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Great Plains Geology

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To my parents, who supported my undergraduate training, to Jacob Freedman of Franklin and Marshall College, who inspired me to further my education, to J. A. Fagerstrom, who nurtured me through graduate work, and especially to my wife, Anne, who has always been ready to accompany me on our adventures and to improve my manuscripts about my research and travels.

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PREFACE

This book offers my personal view of the geology of the Great Plains. It is intended for ecotourists, anyone with a broad interest in geology and some general education in science, professional geologists and geographers wanting to become more familiar with the region, and students, farmers, ranchers, and K-12 educators who want to know about the Great Plains and its geological development. Any errors of interpretation or fact in this book are solely my own.

The book is arranged in three chapters. The first two discuss the region's boundaries and provide a brief geologic history to explain how the Great Plains came to be in its present form. The third chapter describes 57 outstanding geologic sites from Alberta and Saskatchewan, Canada, to southern Texas. Features at these sites illustrate various aspects of the geology of the Great Plains. Most of the photographs of these sites are my own.

Figure 1, the geologic time scale and rock column, follows the acknowledgments, not because you need to refer to it now, but for you to note it for later. You will find it helpful throughout this book. Use this figure to see the chronological relationships among the geological time spans and the rock units deposited in those time spans. The names of these time spans and rock units appear frequently in the book. Use this figure also to identify the occurrence of important events that

affected the Earth's development, such as mass extinctions, glaciations and meteor impacts.

I have included three appendices for background: the first on the boundaries and subdivisions of the Great Plains; the second an overview of the development of key geologic concepts; and the third a list of cautions regarding travel in the Great Plains. These are followed by a glossary of the geologic terms used in the text, a list of references, and an index.

For easier reading, I have eliminated the accepted scientific style of citing references in the text in favor of a simplified style of citing the name of the principal author of a work on some of the topics I am discussing. Please refer to that name in the references section at the end of the book to find the appropriate source.

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I am indebted to Richard C. (Rick) Edwards, director of the Center for Great Plains Studies at the University of Nebraska, for providing me with office space, hardware, and supplies during my research and writing. Financial support for travel and associated activities came from the University of Nebraska–Lincoln Emeriti Association and the Conservation and Survey Division of the School of Natural Resources, University of Nebraska–Lincoln. Ms. Dee Ebbeka drafted several of the figures.

To my colleagues and friends who tramped with me and talked with me about the geology of the Great Plains over the years—Mike Voorhies, Bob Hunt, Jim Swinehart, George Corner, Larry Agenbroad, Cinda Temperly, Gerry Schultz, Tex Reeves, Tom Gustavson, Dale Winkler, Jason (Jay) Lillegraven, and others—I express my gratitude for all of their help.

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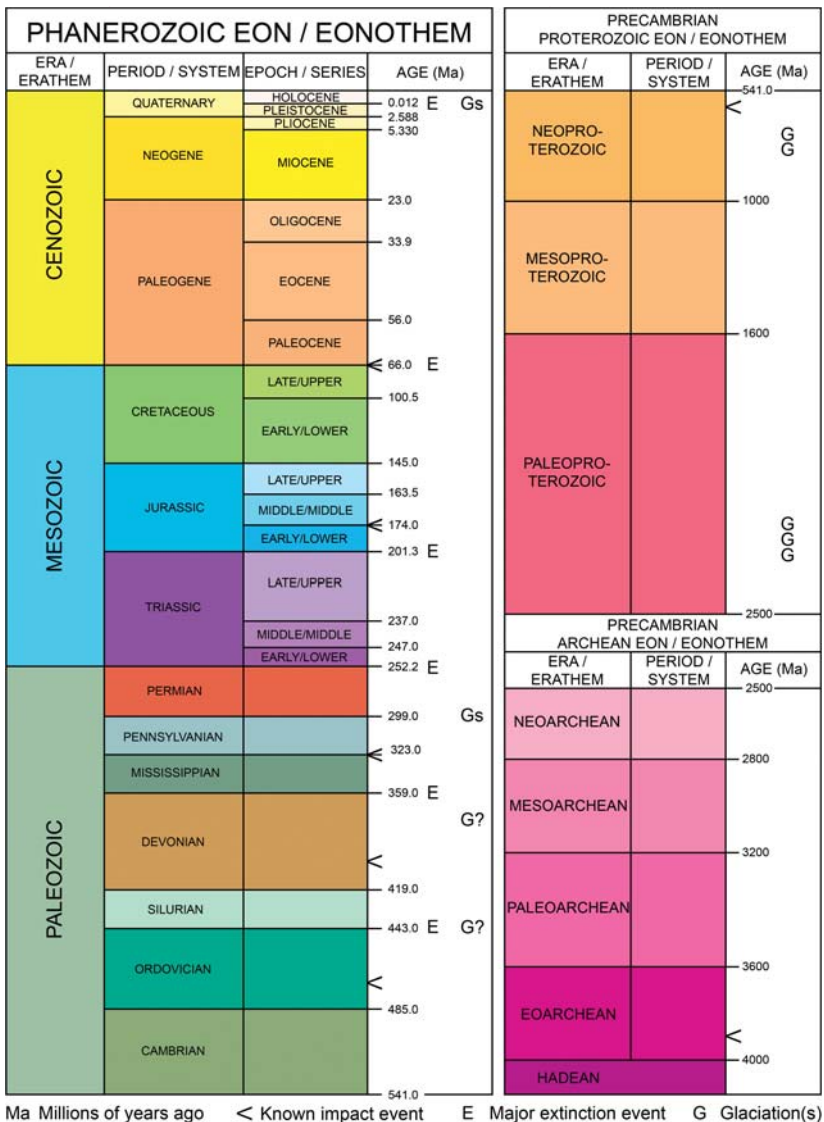


Fig. 1. Geologic time scale and rock column. U.S. Geological Survey.

INTRODUCTION

Like art and beauty, what constitutes the Great Plains lies in the eye of the beholder. For people who have never traveled in the American heartland, the name may conjure up images of cowboys, Indians, buffalo, prairie dogs, grasshopper swarms, cattle drives, heat, wind, dust, blizzards, tornadoes, floods, and very flat land. For those who live in the central parts of the lower 48 states, it can be some or all of these things. After hearing a college student of mine from the inner city of Chicago define a prairie as a vacant city lot, I came to better understand that our views are shaped by our experiences and differ from one another's perceptions, often in major ways. "I know what the Great Plains region is, and this place is clearly not part of it!" one person would say and another would differ completely.

Captain William Clark thought that he saw where the plains began on the west bank as he traveled up the Missouri River near the present-day border of Kansas and Nebraska on July 10, 1804. Others have seen the beginning of the Great Plains in places to the east or to the west of that place (fig. 2).

John Wesley Powell, ethnographer, writer, explorer of the American West and second director of the U.S. Geological Survey, was, so far as I know, the first person to describe and to draw a map showing the boundaries of the major physiographic regions of the lower 48 states, including the Great Plains (fig. 3). Powell also recognized that the Great Plains

extended northward into Canada and southward into the Republic of Mexico. Later published works have varied on the size and boundaries of the Great Plains, but Powell was probably the first scholar to give the region that written name and a description. And that name has stuck both in literature and in the popular imagination.

For me, the Great Plains is a land of wide-open spaces with few trees except along watercourses or on local uplifts like the Black Hills. It is a land of big, wild, and scenic rivers, sadly now controlled to a greater or lesser extent by dams and water diversions. It is a land usually short of water, yet it includes one of the major aquifers (variously called the High Plains, Ogallala, or High Plains/Ogallala; hereafter the High Plains aquifer) in the United States. The Great Plains can look markedly different at any one place, depending on the time of day and the quality of the light; there is a mirage-like quality to the country. Plain or otherwise, it is a beautiful place, often of few people and much livestock. I love the region.

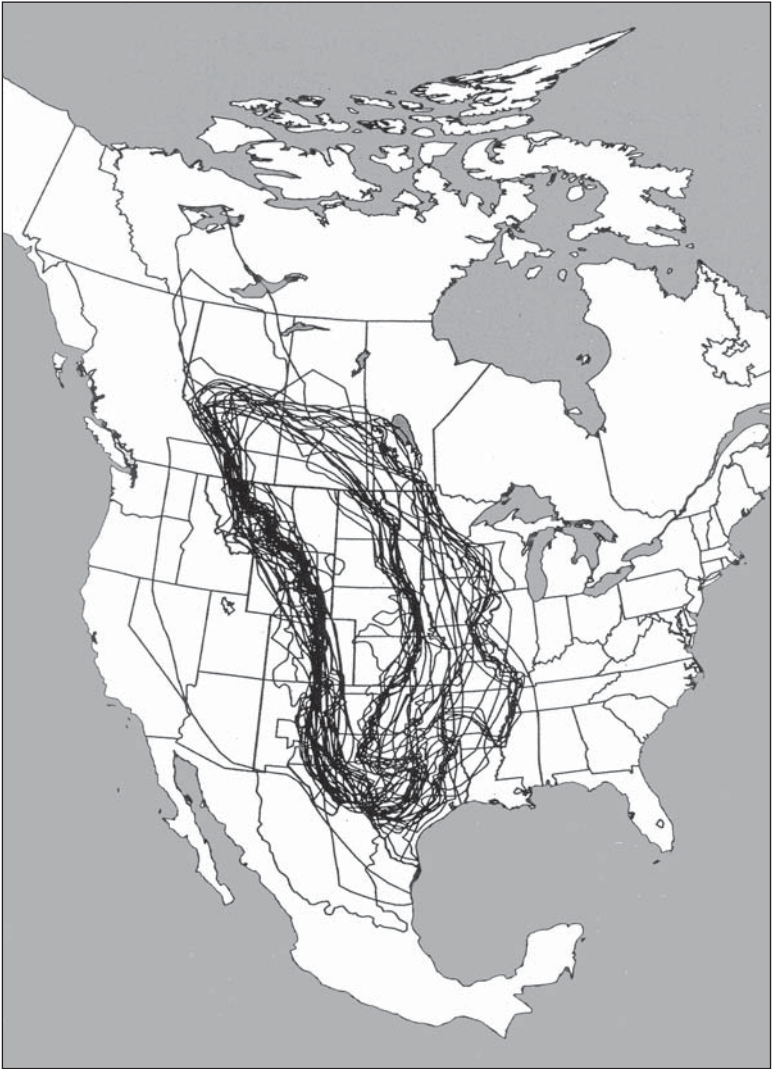


Fig. 2. Fifty published versions of the Great Plains regional boundary. Copyright 2000. Reproduced from figure 1, p. 546, of "Where Are the Great Plains? A Cartographic Analysis," *Professional Geographer* 52, no. 3, by Sonja Rossum and Stephen Lavin. Reproduced by permission of Taylor & Francis Group, LLC (<http://www.tandfonline.com>).

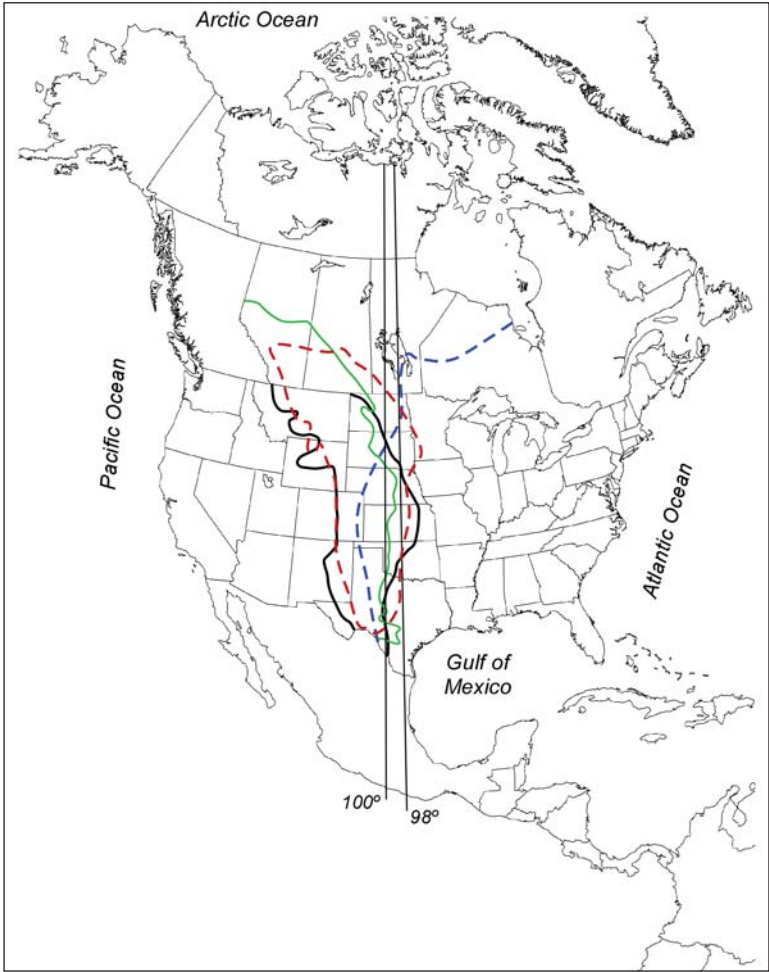


Fig. 3. J. W. Powell's boundaries for the Great Plains in the United States and some of the other possible choices proposed for the eastern boundary. The green line is the approximate 2,000-ft. contour; the blue dashed line is the approximate 20-in. precipitation line; the red line is the approximate area of alkaline and transitional soils. Solid black lines are Powell's eastern and western boundaries of the Great Plains. From Powell, "Physiographic Regions," 98–99.