Objectives: To understand how marine magnetic anomaly patterns develop and to use them to interpret the timing and nature of sea floor spreading in the world's oceans.

Introduction: Where two tectonic plates diverge new sea floor is created. Magma flowing up from the interior solidifies and becomes magnetized with either normal or reversed magnetization, depending on the direction of the Earth's field at the time. As sea floor spreads, approximately half the newly magnetized material moves to one side and half to the other, forming two symmetrical magnetized bands. By dating the bands on the sea floor using the magnetic stratigraphy worked out from dated lavas on land, we can determine the age of the ocean floor and from this, how fast the oceans are opening.

Exercises: Selected profiles from the Pacific, north and south Atlantic, and Indian Oceans have been marked on portions of the map Magnetic Lineations of the World's Ocean Basins provided to you. The magnetic anomaly time scale provided in both graphic and table form comes from the work of S. C. Cande and D. V. Kent, 1992, A new polarity time scale for the Late Cretaceous and Cenozoic. For each profile complete the following:

A. Use the magnetic anomaly position and the reversal time scale provided to construct plots of distance from the ridge vs. age for all profiles. Use as many identifiable anomalies as possible. Construct a table of your data containing distance from ridge, anomaly number, and age. For the North Atlantic ocean, construct an age profile that goes out to the same anomaly in both directions. Transfer this data to a computer (maybe Kaleidagraph) and calculate half spreading rates. Make plots of age vs. distance from the ridge for all four profiles make them look good.

B. From your distance vs. age plots, determine average half-spreading rates and rates as a function of time, if appropriate, for each profile by fitting lines to various sections of your graphs. Record the spreading rates appropriate for the different time periods in your file.

C. Provide a summary of the spreading episodes for each profile, including (but not limited to) time of initiation of spreading, periods of fast and slow spreading, symmetric or asymmetric spreading (compare the detailed profiles you constructed from one side of the ridge with the anomaly pattern from the other side of the ridge), and any other details you deem interesting or important.

D. From your knowledge of the growth of lithosphere by conductive cooling, generate a plot of the expected lithospheric thickness in km vs. age in Ma for the north Atlantic. Use the formula we have derived in class in which the thickness is simply \( D = 2.3(\kappa t)^{1/2} \).

E. Finally, discuss the various profiles in a brief essay (≤ 250 words). Comment on the appearance of any synchronous behavior among the various ridge systems. Is there a global or near-global response to changes in spreading at one ridge system?