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QUATERNARY CLIMATE, ENVIRONMENTS, AND MAGNETISM, edited by Barbara H. Maher and Roy Thompson. 1999. Cambridge University Press, Cambridge, 390 pp., hardcover $120.00.

For geologists, paleontologists, and geophysicists who work with Tertiary and earlier rocks, the term "paleomagnetism" is associated with solving problems of magnetostratigraphic correlation, or determining paleolatitudes or tectonic rotations. But as this fascinating volume shows, there is a small, but productive, subset of geologists who use different magnetic tools in understanding climates and environments of the Quaternary. These scientists measure not magnetic polarity or magnetic direction, but a whole suite of magnetic characteristics of sediments and sedimentary rocks (such as susceptibility, hysteresis, isothermal remanence, and other properties) that reveal many other interesting stories

As the historical introduction to the subject by Bradley and Heller points out, the field actually began in 1926 (very early in the days of any kind of paleomagnetic study) with Gustav Ising's measurements of magnetic susceptibility and natural remanence in varved lake sediments. Maher et al. then follow with a chapter describing the fundamental principles of Quaternary paleomagnetism, and giving a good background to the subject for those who have at least a passing familiarity with Quaternary geology and the principles of rock magnetism. The remaining chapters of the book then summarize and review the major subfields of research within Quaternary paleomagnetism. Stoner and Andrews show how magnetic susceptibility measurements of North Atlantic cores have proven excellent tools for detecting climatic changes, since pulses of ice growth and melting increase or decrease the volume of magnetic minerals in these fine-grained deep-sea sediments. Maher and Thompson show (in two different chapters) how magnetic susceptibility measurements of Chinese loess and eolian dust in the Indian Ocean are excellent climatic indicators, since the magnetic content of these sediments is largely determined by wind-driven particles in ancient monsoonal climates.

Hesse and Stolz discuss the discovery that much of the magnetite in the deep sea comes from magnetotactic bacteria, and show how these "magnetofossils" are highly sensitive to water-depth and oxygenation changes driven by climate change. Snowball and Torii describe how the occurrence of iron sulphides is a useful paleoclimatic tool, especially in the recognition of poorly oxygenated or brackish water environments. Dearing discusses the ways in which magnetic content (as measured by susceptibility) of lake sediments is a powerful paleoclimatic indicator. Petrovsky and Ellwood point out that modern human-induced pollution produces a variety of tiny magnetic particles (particularly heavy metals released from smelters, and from coal-burning power plants) that can be detected and used as powerful tools for tracking down sources of pollution in the modern environment. Lund and Schwartz discuss how measurements of the fluctuations in paleointensity in lake sediments and marine cores are also highly sensitive to climate change (once the data have been standardized for grain size). Finally, Langereis and Dekkers discuss how highly cyclical marine deposits of the northern Mediterranean vary not only in their sedimentary properties, but also in their magnetic properties. Like isotopic curves and other proxies of the Milankovitch cyclicity, the magnetic intensity (as measured by anhysteretic remanent magnetization) tracks the orbital variations of the earth at a very high resolution, allowing correlation by cycle patterns to the nearest few hundred years. Such incredible detail is a real eye-opener for those of us accustomed to much coarser resolution in the pre-Quaternary record. For that reason and many others, I highly recommend this well-written and organized book to anyone interested in the latest tools for understanding climatic change.

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