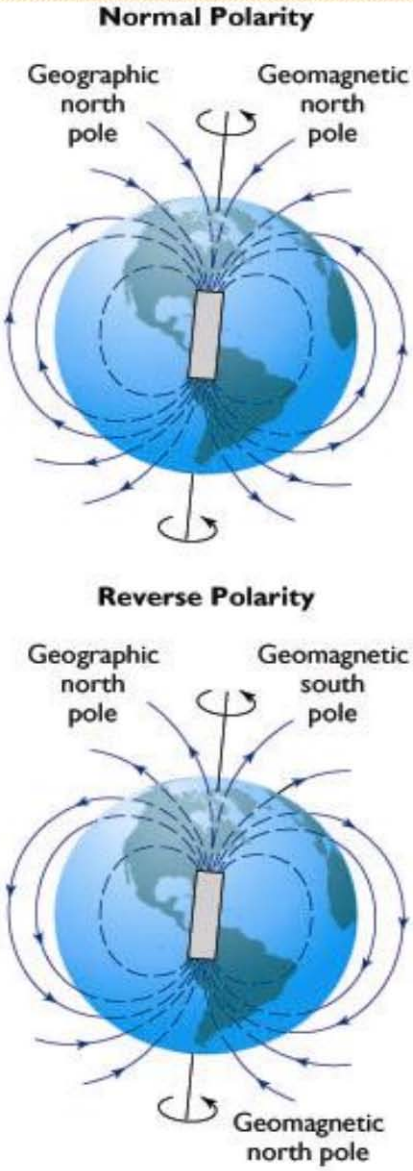
Geotectónica 2012

ANOMALIAS DE FONDO OCEÁNICO

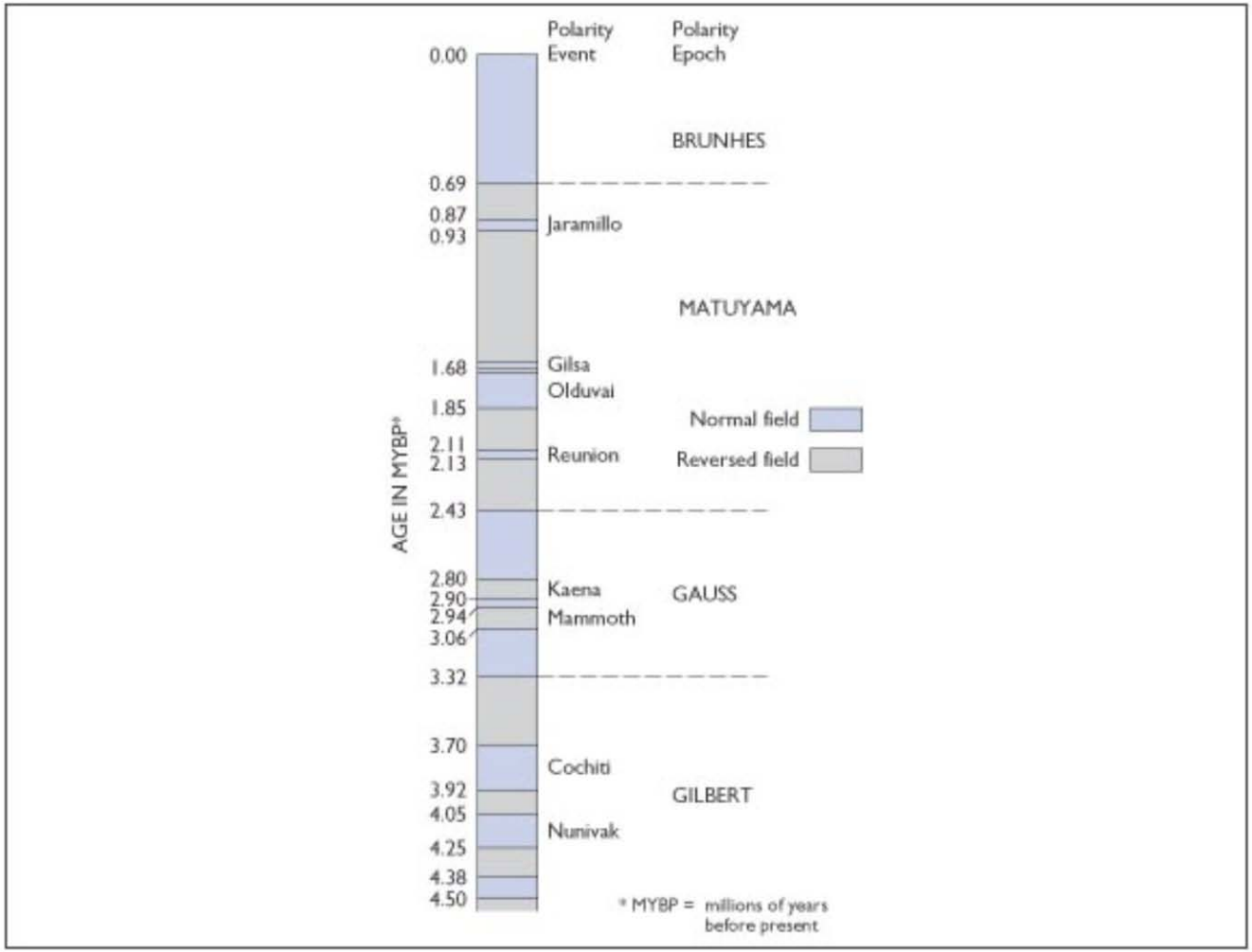
Geomagnetic Polarity Reversals



History of Geomagnetic Polarity Reversals

Analyzing lava flows on land, the pattern of polarity reversals of the Earth's magnetic field has been accurately established.

Figure 3.4c

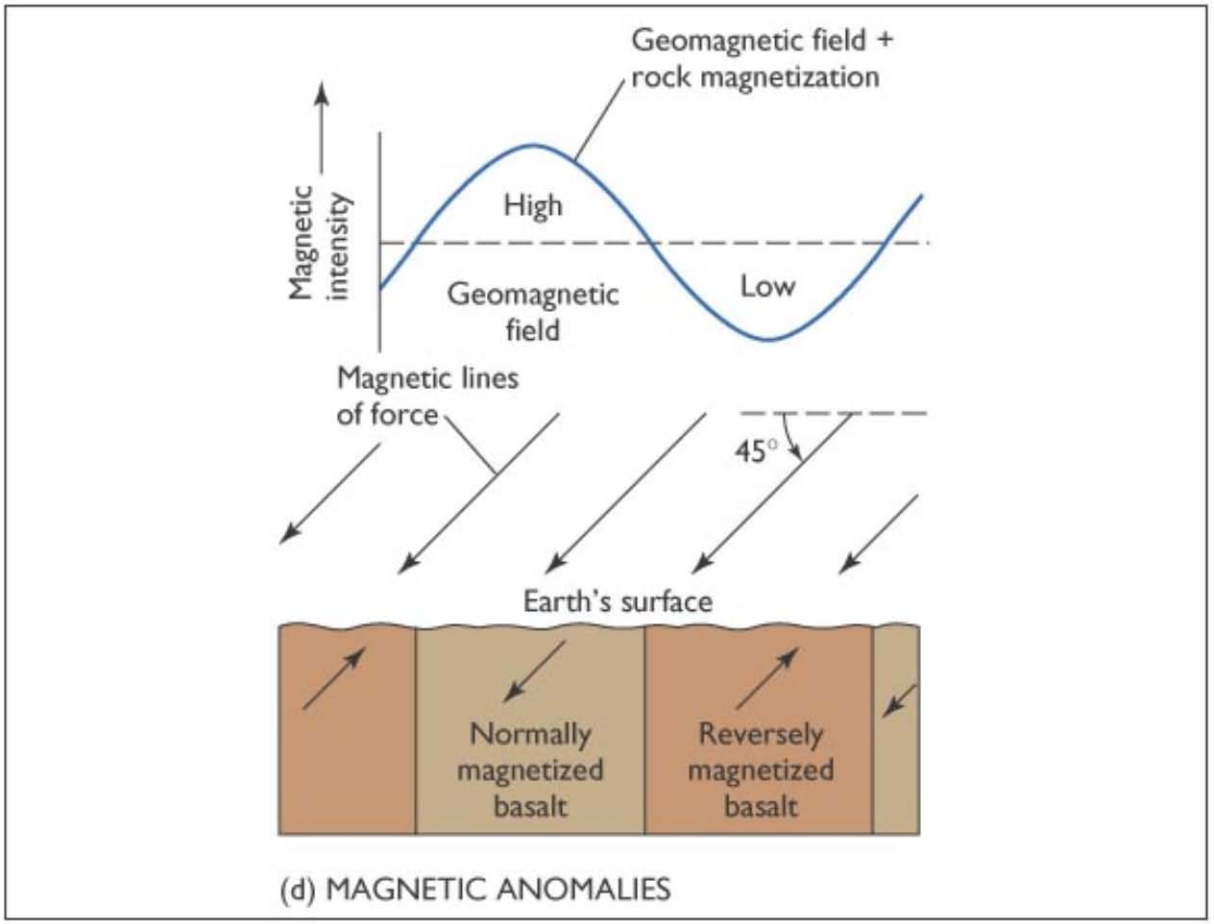


3-2 Sea-Floor Spreading

- **Moving across the ocean floor perpendicularly to the oceanic ridges, magnetometers record alternating strong (positive) and weak (negative) magnetic measurements (called magnetic anomalies) in response to the influence of the sea floor rocks.**

A magnetometer measures simultaneously both the Earth's magnetic field and the fossil magnetization in the rocks.

Figure 3.4d

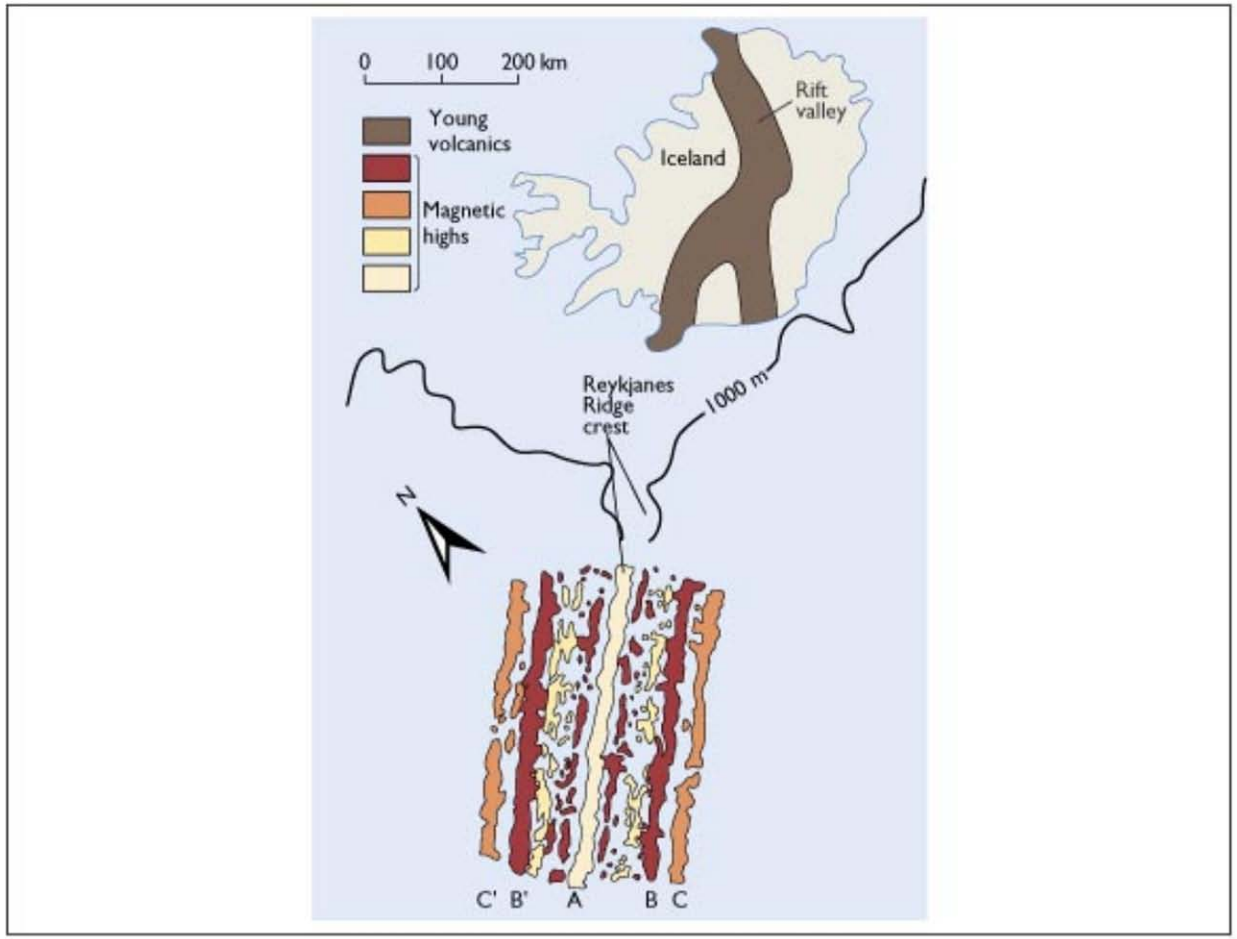


3-2 Sea-Floor Spreading

- **Magnetic anomalies form parallel bands arranged symmetrically about the axis of the oceanic ridge.**

Magnetic anomaly stripes.

Figure 3.3



3-2 Sea-Floor Spreading

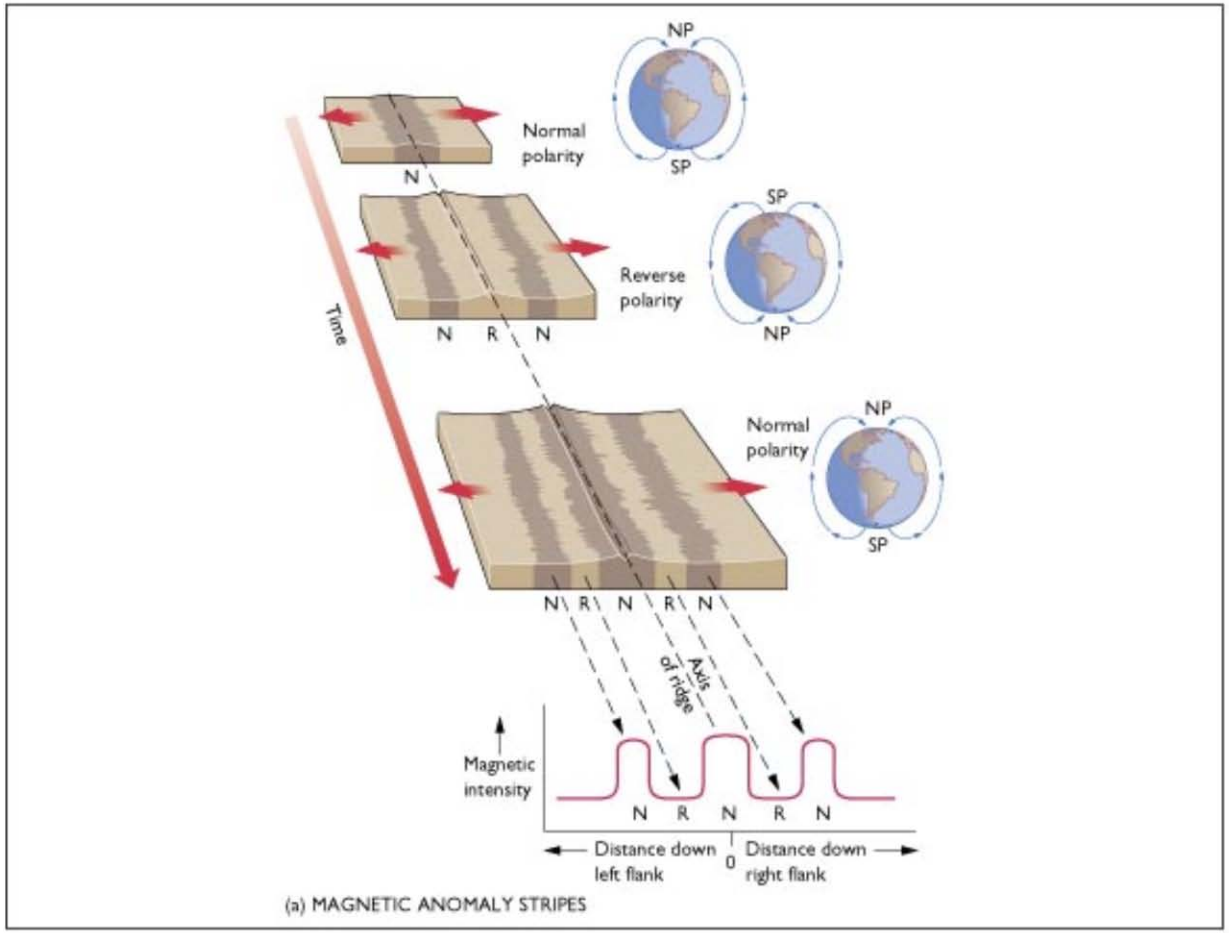
- As basaltic rocks crystallize, some minerals align themselves with Earth's magnetic field, as it exists at that time, imparting a permanent magnetic field, called paleomagnetism, to the rock.
- Periodically Earth's magnetic field polarity (direction) reverses poles.

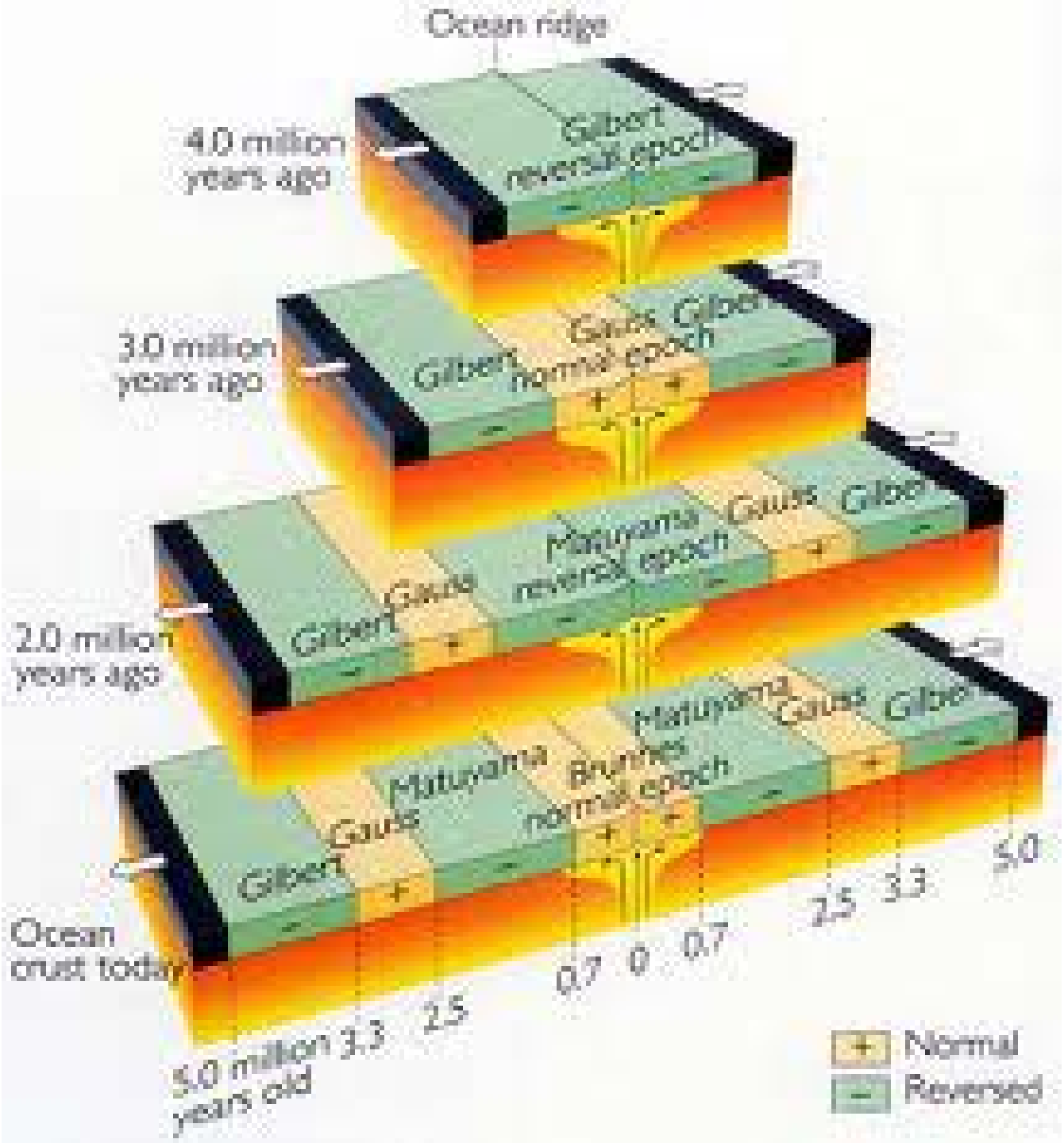
3-2 Sea-Floor Spreading

- **Rocks forming at the ridge crest record the magnetism existing at the time they solidify.**

Sea-floor spreading combined with geomagnetic polarity reversals creates the magnetic anomaly stripes that are symmetrically arranged about the axis of active

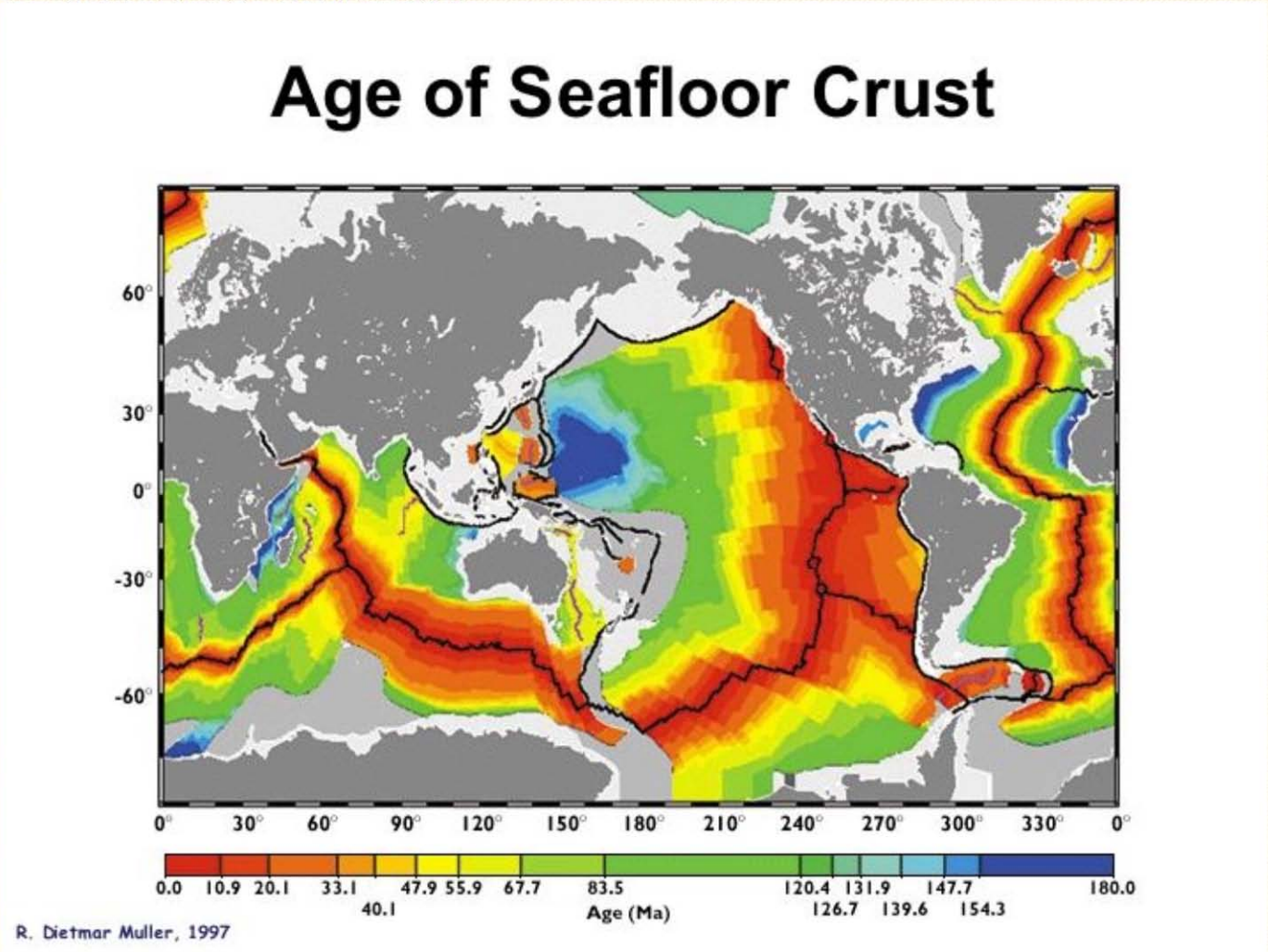
Figure 3.5a




Ocean ridge
4.0 million years ago
Gilbert reversal epoch
3.0 million years ago
Gilbert
Gauss normal epoch
Gilbert
2.0 million years ago
Gilbert
Gauss
Matuyama reversal epoch
Gauss
Gilbert
Ocean crust today
Gilbert
Gauss
Matuyama
Bruhnes normal epoch
Matuyama
Gauss
Gilbert
5.0 million years old
5.0
3.3
2.5
0.7
0
0.7
2.5
3.3
5.0
Normal
Reversed

3-2 Sea-Floor Spreading

- **Sea floor increases in age and is more deeply buried by sediment away from the ridge because sediments have had a longer time to collect.**

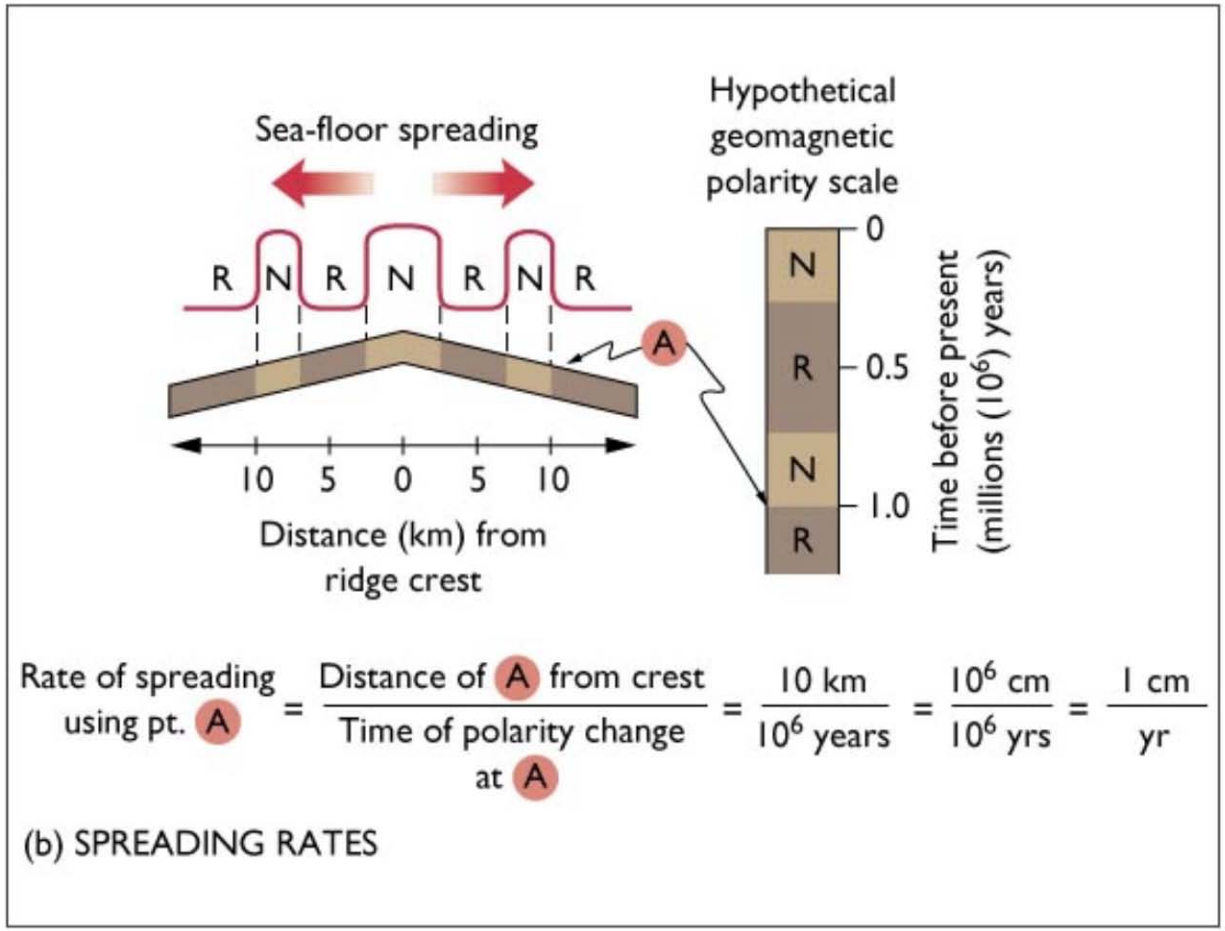


3-2 Sea-Floor Spreading

- **Rates of sea-floor spreading vary from 1 to 10 cm per year for each side of the ridge and can be determined by dating magnetic anomaly stripes of the sea floor and measuring their distance from the ridge crest.**

The rate of sea-floor spreading is easily calculated, using the age and distance from the ridge crest of any magnetic anomaly stripe.

Figure 3.5b



opposite directions as the polarity changes, but only the first magnetic reversal is

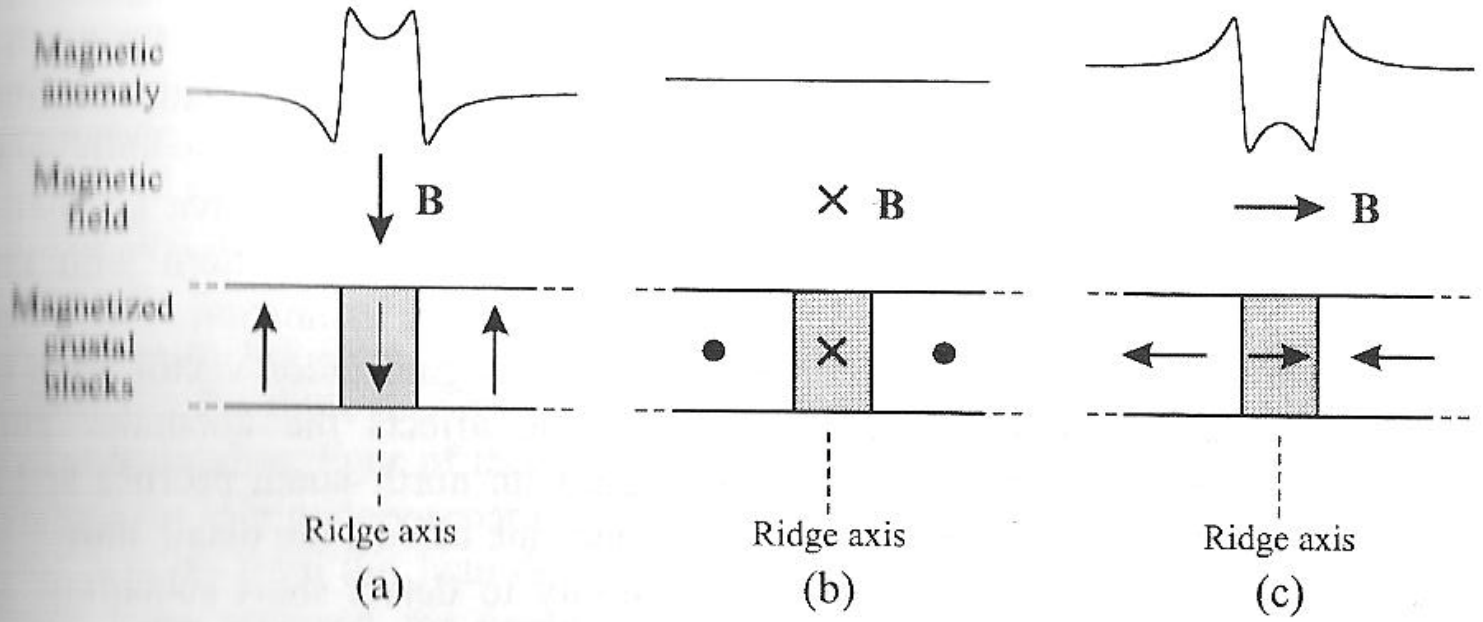


Fig. 5.1. Latitude variation of the shape of the magnetic anomaly due to magnetized crustal blocks adjacent to the axis of a spreading ridge. Normal polarity block is shaded. The external magnetic field **B** due to an axial geocentric dipole is shown for three cases. (a) At the north pole the intensity of the field is increased over the ridge axis. (b) At the equator a north–south oriented ridge spreading east–west produces no magnetic anomaly (crosses and dots indicate north–south horizontal fields perpendicular to the page, in and out respectively, along the ridge). (c) At the equator, for an east–west oriented ridge spreading north–south, the intensity of the field is decreased over the ridge axis.

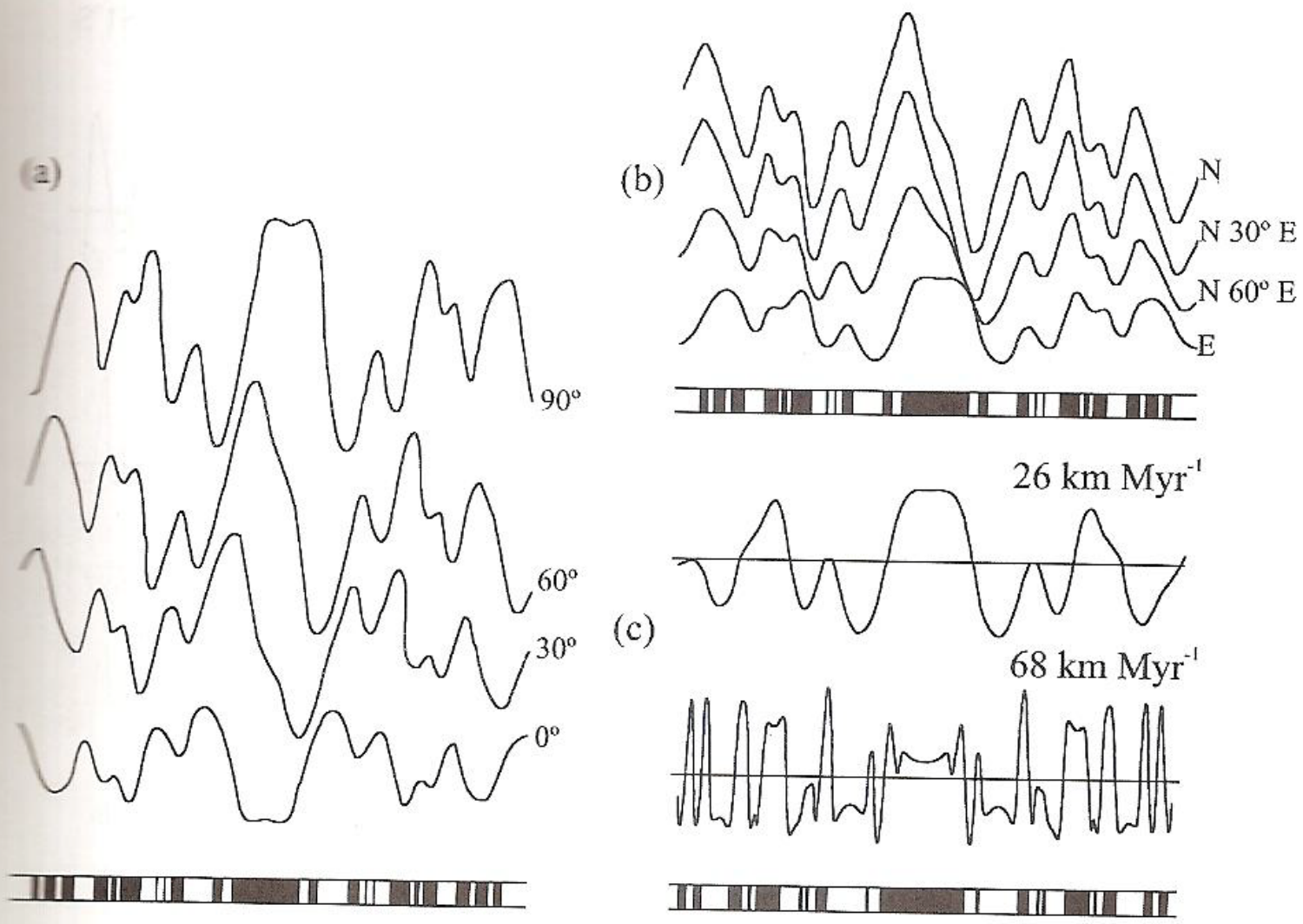


Fig. 5.11. The effects of latitude, profile orientation and spreading rate on the magnetic anomaly patterns. After Kearey and Vine (1996) and DeMets *et al.* (1994).
(a) Variation with geomagnetic latitude for north–south profiles. Angles refer to magnetic inclination.
(b) Variation with profile orientation at a fixed latitude, where the magnetic inclination is 45°.
(c) Variation with spreading rate. More detail can be obtained from the fast-spreading ridge.

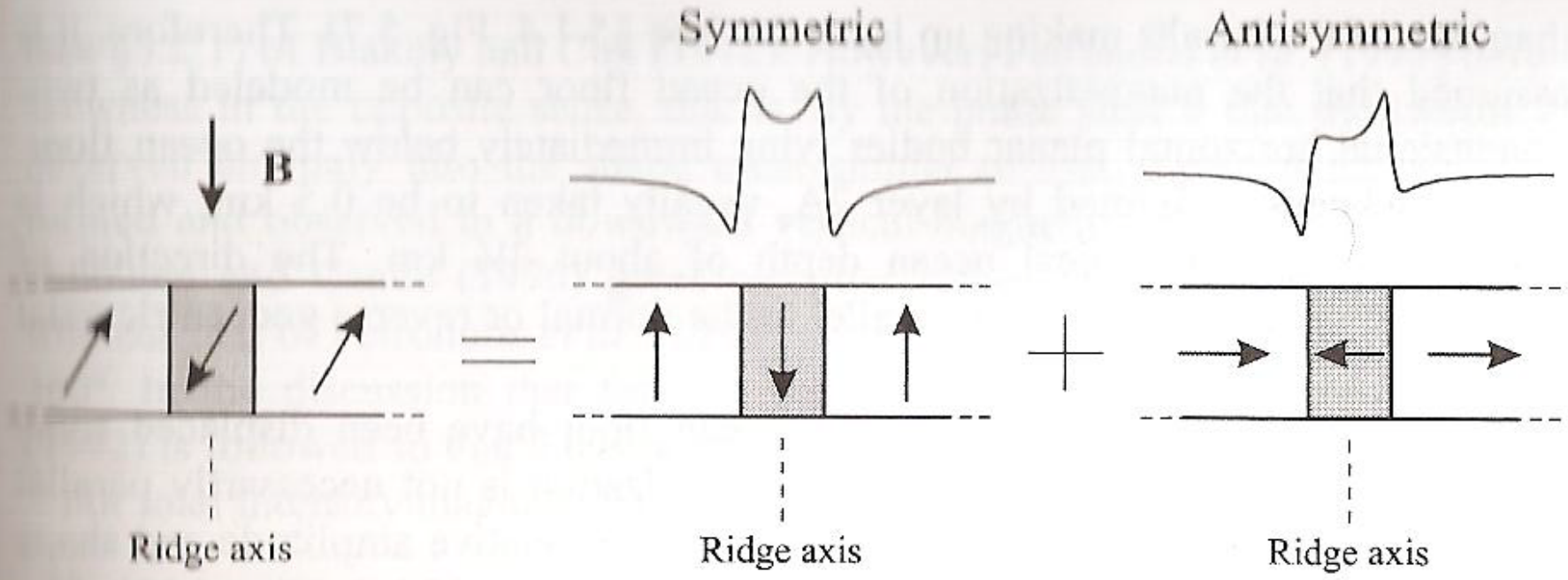


Fig. 5.13. Symmetry of magnetic anomalies about a ridge axis. Normal polarity block is shaded. A symmetrical magnetization of the crustal blocks (left) is not parallel to the present external field **B** (taken to be vertical) because the magnetization was acquired at another place and the magnetized blocks have subsequently been displaced to their present position. The magnetization can be divided into a component parallel (center) and perpendicular (right) to the external field. These components produce symmetric and antisymmetric anomalies, respectively.

Vine (1966) showed that the model could be used beyond the limits of the