Essentials of GEOLOGY

JUDITH ROSALES

Delve Publishing

Essentials of Geology

Geology means, literally, the study of the earth, the materials of which it is made, the structure of those materials, and the processes acting upon them. It includes the study of organisms that have inhabited our planet. An important part of geology is the study of how Earth's materials, structures, processes and organisms have changed over time. Geologists work to understand the history of our planet. The better they can understand Earth's history the better they can foresee how events and processes of the past might influence the future. Geology is also about understanding the evolution of life on Earth; about discovering resources such as metals and energy; about recognizing and minimizing the environmental implications of our use of those resources; and about learning how to mitigate the hazards related to earthquakes, volcanic eruptions, and slope failures. All of these aspects of geology, and many more, are covered in this textbook. Geology gives insight into the history of the Earth by providing the primary evidence for plate tectonics, the evolutionary history of life, and past climates. Geology is important for mineral and hydrocarbon exploration and exploitation, evaluating water resources, understanding of natural hazards, the remediation of environmental problems, and for providing insights into past climate change. The majority of geological data comes from research on solid Earth materials. These typically fall into one of two categories: rock and unconsolidated material. Seismologists can use the arrival times of seismic waves in reverse to image the interior of the Earth. Early advances in this field showed the existence of a liquid outer and a dense solid inner core. Methods for relative dating were developed when geology first emerged as a formal science. Geologists still use the following principles today as a means to provide information about geologic history and the timing of geologic events. Geology also plays a role in geotechnical engineering and is a major academic discipline.

Prof. Judith is an Ecologist and Environmental Specialist with more than 30 years of academic and consulting experience. She holds a PhD in geography from the University of Birmingham UK and wrote the PhD and Master Academic Programs of Environmental Sciences for the Universidad de Guayana, Venezuela.

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About the Editor

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List of Abbreviations

CCS	Carbon capture and storage
CO	Carbon monoxide
CAMP	Central Atlantic Magmatic Province
CTL	Coal to Liquid
CWS	Coal-water slurry fuel
IGCC	Impurities from the coal, gasification
ICE	Intercontinental Exchange
IOCG	Iron oxide copper gold
LAPs	Large andesitic provinces
LBRPs	Large basaltic–rhyolitic provinces
LGP	Large granitic provinces
LIP	Large igneous province
LPP	Large plutonic provinces
LRPs	Large rhyolitic provinces
LVP	Large volcanic provinces
GIS	Geographic Information System
GPS	Global Positioning System
GPR	Ground penetrating radar
NRM	Natural remanent magnetization
PGE	Platinum-Group Element
SDRS	Seaward-dipping reflector sequences
UHP	Ultra-High-Pressure
TNOs	Trans-Neptunian objects
STD	Submarine tailings disposal

Preface

Geology means, literally, the study of the earth, the materials of which it is made, the structure of those materials, and the processes acting upon them. It includes the study of organisms that have inhabited our planet. An important part of geology is the study of how Earth's materials, structures, processes and organisms have changed over time. Geologists work to understand the history of our planet. The better they can understand Earth's history the better they can foresee how events and processes of the past might influence the future. Geology is also about understanding the evolution of life on Earth; about discovering resources such as metals and energy; about recognizing and minimizing the environmental implications of our use of those resources; and about learning how to mitigate the hazards related to earthquakes, volcanic eruptions, and slope failures. All of these aspects of geology, and many more, are covered in this textbook. Geology gives insight into the history of the Earth by providing the primary evidence for plate tectonics, the evolutionary history of life, and past climates. Geology is important for mineral and hydrocarbon exploration and exploitation, evaluating water resources, understanding of natural hazards, the remediation of environmental problems, and for providing insights into past climate change. The majority of geological data comes from research on solid Earth materials. These typically fall into one of two categories: rock and unconsolidated material. Seismologists can use the arrival times of seismic waves in reverse to image the interior of the Earth. Early advances in this field showed the existence of a liquid outer and a dense solid inner core. Methods for relative dating were developed when geology first emerged as a formal science. Geologists still use the following principles today as a means to provide information about geologic history and the timing of geologic events. Geology also plays a role in geotechnical engineering and is a major academic discipline.

Content Coverage

Chapters One and *Two* focus on geology fundamentals and history of the geology, respectively. The history of geology is concerned with the development of the natural science of geology.

Chapters Three and Four are about principles of geology and geologic province, separately. A province may include a single dominant structural element such as a basin or a fold belt, or a number of contiguous related elements.

Chapter Five provides the theory of plate tectonics which deals with the dynamics of earth's outer shell, the lithosphere that revolutionized Earth sciences by providing a uniform context for understanding mountain-building processes, volcanoes, and earthquakes, as well as understanding the evolution of Earth's surface and reconstructing its past continental and oceanic configurations.

Chapters Six and *Seven* present information about structural geology and planetary geology, separately. Structural geology focuses on the study of geological structures, with the goal of learning how, when, and why they formed, whereas planetary geology is concerned with the geology of the celestial bodies such as the planets and their moons, asteroids, comets, and meteorites

Chapters Eight and *Nine* present information about engineering geology and economic geology, seperately. Engineering geology is concerned with how the geological factors regarding the location, design, construction, operation and maintenance of engineering works are recognized and accounted for, whereas Economic geology deals with metal ores, fossil fuels, and other materials of commercial value, such as salt, gypsum, and building stone.

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