

# 山地学概论与中国山地研究

中国科学院  
水利部 成都山地灾害与环境研究所 著

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## 内容简介

本书分上、下两篇。上篇为山地学概论,在介绍国内外山地研究历史和现状基础上,对山地属性、山地学研究对象、内容、任务和目标等进行了系统论述,初步勾划出山地学的理论框架。下篇为中国山地研究,重点对中国山地形成地质背景、山地地貌特征、山地气候与水文、山地生态系统、山地自然资源、山地土地与人口承载力、山地灾害与防治、山地城镇建设与规则和山地可持续发展战略等方面进行了较系统地分析与总结。本书为推动山地学学科建设和促进中国山地研究水平的提高提供了宝贵的资料 and 思想。

本书对从事地理、生态、环境、资源、国土等学科的科技人员及有关大专院校师生有较高的参考价值。

# 前 言

拥有显著起伏度和坡度的三维地貌体——山地有着明显不同于平原或平缓地段的复杂自然与社会人文现象。由于山地现象的特殊性、自然环境过程的复杂性及大多数山地又远离人类经济活动中心,因此目前对山地现象与过程的深入系统的综合研究显得十分的薄弱。

随着人类社会文明的进步和社会经济的发展,山地研究经历了由山地现象的一般性记述,到现象原因的分析;由一般性的定性描写,到半定位、定位观测分析基础上的定量述评;由单一部门或单一学科分散性的局部地区的探查,到多部门和多学科大区域专题性的联合考察研究。通过这些研究工作,涌现了许多有关山地方面的文章、著作以及考察记、探险记等,冠以“山地”二字的学科,如山地气候学、山地生态学等,也相继出现。然而,所有以前的山地研究工作成果都具有鲜明的部门或学科的“个性”,即不同部门和不同学科按照自己的目的和自身的特点从事山地某一方面的研究,缺乏山地系统层面上的综合研究和全球环境高度上的探索,更没有在统一理论体系指导下的山地学方面的研究。

人类社会经历了近代工业的大发展,特别是 20 世纪初以来,工业化、城市化进程速度的加快,带来人们事前没有料及的许多全球性的重大环境问题,其中山地森林植被的破坏,生物多样性的快速减少,水土流失的加速,土壤的薄层化以及土地退化与荒漠化等山地生态环境问题和相应出现的社会经济问题,不但危害山地区人们的生存与发展,而且严重危及到低地和江河中下游地区广大群众生命财产的安全。在全球环境问题和山地生态环境破坏日趋严重的形势下,山地可持续发展问题受到世人的极大关注。20 世纪 70 年代开始了现代山地研究的新时代,1973 年联合国教科文组织在《人与生物圈计划》中,把“人类活动对山地生态系统的影响研究”列为该计划中的一项重大项目。在联合国教科文组织和其它有关国际组织的推动下,山地研究出现了很好的态势,围绕山地区的生态环境和社会经济问题,以重点项目和重点区域为主的山地可持续发展的综合研究得到了极大的加强,并取得了一大批山地综合研究成果。1992 年巴西环境发展大会通过的《21 世纪议程》中,专门安排了一章(即第 13 章)“脆弱生态系统的管理——山地可持续发展”的内容,把山地可持续发展提到全球环境问题的高度上加以重视。此次大会以后,世界山地研究出现了前所未有的大好形势,可以预料,21 世纪的山地研究必将出现一个新的更高的水平。

山地是地球生命支撑体系的重要组成部分,对维系人类生存与发展以及改善人类生存环境的质量起着非常重要的作用。全球陆地有 1/5 的面积为山地,有约 50% 的人口依靠山地资源而生存。中国山地面积约占国土面积的 69%,有 56% 的人口居住在山地区。山地拥有丰富的自然资源,它提供世界一半以上人口所需的淡水资源,拥有世界“水塔”之称。随着人口的增加和环境污染问题的加重,山地的“水塔”作用将越来越重要。山地拥有丰富的生物资源,是目前地球上生物多样性保存最好的地域,有全球生物多样性“核心区”之誉。山地拥有多姿多彩的自然与人文景观,特别是自然生态景观对旅游者具有很大的吸引力。随着工业化和城市化水平的进一步提高,山地旅游业将成为 21 世纪全球最大产业之一的旅游业的中心。山地包容了世界上最多的民族种类,拥有非常丰富的人类传统文化习俗和社会文化遗产。可以说,山地淡水资源,山地生物多样性资源,山地旅游资源和山地社会文化多样性资源是 21 世纪具有全球意义的四大资源,对全球人类的文明与进步具有重大的影响。随

着人口的增加和社会经济的发展以及人类社会文明的进步,这些山地资源的合理开发和利用以及山地生态环境的有效保护和改善必将成为 21 世纪全球关注的热点。不言而喻,山地问题的研究必将受到世界各国的极大重视,山地学科的发展也必将出现一个新的形势。

中国是个多山的国家,山地资源的合理开发和利用以及山地生态环境的有效保护和改善,在实现中国可持续发展战略中占有非常重要的地位。由于历史的原因,中国山地资源的开发与保护方面综合的系统的研究比较薄弱,长期以来处于以部门、单位分散式的研究为主的状态,没有正确的科学理论体系作指导。面对世界山地研究发展的大好形势和山地在中国可持续发展战略地位中的重要性以及山地最为集中的中国西部地区大开发战略的实施,迫切需要加强中国山地的综合性研究以及符合中国山情和国情的山地学理论体系的研究。

在国内外山地研究发展形势的鼓舞下,中国科学院·水利部成都山地灾害与环境研究所于 1996 年提出编著本专著的意见,并得到所科学工作者的大力支持。在所科技处的组织下,由钟祥浩负责本专著内容结构的安排及各有关章节写作人员的落实。在短时间内完成这样一部专著,具有一定的难度。为此,我们确定编写这部专著的宗旨是能起到抛砖引玉的作用,即通过这部专著的出版,能引起社会及有关同行对建立山地学必要性及其理论体系的讨论,使中国山地学的研究能尽快地走在世界的前头。通过中国山地研究的系统总结,期望能为读者提供对中国山地基本情况的了解,同时为中国山地的形成与演变、山地资源的开发与利用、山地生态系统建设与保护、山地城镇建设与灾害防治和山地可持续发展战略等重大问题的深入研究提供基本素材。本专著内容以我所多年从事山地研究的资料和成果为基础,并吸收了国内外山地科学工作者从事山地研究方面的有关成果和资料。经近两年的努力,在资料搜集、调查、分析及部分内容进行专题性研究的基础上完成。

本专著分为上、下两篇。上篇为山地学概论,在对国内外山地研究发展历史作全面介绍分析的基础上,提出加强山地研究,建立和发展山地学是时代发展的需要和科学发展的必然。明确提出山地学研究对象为山地地域系统,该系统具有不同于非山地地域系统的特殊的能流与物流过程,属于能量和物质单向输出为主的不完整的循环系统,因此系统内部具有容易使系统失衡的不稳定的自然动力结构,致使山地环境系统具有不稳定性和山地生态系统具有脆弱性特征。协调人力与自然力之间相互作用的关系,是维系山地地域系统平衡和实现山地可持续发展的关键。为此,需要加强山地地域系统动力结构与物质结构结合后,如何影响物质和能量的运动过程及其对系统中的生态关系、资源赋存关系和生灭关系作用的研究。山地地域系统的研究牵涉到山地环境系统、山地生态系统、山地资源系统、山地动力系统和山地人文系统等结构、功能与动态,其核心是建立协调和谐的山地人地系统,最终实现山地可持续发展。山地学研究内容可概括为三大方面:一是山地属性,包括山地原生属性(自然属性)和山地次生属性(衍生属性和演绎属性);二是山地地域系统的结构与功能;三是山地地域系统的演变动力、过程及规律。通过山地学研究应达到的目标是:能为解释山地现象、认识山地过程规律、保护山地环境和生物多样性以及资源更新机制与替代等提供理论依据,为山地区持续发展提供战略思路和技术方法;使山地学能成为具有明确学术界线和学术分工的独立科学,并且因其有明确的研究对象、内容而具有强大的生命力;以其研究对象的特殊性、研究任务的确定性与研究内容的边缘性和实用性以及理论源泉的交叉性,而显著区别于传统地理学。

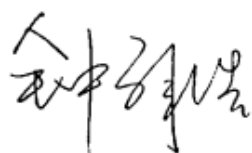
本专著下篇为中国山地研究,重点对中国山地形成的地质背景、山地地貌特征及其利

用、山地气候与水文、山地生态系统、山地自然资源、山地土地与人口承载力、山地灾害与防治、山地城镇和山地可持续发展战略等方面进行了较全面系统地论述。其中既有反映中国山地自然生态环境和自然资源特点的大量的翔实的资料,又有对中国山地研究面临的一些重大课题,如山地形成理论、山地地貌类型区的划分与利用、山地生态系统多样性特征及其保护、山地资源开发利用以及土地资源潜力、山地城镇规划与建设以及山地灾害与防治等的深入分析,并对现状问题解决的途径与对策进行了探讨。在遵循山地地域系统的整体性、系统性和综合性的原则下,提出了符合中国山情的可持续发展战略、途径与对策,对中国山地资源的合理开发利用与保护以及促进山地区社会经济的发展有重要的指导作用。

中国科学院·水利部成都山地灾害与环境研究所从事山地环境与灾害以及山地资源、生态与社会经济的发展等科研工作长达 30 余年,取得了一系列有关的科研成果,积累了丰富的有关资料。自 80 年代中期以来,随着世界对山地开发工作的重视和现代山地研究的兴起,我所部分科技人员开始对建立山地学科必要性及其研究对象、内容和理论体系等,在《山地研究》杂志上进行了探索性讨论,但是这种讨论并未在国内外同行中引起大的反响,这在一定程度上反映了作为一门独立学科——山地学科的建立与发展有它的困难性,其中对于山地定义的准确表达和山地范围的科学界定就是一件难题。但是我们认为,具有显著起伏度、坡度的三维地貌体的存在这是客观事实,这种客体有它自身的能量与物质的运动过程、形式和规律,因而也就有它不同于其它地域的开发利用的途径与对策。因此,我们相信坚持对山地学的讨论与深入的研究,一定会对山地的开发利用起到积极的促进作用。由于定量的严密的山地定义界定的困难性,特别是中国山地现象的复杂性,因此,在中国山地研究篇中有关山地资料的统计沿用了“广义山地”概念,亦即包括了丘陵和高原。鉴于丘陵、山地和高原资源专门性的研究工作基础差,因此“广义山地”资源的统计带有山区的区域特征,不能真实地反映山地资源的特点,但是概括出了中国资源的山地性特征。

本专著是集体智慧的结晶,参与编著者均是我所科技人员。为使该专著能尽快顺利地面世,成立了以钟祥浩为主编、余大富和郑霖为副主编的 11 人编辑委员会。编辑委员会的每一位成员都参与了本专著的编写。各章节执笔人员如下:前言钟祥浩;上篇:第 1、6 章钟祥浩,第 2、3、4、5 章余大富、何昌慧。下篇:第 1 章陈富斌,第 2 章刘淑珍,第 3 章第 1、2 节文传甲,第 3 节程根伟,第 4 章郑远昌、钟祥浩,第 5、6 章郑霖,第 7 章柴宗新,第 8 章傅绥宁,第 9 章陈国阶。各执笔人完成初稿后,主编和副主编进行了审查修改。在此基础上,由钟祥浩进行统稿和定稿。插图中的中国全图示意图之境界已经四川省测绘局审核,地图审核号:川 S(2000)01 号。封面照片由张文敬提供,表示感谢。

由于成书的时间不长,错误之处在所难免。我们殷切希望地学、生态学和环境科学等科技人员,尤其是多年从事山地研究的山地科学工作者,对本专著提出批评和建议,期望在争鸣的气氛中促进山地学科的发展和我国山地研究水平的提高。



2000 年 5 月 18 日 成都



# Preface

With three dimensional rising and falling landforms, mountains have quite different natural and human phenomena from plane and easement regions. Due to the specific features of mountain phenomena, the complexity of natural process and most of monitions far from activity center of human being, comprehensive study on mountain phenomena and its process seems very weak at present.

With the development and progress of human civilization and socio-economy, studies on mountains have gone away from general description of mountain phenomena to analysis of the phenomena; from general qualitative description to quantitative evaluation based on half - fixed location and fixed location observation; from individual regional investigation by individual department, from single subject study to comprehensive investigation of multiple subjects by multiple departments. On the basis of such studies, there appears a lot of articles, written books and investigation records on mountains, and appears the name of "mountain subject", such as mountain climatology, mountain geocology etc. However, all the previous work or research achievements possess obvious department or subject characters, i. e., different departments and branches of learning carry out researches on montology only for their individual purpose and with individual characters of the subject of interests. As a whole, their investigation is characteristic of lacking comprehensive study on the mountain system in combination with global environment. There is no unified theoretical system to guide the research activities on montology study.

The human society underwent the history of modern industrial development, especially since 20 century, the big leap forward of industrialization and citification which bring big problems to the glob. Destroy of forest vegetation, rapid decrease of varieties of biological diversity, loss of water and soil and the thinning out of soil, land degradation and desertification bring a lot of social and economical problems to the world. Such problems not only endanger the existence and development of the people living in mountainous regions, but also endanger the life and property of the people living in the downstream areas. Under the situation of global environment problem and mountain ecological environment being badly destroyed, people pay great interests in the sustainable development of mountain area. A new research time of mountain investigation began in the seventies of 20 century. In 1973, UNESCO proposed a program Man and Biosphere Program and listed a major research project "Study of the impact of human activities on mountain ecosystem". Since then, promoted by UNESCO and other organizations, researches on mountainous regions developed very rapidly. Aiming at the problems such as eco-environment and socio-economy in the mountainous regions, comprehensive researches on some key items and key mountainous regions have been carried out for sustainable development and many research achievements have been gained. In 1992, an environment development conference was held in Brazil, a chapter in the document of "Agenda 21 Century" listed the content of "managing fragile ecosystem: sustainable mountain development". Studies on mountains have been carried out in a wide scope in the world. It can be expected that researches on mountains will enter into a higher level in 21

century.

Mountain is the main part of the life supporting system on the earth, which pays an important role to keep the human alive and improve the existing environment. Fifth of land occupation of the earth are mountainous regions and 50% population live relying on mountain resources. In China, 69% of the land are mountain region with 56% population. The mountain areas exists rich natural resources and water, just like a water tower, providing water supply for half population of the world. Due to increase of population and environment pollution, the "water tower" becomes more important and necessary. There are many bio-diversity resources still existing in the mountain and a lot of beautiful natural and humane scenes and spots in the mountain area, which attract many tourists at nowadays. May be, the mountain area will become the largest tourist center which supports the development of tourism in 21 century. People in the cities will be attracted to the biggest tourist center to enjoy themselves to the tradition, custom of nationalities the scene of nature and cultural relics in the mountain regions. Mountain water resource, mountain biological resource, mountain tourist resource and mountain social and cultural resource will become the biggest four resources of the world in 21 century. They will have a great contribution to human progress and civilization of human being. The development and utilization of those resources and the protection and improvement of mountain ecological environment will be the hot point in 21 century. Studies on mountain problems will be paid great attention by countries all over the world.

China is a beautiful country with hundreds of thousands of mountains spreading over the country. Reasonable development and utilization of mountain resources and effective protection and improvement of the environment will play an important part to the realization of sustainable developing strategy. Due to historic reasons, comprehensive researches on the development and utilization of mountain resources and environment protection are very weak without systematic guiding theory. Only some individual constitutions carry out mountain research in a separate way. Facing the excellent situation of mountain researches all over the world and the importance of mountain to sustainable development of China, it is urgently needed to carry out montology research and the theoretical system in combination with Chinese mountain features and Chinese characteristics.

Encouraged by the excellent situation of mountain investigations both at home and abroad, the Institute of Mountain Hazards and Environment, which belongs to the Chinese Academy of Sciences and Ministry of Water Resource P. R. C. planed to edit a special issue in 1996 on montology study and set-up an editorial board in the same year. This plan was warmly responded by broad scientists in this field. The purpose of publishing this issue attempts to attract researchers and colleagues to discuss the necessary of building montology as well as the theoretical system so that bringing mountain studies in China in the leading position as soon as possible.

Professor Zhong Xianghao, the chief editor, proposed the structure and contents of the issue and invited the authors to write articles for it. The editorial board wants through systematic summary of mountain researches in China, to offer the readers a general knowledge of research activities in China, provides a basic information about the formation and evolution of mountainous regions in China, the development and utilization of mountain resources, the construction and protection of mountain ecological

system, the construction of cities in the mountainous regions, and the sustainable development strategy. Contents of the issue are based on research data and research achievements. Some research achievements and documents from foreign countries are also included in the issue. After two years of hard work, the issue is finally presented to the readers, which makes all of us very happy.

The issue consists of volume A and volume B. Volume A is an outline to montology. Based on the comprehensive analyses of the development track of mountain research both at home and abroad, this volume points out that strengthening the research of mountainous regions, building and developing montology are the need of time and the necessity of science progress. It stresses that study object of montology is mountain areal system. Such system has special energy flow and material flow process, which are quite different from that of non-mountain areal system, and which is an incomplete circular system in characteristic of single direction output of energy and material flow. Therefore the system has a unstable nature dynamic structure which makes the system losing of balance. The mountain environment becomes unstable and the mountain ecological system fragile. Coordinating the interaction of man power and nature power is the key point of maintaining the mountain system balanced and sustainable development. As a result, researches should be concentrated on the impact of material and energy movement process on ecology, resource and existence relationship in the montological system for the combination of the dynamic structure and mass structure of mountain system. Research of mountain areal system refers to mountain environment system, mountain ecological system, mountain resource system, mountain dynamic system and mountain humane system and their structures, functions and state for the purpose of building a harmonic mountain human-land system and implementing sustainable development strategy. Contents of montology study includes three fields, the first one is mountain attribute including original attribute (natural attribute) and secondary attribute (natural attribute evolution and deduction attribute); the second one is the structure and function of mountain areal system; the third one is the evolution dynamics, process and regulation. Through studying montology, people can explain the mountain phenomena, understand the regulation of mountain development and the importance of protecting mountain environment and mountain bio-diversity, and find out a correct way to keep the mountain regions in sustainable development. Due to the specialty of research object, certainty of research task, features of peripheral science and practical application as well as the intersection of theories, montology is quite different from traditional geography.

Volume B is mountain research in China. It emphasizes the geological background of the formation of mountains, mountain geomorphological feature and its utilization, mountain climate and hydrology, mountain ecosystem and mountain natural resources, mountain land and population bearing capacity, mountain hazards and its prevention and sustainable development of mountainous regions. It provides rich information about the ecological environment and natural resources in China, proposes some major research subjects, such as theory of mountain formation, division of mountainous geomorphological regions, diversity features of mountain ecological system, development and utilization of mountain resources, land potentialities, planing of cities construction in mountainous regions and the prevention measures of mountain hazards. On the basis of analyzing the present status of mountainous regions in China, this volume proposes some suggestions and strategies in conformity with Chinese practical con-

ditions of mountains for the sustainable development.

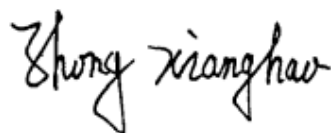
The Institute of Mountain Hazards and Environment has engaged in investigations of mountain environment and hazards, mountain resources, mountain ecology and social economical development for more than 30 years, has gained a lot of achievements. Since middle 1980s, along with the mountain development progress and the research activities in the world, researchers of the institute started to set up mountain subject and began to study the theoretical system of montology and published some articles in the magazine *Mountain Research*, which result in certain response and great interests. However, montology as a separate subject have difficulties at present, in which to define the mountain and its boundary is key one. As a whole, it is a fact that the existence of three-dimensional landforms implies obvious differences for the development and utilization of mountainous regions from other regions. We believe that the deepening of the study of mountain will play an important role in development and utilization of mountain resources, and then promoting formation of montology .

Due to difficult to define mountain concept quantitatively especially the complexity of Chinese mountain phenomena, we adopt a concept of "generalized mountain", i. e. , it includes hills and plateau. The statistics of resources of generalized mountain is characteristic of regional features of mountain & hills. It can not really react the features of mountain resources, but it partly represents that Chinese resources are widely distributed in mountainous regions.

This issue is published by the collective wisdom. All the members of the editorid board have contributed a lot and worked with great enthusiasm. Among them, Professor Zhong Xianghao, the Chief editor, and Professor Yu Dafu and Zhen Lin, the deputy editors, had a careful check and did some modification for the issue. The editorial board here again expresses its heartfelt thanks to the authors: Prof. Zhong Xianghao (Chapter, 1, 6 V. A), Prof. Yu Dafu and Senior Engineer. He Chenghui (Chapter 2,3,4,5, volume A), Prof. Chen Fubin, (Chapter 1, B), Prof. Liu Shuzhen (Chapter 2), Prof. Wen Chuanjia (Section 1,2 Chapter 3,B), Prof. Cheng Genwei (Section 3, Chapter 3, B) Prof. Zhen Yuanchang and Prof. Zhong Xianghao (Chapter 4), Prof. Zheng Lin (Chapter 5, 6), Prof. Chai Zongxin (Chapter 7), Prof. Fu Suining (Chapter 8) and Prof. Cheng Guojian (Chapter 9).

The issue is published in some busy days, mistakes or shortcomings are inevitable. Welcome all readers and colleagues offering us your criticisms and suggestions.

With Best Regards!



May 18, 2000  
in Chengdu.

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