle of Geothermal energy usage:

- Temperature gradient is of the order of 25 ^{o}C to 30 ^{o}C per km
- Common usage 150 m to 200 m with temperature increase of less than 10 ^{o}C
- Oil industry drills 5,000 to 10,000 m, temperature greater than 350 ^{o}C. Electronics will struggle
- Faults will enable access to higher temperatures

Principle of Geothermal energy usage:

- Deep Water Horizon (US, Transocean, 2010): 10.5 km deep
- Sakahlin-1 (Russia, Exxon, 2012): 12.3 km deep

Principle of Geothermal energy usage:

- Anticipated lifetime: approximately 30 years

Conclusions:

1) Geothermal energy preferably tapped near faults
2) Deep drills already being made for oil industry