Appendix

Note on the magnetic polarity time scales used in the Nares Strait volume

The Nares Strait volume focuses on a debate concerning various problems of correlating the onshore geological record of the Nares Strait region with large-scale plate tectonic movements — in particular the spreading history of the surrounding oceans. Complete integration of the onshore and marine geological and geophysical data must be a prime target for any understanding of the Earth's crust. Nares Strait is one region among many where much work remains to be done in this direction. To effect a synthesis between the onland geological data and those of the ocean basins, a common geochronological framework is required; the geomagnetic polarity time scale has provided this standard for correlation.

Since the 'tape-recorder' concept of linear magnetic anomalies, developed by Vine & Matthews and others, was published in 1963, the interpretation of the magnetic anomaly patterns of the oceans has been an extremely valuable tool in sea-floor spreading/plate tectonic research. The Heirtzler et al. (1968) geomagnetic time scale, derived from the idea that the linear magnetic anomaly pattern associated with oceanic ridges is a manifestation of previous geomagnetic field reversals, is based on a particular magnetic profile in the South Atlantic; dates were assigned by extrapolation from a date of 3.35 m.y. that marks the boundary of the Gauss and Gilbert polarity epochs. It was further assumed that spreading rates prior to the Gilbert epoch (pre-anomaly 3) were unchanged at 1.9 cm/yr^{-1}. Absolute ages of the reversals to produce the time scale were obtained by incorporating palaeomagnetic and palaeontological data.

Since the Heirtzler time scale was introduced, many studies from various branches of geology, geophysics and geochemistry have directly and indirectly provided data which have been used in correction and refinement of the scale. The Deep Sea Drilling Project has played a major role in this and it has been directed to many aspects of linking together the magnetic and biostratigraphic records by detailed investigation of the offshore sediments and their relationships to the sites of identified magnetic anomalies. For example, an early modification of the Heirtzler scale from bore-hole data was made by Sclater et al. (1974), who demonstrated that the Cretaceous–Tertiary boundary in the Indian Ocean (site 216), dated radiometrically at 64.1 ± 1 m.y., is located between magnetic anomalies 29 and 30 and not with anomaly 26 as inferred by the Heirtzler scale. The dating of Palaeogene anomalies was also refined by using a spreading rate in the South Atlantic of 2.04 cm/yr. There has been continual revision of the Cretaceous–Cenozoic magnetic polarity time scale as illustrated by the versions published by, for example, Tarling (1971), Sclater et al. (1974), Tarling & Mitchell (1976), La Brecque et al. (1977), Berggren et al. (1978) and Hailwood et al. (1979).

Many of the revised time scales show serious discrepancies with the original Heirtzler scale, and also between each other. This can be illustrated for example by the ages assigned to anomaly 24; an anomaly that holds a critical place in the North Atlantic sea-floor spreading history, being generally interpreted as the oldest recognisable linear anomaly between Greenland and Europe. On the Heirtzler scale this anomaly is assigned an age of 60 m.y. corresponding to mid-Paleocene time, on the Sclater et al. and LaBrecque et al. scales it is designated as 56 m.y., late Paleocene, while on the Tarling & Mitchell scale it is assigned 49 m.y. at about the Paleocene–Eocene boundary. On more recent scales, anomaly 24 is assigned 54 m.y., Paleocene–Eocene boundary (Berggren et al.) and 52 m.y., early Eocene (Hailwood et al.). A main feature of the revision has been a general expansion of the polarity epochs in Paleocene time and it is now apparent that the original geomagnetic time scale assigns ages to the late Cretaceous and early Tertiary magnetic reversals that are at least 10 per cent too high.

Several papers in this volume that deal with the spreading history of the oceanic regions surrounding Nares Strait refer to the magnetic polarity time scale. A main topic discussed is the relationship between the sea-floor spreading history of the North Atlantic, and the Tertiary (Eurekan) orogeny which affected large parts of Arctic Canada and northern Greenland adjacent to Nares Strait. In such instances a common time scale becomes very relevant, so much so that geological correlations not apparent with reference to one time scale may become so by use of a revised scale.

In order to effect an easier comparison in this volume of the onshore geological events to sea-floor spreading history it was hoped that a 'standard' polarity time scale could be adopted. However, in the editing of this volume such an attempt to single out a particular time scale as 'standard' was given up as impracticable. Hence as many as five different polarity time scales are used in the contributions. To ease the difficulties that the reader might have in equating magnetic anomaly 'time' with biostratigraphic and radiometric 'time', the time scales referred to in this volume are summarised in Fig. 1. It

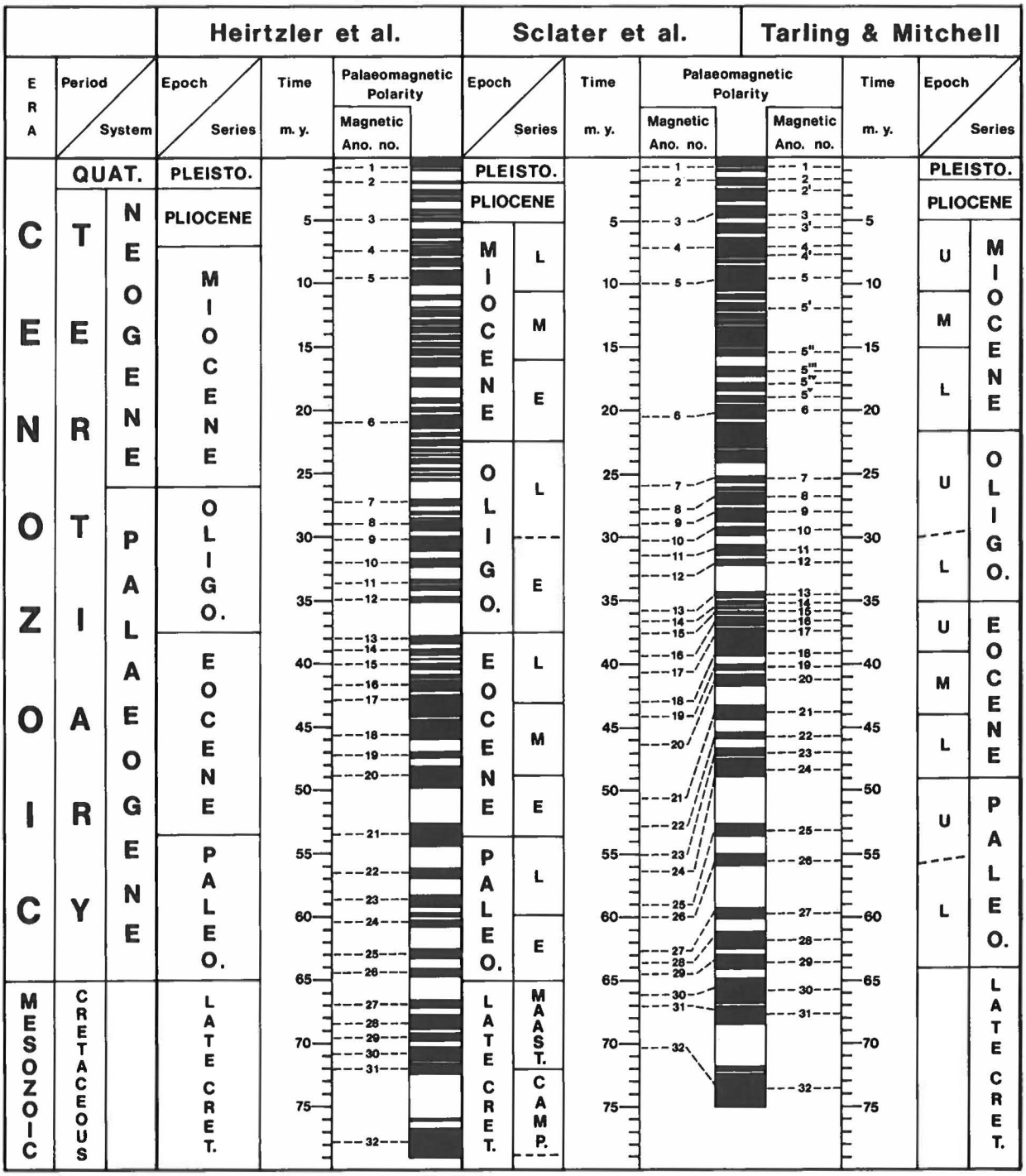
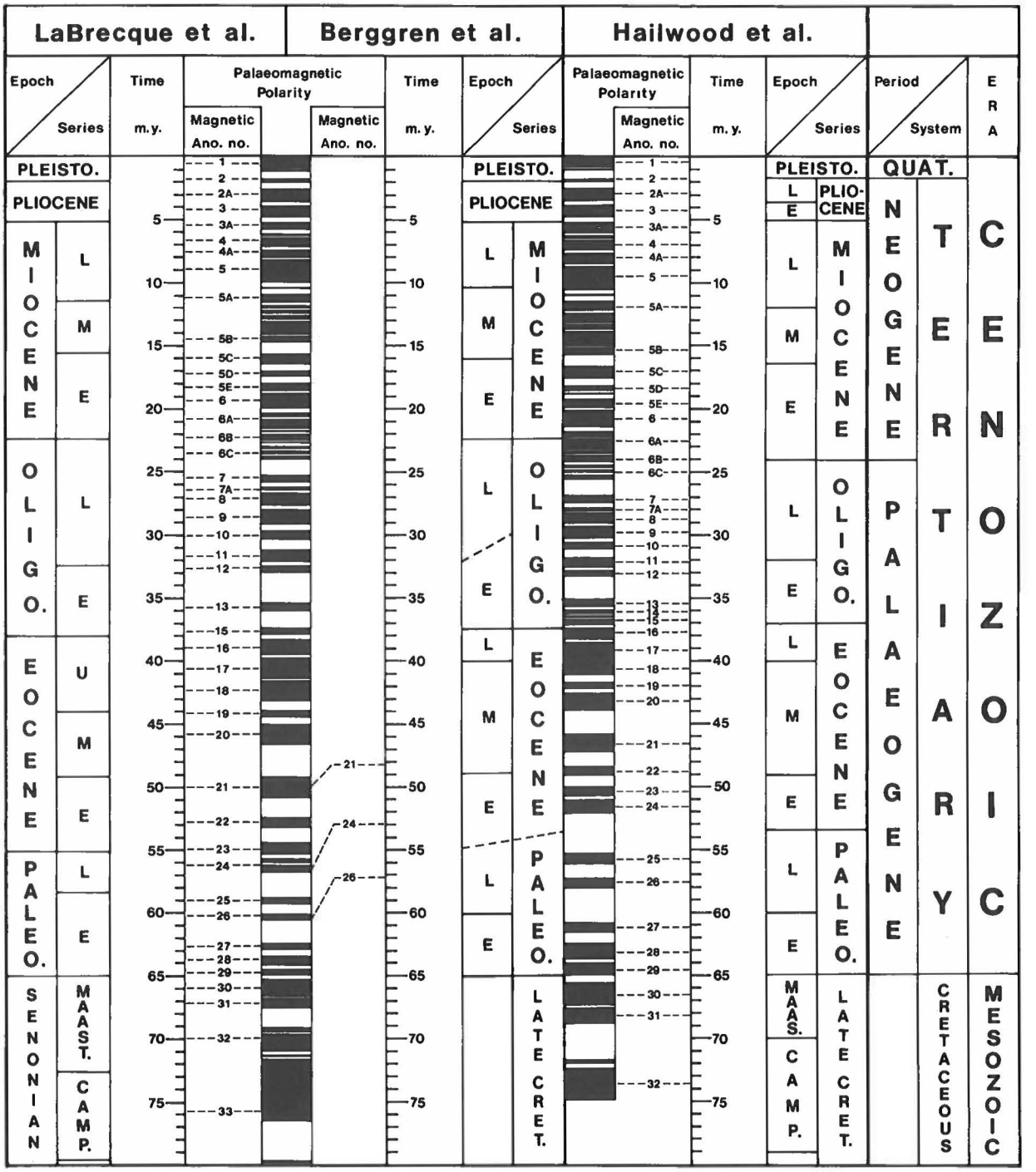


Fig. 1. Comparison of various magnetic polarity and geologic time scales redrawn from Heirtzler et al. (1968), Sclater et al. (1974), Tarling & Mitchell (1976), LaBrecque et al. (1977), Berggren et al. (1978) and Hailwood et al. (1979). The Neogene part of the geologic scale used for Berggren et al. is taken from Berggren (1972). The magnetic polarity scales used in the two central columns are taken from Tarling & Mitchell and LaBrecque et al. so that the magnetic anomaly numbers for Sclater et al. and Berggren et al. are adjusted to the radiometric time scale (m.y.) accordingly.


LaBrecque et al.
Berggren et al.
Hailwood et al.
Epoch
Series
Time
m.y.
Palaeomagnetic Polarity
Magnetic Ano. no.
Period
System
ERA
PLEISTO.
PLIOCENE
MIOCENE
OLIGO.
EOCENE
PALEO.
SENONIAN
L
M
E
U
MAAST.
CAMP.
PLIO-CENE
OLIGO.
EOCENE
PALEO.
LATE CRET.
QUAT.
NEOGENE
PALAEOGENE
TERTIARY
CRETACEOUS
CENOZOIC
MESOZOIC

should be noted that since the preparation of Fig. 1, the use of the Tarling & Mitchell (1976) time scale in one paper has been discontinued; however, reference to this scale has been retained in the diagram for convenience.

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