World Geomorphological Landscapes

Mauro Soldati
Mauro Marchetti *Editors*

Landscapes and Landforms of Italy

Springer

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Editors

Landscapes and Landforms of Italy

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Series Editors' Preface

Landforms and landscapes vary enormously across the Earth, from high mountains to endless plains. At a smaller scale, Nature often surprises us creating shapes which look improbable. Many physical landscapes are so immensely beautiful that they received the highest possible recognition—they hold the status of World Heritage properties. Apart from often being immensely scenic, landscapes tell stories which not uncommonly can be traced back in time for tens of million years and include unique events. In addition, many landscapes owe their appearance and harmony not solely to the natural forces. Since centuries, or even millennia, they have been shaped by humans who modified hillslopes, river courses, and coastlines, and erected structures which often blend with the natural landforms to form inseparable entities.

These landscapes are studied by Geomorphology—'the Science of Scenery'—a part of Earth Sciences that focuses on landforms, their assemblages, surface and subsurface processes that moulded them in the past and that change them today. Shapes of landforms and regularities of their spatial distribution, their origin, evolution, and ages are the subject of research. Geomorphology is also a science of considerable practical importance since many geomorphic processes occur so suddenly and unexpectedly, and with such a force that they pose significant hazards to human populations and not uncommonly result in considerable damage or even casualties.

To show the importance of geomorphology in understanding the landscape, and to present the beauty and diversity of the geomorphological sceneries across the world, we have launched a new book series *World Geomorphological Landscapes*. It aims to be a scientific library of monographs that present and explain physical landscapes, focusing on both representative and uniquely spectacular examples. Each book will contain details on geomorphology of a particular country or a geographically coherent region. This volume presents geomorphology of Italy—a country with highly diverse landscapes, from lowlands crossed by big rivers to active volcanoes and very high mountains. It is also very dynamic geomorphology, continuously shaped by earthquakes, eruptions, landslides, floods and vigorous erosion in clayey materials producing spectacular badlands. Each of these aspects of Italian geomorphology has received its due coverage. More than thirty selected examples from mainland Italy and its islands are presented, along with fascinating stories behind the marvellous sceneries, including long-term interactions between physical landscapes and people. Thus, the book is not only suitable for scientists and students of Geography and Earth Science, but can also provide guidance to holidaymaking geoscientists as to where to go to enjoy the very best scenery.

The World Geomorphological Landscapes series is produced under the scientific patronage of the International Association of Geomorphologists—a society that brings together geomorphologists from all around the world. The IAG was established in 1989 and is an independent scientific association affiliated with the International Geographical Union and the International Union of Geological Sciences. Among its main aims are to promote geomorphology and to foster dissemination of geomorphological knowledge. I believe that this lavishly illustrated series, which sticks to the scientific rigour, is the most appropriate means to

fulfil these aims and to serve the geoscientific community. To this end, my great thanks go to Profs. Mauro Soldati and Mauro Marchetti for coordinating the efforts of Italian geomorphological community and expertly editing the book, as well as to all individual contributors who worked together to show us the Italian landscape at its best.

Piotr Migoń

Foreword

The great variety of landscapes makes Italy a very significant country from the geomorphological point of view. The geological history has given fundamental imprint to the morphology of the country, building two large chains, the Alps and the Apennines, still evolving. To the north, the Po Valley, between these chains, completes the continental portion of the territory. The Italian peninsular area has its main framework in the Apennine ridge that, starting from the mainland, wedges powerfully into the Mediterranean and launches poetically its string of islands as a safe harbour to the Mediterranean populations. The peninsular Italy, together with the main islands reaches to the south latitudes comparable to those of the northern coast of the African continent. This large latitudinal extension, from north to south, makes Italy a country with extreme climate and, consequently, landscape variability. Climate variability and tectonic events are the foundation of current and past geomorphological evolution. During the Pleistocene the latter created most of the landforms currently observed at different scales and that mainly derive from glacial, fluvial, coastal, volcanic, karst, gravitational and aeolian morphogenetic processes. As in other parts of the world, in Italy the natural geomorphological processes have created beautiful and highly scenic landscapes; next to these, anthropic landscapes of great cultural value are overlapped. A wide range of these landscapes is described in this volume that contains more than thirty cases, representative of all morphogenetic environments, both natural and human. About the cultural value of the Italian landscape, I like to point out that, among the cultural and natural properties recognized by UNESCO as heritage of humanity, Italy is the country that has the largest number of sites included in the World Heritage List. Not by chance, the Italian territory has been a crossroads of peoples and cultures unique in the world where man, over the centuries, has changed river courses, swamps, coasts, slopes, forests, creating sites and morphologies that have been integrated into the natural landscape forming a unique and harmonious entity.

In the European Landscape Convention (ELC), landscape is considered as common heritage of individuals and active subject for the construction of a national and European identity, that people cannot ignore. In this context, the Italian landscape is, in my opinion, the cradle and the laboratory of multi-ethnic cultural and technological identities that go beyond the European context and that are made through the centuries with the participation of many peoples such as Greeks, Phoenicians, Gauls, Romans, Byzantines, Goths, Lombards, Carolingian, Arabs, Normans and, finally, Spanish and French. These peoples, together with the Italians, overlapped their cultures and their way of operating into the landscape, making Italy the largest historical artistic and environmental library. The European Convention defines the landscape as "a certain part of the territory, as perceived by people, whose character derives from natural and/or human factors and their interrelationships." Including all the territory in the concept of active landscape is crucial because each location or natural space is related to other places; all together they establish complex interconnections between them and the urban and rural areas. Therefore, three typologies of landscapes are considered: the exceptional landscapes, the daily-life landscapes and the degraded landscapes. In this context, Geomorphology plays a major role (at different scales): interprets the relations among the great morphodynamic systems (hills, valleys, coasts); identifies the supporting skeleton and that of

greater visual impact among different types of landscape; identifies forces and pressures (natural and anthropic) that can transform them; presents protection and enhancement solutions, in a sustainable perspective. The study of the landscape is characterized by a clear diversity of disciplinary approaches and the consequent relational processes are the main theme of the Convention, which then takes a great effect of stimulation and dialogue between various disciplines. The approaches of each individual discipline to the landscape in many cases lead to consider only some components. However, in my opinion, the issues of "Geomorphology" are the "substrate" of the landscape and contribute significantly to a holistic vision of the same, having the intrinsic ability to relate all the system components (abiotic, biotic and cultural). Fundamental is the contribution of geomorphology to the identification of macro and micro landforms and exploitation of their origin (natural or human), as well as their evolution over time. The contribution of geomorphological methods to the implementation of the Convention guiding philosophy is, in my opinion, considerable and may even result as a good base for dialogue between the various disciplines involved.

Gilberto Pambianchi

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Editors and Contributors

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Contributors

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Introduction to the Landscapes and Landforms of Italy

1

Mauro Soldati and Mauro Marchetti

Alle bellezze ed alle ricchezze scientifiche delle Alpi, noi aggiungiamo quelle così diverse dell'Appennino; e quando avremo descritto i nostri ghiacciai, le nostre rupi e le gole delle Alpi e delle Prealpi, troveremo altri nuovi mondi da descrivere; le emanazioni gazose, le fontane ardenti, le salse e i vulcani di fango, i veri vulcani o vivi o spenti, il Vesuvio, l'Etna, poi ancora il mare e le sue isole, i climi diversi, le diverse zone di vegetazione dalla subtropicale alla glaciale, e così discorrendo, chè l'Italia è quasi (non balbetto nel dirlo) la sintesi del mondo fisico.

To the beauty and scientific richness of the Alps, we add those so diverse of the Apennines; and when we have described our glaciers, our cliffs and gorges of the Alps and Prealps, we will find other new worlds to describe; the gaseous emissions, the fiery fountains, the mud volcanoes, the true volcanoes either alive or extinguished, the Vesuvius, the Etna, and again the sea and its islands, the different climates, the different vegetation zones from subtropical to glacial, and so on, because Italy is almost (I do not mumble in saying it) the synthesis of the physical world.

Antonio Stoppani 1876
II Bel Paese (The Beautiful Country)

Italian landscapes and landforms show an outstanding variety due to long-term geological processes and climate changes. Landscape diversity in many regions of the country is also deeply connected with human presence since ancient times, cultural and political diversity as well as highly varied customs and traditions. Also for these reasons, Italy has been a privileged destination for generations of travellers, intellectuals and artists attracted by fascinating landscapes which perfectly frame architecture and art masterpieces. Nowadays Italy is one of the most important tourist destinations in the world, with more than 50 million international visitors every year.

The first comprehensive essay on the landscape of Italy, *Il Bel Paese* ('The Beautiful Country'), was written by Abbot Antonio Stoppani in 1876. The 'natural beauties, geology and physical geography of Italy' are marvellously described in the original form of conversations to be held on 29 different evenings. Noteworthy is also the first compendium of Italian topographic maps produced in the form of an 'Atlas of Geographic Types' by the Florentine professor Olinto Marinelli—admirer and friend of William Morris Davis—which was published by the Istituto Geografico Militare in 1922. Further and more traditional treatises on the landscape of Italy came a few years after the Second World War as a witness of the increasing interest for landscape appraisal. Roberto Almagià in 1959 provided an outstanding overview of the geography of Italy, included in two weighty volumes (entitled *Italia*) published by UTET publishing house. The first illustrates in detail the physical aspects of the country with the aid of remarkable photographs and a series of valuable historic and topographic maps, whilst the second takes into account economic and human-related aspects. Aldo Sestini in another milestone on the physical geography of Italy, the book entitled *Il Paesaggio* ('The Landscape') and published in 1963 by Touring Club Italiano, stated that the Italian '*landscape acquires higher interest and offers more spiritual pleasure when it is observed by those who are able to recognise the compositional elements, the peculiar variety and the natural and human factors that contributed to form it*'. This is a key issue for those who wish to approach and get to know the Italian territory.

A strong input to the study of physical landscape of Italy was made in 1980s by the National Group 'Geografia Fisica e Geomorfologia' (founded in 1982) of the National Research Council (CNR) which in the year 2000 turned into the Associazione Italiana di Geografia Fisica e Geomorfologia (AIGeo) currently representing Italy as National Scientific Member of the International Association of Geomorphologists (IAG). Within this frame, noteworthy is the

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Fig. 1.1 Location of landscapes and landforms described in Part II of the book (in brackets are the numbers of respective chapters). *1* Glaciers of Piedmont and Valle d'Aosta (Chap. 6); *2* Valtellina and Como Lake (Chap. 7); *3* Adamello-Presanella massifs (Chap. 8); *4* Trentino ancient landslides (Chap. 9); *5* Dolomites of Alta Badia (Chap. 10); *6* Vajont Valley (Chap. 11); *7* Karst in Friuli Venezia Giulia (Chap. 12); *8* Tagliamento River (Chap. 13); *9* Garda Lake (Chap. 14); *10* Venice Lagoon (Chap. 15); *11* Po Delta (Chap. 16); *12* Northwestern Apennines' structural landscape (Chap. 17); *13* Emilia large-scale landslides (Chap. 18); *14* Emilia-Romagna mud volcanoes (Chap. 19); *15* Cinque Terre terraced landscape (Chap. 20); *16* Tuscany hills and valleys (Chap. 21); *17* Urbino Apennine landscape (Chap. 22); *18* Northern Marche coasts (Chap. 23); *19* Central Italy badlands (Chap. 24); *20* Central Italy tuff cities (Chap. 25); *21* Latium ancient volcanoes (Chap. 26); *22* Umbria-Marche intermontane basins (Chap. 27); *23* Abruzzo mountains (Chap. 28); *24* Rome urban landscape (Chap. 29); *25* Sardinia granites (Chap. 30); *26* Sardinia coastal dunes (Chap. 31); *27* Tremiti Islands (Chap. 32); *28* Vesuvius and Campi Flegrei (Chap. 33); *29* Sorrento peninsula and Amalfi coast (Chap. 34); *30* Cilento coasts (Chap. 35); *31* Salento peninsula (Chap. 36); *32* Aspromonte Massif (Chap. 37); *33* Aeolian Islands (Chap. 38); *34* Capo San Vito Peninsula (Chap. 39); *35* Etna Volcano (Chap. 40); *36* Pantelleria Island (Chap. 41). The *blue* rectangle includes the Lampedusa and Linosa islands which are located southward, outside the frame (base map courtesy of Litografia Artistica Cartografica S.r.l., Firenze) ▶

journal *Geografia Fisica e Dinamica Quaternaria* which has been an important recipient of studies on the Italian landscapes and landforms since 1978; the journal is managed by the Comitato Glaciologico Italiano and supported by the AIGeo.

The book *Landscapes and Landforms of Italy*, which comes under the auspices of both the IAG and AIGeo, aims at providing a synoptic overview of the most spectacular landscapes of Italy and at showing outstanding landforms from both a scientific and scenic viewpoint. The volume is divided into three parts. *Part I* introduces the great variety of landscapes and landforms of Italy, providing a background on geological, geomorphological and climatic aspects. *Part II* includes 36 chapters (Fig. 1.1) illustrating different landscapes in a sequence ranging from the high mountains of Northern Italy (the Alps) to the coastal areas of Southern Italy and the islands, passing through hilly and mountain areas of Central Italy (the Apennines). Outstanding landscapes of different origin are described, showing the high geodiversity of the country which includes glacial, fluvial, lacustrine, karst, volcanic, coastal, structural, gravity-induced and aeolian landscapes. Cultural implications on landscapes are also taken into account by two specific chapters devoted to the capital city of Rome and its urban geomorphology, and to landscapes of Central Italy as depicted in Italian Renaissance paintings by famous artists such as Leonardo da Vinci. *Part III* is concerned with peculiar aspects of the country and collects thematic chapters on geoheritage, geomorphodiversity and wine landscapes. Attention is also given to the famous travel of Johann Wolfgang von Goethe and its appraisal of Italian geological landscapes in the eighteenth century.

This book is the result of an exciting joint venture established among Italian geomorphologists, which has also included the participation of valuable experts from other disciplines. More than 80 authors from 29 universities as well as eight research centres and public agencies have contributed to the book.

Every chapter has undergone a thorough peer-review by a team Italian and foreign experts who acted as reviewers, providing precious contribution to the enhancement of the quality of the manuscripts. In this respect, we would like to thank Pierluigi Brandolini, John J. Clague, Doriano Castaldini, Sirio Ciccacci, Paola Coratza, Sunil Kumar De, Maurizio Del Monte, Marta Della Seta, Monique Fort, Paola Fredi, Christian Giusti, Giuseppe Mastronuzzi, Piotr Migon, Gilberto Pambianchi, Mario Panizza, Alessandro Pasuto, Manuela Pelfini, Luisa Pellegrini, Emmanuel Reynard, Daniele Savelli, John A. Schembri and Claudio Tellini.

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Milan
Venice
Genoa
Florence
Ancona
Rome
Bari
Naples
Cagliari
Palermo
Adriatic Sea
Tyrrhenian Sea
Ionian Sea
Mediterranean Sea
0 50 100 km

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Part I
Physical Environment

The Great Diversity of Italian Landscapes and Landforms: Their Origin and Human Imprint

2

Mauro Marchetti, Mauro Soldati, and Vittoria Vandelli

Abstract

An outstanding variety of landscapes and landforms are present in Italy due to its complex geological history, repeated climate changes and increasing human impact through time. This chapter highlights the reasons for the geological and geomorphological diversity of the country by illustrating its geological evolution since the Mesozoic, outlining the paleogeographic changes that occurred as a consequence of Quaternary climate variations, and tracing the unique human civilization history that has so strongly influenced landscape evolution since the Neolithic. Special attention is devoted to the complex history of the country, where peoples coming from different geographical areas met each other contributing to make Italy a compendium of cultural diversity capable of attracting travellers from all over the world. Landscape conservation and protection are finally taken into account.

Keywords

Landscape • Climatic change • Paleogeography • History • Italy

2.1 Introduction

Italy is characterized by extraordinary diversity of landscapes due to its complex long-term geological and climatic evolution, and its unique human civilization history.

From a geological viewpoint, the shape and physical configuration of Italy originates from the collision between the African and Eurasian plates that occurred during the Cenozoic. This geological event caused the closure of the Tethys Sea, and was accompanied by the compression and piling up of its sediments which determined the formation of the two mountain chains that now characterize the Italian territory: the Alps and the Apennines. This tectonic evolution is still ongoing, causing remarkable seismic and volcanic activity, which threaten human settlements and activities. The diversity of Italian landscapes is also due to the wide variety of lithotypes, including the pre-orogenic basement and the successive sedimentary cover.

Dramatic climate changes affected Italy in the last 25,000 years leading to relevant geographical and morpho-climatic changes, including remarkable coastline variations. At present, diverse climatic conditions characterize the country influencing landform evolution. This is principally due to the wide latitudinal extent of Italy, and to the altitudinal range from over 4800 m to sea level, and locally below. In addition, the presence of the Alps and Apennines significantly influences the general air circulation; the fact that the country is enveloped by the sea along *ca.* 7500 km determines also a significant variety of regional and local morphoclimatic conditions.

The human presence since prehistoric times has itself profoundly contributed to the shaping of Italian landscapes. Numerous and different communities who alternatively ruled and lived in the Italian territory have left a clear imprint in

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