The Earth’s magnetic poles have drifted and changed positions several times in Earth’s history.

July 19, 2020

The South Atlantic Anomaly is nowadays one of the most important features of the Earth’s magnetic field. Several studies view this anomaly as an indicator of an upcoming geomagnetic transition, such as a reversal. It is important to study about earth’s magnetic field and different phenomena associated with it.

In News Recently the Earth’s magnetic field got weakened and caused satellites in space to malfunction.
Placing it in syllabus Geography – Interior of the earth
Static Dimension:

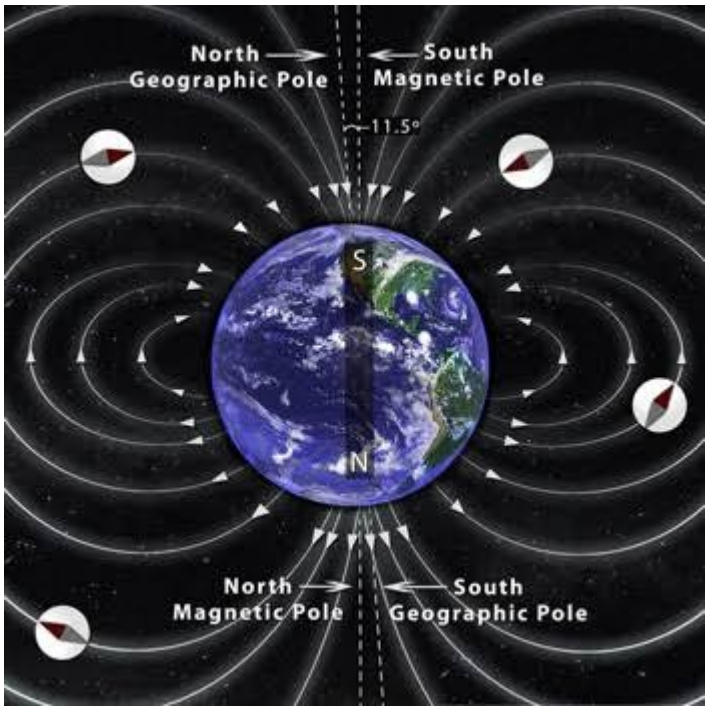
- What is Earth’s magnetic field?
- Visible proof of Earth’s magnetic field

Current Dimension:

- Shifting of magnetic poles
- South Atlantic anomaly.

ContentWhat is Earth’s magnetic field?

- Earth’s magnetic field also called geomagnetic field is approximately a **magnetic dipole,** with the magnetic field **S pole** near the Earth’s geographic north pole and the **N pole** near the Earth’s geographic south pole.



- This makes the compass usable for navigation.
- On Earth, **flowing of liquid metal in the outer core** of the planet generates electric currents.
- The rotation of Earth on its axis causes these **electric currents to form a magnetic field** which extends around the planet and forms the planet's magnetosphere.
- The magnetosphere is the region above the ionosphere that is defined by the extent of the Earth's magnetic field in space.
- According to paleomagnetic study of Australian red dacite it is estimated that the **magnetic field is at least 3.5 billion years old.**

Importance of magnetic field:

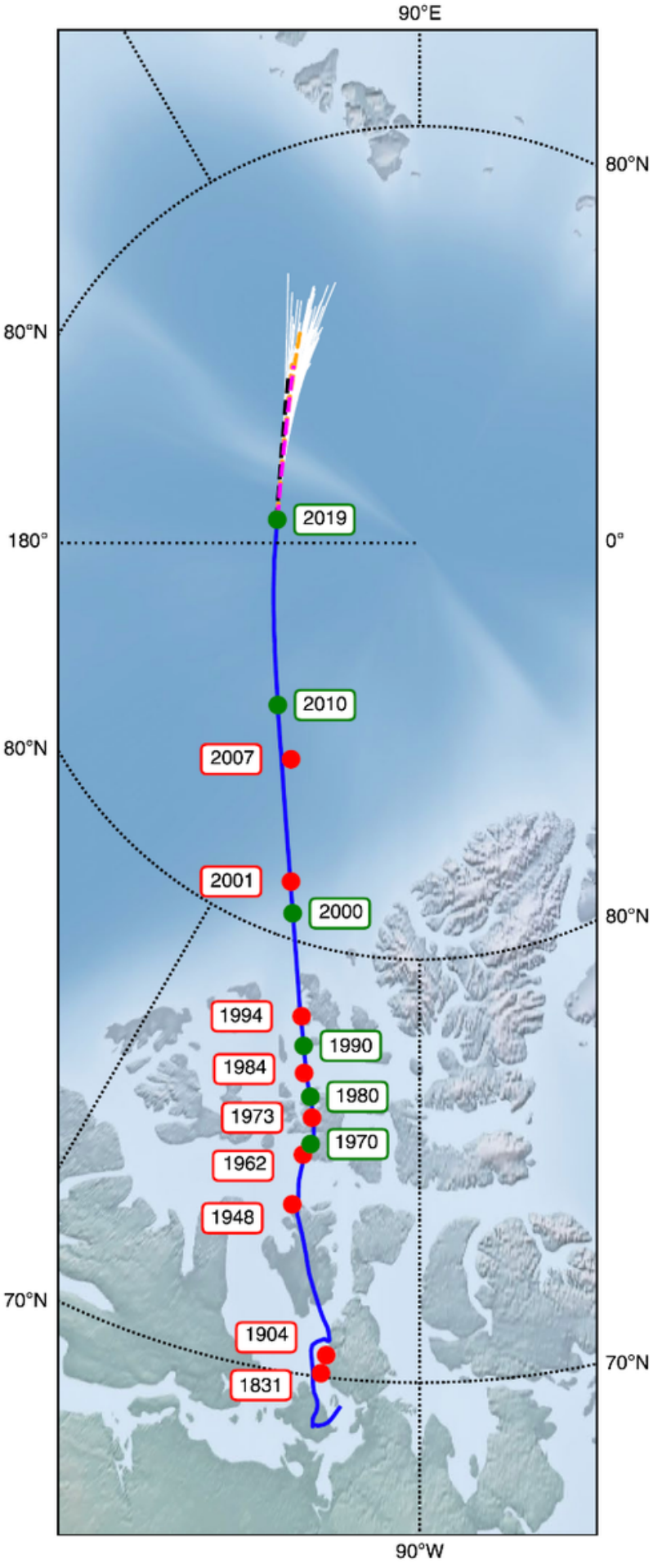
- **Earth is largely protected from the solar wind** by its magnetic field, which deflects most of the charged particles.
- The magnetic field is extremely important to **sustaining life on Earth,** without which earth's atmosphere would be free to leak into space.

Visible proof of Earth's magnetic field:

- Variations in the magnetic field strength have been **correlated to rainfall variation within the tropics.**The polarity of the Earth's magnetic field is recorded in **igneous rocks** and **reversals of the field are detectable as "stripes"** centered on mid-ocean ridges where the seafloor is spreading.
- Reversals also provide the basis for **magnetostratigraphy**, a way of dating rocks and sediments.
- The field also magnetizes the crust and magnetic anomalies can be used to **search for deposits of metal ores.**
- **Compasses** have been used to find direction since the 11th century A.D. and for navigation since the 12th century.
- Using **magnetoreception**, organisms ranging from some types of bacteria to pigeons, use the Earth's magnetic field for orientation and navigation

Shifting of magnetic poles

- From 1999 to 2005, Earth's magnetic north pole went from **shifting 9 miles** at most each year **to as much as 37 miles** in a year.
- This discovery has been made by the **European Space Administration's (ESA) Swarm satellite mission.**
- It has been discovered that since the last two decades the position of the north magnetic pole has been largely determined by two **large-scale lobes of negative magnetic flux on the core–mantle boundary under Canada and Siberia.**

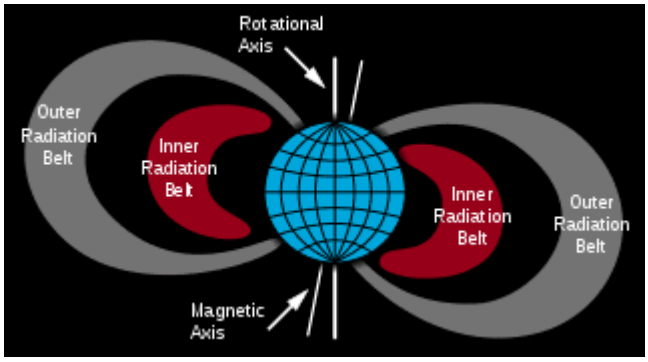

90°E
80°N
80°N
180°
0°
80°N
80°N
70°N
70°N
90°W
2019
2010
2007
2001
2000
1994
1990
1984
1980
1973
1970
1962
1948
1904
1831

The magnetic north pole has shifted over time since scientists first identified its location in 1831.

Between 1970 and 1999, the flow of molten, magnetic material in Earth's outer core changed. Because of these changes, the magnetic blob lurking beneath Canada slowly elongated, this weakening the corresponding magnetic intensity on Earth's surface. Eventually, the blob of molten material beneath Canada split in two and the stronger one slowly shifted toward the blob beneath Siberia. This spurred the magnetic north pole to slip closer and closer to Siberia, where the magnetic intensity was stronger. In 2017, the magnetic north pole fell within 240 miles of the geographic north pole. According to the study, the pole will continue to move towards Siberia. These shifts might have major consequences for global navigation systems.

South Atlantic anomaly

- \Recently an anomaly in Earth's magnetic field was noticed which indicated its weakening and was causing satellites in space to malfunction.
- This is apparently called **'The South Atlantic Anomaly'** (SAA)..
- The SAA refers to the behaviour of Earth's Geo-Magnetic field **in an area between Africa and South America.**



- The Earth's inner Van Allen radiation belt comes closest to the Earth's surface, dipping down to an altitude of 200 kilometres.
- This leads to an **increased flux of energetic particles in this region and exposes orbiting satellites to higher-than-usual levels of radiation.**

- The effect is caused by the non-concentricity of the Earth and its magnetic dipole.
- It is a matter of concern as Earth has lost 9 percent of its magnetic strength on average, according to ESA.
- A minimum field strength of approximately 24,000 nanoteslas to 22,000 nanoteslas has been noticed in the South Atlantic Anomaly over the last 50 years.
- The anomaly has also been moving westward at a pace of 20 kilometres per year.
- ESA's Swarm satellites have revealed that within the past five years, a second centre of minimum intensity has begun surfacing within the anomaly.
- The anomaly has been split into **two separate cells with the original centred over middle South America and the newer one over the coast of southwest Africa.**

Mould your thought: What is the importance of earth's magnetic field? Explain the phenomenon of South Atlantic anomaly.