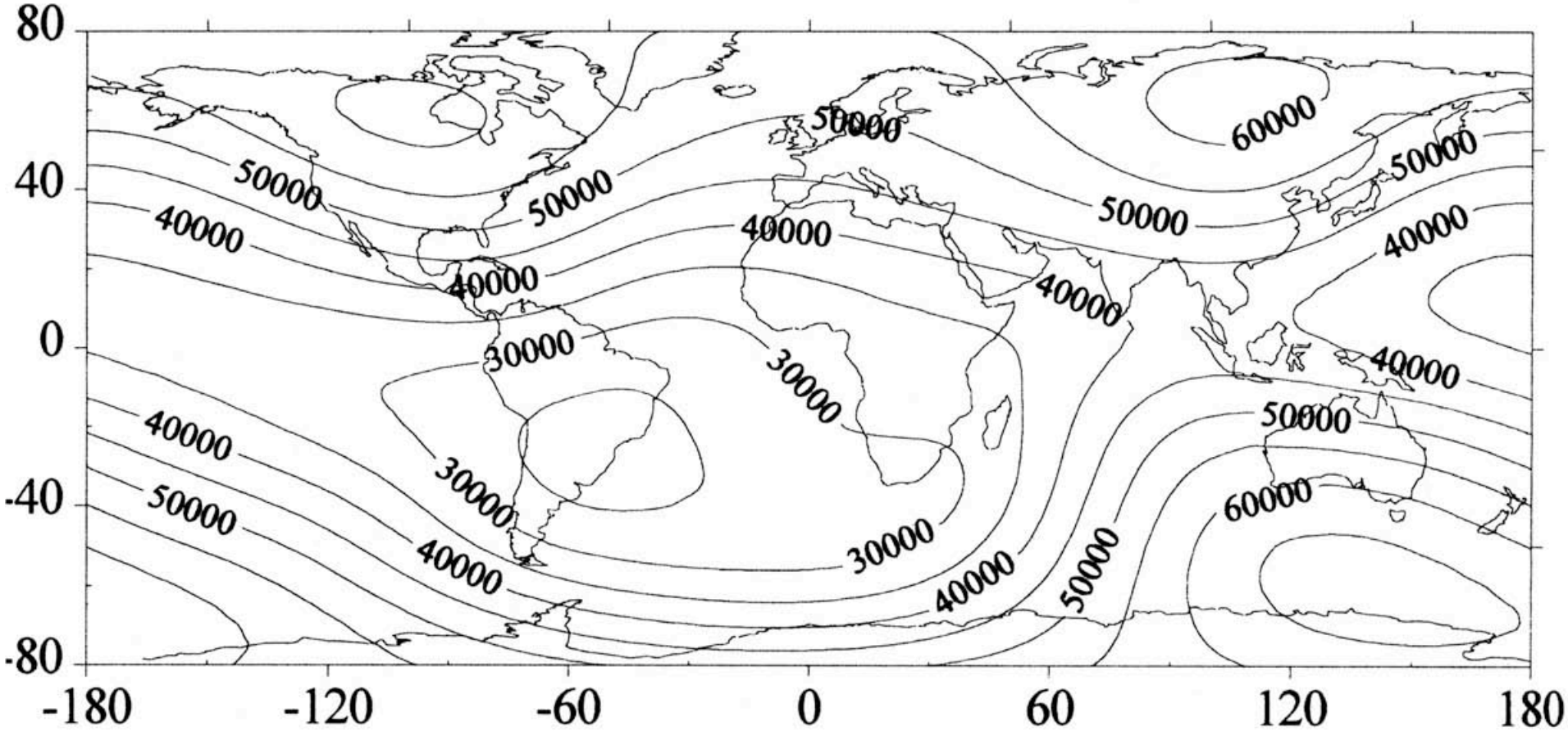
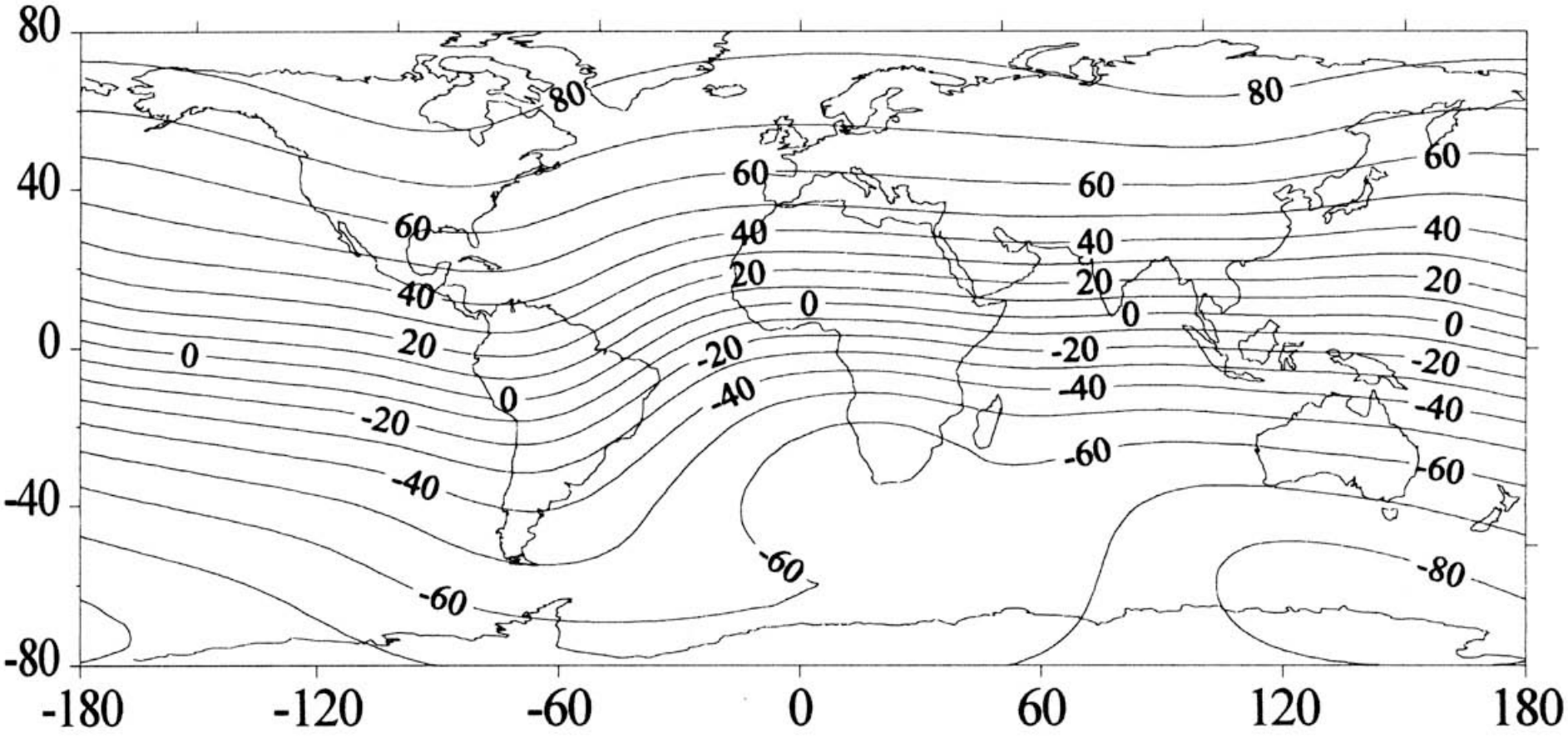
Magnetic field intensity is highest at the poles



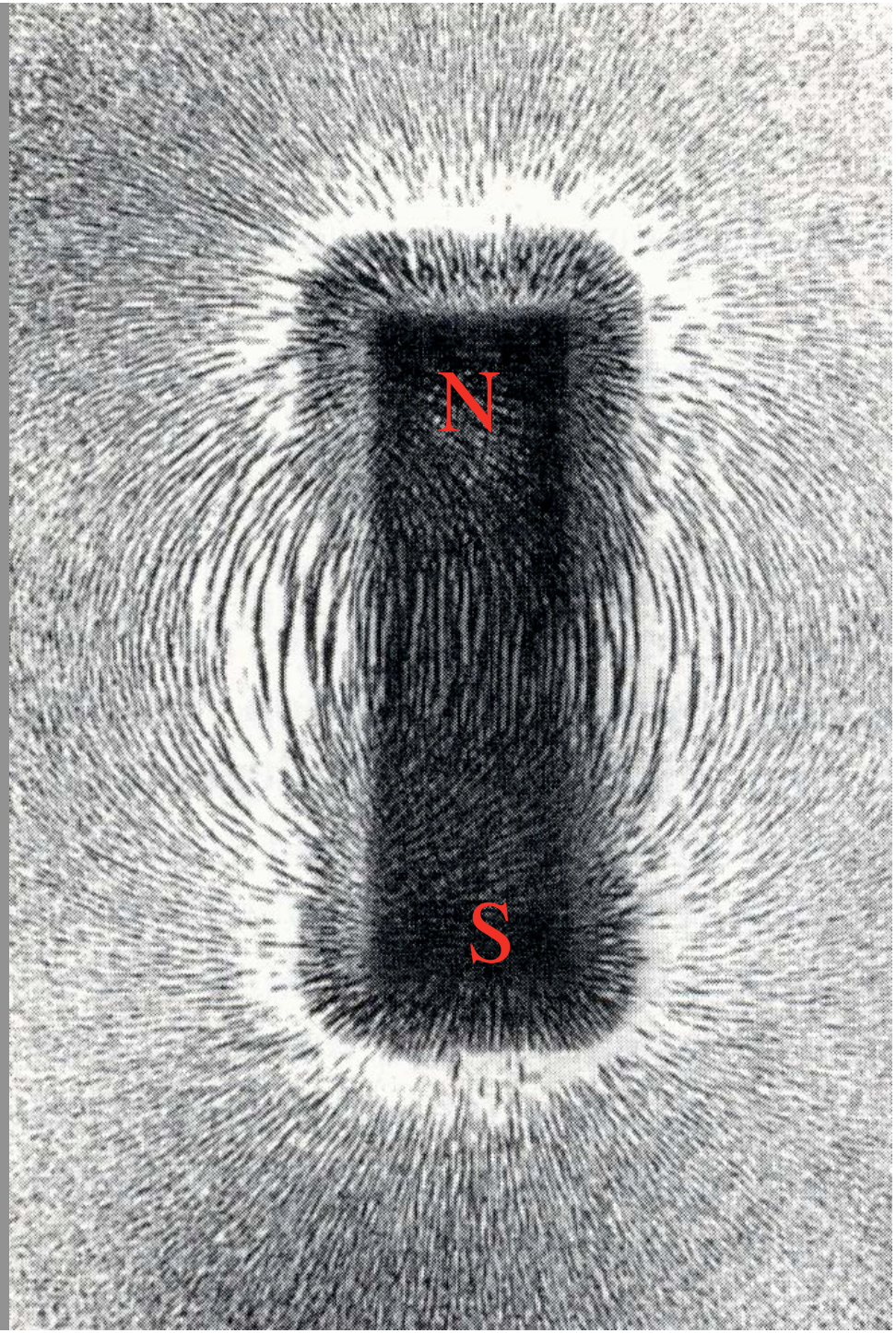
and lowest near the equator

The magnetic field is vertical at the poles

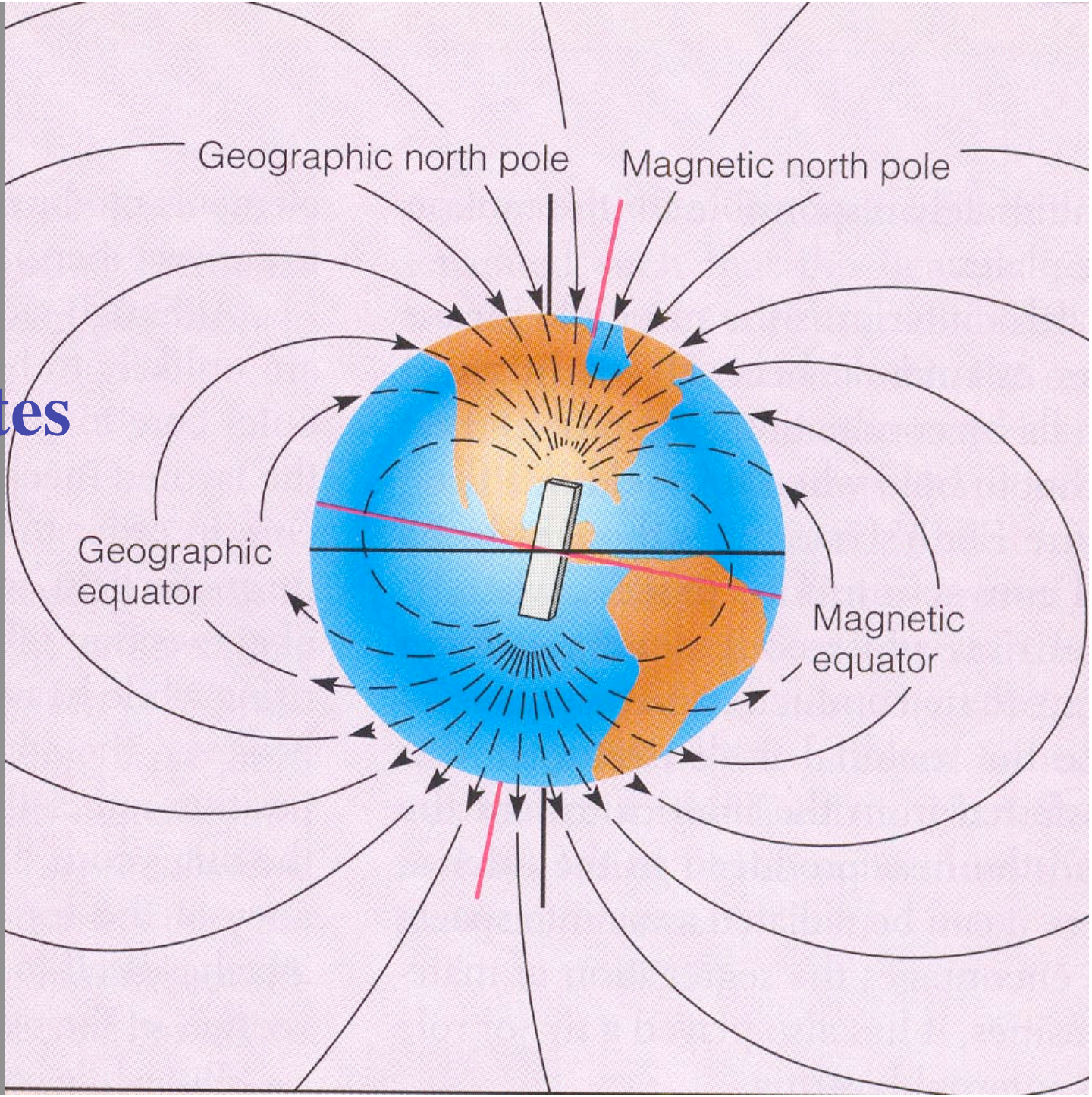


and horizontal at the equator

Magnetic field of a dipole magnet

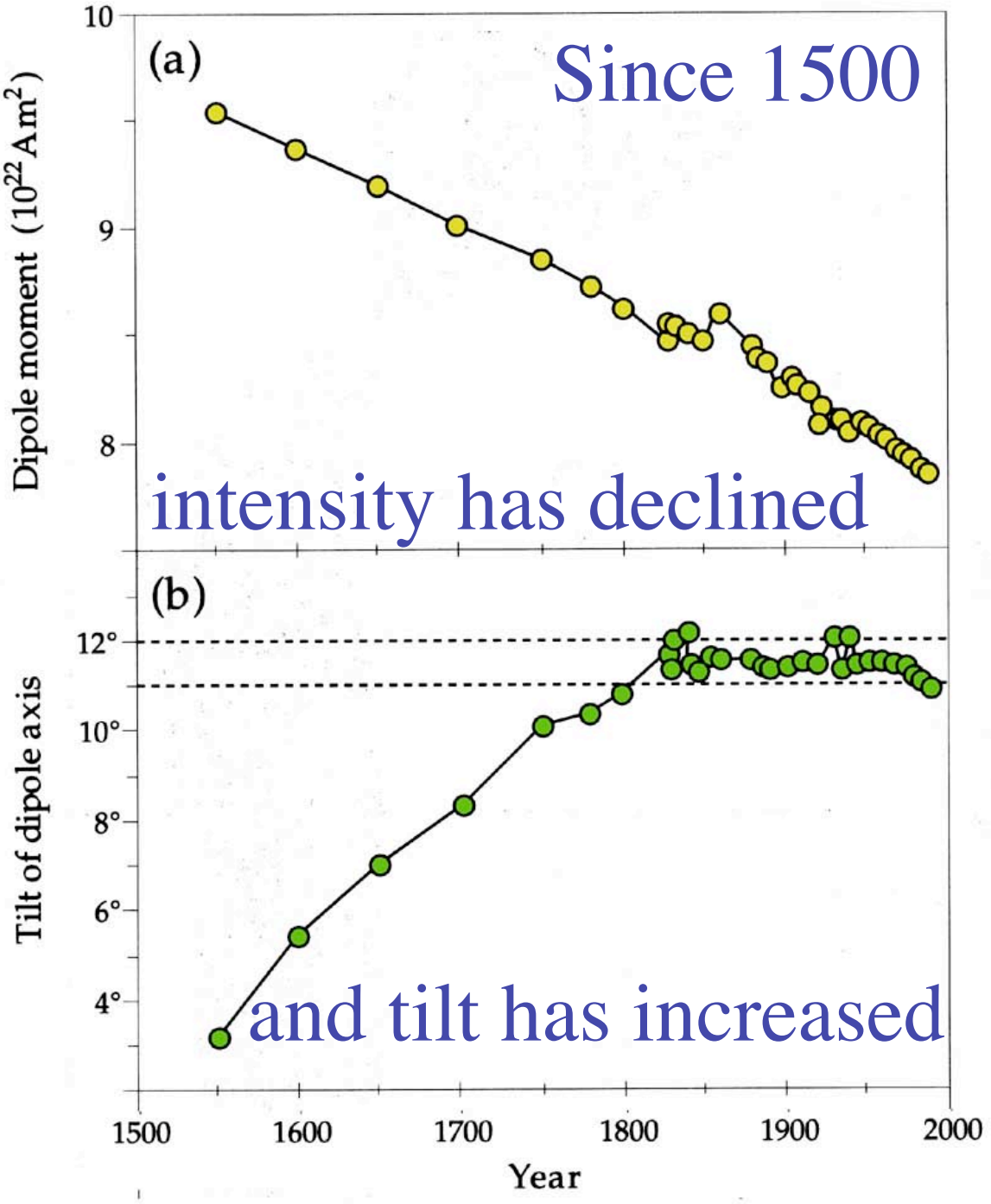


Earth's magnetic field approximates an axial geocentric dipole



Secular variation:

the magnetic field of Earth changes over time

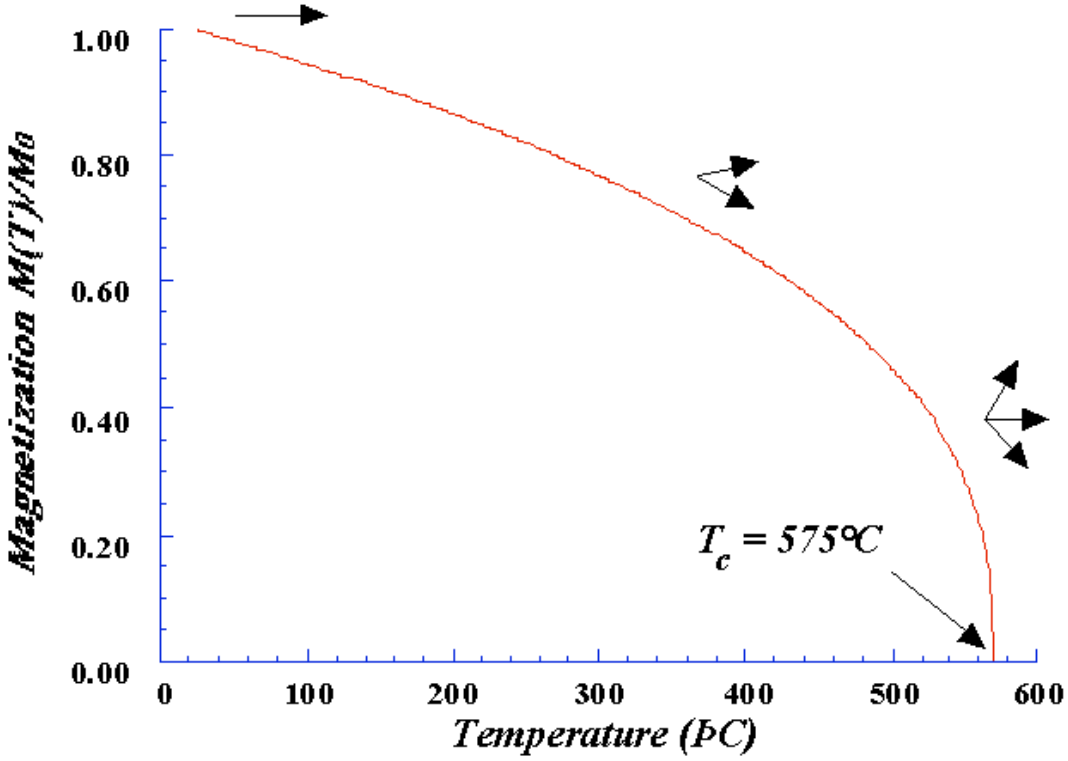


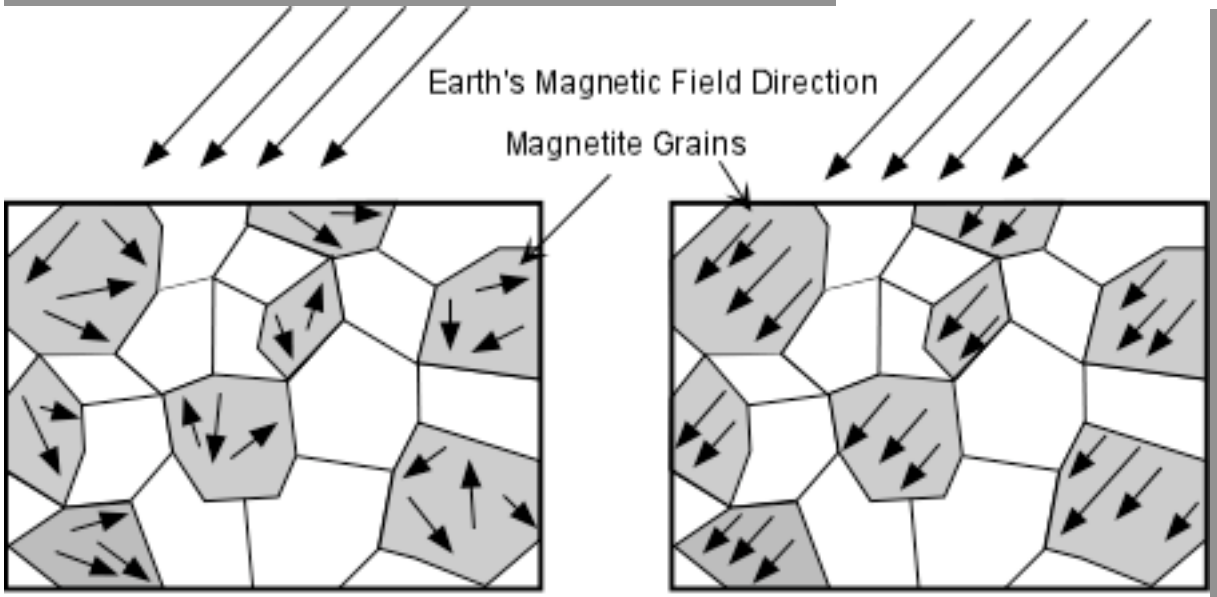
Magnetic N pole has migrated over time

Rapid on a human timescale

…on a geological timescale?

Paleomagnetism (fossil magnetization) is recorded in rocks

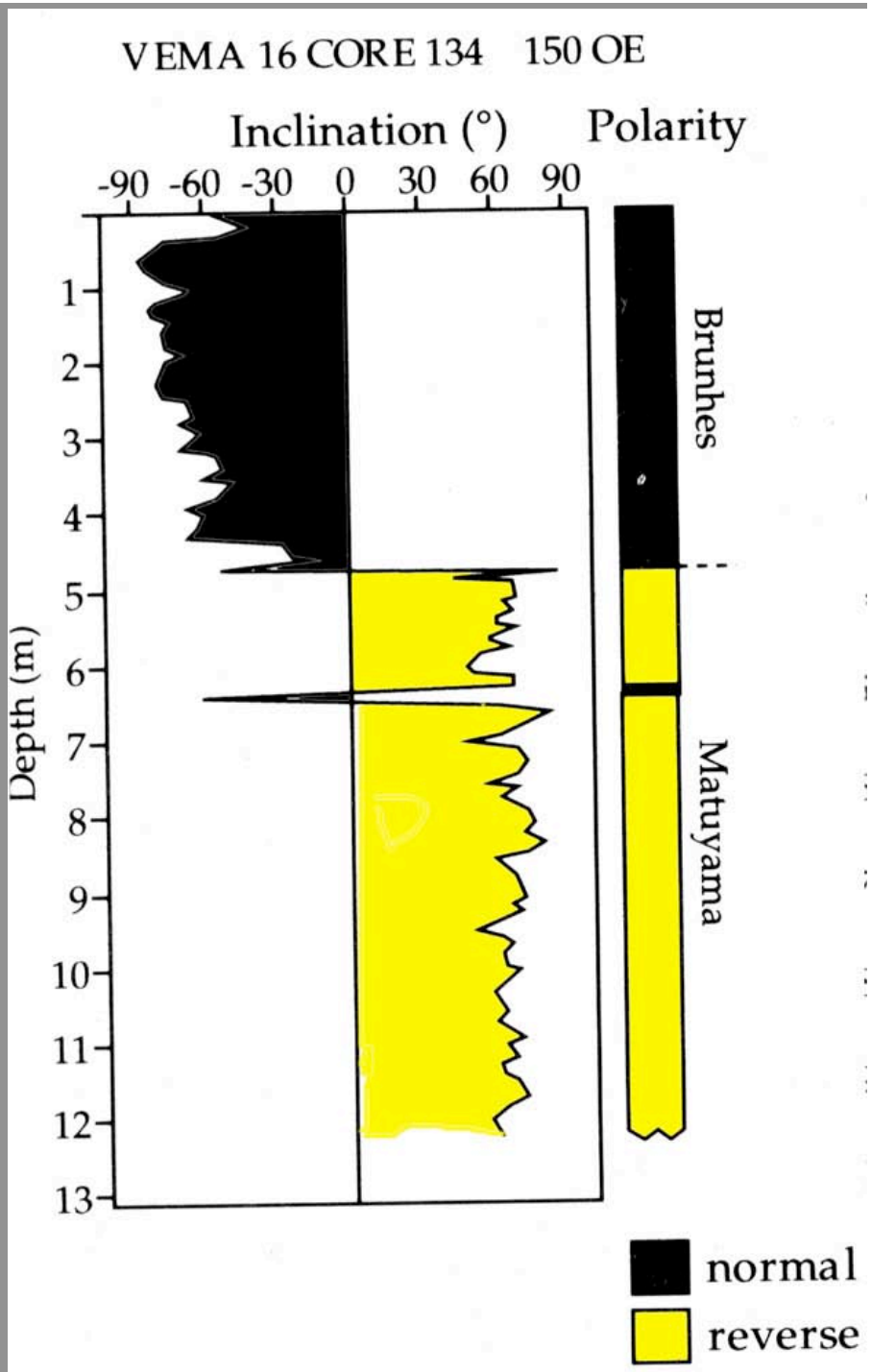




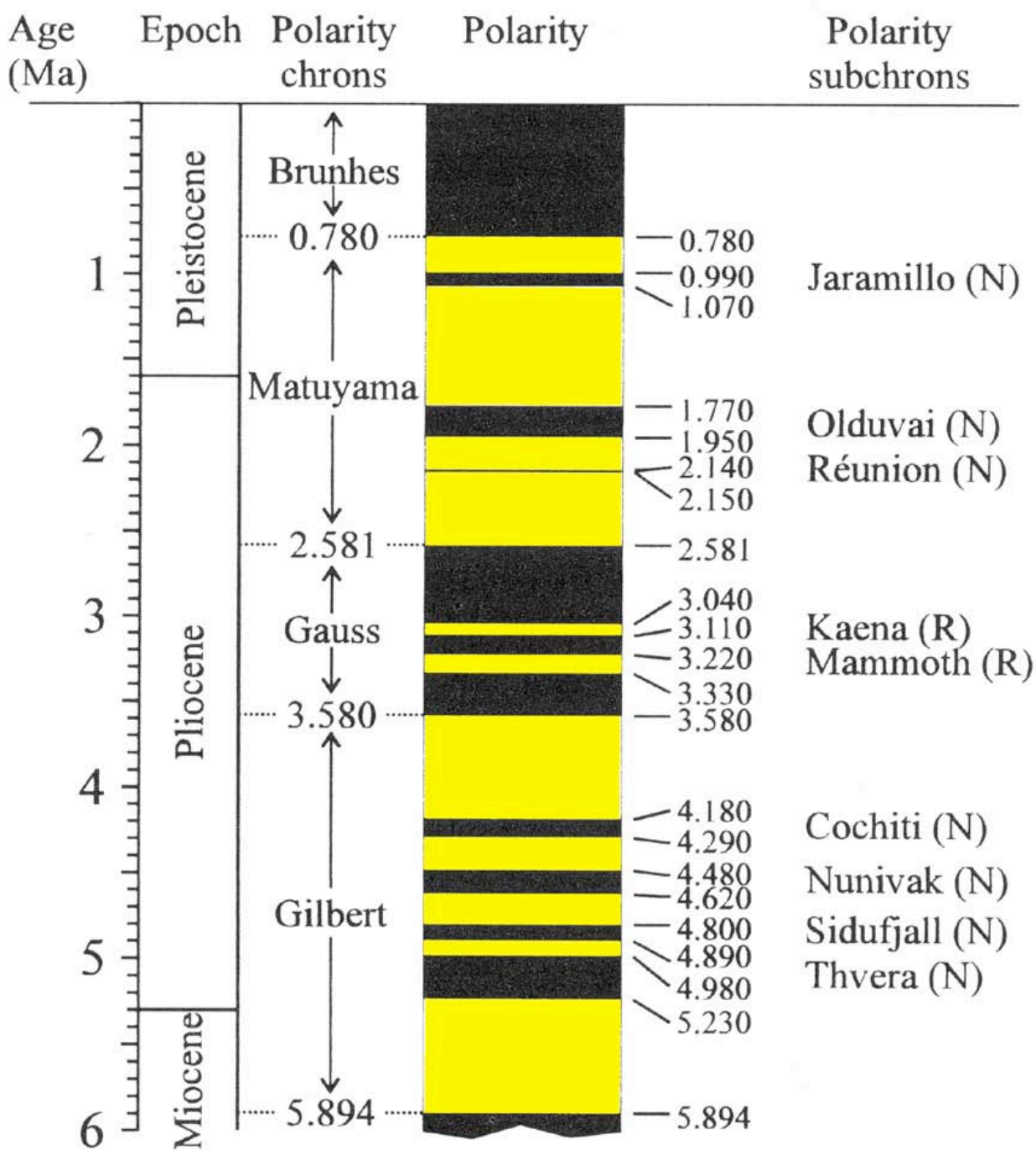
Curie temperature: change from ferromagnetic to paramagnetic

PALEOMAGNETISM (past magnetizations) are recorded in volcanic rocks

The magnetic field has reversed polarity in the past



There have been >20 polarity reversals in the past 5 million years

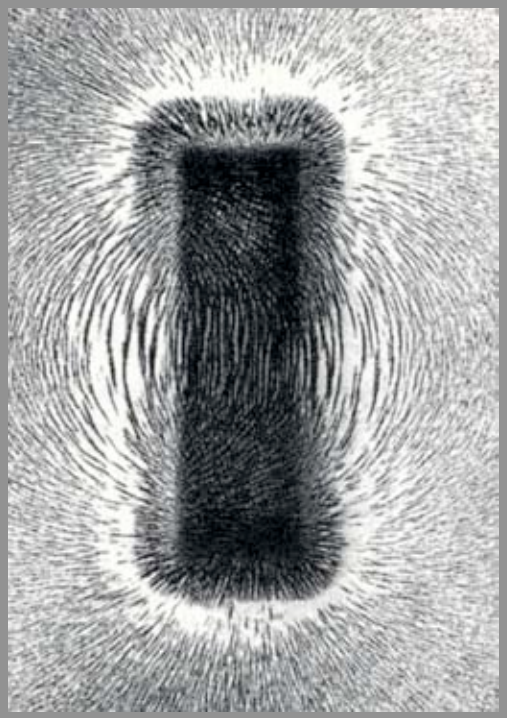


Earth's magnetic field: what we know

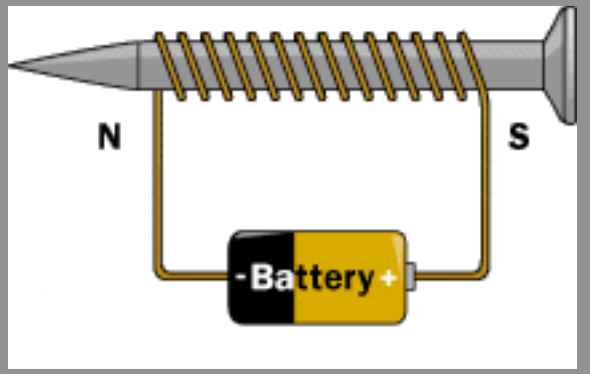
- The field approximates a magnetic dipole
- The field is continuously varying
- The field reverses polarity, on average every ~1/4 million years

Magnetic fields causes:

- **permanent ferromagnets**
  - **iron**
  - **Magnetite**
  - **hematite**

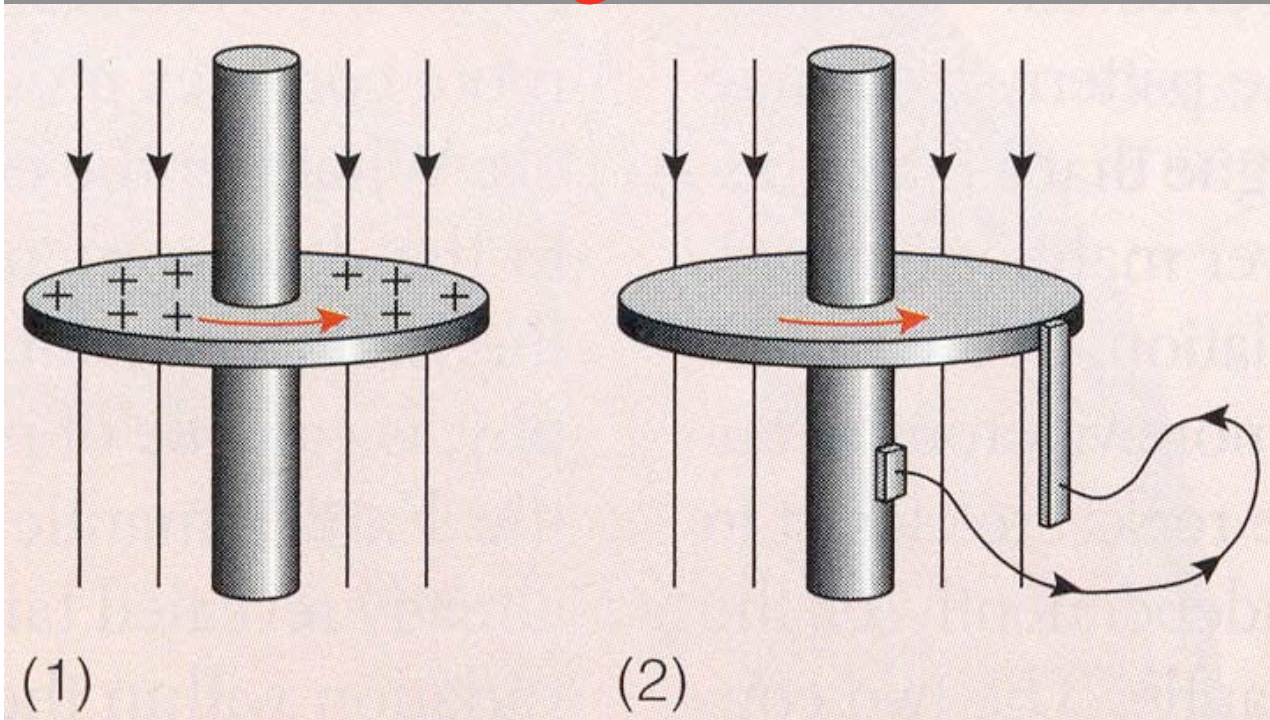


- **electromagnets**



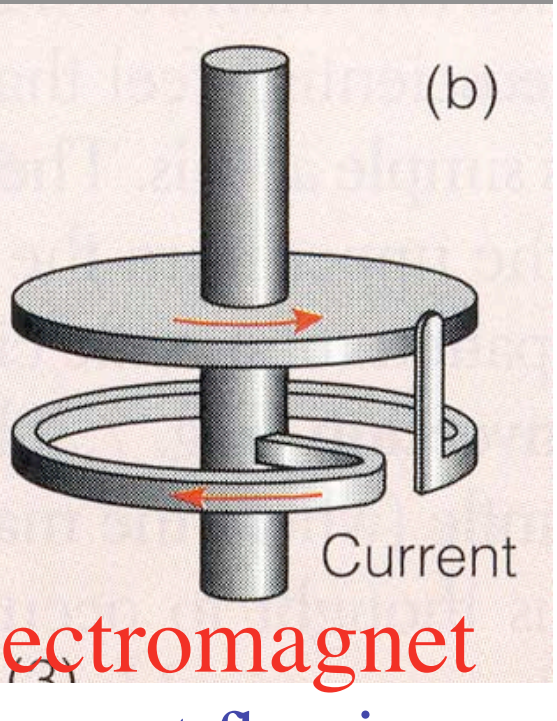
Disc dynamo

external magnetic field



A conductor moving through an external magnetic field creates an electrical current

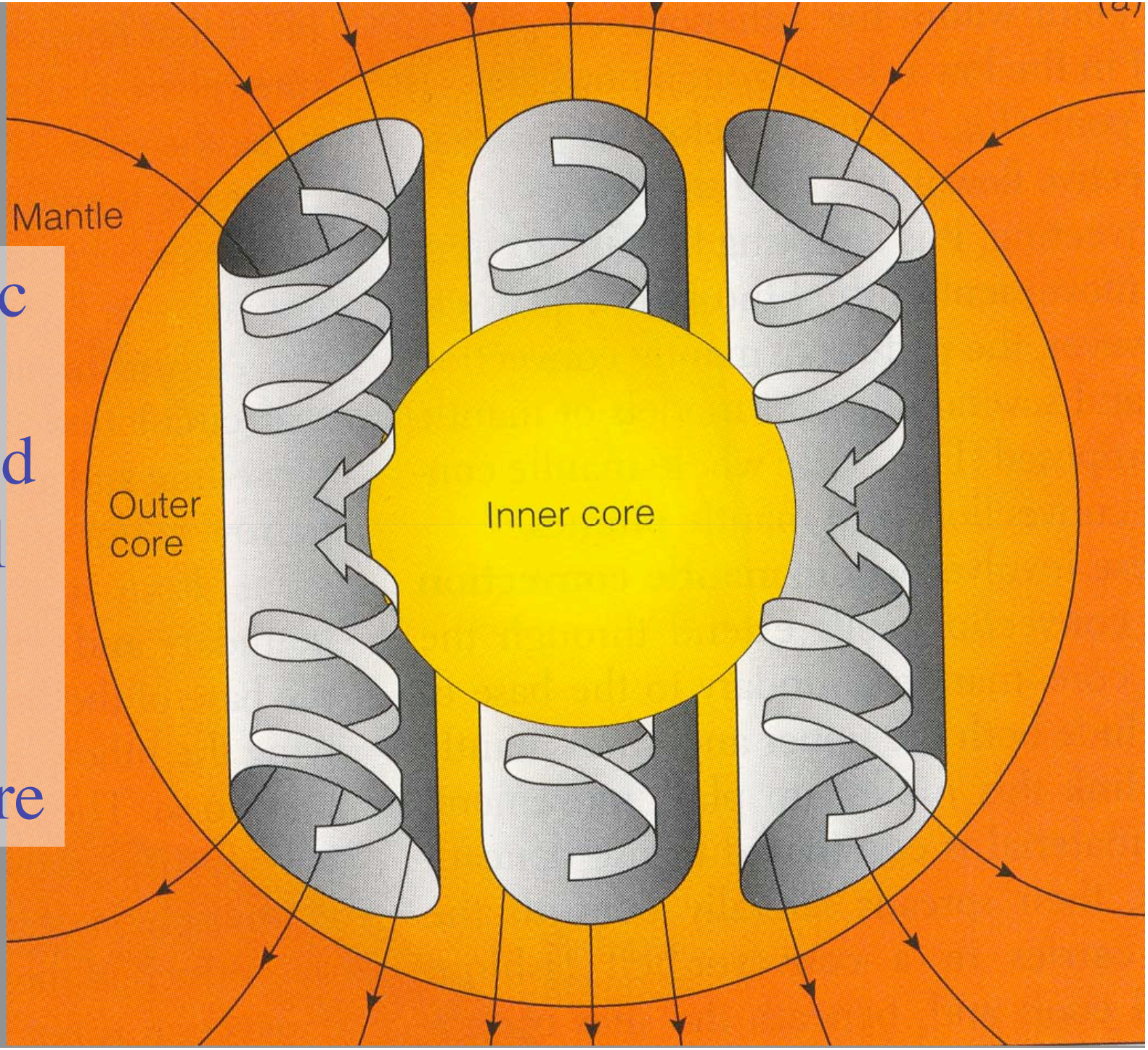
Self generating dynamo

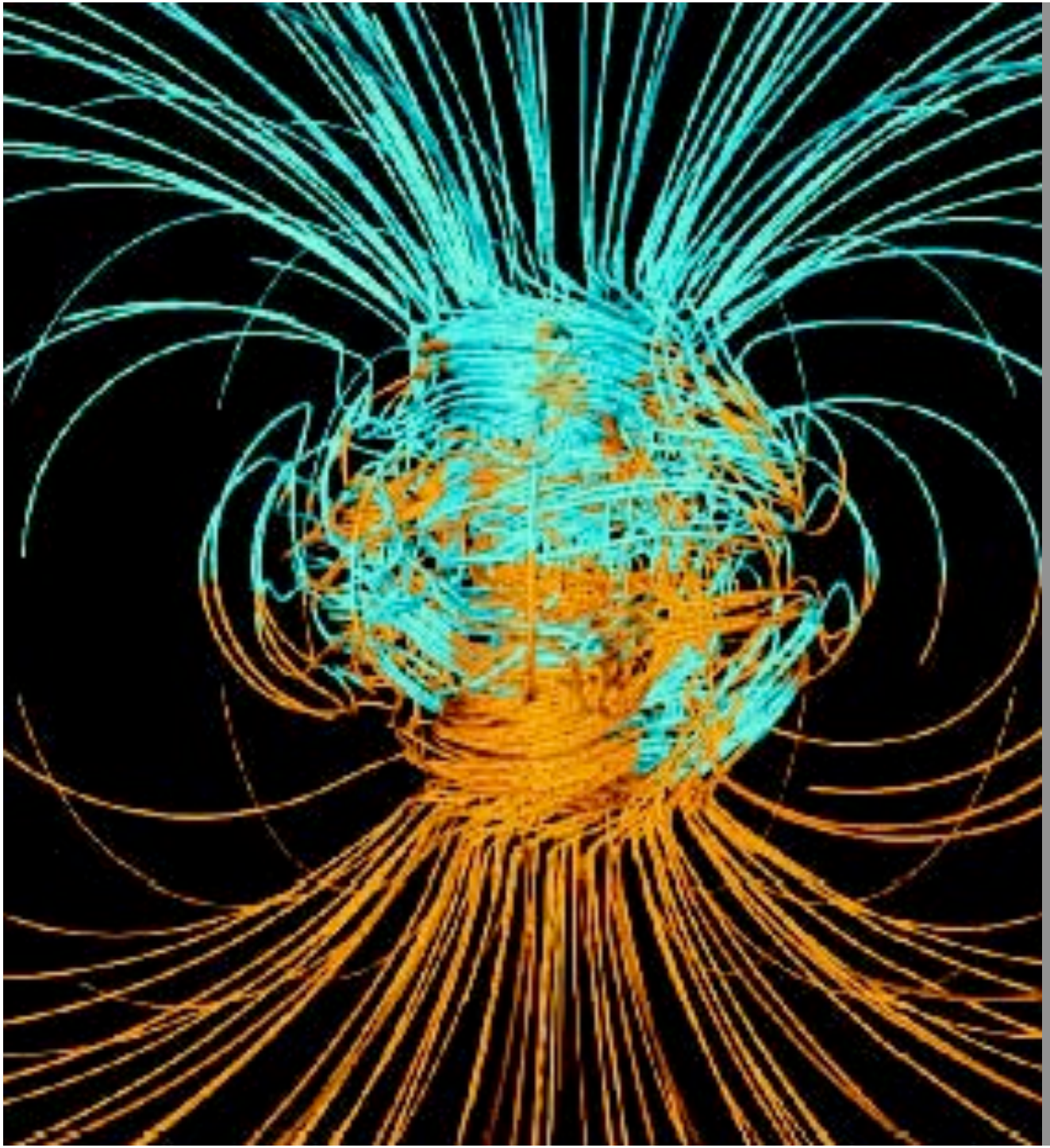


electromagnet

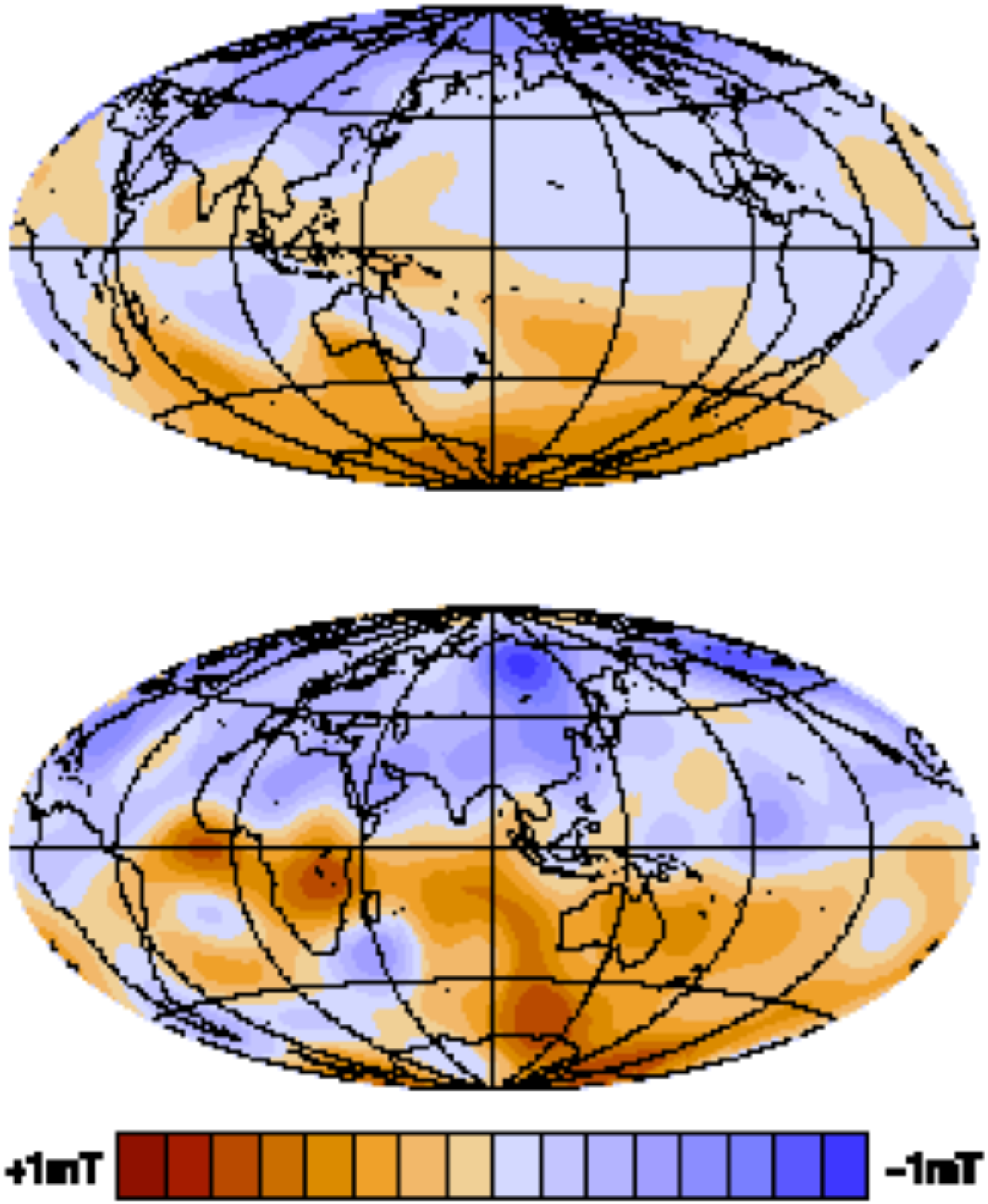
Current flowing through a coiled conductor creates a magnetic field

Magnetic field generated by spiral motions in the outer core





Magnetic field simulation blue: directed out of the core gold: directed into the core



model magnetic field

observed magnetic field