ARCHAEOAN ATMOSPHERE–BIOSPHERE INTERACTIONS

A. HENDERSON-SELLERS
Department of Geography,
University of Liverpool,
P. O. Box 147,
Liverpool, L69 3BX.
U.K.

ABSTRACT. The Archaean, which comprises about 46% of the history of the Earth, has a fundamentally important characteristic in common with the present-day: both are periods in which the biota modified the atmosphere so much that climate changed. The future of mankind depends upon our ability to understand and predict the climatic consequences we ourselves induce through increasing atmospheric carbon dioxide and other trace gas amounts and, perhaps, by massive injections of aerosols into the atmosphere. Changes like these, but much greater in magnitude, occurred throughout the Archaean and yet the climate remained equable and the biota, a diverse and versatile collection of prokaryotes, flourished.

1. Introduction: When, Where and How

1.1 THE ARCHAEAN: HALF EARTH'S HISTORY

The Archaean era terminated about two and a half thousand million years before present (2.5 Ga, Figure 1). By that time the majority of the continental crust had formed, thereby differentiating tectonic processes in the Proterozoic and the Phanerozoic, which have recycled this continental crust, from those of the Archaean that formed it. The recent 2500 million years of the Earth’s history have been characterized by a plate tectonic regime. During the Archaean however, vulcanism, driven by much steeper geothermal gradients, was the predominant geological activity and, at least in the early part, impact bombardment was commonplace.

The transition from the Archaean to the Proterozoic is not as clear-cut as the mark on the time axis in Figure 1 makes it appear or, more correctly, it's the mark itself that is ambiguous since it spans a million or more years. By comparison, the Quaternary period, which encompasses the Pleistocene and the Holocene and all the history of mankind, began only 1.6 million years ago and this length of time, almost the full history of man’s evolution and civilization, is merely the thickness of a tick mark on the axis of time in Figure 1. The transition from the Archaean to the Proterozoic cannot be much better defined, as yet.

The start of the Archaean is also somewhat ambiguous. Geological history began when the Earth was formed approximately 4.6 Ga but there is no direct evidence from the earliest 700–800 million years. The oldest yet discovered rocks of the Earth, which form part of the Isua outcrop in Greenland, have been dated at 3.83 Ga. This first and mysterious period of Earth history, the Hadean, is sometimes, but not always considered as part of the Archaean.

A. Berger et al. (eds.), Climate and Geo-Sciences, 21–38.
Figure 1 Geological timescale for the Earth. The Archaean encompasses approximately half Earth's history from its origin 4600 million years ago to 2500 million years ago. Tectonic processes during the Archaean differed from the plate tectonics characterizing the post-Archaean. Fossil evidence for microbial life extends from the latter half of the Archaean and up to the present day. For comparison mastodons flourished for only 2.5 million years and Man has existed for the latter part of the Quaternary period.