L. DON LEET
SHELDON JUDSON
MARVIN E. KAUFFMAN

PHYSICAL GEOLOGY

FIFTH EDITION

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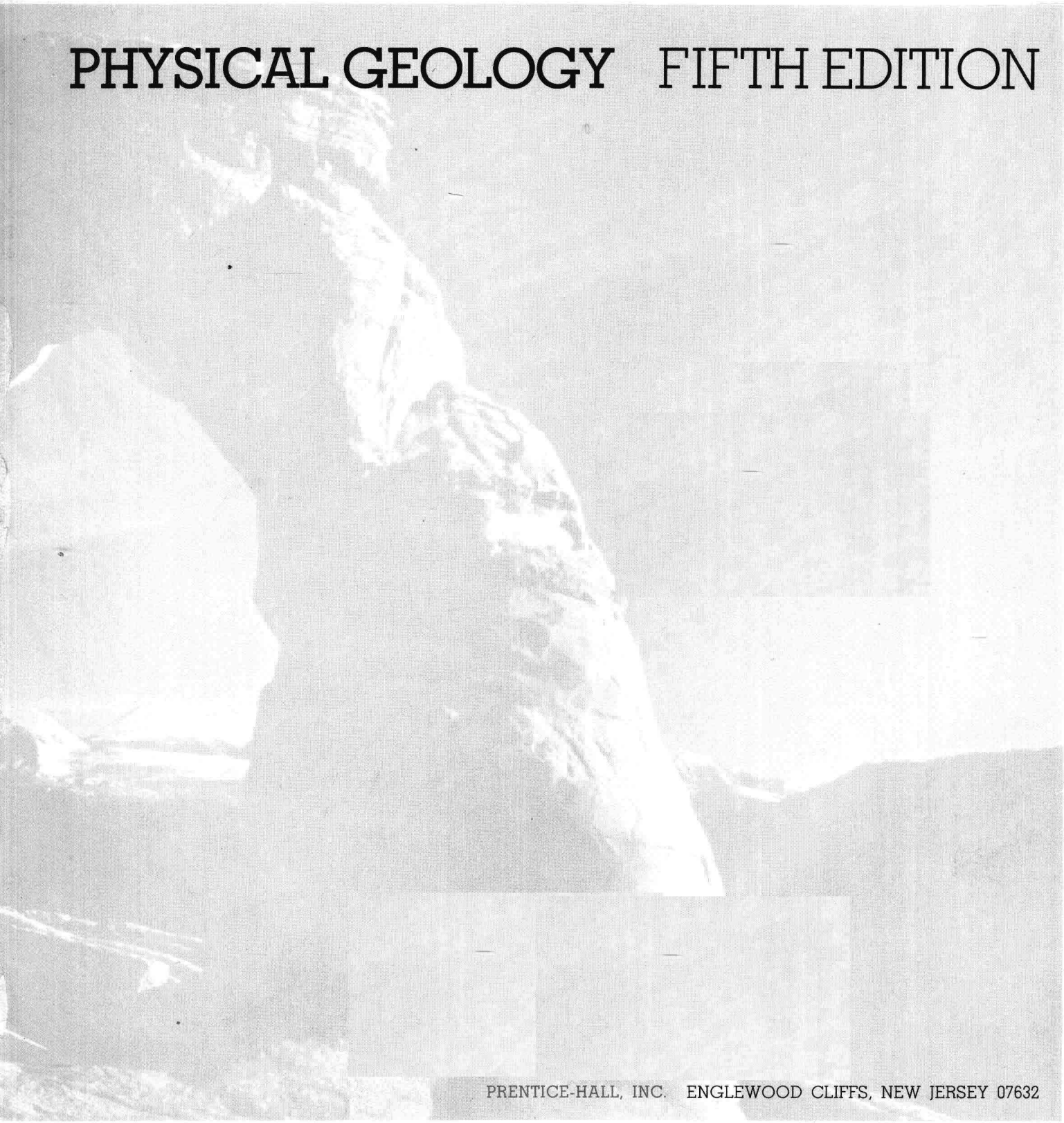

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PHYSICAL GEOLOGY, FIFTH EDITION, has been film-composed in different styles of Cairo, a version of various so-called antique, or "Egyptian," typefaces introduced into Great Britain during the first quarter of the nineteenth century.

David R. Esner was responsible for production, with the assistance of Mary Helen Fitzgerald; design and layout are by Betty Binns Graphics; Betty Binns and David R. Esner art-directed; and the line illustrations were executed by Vantage Art, Inc.

The cover photograph is by David Muench: Differential erosion has produced this spectacular formation in Arches National Park, Utah. The La Sal mountains are in the background.

PREFACE

Since *Physical Geology* first appeared 24 years ago, knowledge of the earth and its near neighbors has expanded in spectacular fashion; moreover, the remarkable contemporary discoveries in the earth sciences are more than ever perceived to be founded on data, principles, and techniques studied over a long time. It is proper, then, that this fifth edition, like its predecessors (particularly the third edition), attempts to integrate new knowledge with traditional knowledge in a balanced and concise synthesis, carefully clarified for those students who will not make geology their life's work. We have once again paid special attention to users' comments and introduced a number of changes that we hope will make *Physical Geology* even more efficient and attractive than its four previous versions.

Chapter 1 sketches out the grand themes of geological understanding, themes that will be expanded upon and illuminated by other information throughout the textbook: time, the cycling of rock materials, and the powerful theories that explain how ocean basins are born, how they grow, and how they disappear—that is, the process of sea-floor spreading and the demonstration that continents drift and move as elements of the large plates composing the earth's crust. And in Chapter 8 we discuss how the earth's magnetic field has reversed itself many times in the past—a discovery that not only helped establish the reality of continental drift but also allowed us to measure its rate and to establish a new way of telling geologic time.

Research of the last 15 years has contributed to an explanation of why most volcanoes and earthquakes occur where they do, and Chapters 3 and 6 indicate that we are closer than ever before to understanding how these major earth forces work: There is now real hope, for instance, that before long we shall be able to predict earthquakes with some certainty.

This edition, especially in Chapters 14 to 16, deals extensively with the current issues of sources and utilization of energy; and we discuss how people can modify the natural processes of earth and atmosphere to affect the physical and biological environment, often to human disadvantage.

And in a new Chapter 17 we have briefly surveyed the exploration of near neighbors in our planetary system.

The foregoing innovations and consolidations of related material do not mean, however, that the standard geological fare has been neglected: The highly accepted treatment in former editions of such topics as atoms and minerals (now Chapter 2), weathering and

sedimentary rocks (Chapter 4), deformation (Chapter 7), and glaciation (Chapter 12) has been continued in this edition, sometimes expanded where necessary to accommodate findings, sometimes combined to throw into higher relief the unity of geology.

Finally we call attention to a new and contemporary format, enabling the book to be kept to around 500 pages, to completely redrawn illustrations in a crisper and less sophisticated style than that of the fourth edition, and to clear black-and-white photographs. We hope that these devices will encourage students in their acquisition of geological knowledge.

We are indebted to the many persons who have helped with previous editions, an assistance that has proved invaluable in the preparation of this edition. In addition helpful comments and reviews of the manuscript were received from several colleagues, whom we wish to thank: George T. Farmer, Jr., Madison College, Harrisonburg, Virginia; William R. Farrand, University of Michigan, Ann Arbor; Martin H. Link, Los Angeles Harbor College, Wilmington, California; John F. Shroder, Jr., University of Nebraska, Omaha; John Stolar, Cheyney State College, Cheyney, Pennsylvania; and Charles P. Walters, Kansas State University, Manhattan.

The staff at Prentice-Hall has continued to provide professional competence, amicable support, and a great deal of patience; we particularly thank David R. Esner and Logan M. Campbell. Sheldon Judson has had editorial assistance from Joan Wyckoff, for which he is grateful. Marvin Kauffman has enjoyed comfort and assistance from family and friends; and he recognizes this aid with love and gratitude.

We owe a large debt to L. Don Leet, an active author of the first four editions of this book. His untimely death occurred before work on this edition had begun. But we gladly acknowledge that we have relied heavily on his earlier contributions.

SHELDON JUDSON
MARVIN E. KAUFFMAN

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