The Geological Society of America
Special Paper 556

Introduction

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This special volume contains recent work and synthesis papers on the Monterey Formation, a Miocene marine unit that occurs extensively in the Coast Ranges and in the continental margins of California, USA. Analogous biosiliceous deposits are found around the Pacific Rim and elsewhere in the world. The cross-disciplinary studies included in the volume offer a composite picture of the sedimentologic, climatic, oceanographic, and tectonic conditions that promote the sedimentation of fine-grained, upwelling deposits like the Miocene Monterey Formation, their diagenetic processes, and the evolution of rock properties. The diatomaceous deposits that characterize the hemipelagic/pelagic facies of the Monterey Formation have been the subjects of classic studies, including those of Professor Robert (Bob) Garrison. Stimulated by the then-revolutionary plate tectonics theory and advances in modern oceanography, during the first half of the twentieth century, Bob and his colleagues pioneered the modern interpretation of the Monterey Formation (and of other biogenic units around the world) and first explored the oceanographic and tectonic conditions that promote deposition and preservation of large volumes of organic-rich, hemipelagic biosiliceous sediments along continental margins and phosphogenesis.

The papers presented in the first section of the volume explore the lithological, physical, and rheological properties of the sedimentary rocks of the Monterey Formation. Dunham explains how the diverse lithologies of the Monterey Formation, with contrasting textures and compositions, have evolved through burial and diagenesis to produce tectonically fractured reservoirs that have made this unit such a rich petroleum resource. Schwalbach and Bohacs use both outcrop and well log records to illustrate how sequence stratigraphy of mudstones can unveil the basin history of Monterey deposition and, more broadly, of margin-basin settings. Wirtz and Behl detail how both the composition and diagenesis of siliceous sediments control the deformation of lithologic units of both the Monterey and overlying Sisquoc Formations in the Santa Maria Basin. By looking at siliceous rocks at a much finer scale, Ross and Kovscek explore the nanometer-scale pore structure of the diagenesis of Monterey sediments of varying composition to reveal trends in sediment porosity, which is so crucial for the development of Monterey petroleum reservoirs.

The chapters in the second section of the volume cover the chronostratigraphic and paleoclimatic frameworks during the late early Miocene through latest Miocene, when the Monterey Formation deposited. Holbourn et al. provide a synthesis of the unique period of earth history between 18 and 12.7 million years ago, characterized by a transition from the warmest state of global climate of the past 25 million years to subsequent periods of polar cooling, intensified latitudinal temperature gradients, and the regime of enhanced upwelling of nutrients that led to the deposition of biologically rich, biosiliceous sediments. In his paper, Barron summarizes the diatom biostratigraphy of the Monterey Formation and overlying biosiliceous rocks in various California basins, detailing tectonic, climatic, and sea-level controls on its deposition. By combining more than 40 years of detailed biostratigraphic, lithostratigraphic, stable isotope, and paleodepth analyses, Blake presents a synthesis of more than 40 years of study of the Monterey Formation at the Naples coastal bluffs near Santa Barbara. Knott et al. provide detailed stratigraphic and compositional correlation of dated volcanic ashes both in California marine sections and in wide-ranging nonmarine sections lying to the north and east, closer to volcanic sources in southern Idaho and southern Nevada. The analysis of the pollen record of

Aiello, I.W., and Ravelo, A.C., 2022, Introduction, *in* Aiello, I.W., Barron, J.A., and Ravelo, A.C., eds., Understanding the Monterey Formation and Similar Biosiliceous Units across Space and Time: Geological Society of America Special Paper 556, p. v–vi, https://doi.org/10.1130/2022.2556(001).

coastal vegetation in California from the Naples coastal bluffs presented by Heusser et al. offers a picture of changing terrestrial climate between 18 and 6 million years ago from a warm, wet flora to an increasingly summer-dry/winter-wet vegetation (that typifies modern coastal California). Parham et al. synthesize the remarkable marine vertebrate fauna that has been recovered from the Monterey sediments of southern California, detailing the evolution of whales, seals, sea lions, and related sea mammals within the biologically productive Miocene upwelling system of California.

The last section of the volume details studies of three different aged biosiliceous sequences very similar both in terms of lithology and depositional environments to the Monterey Formation of California: the Triassic of Alaska, the Eocene of California, and the Pleistocene of the Bering Sea. Dumoulin et al. provide detailed correlation and facies analyses of the petroleum-rich Middle and Upper Triassic Shublik Formation of northern Alaska. The authors show how Shublik deposition responded to both changing climatic and tectonic conditions. The lithostratigraphic and chemostratigraphic framework of the Eocene Kreyenhagen Formation of central California presented by Giannetta and Behl offers a picture of unprecedented detail of sea-level and climate history of the middle Eocene California margin. Finally, Drake et al. correlate gamma-ray attenuation porosity logs of deep-sea cores of biosiliceous sediments from the Bering Sea to changes in diatom valve abundance and preservation in response to Pleistocene paleoceanographic cycles.