The Chronology of the Geological Record

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Preface

The measurement of geological time and the construction of a geologic time-scale composed of standard stratigraphic divisions based on rock sequences and calibrated in years has long attracted the attention of geologists and has done much to provoke international co-operation. Thus the Committee for the Measurement of Geological Time, set up in December 1923 by the National Research Council of the USA almost immediately attracted the co-operation of the pioneers concerned with the dating of rocks by radioactive decay and served as a world-wide forum through to the 1950s. The first steps to establish a chronostratigraphic scale were taken much earlier at the International Geological Congress held in Bologna (Italy) in 1881 and both of these activities are now co-ordinated through the various Subcommissions of the Commission on Stratigraphy of the IUGS.

Progress in nuclear physics and the development of new tools for isotope research saw the effective birth of *isotope geology* in 1950 (Rankama 1954) and the following decade saw a major data explosion in this subject. Much of this early work was essentially geochronometric though not necessarily directed towards the establishment of a geologic time-scale. However, the possibility of improving the time-scale, at that time the virtual brain child of one man — Arthur Holmes — resulted in the holding of an interdisciplinary symposium by the Geological Society of London, and the subsequent publication in 1964 of *The Phanerozoic Time-Scale* followed by a supplement in 1971. Important aspects of these influencial publications were the inclusions of over 300 *items* or 'abstracts of published radiometric and stratigraphic data with comments' which now constitute the foundation data bank for virtually all time-scale publications.

A notable problem apparent in these pioneering works is the considerable element of uncertainty introduced by differing opinions concerning the numerical values of the decay constants, particularly for potassium-40 and rubidium-87, the two parent isotopes with the widest application in practical geochronometry. The use of the differing decay constants for the same analytical data could result in a discrepancy of about 30 Ma for Palaeozoic rocks. Fortunately the vigorous persual of this problem by a few researchers, backed by pressure from the Subcommission on Geochronology which circulated questionaires for surveys, resulted in the presentation at the International Geological Congress in Sydney, Australia, in 1976 of a 'Convention on the Use of Decay Constants in Geochronology and Cosmochronology' (Steiger & Jäger 1977) which has since been universally adopted. The effective resolution of this problem has prompted re-evaluations of the 1964 time-scale, notably by Harland, Cox, Llewellyn, Pickton, Smith, and Walters (1982) and by Odin (1982). The former work relies heavily on a data base generated by Armstrong (1978) which re-evaluated *The Phanerozoic Time-Scale* data bank eliminating nearly half of the pre-Cenozoic data but replacing them by as much and more new data. The latter work also reassesses the previous data and in addition incorporates a new data bank of 251 items with very detailed comment on, and evaluation of, their radiometric and stratigraphic significance.

The contributors to this volume have among other things attempted a further reassessment of the aforementioned data bases. Hopefully this iterative process will in time produce an accurate time-scale, but at the moment it seems more realistic to view the suggested summary/compromise time-scale as ephemeral. A particularly noticeable aspect of this volume is the combined use of ocean floor spreading and reversals of the Earth's magnetic field as secondary time keepers. It is already clear that this seconday clock will allow a very fine resolution of Cenozoic time, but it is equally clear that the clock has yet to be accurately calibrated. Consideration in this volume is also given to the problems of the Precambrian time-scale and it would seem that following the deliberations of the Subcommission on Precambrian Stratigraphy and the findings of IGCP Projects 99 and 118 (Geochronological Correlation of Precambrian Sediments and Volcanics in Stable Zones, and Upper Precambrian Correlations respectively) the geological community is on the threshold of a significant advance, albeit one that may be proceded by valuable controversy.

Although there is still room for improvement in the accuracy and resolution of the time-scale it is nevertheless sufficiently accurate to allow very useful estimates of the rates at which many geological processes proceed to be made, some of the these processes are the subject of papers in the second part of this volume.

It is inevitable that the task of drawing up a geological time-scale will remain a collaborative and co-operative effort and it is encouraging that the hope expressed in *The Phanerozoic Time-Scale* 'that this co-operative venture will continue' continues to be realized. The efforts of many of the authors to produce up to the minute reviews of their subject is particularly appreciated by the sponsors of this symposium.

This volume is based on papers presented at a symposium: Geochronology and the Geological Record, held on the 11th and 12th May 1982 in the Scientific Societies Lecture Theatre, London and sponsored by the Geological Society of London and the Subcommission on Geochronology (IUGS). The sponsors are deeply indebted to V.G. Micromass Ltd. for their generous support and to Dr Gilles Odin who generously made available prior to publication copies of the proofs of his work *Numerical Dating in Stratigraphy* for the use of contributors to this volume.

June 1984 N. J. SNELLING

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