1 Introduction

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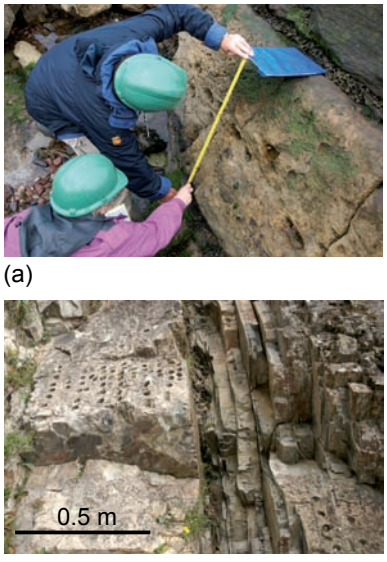
The main aim of field geology is to observe and collect data from rocks and/or unconsolidated deposits, which will further our understanding of the physical, chemical and biological processes that have occurred over geological time. Many of the basic observational principles used in field geology have not changed for hundreds of years, although the interpretation of the data, the scale of resolution and some of the equipment has advanced greatly. Fieldwork involves making careful observations and measurements in the field (Figure 1.1a) and the collection and precise recording of the position of samples for laboratory analysis (Figure 1.1b). The very act of collecting field data often raises questions about processes on Earth, which had perhaps not previously been envisaged. Furthermore, during fieldwork it is usual to initiate, or to build on, constructing and testing different hypotheses and interpretations based on the observations; this iterative process will help to determine the essential data and samples to collect.

This book is divided into 14 chapters. Chapter 2 covers the most commonly used field equipment and outlines field safety procedures. Chapter 3 explores the general objectives of fieldwork and how to make a start. Chapter 4 is devoted to the production of a field notebook (hard copy or electronic), as this is the key record of geological field data. The bulk of the book comprises five chapters covering the necessary skills for the collection of palaeontological (Chapter 5), sedimentological (Chapter 6), igneous (Chapter 7), structural (Chapter 8) and metamorphic data (Chapter 9). Chapter 10 uses the field techniques covered in the previous five chapters to introduce geological mapping, where it is usually necessary to deal with a range of rock types and different kinds of exposure*. The book concludes with short chapters on recording numerical and geophysical data (Chapter 11), photography (Chapter 12) and sampling (Chapter 13).

*The term exposure is used to indicate areas where rocks are visible at the Earth's surface. This is in contrast to the term outcrop which also encompasses those areas where the rock is at the Earth's surface but is covered by superficial deposits and soil.



(a)

(b)

Figure 1.1 (a) Geologists collecting data for a graphic log (Section 6.3) to record how a sedimentary succession has changed through time and to decipher the overall depositional environment. By working together they can share tasks and discuss their observations. (b) The recessed bed marks the Cretaceous–Paleogene boundary at Woodside Creek, near Kekerengu, New Zealand. Note the holes where samples have been extracted for palaeomagnetism studies. In this case the number of holes is rather excessive and breaks the code of good practice (Section 2.12 and Chapter 13). (a and b: Angela L. Coe, The Open University, UK.)

Geological Field Techniques, 1st edition. Edited by Angela L. Coe. © 2010 by The Open University.

Field geology presents four main intellectual challenges. These are:

1. Deciding what data to collect in order to address the scientific question(s).
2. Finding the most suitable exposures from which to collect the data.
3. Making a good record of the data collected; preferably a record that can be understood by others and can be used years after the data were collected.
4. Understanding and interpreting the basic observations that you make.

This book deals with challenges 1, 2 and 3. Challenge 4, interpreting the observations, is to a large extent a matter of experience and having a good theoretical understanding of geology and geological processes. There are many general geological and Earth science textbooks on the market, a selection of which are included in the further reading lists at the end of each chapter. Deciding what data to collect relates directly to the objective of the fieldwork (Chapter 3). Some typical overall objectives are: constructing the geological history of a region (Chapter 10), collecting data on a period of climate change (Chapter 6), gathering evidence for a mass extinction event (Chapter 5), understanding a phase of igneous activity (Chapter 7) or mountain building (Chapters 8 and 9), together with finding and evaluating mineral or water resources and understanding natural hazards (e.g. landslides, earthquakes and floods; Chapters 6 and 8). Within each of these major objectives the fieldwork should be broken down into achievable daily tasks. Locating the most suitable exposures is crucial if the objective of the fieldwork is anything other than detailed mapping where ideally all exposures need to be examined. The different types of exposure are dealt with in Chapters 3 and 10, and more specific examples are given in Chapters 5–9. Throughout the book, but particularly in Chapter 4, we have provided ideas and examples for constructing effective field notebooks. We have also added practical tips in the margin, and flowcharts for deductive thinking processes and tasks. In Chapters 5–10 we have used worked examples to demonstrate both the method of reasoning and the way in which particular problems have been tackled.

1.1 A selection of general books and reference material on geology

Allerby, M. 2008. *A Dictionary of Earth Sciences*, Oxford University Press, 672 pp.

Bishop, A., Woolley, A. and Hamilton, W. 1999. *Minerals, Rocks and Fossils*, Cambridge University Press, 336 pp. [Small book with colour photos and brief, reliable descriptions of minerals, rocks and fossils.]

Cockell, C., Corfield, R., Edwards, N. E. and Harris, N. B. W. 2008. *An Introduction to the Earth-Life System*, Cambridge University Press and The Open University, 328 pp. [Full colour book covering Earth system science at the Earth's surface with particular reference to life systems.]

Grotzinger, J., Jordan, T. H., Press, F. and Siever, R. 2006. *Understanding Earth* (5th edition) W. H. Freeman & Co., 670 pp. [An outstanding, clearly written, widely used introduction to Earth sciences with many colour illustrations providing a global perspective.]

Keary, P. 2005. *Penguin Dictionary of Geology*, Penguin, 336 pp.

Murck, B. W. 2001. *Geology: A Self-teaching Guide*, John Wiley & Sons, 336 pp.

Rogers, N. W., Blake, S., Burton, K., Widdowson, M., Parkinson, I. and Harris N. B. W. 2008. *An Introduction to Our Dynamic Planet*, Cambridge University Press and The Open University, 398 pp. [Full colour book covering the solid Earth aspects of Earth system science, including planetary formation, the Earth's structure, plate tectonics and volcanology.]

Rothery, D. A. 2010. *Teach Yourself Geology* (4th edition), Hodder and Stoughton, 288 pp. [Covers all of the basics and is useful as either a primer or a refresher.]

Stanley, S. 2005. *Earth System History*, W. H. Freeman & Co., 567 pp. [Accessible look at the Earth as a system. Extensively illustrated in full colour.]

1.2 Books on geological field techniques

Compton, R. A. 1985. *Geology in the Field*, John Wiley & Sons, 398 pp. [Comprehensive but dense black and white book on basic geology and field techniques. Replacement of Compton's *Manual of Field Geology* (1962).]

Freeman, T. 1999. *Procedures in Field Geology*, Blackwell Science, 93 pp. [Pocket sized, black and white book covering mainly mapping techniques, with particular emphasis on compass-clinometer and trigonometric solutions for recording the geometry of geological features.]

Maley, T. S. 2005. *Field Geology Illustrated*, Mineral Land Publications, 704 pp. [Book illustrating geological features and terms through hundreds of clear black and white photographs and line drawings.]

See also: Barnes and Lisle 2003 (Section 10.7); Fry 1991 (Section 9.5); McClay 1991 (Section 8.4); Stow 2005, Tucker 2003 (Section 6.6); and Thorpe and Brown 1991 (Section 7.5).