

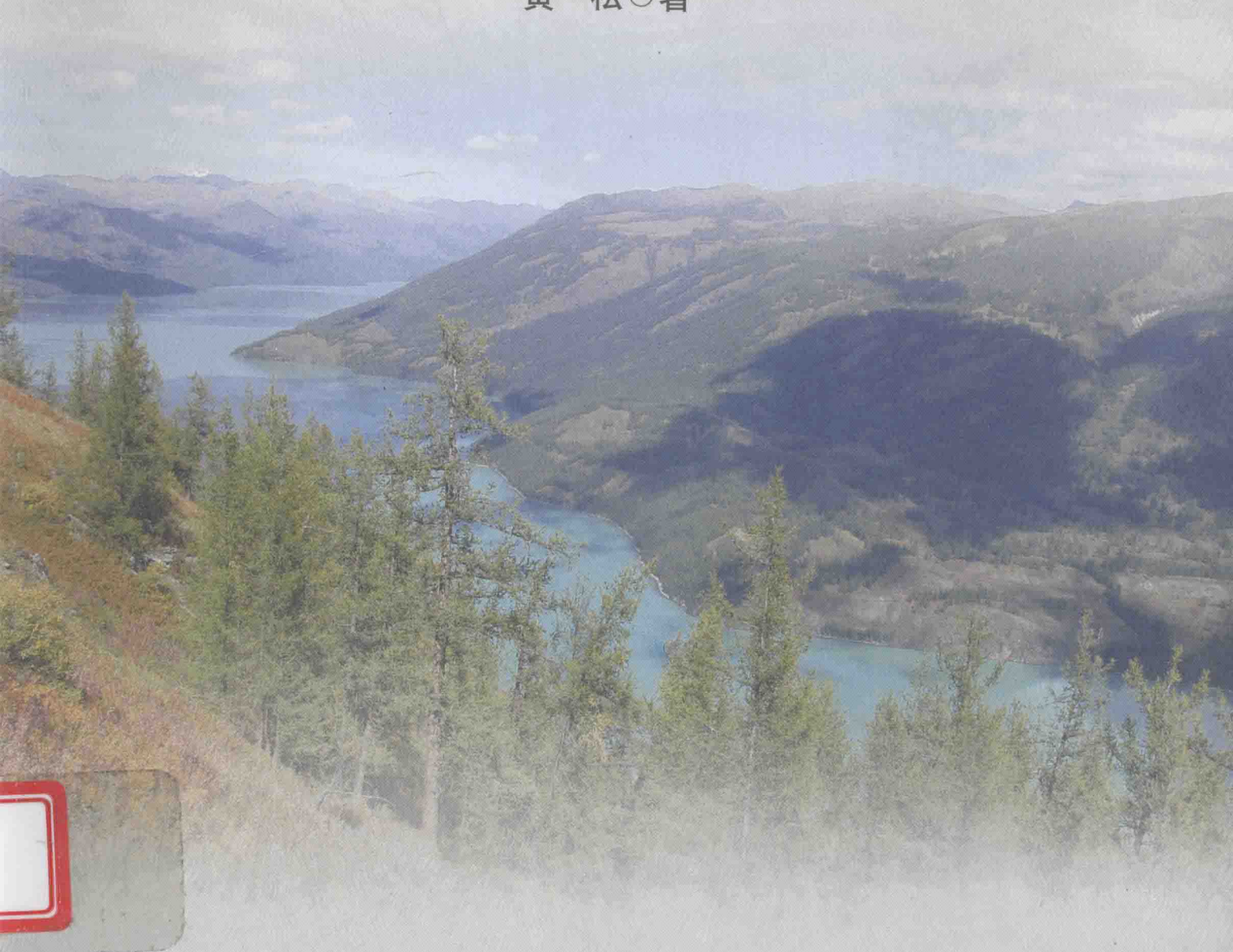
广西师范大学优秀学术著作出版基金资助

THE RESEARCH ON GEOPARKS IN XINJIANG

BASED ON THE SYSTEM INTEGRATION
FRAMEWORK

基于系统集成框架的 新疆地质公园研究


黄 松◎著



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 GUANGXI NORMAL UNIVERSITY PRESS
广西师范大学出版社

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图书在版编目 (CIP) 数据

基于系统集成框架的新疆地质公园研究 / 黄松著. — 桂林: 广西师范大学出版社, 2009.12
ISBN 978-7-5633-9261-2

I. 基… II. 黄… III. 系统集成—应用—地质—国家
公园—研究—新疆 IV. S759.93-39

中国版本图书馆 CIP 数据核字 (2009) 第 222705 号

广西师范大学出版社出版发行

(广西桂林市中华路 22 号 邮政编码: 541001)
(网址: <http://www.bbtpress.com>)

出版人: 何林夏

全国新华书店经销

广西师范大学印刷厂印刷

(广西桂林市临桂县金山路 168 号 邮政编码: 541100)

开本: 890 mm × 1 240 mm 1/16

印张: 12.25 插页: 21 字数: 380 千字

2009 年 12 月第 1 版 2009 年 12 月第 1 次印刷

定价: 48.00 元

如发现印装质量问题, 影响阅读, 请与印刷厂联系调换。

摘 要

作为地球 46 亿年演化过程中内外动力地质作用的历史见证,地质遗迹以一定的物质和形态反映地质历史时期地球物质运动、生物进化及内外动力作用特征,是具有极为重要的科学价值和美学价值的地质自然遗产。为保护地质遗迹资源,1999 年 3 月,联合国教科文组织(UNESCO)第 156 次执行局会议正式通过了“世界地质公园计划”议程。UNESCO 强调建立地质公园(Geopark)的三项重要目的:一是保护地质遗迹及其环境;二是促进地球科学科普教育和科学研究的开展;三是合理开发地质遗迹资源,促进所在地区社会经济的可持续发展。“保护与开发相协调”的目的与 UNESCO“世界遗产”和“人与生物圈保护区”单一保护的目​​的明显不同,成为地质公园最重要的特征。

UNESCO 倡导的“世界地质公园计划”得到了世界各国的广泛响应与积极参与,中国和欧洲是地质公园建设最卓有成效的国家和地区,尤其是中国的地质公园建设及其对地方社会经济可持续发展作出的贡献使其成为世界的典范,得到联合国教科文组织的高度评价。同时,地质公园研究得到国际学术组织和国内外学者的广泛关注。相比较而言,国外学者往往侧重地质公园的地球科学内涵研究,而国内学者更注重地质公园的保护开发与规划管理研究,但均忽略了对支撑地质公园研究发展的基础理论的探讨。地质公园作为开放性的复杂系统,地质公园研究作为一个横断性极强的研究领域,目前缺乏与地质公园复杂系统特征相匹配的科学的方法论指导,且研究成果多局限于某一特定地质公园的有限区域,缺少宏观大尺度的深入研究。

新疆幅员辽阔,是我国面积最大的省区,也是国际地学界研究、关注的热点区域。优越的地质条件使新疆成为我国地质遗迹资源最丰富的省区。然而,与巨大的资源优势形成鲜明对比的是,新疆地质公园建设明显滞后,地质公园的系统研究也少有学者涉及。因此,以新疆这一典型区域为研究对象,进行地质公园系统研究,探讨宏观大尺度背景下地质公园研究的理论和方法,为新疆乃至我国地质公园的规划、建设提供理论指导和方法支持,无疑具有重要的理论价值与现实意义。同时,本文针对地质公园研究缺乏与地质公园复杂系统特征相匹配的科学方法论指导的现状,创新性地将系统集成理论引入地质公园研究领域,通过地质公园系统集成框架的构建,为新疆地质公园研究提供先进的方法论支撑。

本书以新疆丰富的地质遗迹资源为主要研究对象,在新疆全境的宏观背景下,进行以下科学问题的研究:1. 地质公园系统集成框架研究;2. 新疆地质公园资源集成研究;3. 新疆地质公园开发集

成研究;4. 新疆地质公园保护集成研究;5. 新疆地质公园管理集成研究。本书的关键科学问题是:地质公园系统集成框架的构建及其在新疆地质公园研究中的应用。因此,本书的研究思路按照此逻辑主线展开:首先构建地质公园系统集成的框架模型,为地质公园研究提供方法论支持,之后根据地质公园系统集成各集成单元的耦合关系,按基础集成(资源集成)→应用集成(开发集成、保护集成)→组织集成(管理集成)的顺序进行新疆地质公园实证研究。

全书共分绪论、地质公园系统集成框架研究、新疆地质公园资源集成研究、新疆地质公园开发集成研究、新疆地质公园保护集成研究、新疆地质公园管理集成研究六部分,主要研究结论概括如下:

1. 地质公园系统是一个由资源子系统、开发子系统、保护子系统、管理子系统四个子系统构成的开放性复杂系统,地质公园系统的各个子系统之间及其与外部的自然环境、社会经济环境等相关因子之间时刻进行着物质、能量和信息的交换,维持着地质公园系统动态平衡和稳定,地质公园系统具有整体性、复杂性、自组织性和耗散结构,并可产生协同效应。

2. 地质公园系统集成是将地质公园视为开放的复杂系统,为实现系统整体功能最优的目标,充分整合、调控地质公园系统中各相关子系统及其要素的理论、方法与技术有机集合的完整体系。地质公园系统集成由资源集成、开发集成、保护集成、管理集成四个相互作用的集成单元构成:资源集成属基础集成,是地质公园系统整体功能最优的资源保障;开发集成和保护集成属应用集成,是地质公园系统集成中分别以开发和保护为核心内容的实施操作;管理集成属组织集成,是地质公园系统整体功能最优的措施保障,是实施基础集成与应用集成的关键。

3. 本书构建了包含宏观目标层、中观单元层和微观过程层三个层次的地质公园系统集成理论框架模型。其中,中观单元层由地质公园系统集成中相互作用的四个集成单元组成,是地质公园系统集成的核心和主体,而目标层和过程层则与单元层相匹配而存在。地质公园系统集成的实现主要是在目标层的控制约束下,沿着过程层的发生序列,对单元层进行优化、调整,并将结果反馈到目标层与之验证,两者相符则开始实施,同时将实施结果反馈回目标层。由于地质公园系统集成内部各种因素的随机扰动,由此产生的系统相干效应可能使系统集成的整体发生涨落,从而使地质公园系统集成的行为偏离设定的目标,因此,这一优化、调整、实施的过程将不断循环往复以保证地质公园系统集成的不断完善和发展。

4. 地质公园资源集成的核心集成要素是地质遗迹资源。基于首次全疆范围的地质遗迹资源调查,将新疆 209 处地质遗迹分为 7 个主类和 28 个亚类,7 个主类中以地质地貌景观和水体景观占绝大多数,28 个亚类中以湖泊景观、风成地貌、河流地貌景观、典型矿床及采矿遗迹景观、冰川地貌、山岳地貌、古生物化石保存地、火山地貌和泉类景观为主。新疆地质遗迹数量大、分布广、类型齐、品质优,具有极高的科学价值和美学价值。定量评价显示,国家级和自治区级地质遗迹是新疆最主要的地质遗迹类型,国家级以上的地质遗迹有 88 处,大量稀缺和具有垄断性的地质遗迹为新疆地质公园建设创造了优越的条件。

5. 受地质条件和地理环境的影响和制约,新疆地质遗迹分布具有明显的空间分异特征。以决

定地质遗迹空间格局的关键因素——深大断裂和大地构造单元为主要依据,建立了多级次的新疆地质遗迹空间格局区划系统。该区划系统包括5个一级区划单元——地质遗迹区、13个二级区划单元——地质遗迹亚区以及35个三级区划单元——地质遗迹带。设计了地质遗迹的数量、级别、类型、保护开发条件等4类定量表征指标和10项具体指标因子,对新疆地质遗迹的空间格局特征进行全面刻画和定量表征,最终确定一级区划单元中的天山、昆仑—阿尔金、阿尔泰地质遗迹区为优异(Ⅰ级),准噶尔、塔里木区为良好(Ⅱ级);二级区划单元中北天山、西昆仑、南天山、北阿尔泰地质遗迹亚区为优异(Ⅰ级),吐哈、准中、塔东、东昆仑—阿尔金、中昆仑、塔西亚区为良好(Ⅱ级),南阿尔泰亚区为一般(Ⅲ级),准西、准东亚区为较差(Ⅳ级)。结果显示,山地型地质遗迹区(亚区)明显优于盆地型地质遗迹区(亚区)。

6. 地质公园开发集成有效实现的关键是科学、合理的布局。本书提出基于地质遗迹资源与人地关系耦合的地质公园开发布局新思路,探索建立在定量分析基础上的区域地质公园开发布局新途径:首先,建立由自然结构、人口结构、社会结构、经济结构4个评价结构层和11个评价指标层组成的新疆人地关系综合评价指标体系,采用聚类分析法将新疆14个地区(州、市)划分为发达城市地区,城镇型少数民族地区,一、三产业为主导的城镇地区,旅游业发展较快的欠发达农村型少数民族地区,较发达资源型(石油)工业地区,贫困农业型少数民族地区6种人地关系类型;然后,将上述人地关系类型与地质公园资源集成中优异、良好、一般、较差地质遗迹区划单元相耦合,根据两者的耦合关系确定新疆地质公园开发布局。

7. 旅游产品开发是地质公园开发集成中的核心内容,也是地质公园系统集成各集成单元相互联系、相互作用而产生协同效应的载体和表现形式。基于地质公园旅游产品的认知度分析和新疆旅游产品的价值取向分析,构筑以观光旅游为主导,度假旅游为目标,科考、探险旅游为特色,文化、民族旅游为辅助的多元化新疆地质公园旅游产品体系,充分展示地质公园综合性公园而非专业性公园的属性。通过新疆地质公园旅游的四条骨干线路和十七条支线线路的组织,形成遍布全疆的地质公园旅游线路网络,并在区域旅游形象驱动分析和区域地格分析的基础上,提出“震撼人心的神奇之旅,恒久铭记的深度体验”的新疆地质公园区域旅游形象理念和口号。

8. 地质遗迹保护是地质公园保护集成的核心要素。本文强调保护集成与地质公园系统集成其他集成单元,尤其是开发集成的相互作用关系,指出地质公园保护集成绝非单一的保护,而是保护与开发的集成。新疆地质遗迹的保护现状为从属保护、级别较低、数量较少,而保护与开发协调性差是其根本原因。依据保护与开发各环节间的因承关系,确定保护类型→保护形式→保护模式→保护级别→保护时序→保护分区的六大地质遗迹保护实施步骤。提出地质公园与地质遗迹保护区以及其他保护地相结合的复合型地质遗迹保护优选模式,并据此建立针对新疆209个重要地质遗迹的保护备选名录,形成以地质公园为主体,地质遗迹保护区和其他保护地为辅助的新疆地质遗迹保护体系。

9. 地质公园管理集成通过有效的组织实现地质公园系统集成中各个集成要素之间的有机整合。在地质公园管理集成的各集成要素中,法律体系的完善是根基,管理模式的构建是措施保障,

管理信息系统建设是技术支持,地质公园教育科研体系建设是科学依托。针对我国地质遗迹管理立法在国家、部门、地方三个立法层次上均明显滞后的现状,提出完善地质遗迹管理立法的《宪法》和《环境保护法》依据;制定统一的《地质遗迹法》和与之配套的单行法规;完善地质遗迹管理的地方立法,力争“一区一法”的建议。分析我国“三权混同”地质遗迹管理模式的弊端,构建地质公园“三权分离”的管理模式,同时,还提出构建地质公园管理信息系统,为地质公园系统集成各集成单元的有机整合提供技术支撑的构想,以及通过地质公园教育科研体系建设,使地球科学成为地质公园管理的知识支撑的措施。

本书的主要创新概括为:1. 将系统集成理论引入地质公园研究领域,从地质公园系统的结构、功能和特征等系统科学基本范畴入手,界定地质公园系统集成的内涵,构建地质公园系统集成的理论基础和框架模型,为地质公园研究的进一步深入提供先进、科学的方法论指导;2. 以地质公园系统集成的基础理论和框架模型为方法论指导,以新疆首次全境范围的地质遗迹系统调查为依托,按地质公园系统集成相互作用的四个集成单元——资源集成、开发集成、保护集成、管理集成进行新疆地质公园实证研究,探讨宏观大尺度背景下地质公园研究的理论和方法,弥补新疆地质公园系统研究的不足。

关键词:新疆;地质遗迹;地质公园;系统集成;资源集成;开发集成;保护集成;管理集成

ABSTRACT

Geological heritages have been formed and preserved by the effect of the external and internal forces during 4.6 billion years of geological evolution. Precious and non-renewable, they are the common wealth of all human beings with very important scientific and aesthetic values. In March of 1999, the 156th session of the Executive Board of UNESCO officially and formally adopted an agenda of “UNESCO Geopark Programme” in order to protect these geological heritages, the witness of the earth’s evolution. Three purposes were stressed by UNESCO: 1. to protect the geological heritages and their environment; 2. to promote the development of the scientific popularization education and researches on the earth science; 3. to accelerate the local social economy in a sustainable way through exploiting the geological heritage resources properly. The purpose of “coordination between protection and exploitation”, which becomes the most important feature of geoparks, is obviously different from that of the “World Heritage” and the “MBA” which show interests in the single protection.

The “UNESCO Geopark Programme”, advocated by UNESCO, has received worldwide responses and active participation. The geopark construction projects in Europe and China are the most distinguished ones in the world, particularly China’s geopark construction and its contribution to sustainable development of local social economy have been highly praised by UNESCO to be the model of the world. Meanwhile, international academic organizations, scientists in China and abroad have paid much attention to geopark researches. Comparatively speaking, Foreign scholars emphasize particularly on the researches of the earth science while Chinese scholars lay their eyes on the geopark protection, exploitation, planning and management. Unfortunately, the basic theoretical research has largely been neglected. At present, scientific methodologies are insufficient to match with the open and complex geopark system, achievements we have accomplished are limited only in certain geopark regions and a macro-scale research is in urgent need.

Xinjiang is the largest province in China, international geoscientists have always been focusing on this region. Xinjiang is also one of China’s provinces richest in geological heritage resources owing to its superior geological conditions. However, in Xinjiang the construction of geoparks lags behind and the scholars rarely relate their study to geopark researches. Thus, it is of high significance in both theory and application to take Xinjiang as a typical object to study the geopark

system, to discuss geopark research theories and methods under a macro-background, and to provide theoretical guidelines and methods for the geopark planning and construction in Xinjiang, even in china. In view of the present condition that the geopark researches have no theories and guidelines matching with the complex system of geoparks, this book creatively introduces the system integration into geopark researches. Through constructing the system integration framework of geopark researches, this book will provide advanced methodologies supporting the geopark researches in Xinjiang.

The research work of this book is financially supported by the Special Project of the Resource Compensation of Xinjiang —— The Survey of Tourism Geological Heritage Resources in Xinjiang (No. 2004046), and will focus on the rich geological resources in Xinjiang. Under the background of the whole territory of Xinjiang, the research work is focusing on the following subjects; the research on the geopark system integration framework; the research on the geopark resource integration in Xinjiang; the research on the geopark exploitation integration in Xinjiang; the research on the geopark protection integration in Xinjiang; the research on the geopark management integration in Xinjiang. The key scientific object of this book is the construction of a geopark system integration framework and its application in Xinjiang. The book unfolds logically as following: first, to construct a geopark system integration framework to support geopark researches, then to have an empirical case study on the geoparks in Xinjiang according to the geopark system integration coupled integration modules in the order of the basic integration (the resource integration) → the application integration (the exploitation integration, the protection integration) → the organization integration (the management integration).

The whole book consists of five chapters:

Prolegomena: Based on the analysis of the present geopark researches and problems in China and abroad and also in Xinjiang, this chapter ascertains the purpose, contents, key problems of this book, and furthermore determines the research idea and structure.

Chapter 1: The research on the geopark system integration framework. Starting with the discussion of the basic categories such as the structure, functions and features of the geopark system under the background of the system science, this chapter defines the intension of the system integration of geoparks and constructs its theoretical basis and framework.

Chapter 2: The research on the geopark resource integration in Xinjiang. This chapter analyzes the geological conditions in Xinjiang, classifies and estimates the geological heritage resources in Xinjiang, discusses the cause for the formation and features of these geological heritage resources, builds a space-regionalization system for geological heritages, and quantitatively analyzes the features of various regionalizations.

Chapter 3: The research on the geopark exploitation integration in Xinjiang. This chapter analyzes the present exploitation situation of the geoparks in Xinjiang from the perspective of the human-land relationship, brings about new ideas about the layout of the geopark exploitation based on geological heritage resources coupled with human-land relationship. In the light of all these, the

tourism product exploitation, the tourism routines and the regional tourism image can be designed accordingly.

Chapter 4: The research on the geopark protection integration in Xinjiang. Beginning with the analysis of the development of the geological heritage protection in China and abroad, this chapter, on basis of the analysis of the present protection situation and the feasibility of the geological heritage protection in Xinjiang, puts forward some implementation steps, optimal-selection modes and a reserve list etc.

Chapter 5: The research on the geopark management integration in Xinjiang. This chapter studies the following problems: the perfection of the law system for the geological heritage management, the construction of a geopark management model, the establishment of an information system of the geopark management, and the building of a geopark education-research system.

The main conclusions of the book are listed below:

1. The geopark system is an open and complex system composed of a resource subsystem, an exploitation subsystem, a protection subsystem and a management subsystem. The inner subsystems of the geopark system exchange materials, energy and information, so do the subsystems with their external natural environment, social-economic environment and other related factors. All these have maintained the dynamic equilibrium and stability of the geopark system. With its integrity, complexity, self-organizing and dissipation structure, the geopark system generates a synergistic effect.

2. The geopark system integration takes the geopark system as an open and complex system, which is a complete system genetically integrating relevant theories, methods and techniques. It integrates and coordinates the subsystems of the geopark system to optimize the function of the system. The geopark system integration consists of the resource integration, the exploitation integration, the protection integration, and the management integration. The resource integration is basic, which provides resource-ensuring to optimize the whole function of the geopark system. The exploitation integration and the protection integration are application parts, which, taking exploitation and protection as their core contents respectively, are the operational management integration. The organization part is the safeguard for the optimization of the integrated function, which is the key for the implementation of the basic integration and the application integration.

3. This book innovatively builds a system integration framework, including the macro-objective layer, the medium-scale section layer and the micro-process layer. Particularly, the medium-scale section layer, made up of 4 interactional integration units, is the core and main part of the geopark system integration. The macro-objective layer and the micro-process layer exist to match with the medium-scale section layer. The realization of the geopark system integration is under the control of the macro-objective layer. The medium-scale section layer is going to be optimized and adjusted according to the sequence of the micro-process layer, and then transmits feedbacks to the macro-objective layer to verify. If the result is accepted by the macro-objective

layer, it will be carried out, and then feed the result back to the macro-objective layer once again. The geopark system integration may deviate from the goals due to the random disturbances of its intern factors and the frequent mutual interference effect among these factors. Thus, the process of the optimization, the adjustment, the implementation should be circulated to ensure the continuous improvement and development of the geopark system integration.

4. The key element of the geopark resource integration is geological heritages. On the basis of the first systematic investigation of geological heritages in the whole area of Xinjiang, 209 geological heritages are divided into 7 main-categories and 28 subcategories. Most of the 7 main categories are taken up by the geologic-geomorphic landscape and the water landscape; and the lacustrine landform, the aeolian landform, the fluvial landform, the typical ore deposit and mining relic landscape, the glacial landform, the mountain landform, the paleontologic fossile site, the volcanic landform and the spring landform are the primary kinds under 28 subcategories. Geological heritages in Xinjiang are of high scientific and aesthetic value for their large quantity, widespread distribution, complete type and good quality. The quantitative assessment has revealed that the main types of the geological heritages in Xinjiang are of the national level and the provincial level. There are 88 geological heritages above the national level. The rare and monopoly geological heritages in Xinjiang have provided excellent conditions for its geopark construction.

5. Influenced and restricted by geological conditions and the geographical environment, the distribution of the geological heritages in Xinjiang obviously has a feature of spatial differentiation. Considering the deep fracture and the tectonic unit, which are the key factors to decide the distribution of geological heritages in space, this book innovatively establishes a multi-level system of spatial pattern of geological heritages in Xinjiang. This system includes 5 regionalization cells of grade I — the geological heritage area, 13 cells of grade II — the sub-geological heritage area, and 35 cells of grade III — the geological heritage belt. 4 categories of indicators — quantity, grade, type, protection condition, and 10 specific indicator factors have been designed in order to bring a comprehensive and quantitative representation to the space pattern of geological heritages in Xinjiang. In the regionalization cells of grade I, Tianshan, Kunlun-Altun, Altai are classified to be excellent sites while Junggar, Tarim to be good. In the cells of grade II, Northern Tianshan, Western Kunlun, Southern Tianshan, Northern Altai are classified to be excellent sites, Turpan-Hami, Middle Junggar, Eastern Tarim, Eastern Kunlun-Altun, Middle Kunlun, Western Tarim to be good, Southern Altai to be medium while Western Junggar, Eastern Junggar to be poor. The results show that the mountain-regionalization cells of geological heritages are obviously superior to the basin-regionalization cells.

6. The key to the realization of the geopark distribution integration is the scientific and rational layout. This book innovatively puts forward a new distribution idea based on the geological heritage resources coupled with the human-land relationship, and proposes some new ways to exploit regional geoparks on the basis of the quantitative analysis. First, the book establishes a comprehensive evaluation system of human-land relationship in Xinjiang including a four-evaluation-

structure including natural structure, population structure, social structure, economic structure and a 11-evaluation-indicator-layer, using the cluster analysis to divide 14 regions (cities and municipalities) in Xinjiang into 6 human-land relationship types: the developed urban area, the urban-based minority area, the agriculture-oriented urban area, the tourism exploitation fast but underdeveloped rural minority area, the rich resource-based (oil) industry area, and the agriculture-based poverty minority area. Then we couple different types of human-land relationship respectively with excellent, good, general, poor geological heritages in the geopark resource integration, and determine the geopark distribution pattern according to the coupled results.

7. The tourism product exploitation is the core of the geopark distribution integration and the carrier and the manifestation of the interrelating and interacting relationship of different integration cells among the geopark system integration. According to the cognition-and-value-oriented analysis of the geopark tourism products in Xinjiang, the tourism product system of the geoparks in Xinjiang can be established consisting of the sightseeing as the dominant, the vacation tour as the target, the scientific investigation and exploration tourism as the unique feature, the cultural and ethnic tourism as the supplement, which can fully display its comprehensive characteristics as a geopark. Through the organization of 4 key lines and 17 extension lines, tourism line nets throughout all the geoparks in Xinjiang can be formed. On the basis of the regional tourism image-driven analysis and the placeality analysis, the image and the slogan of the regional tourism in Xinjiang, “A shocking magic trip, an everlasting intensive experience”, can also be proposed.

8. The geological heritage protection is the core element of the geopark protection integration. This book emphasizes that the geopark protection is not just a single protection, but a combination of protection and exploitation. The current situation of the geological heritage protection in Xinjiang can be described as a subordinate protection with a low level and in a small number. The inefficient coordination between protection and exploitation is the fundamental cause for the poor geological heritage protection at present. Based on the relationships of the different links of protection and distribution, 6 protection steps are proposed, from determining protection types, protection forms, protection modes, protection grades, protection sequences to determining protection zones. The optimal-selection model, which integrates geoparks with geological heritage protection areas and other protection areas, is put forward. Therefore, a protection and exploitation reserve list of 209 important geological heritages in Xinjiang is made, forming a protection system taking geoparks as the main body, the geological heritage protection areas and other protection areas as the supplement.

9. The various factors of the geopark system integration are organically integrated under the effective organization of the geopark management integration. Among all the factors of the geopark management integration, the perfection of the legal system is the foundation, the construction of the management is the safeguard; the building of the management information system is the technical support, the structuring of the geopark education-research system is the scientific support. Under the present situation that the management legislation for geological heritages lags

obviously behind on national, sectoral and local levels, it should be put forward to improve the legislation of the geological heritage management according to Constitution and Environmental-Law, to constitute the consistent Geological Heritage Act and its matching rules and regulations, to improve the local legislation of the geological heritage management and try to establish the “One-District-One-Act” policy. Following the analysis of the defects of the geological heritages management in our country which is “confusion of three powers”, a model of “separation of three powers” should be constructed, whose core is: selecting local people-congresses as the delegate of mandated ownership of geological heritage resources; local governments having the management right of the geological heritage resources; the compensated use of the operational rights of geoparks transferred to enterprises through fair competition; the ownership, the management right and the operational right of geological heritage resources separated with mutual constraints on each other. At the same time, the establishment of the geopark management information system should also be put forward to provide the technical support for the organic integration of different geopark system integration cells, and through the construction of the geopark education-research system, the earth science will be made the knowledge support for the management of geoparks.

The innovations of the book are:

1. This book introduces the system integration theory into geopark researches. Beginning with the basic categories such as structure, function and features of the geopark system under the background of the system science, it defines the intension of the geopark system integration, constructs its theoretical basis and overall framework to provide the advanced scientific methodology guidance for geopark researches.

2. Guided by the system integration theory and under its framework, based on the first systematical investigation of the geological heritages throughout Xinjiang, and in the light of the four interactive integration sections —— the resource integration, the distribution integration, the protection integration and the management integration, this book discusses the theories and methods about geopark researches under a macro-background, which fills in the gap of the geopark researches in Xinjiang.

Key Words: Xinjiang; geological heritages; geoparks; the geopark system integration; the resource integration; the exploitation integration; the protection integration; the management integration

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