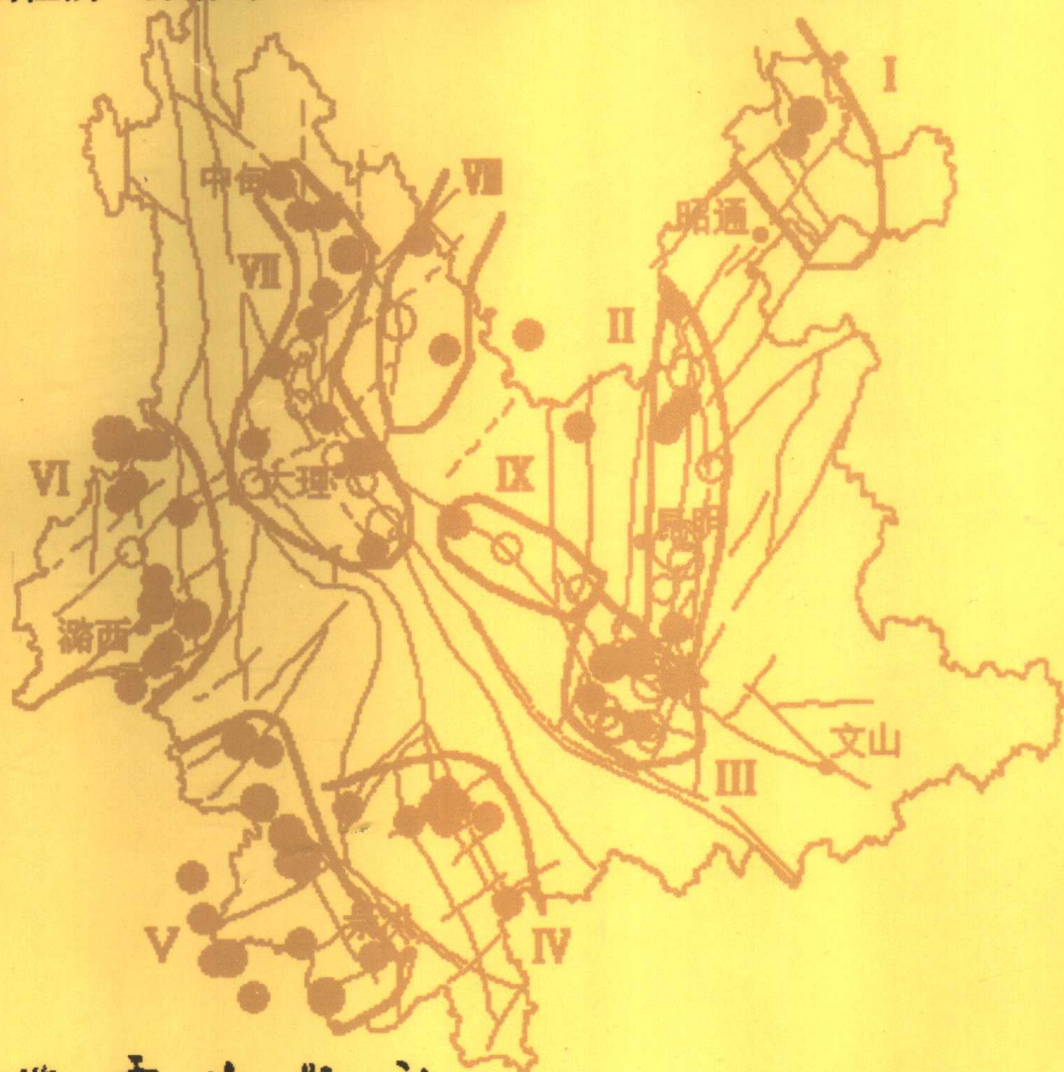


20世纪

云南地震活动

刘祖荫 苏有锦 秦嘉政 李忠华 张俊伟 编著



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前 言

在宇宙中，运动是永恒的。无论在星际之间，还是在物体内部，物质总在运动，地球上的地震和火山喷发就是地球内部物质运动的重要表现。

地球上从什么时候开始有地震发生，每年究竟发生多少次，恐怕任何人也难以说清楚。有人说地球上每年要发生 50000 次地震，这个数字必定是在一定条件下的估计。在今天，随着地震观测技术的不断提高，已经能够观测到负震级的地震，显然每年的地震数量已极大地增多。地球上发生地震的年龄有多大也是一个很重要问题。按一般常识讲，大概在地球形成之后就应该有地震发生，那么它应该与地球形成的年龄差不多。显然在人类历史之前及初期的漫长年代里不可能有地震记载。世界上记载地震历史最悠久的国家——中国也只有 3000 余年的地震记载，而且在 20 世纪前多有遗漏，资料明显不完整。只有发明地震仪之后，在 20 世纪世界上才有较完整记录的强地震目录，并随着地震仪器的不断改进，中小地震目录也逐渐完整起来。所以我们想了解地震活动的基本规律，系统地研究它的基本特征，显然用漫长历史时期的全部地震资料那是不可能的。在科学技术较发达的今天，科学家常截取较长时间段的段代资料经过系统的分析，推演事物发展的某些基本规律是可以实现的，这也正是现代地震学地震活动性学科研究的基本任务。

20 世纪是不平凡的世纪，也是地震科学发展不平凡的 100 年。人类首次全面科学的观测地震、认识地震，研究它的活动规律。随着人类社会文明的进步，迫于地震不断造成严重灾难，人类在逐渐认识地震的过程中，产生了要掌握它、预测它，甚至改造它的梦想。不少地震学家为此付出一生努力，耗尽了毕生心血。云南的地震科学工作者在这不平凡的世纪里，也做出了他们应做出的贡献。

云南地处中国西南边陲。由于特殊的地理位置和特殊的地质构造条件，使这里成为中国地震活动频度最高、强度最大、分布最广、灾害很重的主要省份。然而这里远离中国内地，民族繁多，毗邻国家多较落后，长期以来这里的政治、经济、文化一直处于封闭、落后、原始的状态。随着 20 世纪中国社会的大变革，这里的一切也随之发生了翻天覆地的变化，地震科学研究也随之而蓬勃发展起来。

1957 年国家在昆明黑龙潭建成了云南省第一个地震观测台。进入 20 世纪 60 年代，国家为在攀枝花、西昌一带建立中国西南地区最大的钢铁基地，于 1965 年在四川西昌、攀枝花一带与其接壤的丽江、剑川、永胜、华坪等云南西北地区建起一组区域性地震观测台网；次年在昆明成立了中国科学院昆明地球物理研究所，专门研究西南地区的地震问题；同期，地质、测绘、地化等方面的研究单位从不同的学科领域介入云南的地震工作，从此云南开始了地震科学与地震灾害研

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究全面发展的时期。特别是 1970 年通海地震、1974 年永善-大关地震、1976 年龙陵地震、1988 年澜沧-耿马地震、1995 年勐连西地震和 1996 年丽江地震等一个个大地震的发生，给云南造成了严重灾害，同时也为广大地震科学工作者全面深入研究地震提供了难得的机遇。他们抓住时期，不仅在地震研究的内容上从单一的为工程建设服务的地震烈度区划扩展到地震预报、地震机制、地震动力过程、地震灾害等多个学科领域，而且在地震科学事业的管理体制上，逐渐建立起在中国地震局统一领导下的省、地（州）、县各级地震局（办）系统管理机构。

云南毗邻印度板块与欧亚板块碰撞带和地中海-喜马拉雅地震带，加之近几十年大地震的频繁活动，这里自然成为众多地震学者关注并积极进行地震科学实验的基地。从 1965 年以来的 35 年间，来自世界十几个国家和国内几十个单位千余人次地震专家到这里工作；发表有关云南地震方面的研究论文或报告多达数千篇，内容涉及地震学、地球物理学、地球化学、天文气象与地震和地震经济等诸多领域，使云南的地震与地震灾害研究得到了前所未有的发展。

需要指出的是，云南的地震工作者，对云南这块不足全国面积 4% 的区域，整理和记录的 20 世纪这 100 年时间段内较完整的地震目录资料是全国平均水平的几倍之多，对 100 余次破坏性地震进行过现场地震地质和地震灾害调查，考察过规模不等的几十条与强地震发生有关的活动断裂构造。通过对这批丰富的地震资料研究，取得了一批很有见地和意义深广的成果。因此，认真总结这批地震科学财富，将是人类认识地震的一种升华，对 21 世纪云南地区乃至更广大范围地震的深入研究无疑有很大的帮助。基于这种认识，我们萌发了编写《20 世纪云南地震活动》一书的构想。

在现代地震学中，涉及的研究内容十分广泛，学科也相当多，任何人也不可能对所有问题涉猎。但是，地震作为自然界的一种自然现象有其自身的发生、发展规律。无论地震发生在哪里，这些基本规律应该是一样的，只是在不同的区域，不同的构造环境下表现的特征、强弱程度有所不同。对一个地区来讲，研究这个地区地震群体活动的时间、空间和强度分布特征是认识这个地区地震发生本质的基础。研究云南地区的地震活动特点既展现了云南地区区域性地震活动的特征，也透射出地震活动共同的基本特点。而且近几十年云南的地震学研究，在地震活动的时空特征、地震活动的动力环境、地震序列等方面的研究更有长足的进展。在规划编写这本《20 世纪云南地震活动》专著时，我们确定将笔触的视角投射到突显云南地区地震活动的基本特征或规律、强地震前地震活动图像及其演变、地震序列的基本特征与强震的关系等基本认识上。为了帮助读者认识这些特征，对形成云南地区地震活动基本特征的动力学环境有所了解，我们还对云南地区的地球动力环境、地壳结构、地震地质条件、地震应力场等作了简要阐述。

本书共分 6 篇 22 章，由绪论、大区域地震活动背景与构造环境、云南 20 世纪地震活动基本特征、地震活动图像及演变、地震序列、建立云南地震预报体系的思路和建议等 6 部分将其概括。书中所编写的内容并非全由我们几个人研究所得，我们只是从作者自己的认识角度，综合汇编了众多在云南地区工作过的地震

科学工作者辛勤劳动的成果。我们的作用只在整理加工而已。由于我们的水平有限，不少领域疏于研究，难免有缺点或错误，恳请读者指正。在本书的编写过程中，得到了云南地震局领导和赵洪声、毛玉平、谭春文、石绍先等同事和朋友的支持与帮助。在此，对他们和在云南从事地震工作辛勤劳动的同行、同学、同事与朋友们一并表示衷心感谢！

作 者

Preface

The Motion is forever in universes. It always exists material motion whether is the interplanetary or in the matters. Earthquakes and volcanoes on the earth are the representation of the interior matter motion of the earth.

It is very difficult to say when there was earthquake occurrence initially on the earth? How many earthquakes occur every year? Someone said there are 50,000 earthquakes every year on the earth, it may be a estimation in the some conditions. Today, with the advancement of the science and technology, development of seismological observation technology, the earthquakes with minus magnitude had been observed, therefore it is largely increased for the earthquake numbers in every year. It is an important problem how old the age of the earthquake on the earth. Generally speaking, it might have earthquakes took place when the earth be formed, then, it ought to be as much as the age of earth. It is impossible that there were records about earthquakes in the prehistoric and early long time of humankind history. Although, China is a country in the world having the longest record time of earthquakes, it is justly more than 3,000 years. But it exists a mass of lacks before 20th century, the data obviously is incomplete. When the seismograph had been invented in the end of 19th century, We had the relatively complete strong earthquake catalog in the 20th century. And with the advancement of seismograph, moderate and small earthquake catalog was gradually complete. Therefore, it is also impossible to conduct the studies on the basic regulars or features of earthquake activities by using long historical earthquake data. Some knowledge of earthquake activity regular we obtained at present is justly the researched results for the earthquake data in the range of some space and time.

20th century is a century out of common, also is 100 years remarkably for the development of seismology. It is 100 years that humankind observed and studied earthquakes at first in wholly and scientifically. With the development of society, and as well as the earthquake caused big disasters to humankind after by after, the dreams of predominating, predicting and changing it had been put forward in the process of studying it gradually. Many seismologists made efforts of a lifetime for it. Seismologists in Yunnan made their excellent dedications in this unusual century.

Yunnan is located at the southwest of China. Because of its special geographical and tectonic location, it becomes one of provinces with the most widely distribution, the biggest magnitude, the highest frequency of earthquake activities and the most seriously seismic disaster in China. However, it is far from the center of politics and

cultures of China, many kinds of nationality, its neighboring countries underdevelopment, therefore its politics, economy and culture had been in the states of obturation, underdevelopment and primaries. With the big changes of China society in 20th century, all in here took place great variations, and the study of seismology and seismic disasters had also been rapidly developing.

The first seismic station in Yunnan was built at Kunming in 1957. In the 60's of 20th century, a regional seismic network which were mainly distributed at Lijiang, Jianchuan, Yongsheng, Huaping in northwestern Yunnan, and neighboring Xichang, Panzhihua in Sichuan, had been established to build a steel base of Southwest China at Panzhihua, Xichang area. In next year, the Kunming Geophysical Institute, Chinese Academy of Sciences (CAS), was set up in Kunming, Yunnan, which is to conduct the study of earthquakes in Southwest China region. At the same time, some research units from geological, geodetic and geochemistry departments took part in the seismological works in Yunnan. Since then, the study of seismology and seismic disasters had been developed in Yunnan. Especially, with the occurrence of some big earthquakes, such as the 1970 Tonghai earthquake, 1974 Zhaotong earthquake, 1976 Longling earthquake, 1988 Lanchang-gengma earthquake, 1995 Western Monglian earthquake and 1996 Lijiang earthquake et. al., they caused seriously disasters to the peoples in Yunnan, but at same time, they provided the good chance for seismologists to study them. It not only promoted the development of many research aspects on earthquake prediction, mechanism, dynamic process and disasters, but also in the managing aspect of seismological works, a administrant system consisting of provincial, prefecture and county different levels Seismological Bureau (or Office) had been established in Yunnan, under the China Seismological Bureau (CSB).

Yunnan neighbored the collision belt of India-Eurasia plates and the Mediterranean sea-Himalayan seismic belt, and as well as frequently occurrence of big earthquakes in recent decades, therefore, here had been paid much attention by many seismologists and naturally became a base to conduct seismological experiments. Since 1965, there were ten hundreds seismological experts from more than ten countries in the world and tens units in our country come here to work; thousands of research reports and papers on Yunnan earthquakes, including seismology, geophysics, geochemistry, earthquake astronomy & meteorology et. al., had been published. They made the study of earthquake research in Yunnan greatly developed.

The area of Yunnan is less than 4% of countrywide area, but relatively complete earthquake data that had been packed up and recorded during 100 years of 20th century are times of countrywide average. Yunnan seismologists had carried out the field investigation on seismo-geology and seismic disasters for more than 100 destructive earthquakes occurred in Yunnan, as well as investigated several tens of large and small active faults which could be related to the strong earthquake occurrence. A lot of significantly research results had been obtained through the studies of those earthquake

data. Therefore, it is doubtlessly useful for the deep studies of earthquake in Yunnan or larger regions in twenty-first century to summarize those seismological treasures earnestly. On the basis of this understanding, the idea to write a book on “Seismicity in Yunnan on 20th century” had been given birth.

It includes much widely research fields and more subjects in the modern seismology, and it is difficult to study all aspects. Earthquake as a natural phenomena on the earth, has itself occurring and developing regulars. The basic features of these regulars could be same wherever the earthquake occurs, only the expressional ways and the strength or weak of earthquake activity could be dissimilarity in the different regions and tectonic environments. The studies of distribution features on time, space and strength of earthquake activity in one region are the basics to understand the essence of earthquake occurrence in one region. The studies of the characteristics of seismicity in Yunnan region can also give some commonly basic features on earthquake activity, besides Yunnan regional regular of earthquake activity. In the recent decades, the studies of seismology in Yunnan, especially on the studies of space-time features of earthquake activities, dynamic environments of earthquake occurrence, earthquake sequence et. al, got more advancement. In the design of this book on “Seismicity in Yunnan on 20th century”, we focus on the common understandings of many seismologists in Yunnan, on the basic features or regulars of earthquake activity in Yunnan region, the evolution process of seismicity in source zone and its near area before strong earthquake, the basic features of earthquake sequence and its relations to strong earthquake et. al.. In order to help readers to study it easily as well as have some knowledge about the dynamic environments of earthquake occurrences in Yunnan region, we also made simply discussions on the geodynamic environment, crust structures, seismo-geological conditions and stress fields et. al..

There are 6 parts, 22 chapters in this book, it is consisted of Introduction, Tectonic Environment and Seismicity Background, Basic characteristics of seismicity in 20th century in Yunnan, Seismicity Pattern and Evolution, Earthquake Sequence and Establishment of Earthquake Prediction System in Yunnan 6 parts. All contents in this book are not ourselves research results, we only compiled synthetically research results of many seismologists worked in Yunnan, in views of ourselves understanding. We cordially hope readers to give suggestions and criticisms for the mistakes in this book. The publication of this book had been supported and helped by the leaders of Seismological Bureau of Yunnan Province, as well as many colleagues and friends such as Professor Zhaohongshen, Professor Maoyiping, Mr. Tanchunwen, Professor Shishaoxian et al.. We would like to thank to them.

Authors

December, 1, 2001

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