

地质力学的方法与实践

第一篇

地质力学概论

(第二版)

李四光 著



地质出版社

地质矿产部“八五”重要基础研究项目

地质力学的方法与实践

第一篇

地质力学概论

(第二版)

李四光 著

地质出版社

· 北 京 ·

内 容 提 要

本书全面系统、简明扼要地总结了地质力学理论研究和科学实践成果,是地质力学这门地质学的边缘学科,最经典、最权威的一部专著,为构造地质学和动力地质学之间架起了一座桥梁,开辟了研究地壳运动的新途径。它主要从地壳结构的观点研究地质构造,即从发生的观点分析研究岩块或地块的构造形态,并按照动力作用的方式、方向来确定一切个别构造形象的分类和具有成生联系的各项构造形象的组合规律,建立起构造体系的概念。一个构造体系,是一定方式一场区域性构造运动的产物,是组成物质存在的型式。构造体系不仅仅是分析研究地质构造运动、地壳运动、乃至地球的圈层运动和整体运动的基础,而且构造体系对各种地质作用、矿产的形成与分布、环境地质、地震地质、地质灾害、工程地质、水文地质、各种地球物理场与地球化学场等均有重要的控制作用。全书共分四章,分别论述了地质力学方法、全球构造、地壳运动等有关问题,提出一系列的见解,这次修订时还增录了作者4篇重要论文,均具有很高的研究和实践应用价值,可供广大地质科研人员、高等院校师生和广大地质工作者学习、研究和参考。

图书在版编目(CIP)数据

地质力学概论:地质力学的方法与实践 第一篇/李四光著. -2版. -北京:地质出版社,1999. 10
ISBN 7-116-02862-5

I. 地… II. 李… III. 地质力学 IV. P55

中国版本图书馆 CIP 数据核字(1999)第 32280 号

地质出版社出版发行

(100083 北京海淀区学院路 29 号)

·责任编辑:袁方 谭惠静

责任校对:田建茹

*

北京印刷学院实习工厂印刷 新华书店总店科技发行所经销

开本:787×1092 1/16 印张:15.25 插页:4 页 字数:364000

1999 年 10 月北京第二版·1999 年 10 月北京第一次印刷

印数:1—500 册 定价:40.00 元

ISBN 7-116-02862-5

P·2032

(凡购买地质出版社的图书,如有缺页、倒页、脱页者,本社发行处负责调换)

序

与地质力学密切相关的第一篇文章“地球表面形象变迁之主因”发表于1926年。构造型式和构造体系的概念是在本世纪20年代末期提出的(Lee, 1929)。结合中国大陆及东亚地区的地质实际,根据地球表面实际见到的不同型式的构造体系来论断地壳运动的,是1939年出版的《中国地质学》(英文版)一书。地质力学作为一门学科是1941年秋冬之际,李四光教授应厦门大学校长萨本栋教授之邀为该校数学力学和物理系(当时由于抗战该校迁至福建长汀)的同学讲演时提出的。之后,李先生开始写《地质力学之基础与方法》,并于1945年完稿。该书稿曾由重庆大学地质系油印,当时,在重庆的中国地质学会同仁还举行过多次学术报告会。该书于1947年春由中华书局正式出版。

1949年10月1日中华人民共和国成立后,为了适应国家经济建设需要,开展了大量地质工作,包括矿产勘探、工程地质、水文地质以及国家建设中出现的其他各种地质问题。地质力学在李四光教授亲自领导和参与下投入到国家建设洪流之中,与其他地质科学一样取得了迅速的进展。60年代初,内部出版了《地质力学概论》。1970年,内部刊印了《天文、地质、古生物资料摘要(初稿)》一书。上述两本书均由李先生亲自执笔。书中不少的地质实际资料是由各方面的地质工作者提供的。

李四光教授在他早年和晚年的著作中均曾提出过:地质力学的主要目的是研究地壳构造和地壳运动的规律,探索地球运动的起源;研究各种矿产在地壳中的分布规律以及现代地壳运动的程式,借以指导矿产资源预测以及地壳稳定性评价,防治可能发生的各种自然灾害。

李四光教授在其遗著中曾提示我们:研究地球科学,要从地球看宇宙,要以事物的生因、发展和系统联系的观点,从事实现象追寻本质的要求,来研究地壳运动所产生的各种地质现象发生、发展的规律。

从李四光教授1926年发表第一篇文章起至1971年4月底他逝世这45年间,他为地质力学学科的建立及应用,做了大量的实际工作,开辟了地壳运动研究的一条新途径,为发展地球科学作出了重要贡献。从李四光教授逝世到现在,许多地质工作者沿着他开拓的道路又进行了21年的工作。从1926年到现在这66年间,在国家经济建设和人类社会生活需要的各种自然资源的寻找以及与人类生存相关的各种自然灾害的斗争中,地质力学伴同其他地球科学做了大量的有益工作。《地质力学的方法与实践》丛书,就是这项工作的一种记录。今后,我们将把这项工作继续下去,为认识自然和改造自然作出新的贡献。

孙殿卿

1994年11月,北京

PREFACE

The first paper closely related to geomechanics entitled the "Main Cause of the Changes of Superficial Features on the Earth" was published in 1926. As for the conception about the tectonic patterns and tectonic systems, it was put forth at the end of the twentieth century (Lee, 1929). It was in the book entitled the "Geology of China" (in English version) published in 1939 that the crustal movement had been proved by the author with the tectonic systems of different types actually found on the surface of the Earth, and in combination of the practical geological situation in the mainland of China and East Asia. Geomechanics as a branch of sciences was established in the autumn and winter time of 1941 by Prof. Li Siguang (J. S. Lee) during his lecturing for the students from the Department of Mathematics, Mechanics and Physics of the Xiamen University (moved to Changding City, Fujian Province owing to the anti-Japanese War) at the invitation of the Dean of the University. Later on Prof. J. S. Lee began to prepare the book on "The Basis of Geomechanics and Its Method", which was completed and was mimeographed by the Department of the Geology of the Chongqing University, Sichuan Province in 1945, and at the same time it was then once used as lectures for the colleagues of the Geological Society of China at Chongqing City. The particular monograph was officially published by the China Publishing House in the spring of 1947.

Since the founding of the People's Republic of China on October 1, 1949, in order to meet the need of the economic construction of the country vast amounts of geological work have been conducted, including prospecting for mineral resources, engineering geology, hydrogeology and various geological problems that have been occurred during the economic construction of the country. So geomechanics has been thrown into the mighty torrent of the economic construction of the country under the direct guidance of Prof. J. S. Lee himself and his personally taking part in the work, and as other branches of geological sciences, geomechanics in this way has also gained a rapid development. At the beginning of the 60's of this century the monograph: "An Introduction to Geomechanics" was published as a restricted publication, and in 1970 the monograph: "Astronomy, Geology and Palaeontology" (first draft) was also published as a restricted publication. All the above-mentioned monographs were written by Prof. J. S. Lee himself personally, by using a big amount of practical geological data provided by vast numbers of geological workers from various fields.

In his works published in his early and late years, Prof. J. S. Lee had repeatedly remarked that the major objective of geomechanics lies in the study of the regularity of crustal tectonics and crustal movement, in probing into the origin of the movement of the

Earth, and in investigation on the regularity of distribution of various mineral resources in the earth crust, as well as on the mode of occurrence of the modern crustal movement, with the purpose of guiding the prognostication of mineral resources and making the evaluation of the stability of the earth crust, thus preventing from the possible occurrence of these and those natural hazards.

In his posthumous works, Prof. J. S. Lee used to mention to the audience that in the study of geological sciences one must view the cosmos from the Earth and investigate the regularity of occurrence and development of various geological phenomena produced by the crustal movement from the viewpoint of the origin, development and systematic relations, and in accordance with the requirement of study on any matter by probing into the essence of things judging from the phenomena of the fact.

During the forty-five years of his life, starting the publication of his first paper in 1926, and being ended with his death at the end of April in 1971, Prof. J. S. Lee had completed large amounts of practical work for the establishment and application of geomechanics as a branch of sciences, and had opened up a new approach to the study of the crustal movement, thus making a great contribution to the development of geological sciences. From the time of his passing away till the present, many geological workers have conducted great amounts of work for twenty-one years along the path Prof. J. S. Lee had opened up. In the 66 years from 1926 till now, in the prospecting for natural resources needed for the economic construction of the country and social daily necessities of human beings, as well as in the struggle against various natural hazards that are closely related to the existence of human beings, together with other branches of sciences geomechanics has done a lot of useful things. The "Method and Practice of Geomechanics" series represents itself records of this kinds of work. In the future we will certainly keep taking this kind of records in order to make a new contribution to recognition and remaking of nature.

Sun Dianqing
November, 1994, in Beijing

《地质力学的方法与实践》编辑委员会

主任委员：孙殿卿

副主任委员：苗培实

委员：(以姓氏笔划为序)

| | | | |
|-----|-----|-----|-----|
| 马宗晋 | 邓乃恭 | 王小凤 | 王治顺 |
| 王维襄 | 宁崇质 | 刘 迅 | 刘特音 |
| 刘瑞珣 | 孙 叶 | 孙殿卿 | 李东旭 |
| 邵云惠 | 陈庆宣 | 苗培实 | 周济元 |
| 周显强 | 杨开庆 | 高庆华 | 徐炳川 |
| 黄庆华 | 崔盛芹 | 曾佐勋 | |

引 言

地球科学界正热烈地通过各种不同的途径研究岩石圈和全球动力学。地质力学工作者也积极地按照自己多年来形成的途径,即将地质学、地球物理学、地球化学和力学等多种学科结合起来,通过对地壳地质构造和地壳运动的研究,以深化地球动力学和运动学的研究。

因为,地壳虽然是地球整体结构中极薄的一层,但她却记录和保存下了地球形成、发展、演化的踪迹;记录和保存下了地壳以外,诸如包围地球的大气层,围绕地球转动的月球、太阳系,以及其他各种星体对地壳发生的影响,宇宙微尘和陨星之类的坠落等(星)球外事件的遗迹;记录和保存下了地壳以下,在高温高压条件下,地球各圈层物质的物理与化学变化和运动,以及由重力、日月潮汐作用和地球自转而产生的运动,都不可避免地要集中反映到地壳中来。

由此看来,如果其他研究地球动力学途径是科学的、有成效的,那么,地质力学以地壳为对象,通过对地壳地质构造、物质的运动和分布规律、地壳运动的起源和演化等的研究,由表及里、由浅及深、由局部到地球整体,深入地研究地球各圈层的组织构造、相互作用,地球的起源、演化和运动等一系列地球动力学和运动学问题,是不无道理的。

为此,地质力学工作者经过了长期的奋斗,在她自己的努力和各相关学科、广大科学工作者的支持下,做了大量的工作,取得了很多、很有意义的成果。经常地、及时地综合分析研究、总结这些成果,不仅对发展地质力学具有重要意义,对于发展地球科学,促进地质力学更好地为社会发展和国民经济建设服务,也不会没有意义的。地质矿产部和中国地质科学院将《地质力学的方法与实践》列为“八五”重要基础研究项目,在孙殿卿院士指导下予以实施。

早在 60 年代初,地质力学的创始人李四光教授就计划组织人力,编著一套《地质力学的方法与实践》系列专著,总结地质力学研究和实践成果。为此,他亲自草拟大纲,并将他自己主持撰写的《地质力学概论》专著做为该系列的第一篇。其后,他还提出对《地质力学概论》进行修订的意见。

这次的综合研究和总结工作,就是实现李四光教授的遗愿,修订第一篇,编著四篇六本书和一幅全球构造图,即:

第一篇 地质力学概论 李四光著,孙殿卿,苗培实等修订

第二篇 构造体系各论(中国典型构造体系分论) 王治顺等编著

第三篇 岩石力学与构造应力场分析 陈庆宣、王维襄、孙叶等编著

第四篇 地壳运动问题 高庆华等编著

现今地壳运动问题 马宗晋、杜品仁编著

第五篇 地质力学在矿产资源勘查中的应用 刘迅等编著

地质力学在环境地质中的应用 邵云惠等编著

全球构造体系纲要图 苗培实等主编

《地质力学的方法与实践》既然是在广大地质力学工作者和有关学科科学工作者科学研

究与实践应用成果基础上,经过综合分析研究、总结完成的一套丛书,无疑也是大家劳动成果的结晶。因此,除《地质力学概论》一书外,其他各篇册我们都用了“编著”一词,表示这一套书中还包含了他人的成果,并在此予以致谢。如果有什么疏漏和引用上的误解,也请予以批评指正。

《地质力学的方法与实践》编辑委员会

INTRODUCTION

The geosciences circles have now been heartily investigating the lithosphere and global dynamics in different ways. Meanwhile, the geomechanic workers have also actively deepened their investigations on the dynamics and kinematics of the Earth in a way created by themselves in the passing years, namely by combining the geology, geophysics, geochemistry and mechanics with one another, and through the study of geological structures on the earth crust and crustal movement.

So although the earth crust tends to constitute only a thin layer in the whole texture of the Earth, yet it has recorded and preserved all the features formed in the course of origin, development and evolution of the Earth; the results of the influence from the atmosphere surrounding the Earth, the moon rotating around the Earth, solar system, and the other celestial bodies upon the earth crust; as well as the traces of the outer-space events, such as the fall of the cosmic dust and meteorites. Besides, in the earth crust there must have undoubtedly been recorded and preserved in a concentrated way all the expression, under high temperature and pressure, of physical and chemical changes and motion of matter in the litho-, hydro-, air-, and bio-spheres of the Earth.

In view of this, if the other approaches of the study of geodynamics are considered to be scientific and effective, then the geomechanics with the earth crust being as its target of research should also be valid and reasonable, since it keeps to the principle of going deep into the study of geodynamic and kinematic problems concerning the structure and texture of the litho-, hydro-, air-, and bio-spheres of the Earth, mutual actions of the later, as well as the origin, evolution and motion of the Earth in a way proceeding from the outside to the inside, from the simple to the profound, and from the part to the totality through the study of the geological structures of the earth crust, the motion and regularity of distribution of matter in the earth crust, and the origin and evolution of the crustal movement.

For this reason, the geomechanical workers have conducted a great volume of work and have gained lots of meaningful results through their protracted struggle, and with their own effort and under the support of the interrelated branches of sciences and vast numbers of scientists. The frequent and timely comprehensive analysis and summation of these achievements and results are of great importance not only to the development of geomechanics, but also to the development of the whole geological sciences themselves and to promoting geomechanics to provide a better service for social development and national economic construction. With the support from the Ministry of Geology and Mineral Resources and the Chinese Academy of Geological Sciences, the publication of the *Method*

and Practice of Geomechanics series has been placed in the "Eighth Five-Year Plan of the Development of Natural Sciences" as an important project of basic researches to be implemented under the guidance of Academician Sun Dianqing.

As early as at the beginning of the 60's of this century, Prof. J. S. Lee, the founder of geomechanics used to plan to organize labour power to compile a set of the *Method and Practice of Geomechanics* series monograph, aiming at the summation of the achievements and results of the research and practice of application of geomechanics. For this purpose, Prof. J. S. Lee personally took a hand in drafting an outline for the particular series, and decided to take the monograph of his *An Introduction to Geomechanics* as the first volume of this series. Later on, Prof. J. S. Lee made comments on the revision of the monograph *An Introduction to Geomechanics*.

The present comprehensive research and summation is exactly the implementation of the behests of Prof. J. S. Lee, modifying the first volume and compiling six books of four volumes and a sheet of Global Tectonic Map, namely:

Volume I, *An Introduction to Geomechanics*, by J. S. Lee, modified by Sun Dianqing, Miao Peishi and Others.

Volume II, *Separate Treatises on Tectonic Systems (Individual papers on typical tectonic systems of China)* by Wang Zhishun and Others;

Volume III, *Petromechanics and Analysis of Tectonic Stress Field*, by Chen Qingxuan, Sun Ye, Wang Weixiang and Others;

Volume IV, *The Problems on Crustal Movement*, by Gao Qinghua and Others;
The Problems on Recent Crustal Movement, by Ma Zongjin and Du Pinren;

Volume V, *Application of Geomechanics in Prospecting for Mineral Resources*, by Liu Xun and Others;

Application of Geomechanics in Environmental Geology, by Shao Yunhui and Others;

An Outline Map of Global Tectonic Systems, by Miao Peishi and Others.

As the *Method and Practice of Geomechanics* series has been compiled on the basis of comprehensive analysis and summation of the results of research and practice conducted by vast numbers of geomechanical workers and scientists engaged in related branches of sciences, so it should undoubtedly be regarded as a crystallization of common effort of all the people concerned. Except for the monograph *An Introduction to Geomechanics*, for all other volumes of the series we use the term "Compilation", to mean that in the particular series results of research by other people are included, which the authors beg to acknowledge hereby. So and comments on possible oversights any omissions and mistakes in quotations are welcomed.

Editorial Board of *The Method and Practice of Geomechanics*

November, 1994, in Beijing

1973 年出版说明

本书是李四光同志根据我国广大地质工作者的实践经验,对地质力学的理论和方法的系统总结,是反映作者数十年研究成果的重要著作,是作者生前所列《地质力学的方法与实践》专题论著的第一篇。

这本书定稿于 1962 年。十年来,我国地质事业有了迅速发展,积累了丰富经验,获得了大量新资料。作者生前屡次提出要对《地质力学概论》初稿进行补充和修改,并亲自组织和指导这项工作。正值这本书稿的修订工作积极进行之际,李四光同志不幸逝世,修订工作未能在李四光同志主持下按原计划完成。现应各有关方面的要求,将《地质力学概论》按 1962 年版出版。为使广大读者了解作者生前对本书修订、出版问题的一些想法,特将“李四光同志生前谈《地质力学概论》的修订、出版问题的摘要”和他所拟有关《地质力学的方法与实践》的提纲附后。

前 言

地质力学的内容和任务是什么？现在看来，已经有了不少地质工作者注意到这个问题。也有一些地质工作者和“构造物理”工作者不提地质力学这个名词，可是他们的工作，显然是向往着地质力学的这一方面或那一方面。在这种情况下，从事地质力学研究工作的同志们，就迫切地感到有必要把自己所知道的那些，把自己的工作经验，总结一下，扼要地陈述出来，以便和大家商讨。

这个册子，连同将要和它在一起陆续出版的若干册子，就是为了试图满足上述要求而编写的。它们能否算得完满地或到某种程度解答了上面提出的问题，那只有当它们和读者见面时由读者来作出决定。

不待说，这个总结，仅仅是初步的。它还有待于付出大量劳动，加以充实和提高。即使就这样初步总结出来的几条工作方法和若干基本论点来说，它们也经过了一个比较长期的、通过实际工作反复改正过的曲折过程。如果从这个总结中，能够看出地质力学应当发展的方向，能够确定它的工作方法中某些重要的步骤，从而对地质勘探工作中出现的具体问题提供它自己的看法，对地壳运动问题提出它自己立论的根据，那么，这些册子的编印总算不是徒劳的。

本篇中涉及各家提供的资料和意见不少，难于一一列名。外国人名用汉字拼音，到现在还没有统一的办法，所以即使列举姓名，意义也不大。这个缺点，可以由文献目录部分地补偿^①，但很不完备，希望读者原谅。

作 者

① 1962年稿未列参考文献目录。这次出版，在遗留资料中，亦未找见参考文献目录。

目 录

| | |
|--|-------|
| 第一章 有关地质构造的若干传统概念述要 | (1) |
| 1.1 关于讨论地壳运动问题的若干重要观点 | (1) |
| 1.2 从地壳组成的观点研究大地构造的几个方面 | (2) |
| 1.2.1 基底和覆盖沉积层的划分以及它们各别形成的过程 | (2) |
| 1.2.2 隆起和沉降地区的划分以及它们相对的起伏形态的转变过程 | (3) |
| 1.2.3 地槽和地台的划分以及它们转变的过程 | (3) |
| 1.2.4 根据各种褶皱形态的特征推断基底的起伏形状 | (3) |
| 1.2.5 从造山褶皱、区域变质、火成岩活动地带的转移和硅铝层、硅镁层在地球表面分布的范围推断大陆成长的过程 | (4) |
| 1.2.6 在地面露出和假定埋伏在地下的深断裂对地块的划分亦即地壳的组成形式所具有的意义 | (4) |
| 1.2.7 从古地理形势的演变,或根据古地理形势的假定,结合区域地质的某些条件,划分构造区域为“构造单位”;并根据构造单位的某些共同特点,分别构造单位的类型;或按照它们各别固有的特点,划分独特的构造区 | (5) |
| 1.2.8 其他 | (5) |
| 1.3 从地壳结构的观点划分构造形态的若干传统概念 | (5) |
| 1.3.1 普通构造形迹类型的传统名称述要 | (6) |
| 1.3.2 多少被认为具有普遍性的构造带(或区)的若干重要类型 | (7) |
| 第二章 地质力学的方法 | (10) |
| 2.1 鉴定每一种构造形迹或构造单元(在地质力学上称为结构要素)的力学性质 | (10) |
| 2.2 辨别构造形迹的序次,按照序次查明同一断裂面力学性质可能转变的过程 | (17) |
| 2.3 确定构造体系的存在和它们的范围 | (18) |
| 2.4 划分巨型构造带,鉴定构造型式 | (20) |
| 2.4.1 第一类 横亘东西的复杂构造带 | (20) |
| 2.4.2 第二类 走向南北的构造带 | (24) |
| 2.4.3 第三类 各种扭动构造型式 | (26) |
| 2.5 分析联合和复合的构造体系 | (79) |
| 2.6 探讨岩石力学性质和各种类型的构造体系中应力活动方式 | (85) |
| 2.7 模型实验 | (93) |
| 第三章 当前地质力学中存在的问题 | (100) |
| 3.1 构造运动时期的鉴定 | (100) |
| 3.2 古构造型式的鉴定 | (102) |
| 3.3 各级构造型式对大矿化带和矿田的控制作用 | (103) |

| | |
|---|-------|
| 3.4 构造型式所涉及的地壳深度 | (103) |
| 3.5 各种结构面或构造面显示力学含义的特点 | (104) |
| 3.6 各别褶皱形式的决定因素 | (105) |
| 3.7 岩石的弹、塑性能的统一性与松弛现象 | (106) |
| 3.8 在岩层中不显示构造迹象的应力作用和现时尚在活动的应力分配 情况的探测 | (109) |
| 第四章 地壳运动起源问题 | (110) |
| 4.1 运动发生的时期 | (110) |
| 4.2 运动的方式和方向 | (111) |
| 4.2.1 从地壳各部分的组成探讨它们所经过的运动的方式和方向 | (111) |
| 4.2.2 从地壳各部分的结构探讨它们所经过的运动的方式和方向 | (113) |
| 4.3 运动的起源和动力的来源 | (116) |
| 主要参考文献 | (122) |
| 外国人名、地名索引 | (132) |
| 北半球表面出露的主要构造带简化图 | (136) |
| 附录 | (137) |
| 李四光同志生前谈《地质力学概论》的修订、出版问题摘要 | (137) |
| 《地质力学的方法与实践》(提纲) | (139) |
| 新增附录 | (140) |
| 地球表面形象变迁之主因 | (140) |
| 受了歪曲的亚洲大陆 | (166) |
| 关于地质构造的三重基本概念 | (183) |
| 地壳构造与地壳运动 | (190) |
| 英文摘要 | (220) |
| 后记 | (227) |

CONTENTS

| | | |
|------------------|--|------|
| Chapter 1 | Essentials of Some Traditional Concepts Concerning Geological Structures | (1) |
| 1.1 | Some Important Viewpoints Relating to the Discussion of Crustal Movements | (1) |
| 1.2 | Some Aspects of the Study of Tectonics from Crustal Construction | (2) |
| 1.2.1 | Division of the crust into basements and sedimentary covers and the course of their individual formation | (2) |
| 1.2.2 | Division of the crust into subsidence and uplift regions and the process of transformation of their relative undulations | (3) |
| 1.2.3 | Division of the crust into geosynclines and platforms and the processes of their transformation | (3) |
| 1.2.4 | Inference of the configuration of the undulations of the basement from the characteristic features of various fold types | (3) |
| 1.2.5 | Inference of the process of growth of continents | (4) |
| 1.2.6 | Significance of the exposed and supposedly buried deep-seated faults in the division of landmasses | (4) |
| 1.2.7 | Division of a tectonic region into tectonic units | (5) |
| 1.2.8 | The others | (5) |
| 1.3 | Some Traditional Concepts about the Classification of Structural Forms from Crustal Structures | (5) |
| 1.3.1 | An outline of the traditional terms for the common structural features | (6) |
| 1.3.2 | Some important types of tectonic belts | (7) |
| Chapter 2 | The Geomechanical Method | (10) |
| 2.1 | Determination of the Mechanical Properties of Each Kind of Structural Feature or Structural Unit | (10) |
| 2.2 | Discrimination of the Generations of the Structural Features and Investigation of the Possible Change of the Mechanical Properties | (17) |
| 2.3 | Ascertaining the Existence of Tectonic Systems and Delimiting their Extent | (18) |
| 2.4 | Differentiation of Large-scale Tectonic Belts and Identification of Tectonic Types | (20) |
| 2.4.1 | Complex E-W trending tectonic belts | (20) |
| 2.4.2 | N-S trending tectonic belts | (24) |
| 2.4.3 | Various shear tectonic types | (26) |
| 2.5 | Analysis of the Conjunction and Compounding of Tectonic Systems | (79) |
| 2.6 | Mechanical Properties of Rocks and the Manner of Stress Activity in | |

| | |
|--|--------------|
| Various Types of Tectonic Systems | (85) |
| 2. 7 Model Experiment | (93) |
| Chapter 3 Problems Currently Present in Geomechanics | (100) |
| 3. 1 Determination of the Age of Tectonic Movements | (100) |
| 3. 2 Determination of Old Tectonic Types | (102) |
| 3. 3 Control of Large Mineralized Zones and Ore Fields by Tectonic Types of Various Orders | (103) |
| 3. 4 Crustal Depth Involved in Tectonic Types | (103) |
| 3. 5 The Characteristic Mechanical Implications as Indicated by Various Tex- tural or Structural Planes | (104) |
| 3. 6 Factors Deciding the Forms of Individual Folds | (105) |
| 3. 7 The Unity of Elasticity and Plasticity of Rocks and Relaxation | (106) |
| 3. 8 Stresses Causing no Sign of Structural Features in Rocks and Measure- ments of the Distribution of the Presently Active Stresses | (109) |
| Chapter 4 Origin of Crustal Movement | (110) |
| 4. 1 Period of Movement | (110) |
| 4. 2 Manner and Direction in which the Movement Operates | (111) |
| 4. 2. 1 Study of the manner and direction of the movements of different crustal parts from their construction | (111) |
| 4. 2. 2 Study of the manner and direction of the movements of different crustal parts from their structures | (113) |
| 4. 3 Origin of Movements and the Source of the Dynamic Force | (116) |
| Main References | (122) |
| Index of Foreign Person and Place Names | (132) |
| Sketch of the Major Tectonic Belts Exposed in the Northern Hemisphere | (136) |
| Appendix | (137) |
| Mr. J. S. Lee Talked about the Modifying and Publication on the <i>An Intro- duction to Geomechanics</i> in 1970 | (137) |
| An Compiled Outline of the <i>Method and Practice of Geomechanics</i> | (139) |
| Increased Appendix | (140) |
| The Fundamental Cause of Evolution of the Earth's Surface Features | (140) |
| Distortion of Continental Asia | (166) |
| Triple Basic Concepts of Geological Structures | (183) |
| Crustal Structure and Crustal Movement | (190) |
| Introduction to Geomechanics in English | (220) |
| Postcript | (228) |