
Preface

The stratigraphic record is the major repository of information about the geological history of Earth, a record stretching back for nearly 4 billion years. Stratigraphic studies fill out our planet's plate-tectonic history with the details of paleogeography, past climates, and the record of evolution, and stratigraphy is at the heart of the effort to find and exploit fossil-fuel resources.

The exploration of this history has been underway since James Hutton first established the basic idea of uniformitarianism toward the end of the eighteenth century, and William Smith developed the stratigraphic basis for geological mapping a few decades later. Modern stratigraphic methods are now able to provide insights into past geological events and processes on time scales with unprecedented accuracy and precision, and have added much to our understanding of global tectonic and climatic processes. But it has taken 200 years and a modern revolution to bring all the necessary developments together to create the modern, dynamic science that this book sets out to describe.

It has been a slow revolution, but stratigraphy now consists of a suite of integrated concepts and methods, several of which have considerable predictive and interpretive power. It is argued in Chap. 1 of this book that the new, integrated, dynamic science that stratigraphy has become is now inseparable from what were its component parts, including sedimentology, chronostratigraphy, and the broader aspects of basin analysis. In this chapter, the evolution of this modern science is traced from its nineteenth-century beginnings, including the contributions that such special fields as facies analysis, fluid hydraulics, plate tectonics, and the reflection-seismic surveying method have made to its evolution.

The following are just some of the major features of the stratigraphy of the early twenty-first century: Sequence stratigraphy has become the standard methodology for documentation, mapping and interpretation, replacing the old descriptive practices of lithostratigraphy; reflection-seismic methods, including the use of 3-D seismic and the application of seismic geomorphology, have become steadily more advanced tools for subsurface exploration and development; the Geological Time Scale is being standardized with the universal adoption of the system of Global Stratigraphic Sections and Points (GSSPs) and has become much more precise, with the incorporation of several new methods for evaluating deep time.

The basic field and subsurface observations on which stratigraphy is based are described in Chap. 2. Facies analysis methods are detailed in Chap. 3, and the recognition of depositional environments by facies methods is described in Chap. 4. Chapter 5 provides a succinct summary of sequence models for siliciclastic and carbonate sediments, and Chap. 6 describes modern mapping methods for use in surface and subsurface studies, including seismic methods. The synthesis of all this material is detailed in Chap. 7, which includes a discussion of the current attempts to standardize sequence-stratigraphic terminology and the Geological Time Scale.

Chapter 8, the concluding chapter of the book, focuses on the new understanding we are acquiring about the processes by which the stratigraphic record preserves elapsed geologic time. Refinements in chronostratigraphic methods are revealing the importance of breaks in the sedimentary record and the ubiquity of missing time, and are revealing an important disconnect between sedimentation rates and preservational processes operating at the present

day versus those we interpret from the rock record. This calls for a significant modification in the way that we apply the traditional principles of uniformitarianism to our reconstructions of geologic history.

The new synthesis that is the subject of this book is offered for advanced undergraduate and graduate training and for use by professionals, particularly those engaged in mapping and subsurface exploration and development.

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