

Guidelines for Analysis and Description of Soil and Regolith Thin Sections

To my wife Marthe for her patience during the many **hours**, days, weeks of writing, and for her continuous moral support. As a souvenir to the many "holidays" in the **mountains** and seaside during which piece by piece, year **by year**, most of these notes were prepared.

Guidelines for Analysis and Description of Soil and Regolith Thin Sections

by

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partially based upon

Handbook for Soil Thin Section Description

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FOREWORD

Having picked up this book and chosen to read this foreword, you already know that micromorphology is an indispensable method for the study of undisturbed soil and regolith samples using a microscope. *Guidelines for Analysis and Descriptions of Soil and Regolith Thin Sections* is a new version of a guide to thin sections published under the auspices of the International Society of Soil Sciences in 1985. The earlier edition has been out of print for a decade; thus, the time is right for a revised version. The applications of micromorphology have expanded since the original publication and the tools for viewing and interpreting thin sections have evolved and improved since the earlier publication. This book provides a system of analysis and description of soil and regolith materials as seen in thin sections and will be useful to scientists and students from a wide array of disciplines, from archaeology to pedology. The author is one of the world's premier practitioners of the technique and a recognized authority on interpretation of thin sections.

A unique lexicon has developed for the study of soil and other earthy samples using micromorphology. This book organizes and reviews the language so that communication among scientists using the technique will be facilitated. From the chapter that introduces definitions of micromorphology and reviews the history of the technique through to the detailed keys, the users of this book will find a ready guide to interpreting thin sections. The definitions and examples are well illustrated with drawings and an accompanying CD with hundreds of thin section images. Chapters are replete with references that enable further study of the evolution of the techniques and descriptions that are described. Everyone from the "new recruit" to seasoned veteran of thin section interpretation will find this book to be an informative and useful addition to her/his personal and laboratory library.

This publication of the Soil Science Society of America is another example of service to our membership. I hope you enjoy this book and find it useful in your research and study of soils and other earth materials.

MICHAEL J. SINGER
President
Soil Science Society of America

PREFACE

Micromorphology is the study of soil and related materials in their undisturbed state at the microscopic level. It applies a system of concepts and terminology to describe, measure, and interpret the formation and function of soil materials. While the concepts and terminology were developed for microscopic examination, they can be applied at a variety of magnifications and some can be used with the naked eye. These tools have been applied to studies on soil genesis, soil physics, mineralogy, and soil microbiology, to name a few.

The first textbook devoted to micromorphology, *Micropedology* by W.L. Kubiena (1938), is generally credited with establishing the field of soil micromorphology. Although Kubiena was an Austrian pedologist, the book was based on lectures he gave at Iowa State University in the United States. In *Micropedology* Kubiena argued that in order to understand how soils form and function, one had to examine undisturbed pieces of soil to see how the soil was constructed. Chemical and physical analyses were useful to define basic soil components, but these analyses did not show how the soil “worked”. He used various analogies to express this idea. One of these was to liken the soil to a watch (Kubiena, 1964, 1970):

We are able to investigate a watch in very different ways. We can put it into a mortar and pound it to a very fine powder. The chemical analysis of this powder gives us complete information on the nature and quantity of elements used for the construction of the whole.... Of course this analysis cannot tell us anything about the existence of the numerous small driving wheels and checking wheels,...springs, screws, levers, small metal wires, bridge elements, etc. of which the works are composed. For this purpose a mechanical analysis would be necessary which would sort all these isolated components and investigate them either in groups or individually. It is easy to understand that by this mechanical analysis it will not be possible to conclude from the nature of these components the function of each or the function of the whole, or to establish a hypothesis describing the connection of the individual elements in the whole. A third mode of analysis of such a watch would be to investigate its works without destruction, endeavor to examine every part in its place and determine the nature of their connection.

Only by this latter way can we understand how the watch works.

Micromorphology has been used mostly by specialists in the field, in part, because its terminology can be confusing. Several books have been written outlining different descriptive systems, but all offered different terms for similar features, and most of these books are out of print (Brewer, 1964; Bullock et al., 1985; Fitz-Patrick, 1984, 1993; Kubiena 1938, 1964, 1970). One of the latest and most comprehensive, *The Handbook for Soil Thin Section Description*, was published in Europe by a group who were experts in various fields field (Bullock et al., 1985). The book was widely used around the world but since approximately 1990 only photocopies of the work were being distributed. In Russia, the last copy in one laboratory was kept in a safe when not in use. The original publisher was small and went out of business. so later editions could not going to be produced. Other publishers

shied away from reprinting the book because it contained many color photographs, which were expensive to print, and the market for such a specialized text was small.

The Soil Science Society of America's Micromorphology Committee stepped into the situation and asked the Society to consider reprinting the 1985 text. During the discussions, one of the authors of the original text offered to rewrite and update the book and make it available to SSSA for publication. This book is the result of that effort. It is hoped that with SSSA's backing, this text and its system of description will be available for many years to come.

The author, Dr. Georges Stoops of the University of Ghent, has been teaching micromorphology for more than 30 years. He is one of the foremost experts in the field and, in my opinion, one of the finest teachers on the subject. We are fortunate that he has agreed to this undertaking.

This book could not have been published without the generous financial support of the Soil Survey Division of the USDA-Natural Resources Conservation Service. Its director at the time, Horace Smith, graciously agreed to contribute to this project. I want to again thank and recognize the Soil Survey Division for this critical financial contribution.

MIKE VEPRASKAS
Editor
Raleigh, North Carolina

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I also want to acknowledge the contributions of numerous students to whom I have taught micromorphology over the last 30 years, at the International Training Centre for Post-Graduate Soil Scientists, University of Gent, or as a visiting professor in Europe and overseas. Their remarks and questions helped me to rephrase, reshape and complete definitions, subdivisions and comments. Looking to the *Handbook for Soil Thin Section Description* with the eyes of the student was very instructive, although, as a co-author, not always a very satisfactory experience.

Many individuals have contributed to the final result of this book. Mentioning every contribution would be impossible. Among those that sent in the past opinions on the *Handbook* I want to acknowledge especially Dr. H. Morras (INTA, Argentina) for his detailed and well-considered comments. Several colleagues improved the manuscript of the “Key to the ISSS Handbook for Soil Thin Section Description”, which forms an essential part of this manual, determining the way in which several concepts were modified and interrelated. Among them I want to acknowledge the contributions of Dr. J. Arocena (UBC, Canada) and Dr. A. Ringrose-Voase (CSIRO, Australia). A great help to me were the comments of Dr. L. Drees (Texas A&M University, USA) on the first manuscript of this book, both with respect to the content and the redaction. Thanks go also to the members of the Editorial Committee who reviewed the manuscript. I really appreciate their comments and corrections. Following scientists were involved: Prof. A. Busacca (Washington State University), Dr. L. Drees (Texas A&M University), Prof. Dr. P. Goldberg (Boston University), Prof. Dr. R.W. Griffin (Prairie View A & M University, Texas), Dr. A. Jongmans (Wageningen Agricultural University, The Netherlands), Prof. Dr. D.L. Lindbo (North Carolina State University), Dr. W.D. Nettleton (USDA), Dr. F.E.

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GEORGES STOOPS