The Past Three Million Years: Evolution of Climatic Variability in the North Atlantic Region edited by N. J. Shackleton, R. G. West, and D. Q. Bowen. The Royal Society, 1988, 278p., £47.50 (ISBN 0-85403-348-3).

THIS VOLUME IS a collection of 14 papers presented at a symposium of the same title organized by the editors and held on February 25–26, 1987. As the title implies, the common theme is the evolution of climate in the North Atlantic region during the last three million years encompassing the initiation of glaciation at about 2.4 Ma and the increased climatic variability of the last one million years. The contributors review and present sedimentologic, faunal, and floral evidence from marine or terrestrial sediments spanning variable time intervals. Because of the large variety of approaches and scopes used to investigate climate in different areas of this region, it is difficult to group papers into themes or topics. About an equal number of contributions deal with pelagic, continental margin, and terrestrial deposits, but only two of the papers treat environments in North America.

The volume starts with a paper by W. F. Ruddiman and M. E. Raymo summarizing the evidence from deep-sea sediments for changes in the periodicity of the global glacial regime due to orbital-controlled variations in isolation. They propose grand-scale uplift in Tibet and North America as the cause for the initiation and intensification of glaciation in the Northern Hemisphere. Shackleton et al. discuss the periodicity in the $\delta^{18}O$ signal from North Atlantic Site 552. Sarnthein and Fenner contrast global oceanographic conditions at and about 0.75 Ma before the onset of glaciation and conclude that climatic deterioration was accompanied by increased wind-induced upwelling in the equator and along eastern continental margins. Based on the similarity between isopollen maps in marine sediments from the northwest African coast, Hooghiemstra determines that neither the African easterly jet nor the trade winds were latitudinally displaced at 18 and 9 Ka BP from the present paths. Glacial, interglacial, and sometimes interstadial events can be recognized in vegetational changes in the eastern Atlantic margin inferred from pollen analysis. Pollen records from the Netherlands for the last 2.4 Ma are interpreted by de Jong to reflect a long-term cooling with significantly more severe glacials during the last one million years similar to the pattern in deep-sea $\delta^{18}O$ records. A detailed evaluation by Turner and Hannon of lacustrine pollen records from northern Spain and southern France reveals a strong regional contrast in climate after the last glacial maximum, as evidenced by the earlier establishment of deciduous oak forest in NW Spain than in the Pyrenees. They argue for periglacial refugia near the Atlantic coast instead of the Pyrenees, as some authors hold, and the unreliability of pollen evidence from caves and rock shelters to infer interstadials between 30 and 16 ka.

Catt treats the subject of interpreting the climate of interglacials from soil horizons and correlates soils in loess sequences in eastern Europe and Asia with deep-sea $\delta^{18}O$ stages. The problem of defining the duration and complexity of cold stages in NW Europe due to the different levels of sensitivity of proxy indicators is discussed by West. Gibbard reviews the evolution of the great NW European rivers in response to climatic changes. In the expanded record of continental-shelf sediments in the southern North Sea described by Long et al., cold periods are characterized by moraine and glaciofluvial deposits, regressive facies, and low sea-level stands, whereas interglacials are transgressive facies and high sea-level stands. Bowen and Sykes discuss their interesting results about the timing and extent of glaciations in Britain and Scandinavia based on correlation of stratigraphic units, representing high sea-level stands, using aminostratigraphy and tie these to the deep-sea $\delta^{18}O$ record.

Einarsson and Albertsson deal with the climatic deterioration in Iceland from sudden cooling at about 3 Ma, ice caps during cold spells until 2 Ma, and at least 12 ice sheets reaching sea level in the last 2 Ma. In the eastern margin of Baffin Bay in arctic Canada, faunal and floral evidence discussed by Andrews indicates warmer conditions during previous interglacials than at present. Ostracod assemblages and sediments along the eastern coast of the United States indicate progressive warming from 4 to 2.8 Ma terminated by a sharp drop of sea level until 2.0 Ma. According to Cronin, this series of events reflects the emergence of the Isthmus of Panama, the strengthening of the Gulf Stream, as well as glaciation of the Northern Hemisphere.

The papers are of high quality and are presented in a logical manner, more or less according to geographical location. Presentation of the articles and figures are adequate. As expected for contributions submitted to a symposium, the degree of specialization is highly variable. Some papers discuss evidence and arguments in detail for the specialist, while others have a more limited coverage. Several of the papers elaborate on the use of specific proxies to infer paleoclimates offering insights into the power of methods and limitations of the data. The strength of the volume lies in its assimilation of current information on topics of paleoclimate in the region and in assembling a large and complex picture of the influence of climatic change on different elements and environments. The volume will be a useful reference to a broad audience interested in paleoclimates.

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X-Ray Fluorescence Analysis in the Geological Sciences: Advances in Methodology edited by S. T. Ahmedali. Geological Association of Canada Short Course, Vol. 7, 1989 (ISBN 0-919216-38-2)

THIS VOLUME IS a collection of eight papers presented as a short course at the Geological Association of Canada-Mineralogical Association of Canada (GAC-MAC) annual meeting in Montreal, Quebec, during May 1989. The intent of the short course was to bring together recent developments in X-Ray Fluorescence Analysis (XRF) that have broad application to the analysis of geological materials, and to provide a link between journal articles and laboratory manuals. The topics covered include (1) evaluation of rock standards, (2) automated fusion of samples, (3) discussion and evaluation of computer algorithms for the correction of matrix effects, (4) the use of Compton scattering for matrix correction in the analysis of trace elements, (5) the analysis of gypsum, anhydrite, and carbonate rocks, and (6) automated X-ray fluorescence analysis in geochemical exploration.

The articles by Abbey and Claisse contain little that is new, although I found useful information in both of them. Abbey reviews his approach to the difficult task of assigning "preferred" or "recommended" values to geological reference standards. Claisse, the originator, over thirty years ago, of the fusion technique in XRF sample preparation, discusses the automation of fusion methods, and provides useful practical tips, particularly for dealing with "difficult" samples. The papers by Harvey and Kocman deal with problems associated with the analysis of unusual or difficult materials, and give specific details of methods used in the authors' respective laboratories. Kocman describes the trials and tribulations of analyzing ten major elements in gypsum, anhydrite, and carbonate rocks. Harvey gives useful details for the determination of up to twenty minor and trace elements in geochemical exploration samples, materials that can be highly variable (gossans, soils, stream sediments, etc.) relative to the "normal" rocks commonly analyzed in XRF laboratories. Elements that are normally present at trace levels or below the detection limit may be important constituents. Consequently, one must be alert to potential interferences, and the usual assumptions (such as the absence of major absorption edges above the wavelength of iron) may no longer hold. The most useful article in the volume is the very thorough review of the use of Compton Scattering for making matrix corrections in trace element analysis provided by Willis. A step-by-step approach is given, and the neophyte XRF analyst should experience little difficulty in adopting this procedure.