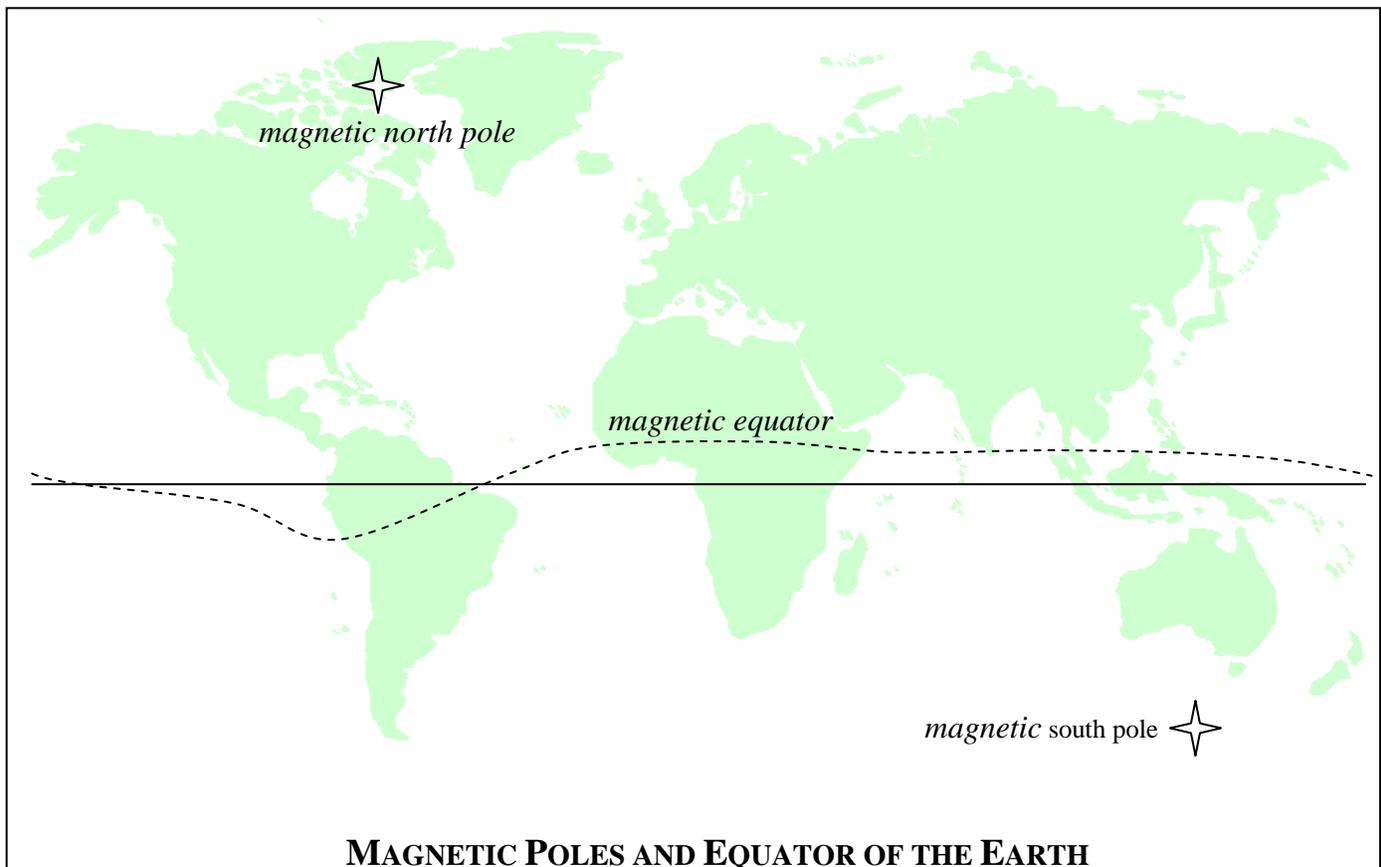


Earth's Magnetic Field

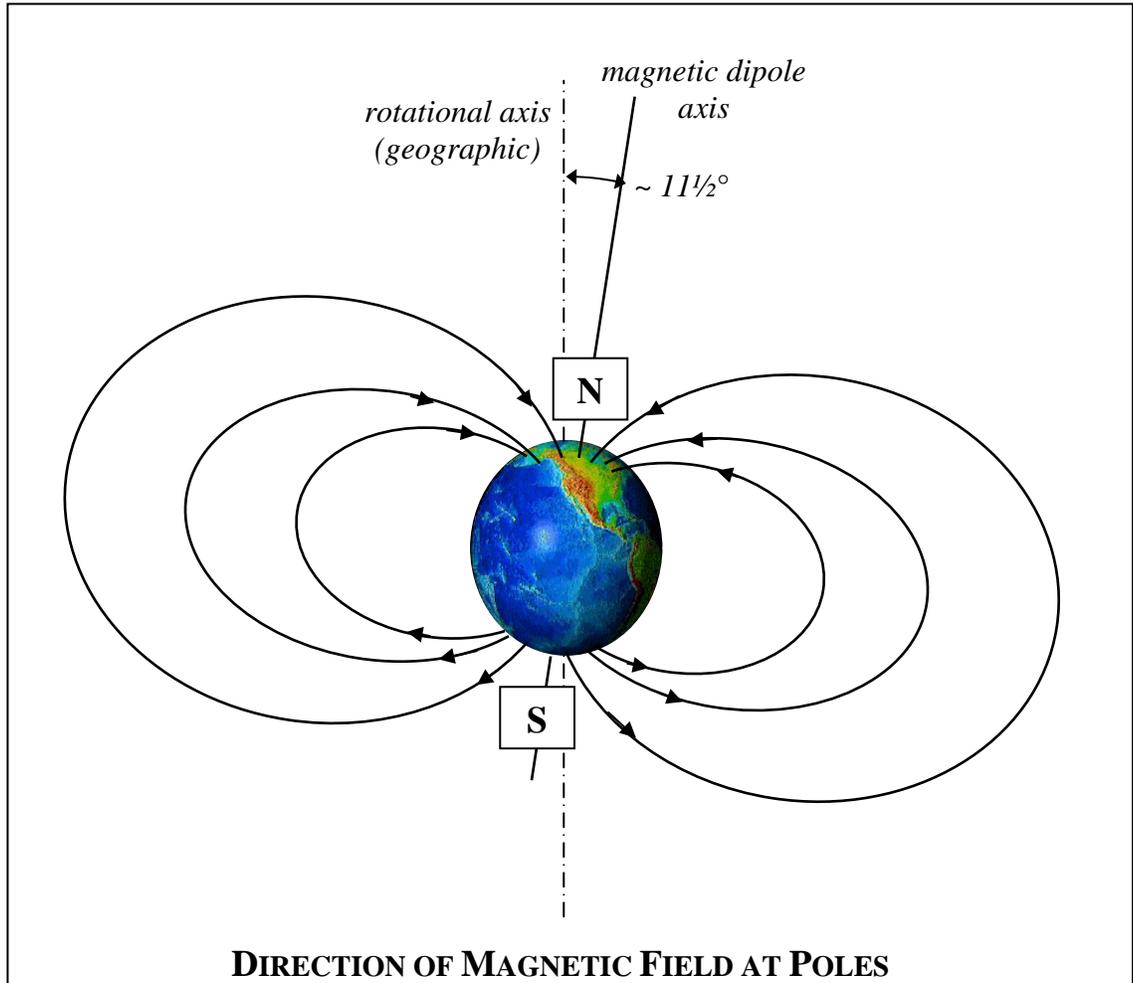
The dipole field

The motions of the liquid iron and nickel outer core of the earth are thought to create the earth's magnetic field. This magnetic field resembles a dipole as if a giant bar magnet was embedded inside. However, the axis of the dipole is not aligned with the rotational axis of the earth. Neither is it centered in the earth.

Dipole tilt. The magnetic dipole axis of the earth is tilted about $11\frac{1}{2}^\circ$ from the rotation axis. This means the magnetic north pole and the geographic north pole are not in the same place. The magnetic poles of the earth are defined as the location of the strongest vertical magnetic field. This places the magnetic north pole just west of northern Greenland (about $N80^\circ W70^\circ$) and the magnetic south pole near the coast of Antarctica south of Australia (about $S75^\circ E150^\circ$), as the following diagram shows. The magnetic equator is defined as the line around the earth where the magnetic field is horizontal, or parallel to the earth's surface. It does not circle the earth as a smooth line like the geographic equator, but instead it meanders north and south, as shown.



Magnetic North and South Poles. Magnetic field lines of the earth *enter the north geographic* pole and *exit the south geographic* pole, as the following diagram indicates. So as the earth turns, its magnetic dipole axis wobbles around the rotational axis.



Dipole offset. The magnetic dipole of the earth is not centered on the earth's core, but instead is offset by about 700 kilometers towards the direction of southeastern Asia. This creates two features in the magnetic field at the earth's surface.

The South Atlantic Anomaly (SAA). The point on the earth's surface that is *furthest* from the dipole center is the western South Atlantic region. Since the magnetic field strength of a dipole decreases with distance from the center of the dipole, the magnetic field in the western South Atlantic is unexpectedly weak compared to the magnetic field measured over the rest of the planet.

The SE Asian Anomaly. The point on the earth's surface that is *closest* to the dipole center is the southeastern Asia region. This means the magnetic field is unexpectedly strong there compared to the magnetic fields measured over the rest of the earth's surface.

The following diagram shows these anomalies. Blue indicates weaker magnetic field strength; the darkest blue regions **identify** the SAA. Orange indicates stronger magnetic field strength; the maximum field strength along the magnetic equator lies in the greenish area over SE Asia—this is the area of the SE Asian anomaly.

