EDEN IAS - GEOGRAPHY CLASS NOTES

EDEN IAS MISSION PRELIMS 2021

GEOGRAPHY CLASS - 2

Distribution of Continents

- The total landmass on earth is formed of seven continents of various sizes. Some are connected to each other while others are not. All of them have a different number of countries forming them.
- The names of the seven continents of the world are: Asia, Africa, Europe, Australia, North America, South America, and Antarctica.
- Earth is around 71 per cent water per cent water and 29 per cent land. In fact, billions of years ago, the seven continents of the world were joined together as a single massive landmass called Pangaea. But thanks to plate tectonics, they gradually broke apart and separated. Europe and North America are still moving apart at the rate of 7 cm every year, research says.

Relative Distribution of the Oceans

- Earth possesses one "world ocean." However, those conducting oceanic research generally recognize the existence of five major oceans: the Pacific, Atlantic, Indian, Arctic, and Southern oceans. Arbitrary bound¬aries separate these bodies of water.
- The boundaries of each ocean are largely defined by the continents that frame them. In the Southern Hemisphere the southern portions of the Pacific, Atlantic, and Indian oceans and their tributary seas that surround Antarctica are often referred to as the Southern Ocean.
- Many subdivisions can be made to distinguish the limits of seas and gulfs that have historical, political, and sometimes ecological significance.
- However, water properties, ocean currents, and biological popula¬tions are not constrained by these boundaries. Indeed, many researchers do not recognize them either.

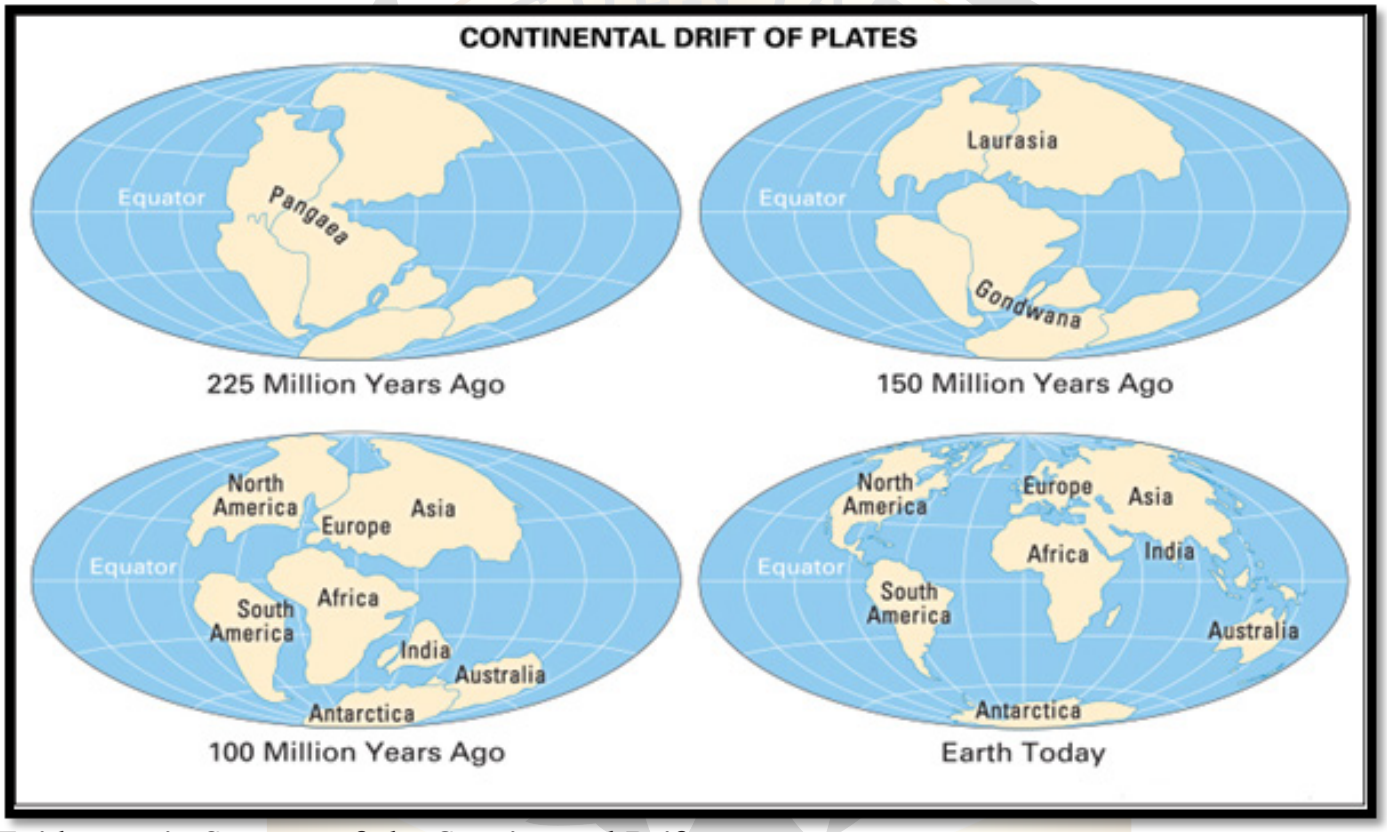
DISTRIBUTION OF OCEANS AND CONTINENTS ACROSS THE WORLD

NOTES

To explain the present distribution of oceans and continents, various theories have been proposed. Continental Drift Theory is considered a pivotal theory which provided various conclusive proofs to establish the movement of the earth's crust but the theory failed to establish the mechanism behind the process.

Continental Drift Theory

- **Alfred Wegener—**a German meteorologist has put forth "the continental drift theory" in 1912. This was regarding the distribution of the oceans and the continents.
- According to Wegener, all the continents formed a single continental mass and Mega Ocean surrounded the same. The super continent was named **PANGAEA**, which meant all earth. The mega-ocean was called **PANTHALASSA**, meaning all water.
- He argued that, around 200 million years ago, the super continent, Pangaea, began to split. Pangaea first broke into two large continental masses as Laurasia and Gondwanaland forming the northern and southern components respectively.
- Subsequently, Laurasia and Gondwanaland continued to break into various smaller continents that exist today.



Evidences in Support of the Continental Drift

A variety of evidence was offered in support of the continental drift. Some of these are given below:

1. **Jig –Saw –** Fit of the Continents (The Matching of Continental shorelines): The shorelines of Africa and South America facing each other have a remarkable and unmistakable match.
2. **Existence of Rocks of Same Age across the Oceans:** The radiometric dating methods developed in the recent period have facilitated correlating the rock formation from different continents across the vast ocean. The belt of ancient rocks of 2,000 million years from Brazil coast matches with those from western Africa. The earliest marine deposits along the coastline of South America and Africa are of the Jurassic age. This suggests that the ocean did not exist prior to that time.

NOTES

3. **The Glacial Tillite Sediments:** It is the sedimentary rock formed out of deposits of glaciers. The Gondawana system of sediments from India is known to have its counter parts in six different landmasses of the Southern Hemisphere. At the base the system has thick tillite indicating extensive and prolonged glaciation. Counter parts of this succession are found in Africa, Falkland Island, Madagascar, Antarctica and Australia besides India. Overall resemblance of the Gondawana type sediments clearly demonstrates that these landmasses had remarkably similar histories. The glacial tillite provides unambiguous evidence of palaeoclimates and also of drifting of continents.
4. **Occurrence of Rich Placer Deposits:** The occurrence of rich placer deposits of gold in the Ghana coast and the absolute absence of source rock in the region is an amazing fact. The gold bearing veins are in Brazil and it is obvious that the gold deposits of the Ghana are derived from the Brazil plateau when the two continents lay side by side.
5. **Distribution of Fossils:** When identical species of plants and animals adapted to living on land or in fresh water are found on either side of the marine barriers, a problem arises regarding accounting for such distribution. The observations that Lemurs occur in India, Madagascar and Africa led some to consider a contiguous landmass "Lemuria" linking these three landmasses. Mesosaurus was a small reptile adapted to shallow brackish water. The skeletons of these are found only in two localities: the Southern Cape Province of South Africa and Iraver formations of Brazil. The two localities presently are 4,800 km apart with an ocean in between them.
6. **Typical Behaviour of Animals like lemmings:** The behaviour of lemmings, of northern part of Scandinavia, to run towards westward proves that all the land masses were previously united and contiguous in the form of Pangaea.
7. **Geological Structural similarities:** Evidences show that there is geological similarity between both the coasts of Atlantic, eastern coast of America and western coast of Africa.

Forces Responsible For Drifting

- Wegener suggested that the movement responsible for the drifting of the continents was caused by pole-fleeing force and tidal force.
- The Pole fleeing force: The polar-fleeing force relates to the rotation of the earth. You are aware of the fact that the earth is not a perfect sphere; it has a bulge at the equator. This bulge is due to the rotation of the earth.
- The Tidal force: The second force that was suggested by Wegener—the tidal force—is due to the attraction of the moon and the sun that develops tides in oceanic waters. Wegener believed that these forces would become effective when applied over many million years. However, most of scholars considered these forces to be totally inadequate.

Criticism/ Drawbacks of the Continental Drift Theory

- Wegener talks about the role of forces like buoyancy, tidal currents and gravity. But these were not strong enough to drift continents.
- He advocates directional movement either westward or equator ward but movements have taken place in all directions.
- Alfred Wegener failed to explain the Pre-carboniferous history. He did not explain that why the drift began only in Mesozoic-era and not before.
- The theory did not take oceans into consideration.
- The theory did not explain the formation of oceanic ridges and Island arcs.
- Earth's crust is believed to be too rigid to permit large-scale motions. Wegener's ideas have not offered a suitable mechanism justifying the displacement of larger masses for long journeys.

Present status of the Continental Drift Theory

- The Continental Drift Theory was not accepted by most of the scientific community and was hotly debated off and on for decades even after his death in 1930. In the 1920s, the concept of conventional currents in the upper mantle was developed. But Alfred Wegener was not able to incorporate the concept of conventional currents as the most justifying reason for the movement of continents due to his untimely death.

- Although, the Continental Drift theory have become obsolete the main idea of the theory of drift of continent was the driving force behind all other modern theories including the theory of plate tectonics and seafloor spreading.

Post-Drift Studies

- It is interesting to note that for continental drift; most of the evidence was collected from the continental areas in the form of distribution of flora and fauna or deposits like tillite.
- A number of discoveries during the post-war period added new information to geological literature. Particularly, the information collected from the ocean floor mapping provided new dimensions for the study of distribution of oceans and continents.

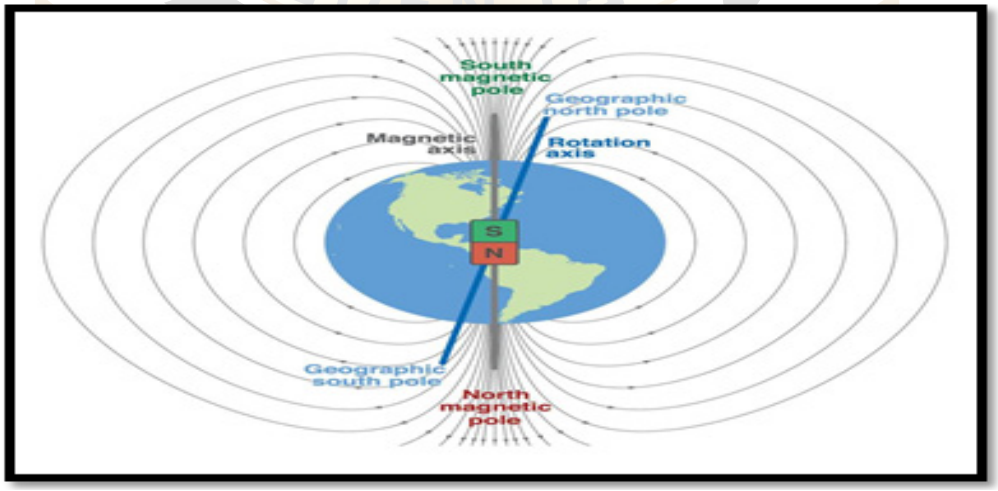
Possibility for formation of another supercontinent

If history is a guide, the current continents will coalesce once again to form another Supercontinent. For example:

- The East African Rift Valley splitting the African plate into two unequal parts: the Somali and Nubian plates. Continental rifting requires the existence of extensional forces great enough to break the lithosphere.
- The East African Rift is an active type of rift, the rise of a large mantle plume is doming the lithosphere upwards, causing it to weaken as a result of the increase in temperature, undergo stretching and breaking by faulting.
- Seismic activity and Volcanism running alongside is a further surface manifestation of the ongoing process of continental break up.
- Evidences suggest eventually, over a period of time seafloor spreading will progress along the entire length of the rift. The ocean will flood in and, as a result, the African continent will become smaller and there will be a large island in the Indian Ocean composed of parts of Ethiopia and Somalia, including the Horn of Africa.

Geo Magnetism

- Geomagnetism is the study of the dynamics of the Earth's magnetic field, which is produced in the outer core.
- The Earth's magnetic field is predominantly a geo-axial dipole, with north and south magnetic poles located near the geographic poles.
- The Earth itself is a magnet due to the convection of Earth's inner core causing electrical currents and a resulting electromagnetic field.
- The South Pole of the Earth's magnet is in the geographical North because it attracts the North Pole of the suspended magnet and vice versa.
- Thus, there is a magnetic S-pole near the geographical North, and a magnetic N-pole near the geographical South.
- The positions of the Earth's magnetic poles are not well defined on the globe; they are spread over an area. The axis of Earth's magnet and the geographical axis do no coincide.



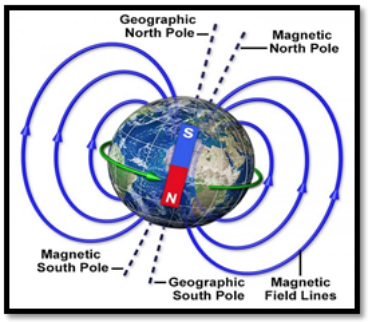
NOTES

Geographical Poles vs. Magnetic Poles

Geographic Poles

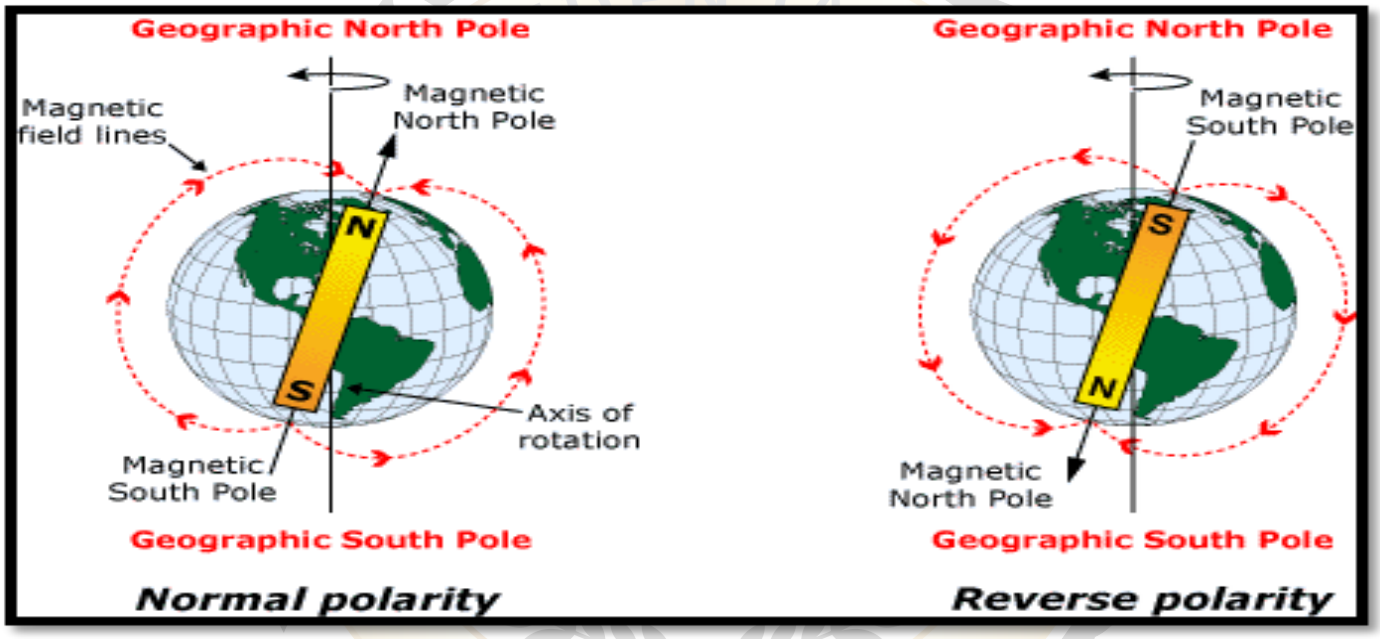
- The Earth rotates on the geographic north and south poles. The geographic north and south poles are where lines of longitude (meridians) converge in the north.
- The south and North Pole are directly opposite to one another.

Magnetic North Pole



- The Earth acts as one big magnet. The Earth consists of a solid iron core. Surrounding the iron core is an ocean of hot, liquid metal.
- The liquid metal that flows in Earth's core creates electrical currents, which in turn creates our magnetic field.
- The Magnetic North Pole (also known as the North Dip Pole) is a point on Ellesmere Island in Northern Canada where the northern lines of attraction enter the Earth.
- This means that a compass needle point to the Magnetic North Pole – which is different from the geographic north

Normal and Reverse polarity of earth



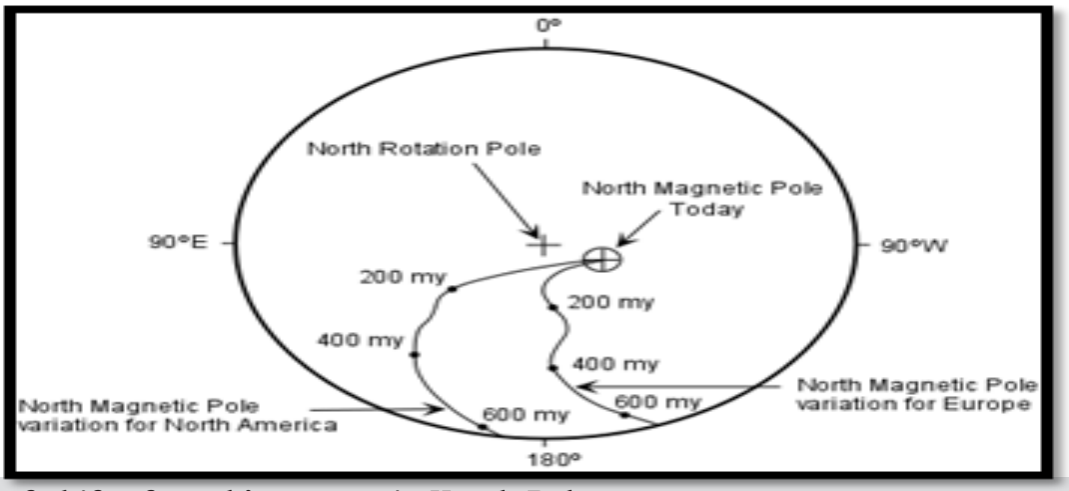
A few times every million years or so, Earth's magnetic field reverses polarity. Imagine a giant bar magnet inside our planet got flipped upside down; iron molecules in the Earth's outer core would switch direction, the magnetic North Pole would become the magnetic South Pole, and the invisible currents of energy that make up our planet's magnetic armour would tangle and break, potentially reducing the shield's protective strength by up to 90 per cent.

Shifting of Earth's Magnetic North Pole

- The British Geological Survey has reported that the earth's magnetic north pole is moving from its current position in Canada to Siberia.
- The shift is causing geophysicists to reconsider the world magnetic model which is used for navigation purposes.
- The World Magnetic Model (WMM) is a standard model of the core and large-scale crustal magnetic field.
- Earth's magnetic field is known to have wandered and flipped in the geologic past.
- This wandering has generally been quite slow, around 9 km a year, allowing scientists to easily keep track of its position.
- But since the turn of the century, this speed has increased to 50 km a year.

NOTES

- Recently, Earth's magnetic North Pole has drifted so fast that the World Magnetic Model (a large spatial-scale representation of the Earth's magnetic field) has had to officially redefine the location of the magnetic North Pole much earlier than expected.
- Earth's magnetic North Pole is quickly moving from the Canadian Arctic towards Russia.



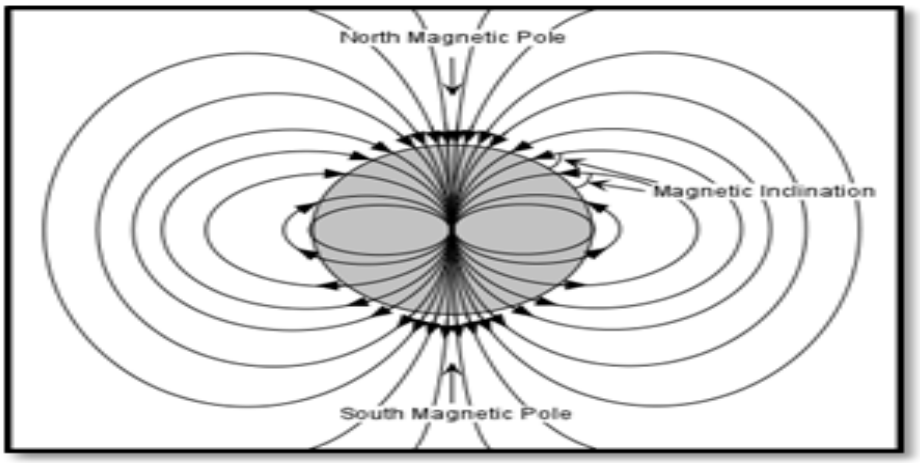
Impact of shift of earth's magnetic North Pole

- The Earth's magnetic field (or geomagnetic field) is an ever-changing phenomenon and these changes can affect health and safety, and economic well-being in a myriad of ways:
- The shifting geomagnetic field, along with its associated phenomena can both assist and hamper navigation and surveying techniques.
- It can impede geophysical exploration; can disrupt electric power utilities, and pipeline operations; and can also influence the functioning of modern communication systems, spacecraft etc.
- Shifting pole can also affect the power of Earth's magnetic field to deflect harmful solar radiation and cosmic rays from entering Earth's atmosphere.
- The Earth's magnetic field is also responsible for creating the northern and southern lights – spectacular events that are only visible near the magnetic poles.
- Thus the present location of these lights might be changed with the shifting of Earth's magnetic North pole.
- Animals that use the Earth's magnetic field for navigation—including birds, salmon, and sea turtles—could get lost during their routine journeys.

Paleomagnetism:

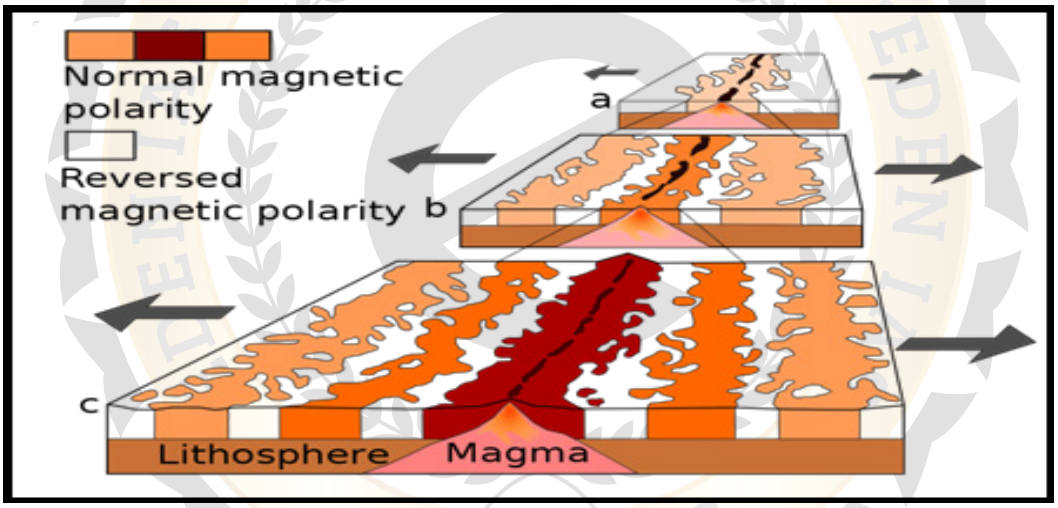
- Paleomagnetism is the study of the record of earth's magnetic field with the help of magnetic fields recorded in rocks, sediment, or archaeological materials.
- The polarity of the Earth's magnetic field and magnetic field reversals are thus detectable by studying the rocks of different ages.
- Paleomagnetic studies of rocks have demonstrated that the orientation of the earth's magnetic field has frequently alternated (geomagnetic reversal) over geologic time.
- The Earth has a magnetic field that causes a compass needle to always point toward the North magnetic pole, currently located near the rotation pole.
- The Earth's magnetic field is what would be expected if there were a large bar magnet located at the center of the Earth.
- The magnetic field is composed of lines of force as shown in the diagram here.
- A compass needle or a magnetic weight suspended from a string, points along these lines of force.
- Note that the lines of force intersect the surface of the Earth at various angles that depend on position on the Earth's surface. This angle is called the magnetic inclination.
- The inclination is 0o at the magnetic equator and 90o at the magnetic poles. Thus, by measuring the inclination and the angle to the magnetic pole, one can tell position on the Earth relative to the magnetic poles.

NOTES



Paleomagnetism and seafloor spreading

- Paleomagnetism led the revival of the continental drift hypothesis and its transformation into theories of Sea Floor Spreading and Plate Tectonics.
- The regions that hold the unique record of earth's magnetic field lie along the mid-ocean ridges where the sea floor is spreading.
- On studying the Paleomagnetic rocks on either side of the oceanic ridges, it is found that alternate magnetic rock stripes were flipped so that one stripe would be of normal polarity and the next, reversed.
- Hence, Paleomagnetic rocks on either side of the mid-ocean or submarine ridges provide the most important evidence to the concept of Sea Floor Spreading.
- Magnetic field records also provide information on the past location of tectonic plates.



Thankyou All the best for Prelims!!!!!!