



中国地质调查局地质调查专报 E0010 号

汶川地震灾区 航天遥感应急调查

REMOTE SENSING EMERGENCY SURVEY
IN WENCHUAN EARTHQUAKE AREA

秦绪文 杨金中 张 志 黄 洁 等著
余德清 陈有明 张 过 谷延群



科学出版社
www.sciencep.com

汶川地震灾区 航天遥感应急调查

REMOTE SENSING EMERGENCY SURVEY
IN WENCHUAN EARTHQUAKE AREA

秦绪文 杨金中 张 志 黄 洁 等 著
余德清 陈有明 张 过 谷延群

科学出版社

北 京

图书在版编目(CIP)数据

汶川地震灾区航天遥感应急调查 / 秦绪文等著. —北京:
科学出版社, 2009

ISBN 978-7-03-024325-6

I. 汶… II. 秦… III. 地震灾害—灾区—航天遥感—调
查报告—四川省—2008 IV. P316.271

中国版本图书馆CIP数据核字(2009)第044990号

审图号: GS(2009)408号

科学出版社出版

北京东黄城根北街16号

邮政编码: 100717

<http://www.sciencep.com>

西安煤航信息产业有限公司地图制印分公司

科学出版社发行 各地新华书店经销

*

2009年3月第一版 开本: 787×1092 1/8

2009年3月第一次印刷 印张: 37 1/2

印数: 1~1000

定价: 800.00元

《汶川地震灾区航天遥感应急调查》

编辑委员会

主 任: 王宝才 中国地质调查局 副局长
钟自然 中国地质调查局 副局长
副主任: 张洪涛 国土资源部 总工程师
中国地质调查局 副局长
王学龙 中国地质调查局 副局长
庄育勋 中国地质调查局基础调查部 主任
叶建良 中国地质调查局科技外事部 主任
侯金武 中国地质环境监测院 院长
成 员: 奚小环 中国地质调查局基础调查部 副主任
肖桂义 中国地质调查局科技外事部科研处 处长
贺 颢 中国地质调查局基础调查部区域物化遥处 处长
韦延光 中国地质调查局科技外事部科研处
李 敏 中国地质调查局基础调查部区域物化遥处
侯春堂 中国地质环境监测院科技处 处长

项目参加人员

综合研究组:	秦绪文	杨金中	张 志	黄 洁	杨 冰				
数据处理组:	张 过	郝跃生	谷延群	孟 昆	张瑞丝	高 培	孙 瑞	王云涛	
	杨军杰	黄 庭	郝利娜	路 丽	张 路	孙升敏	祝晓勇		
灾害解译组:	陈有明	余德清	褚进海	刘同庆	黄 燕	杨 扬	李 郑	姜端午	
	刘 立	夏 乐	黄树春	徐军伟	赵龙辉	李应真	乔彦肖	冯现辉	
	王飞跃	王亚红	强建华	卢中正	尹卫军	韦延光	李 敏	朱建省	
	殷志强	叶 林	杨小泊	计 方	马书玉	王选革	段 琦		
成果图制作组:	石 静	蒋华标	彭 宇	刘 智	田 立	焦润成	党 伟	栾学文	
	张 钊	李剑锋	陈 勇	武慧智	周智勇	许军强	冯 涛	仇大海	
	钟江文	曾 涛	李风艳	杜军海	高晓梅	孙吉祥	陈小琪	薛海红	
	蔺让霞	顾宇红	李 军	何 涓	李雅萍	同雪珍			
责任编辑:	彭胜潮	关 焱							

Editorial Committee of Remote Sensing Emergency Survey in Wenchuan Earthquake Area

Panel Chief:

Wang Baochang	Deputy Director General of China Geological Survey
Zhong Ziran	Deputy Director General of China Geological Survey

Deputy Panel Chief:

Zhang Hongtao	General Engineer of the Ministry of Land & Resources
	Deputy Director General of China Geological Survey
Wang Xuelong	Deputy Director General of China Geological Survey
Zhuang Yuxun	Director of Dept. of Geological Investigation, China Geological Survey
Ye Jianliang	Director of Dept. of Science and Technology and International Cooperation, China Geological Survey
Hou Jinwu	Director of China Institute of Geo-Environmental Monitoring

Members:

Xi Xiaohuan	Deputy Director of Dept. of Geological Investigation, China Geological Survey
Xiao Guiyi	Director of Division of Geo-science, Dept. of Science and Technology and International Cooperation, CGS
He Hao	Director of Division of Geophysics, Geochemistry & Remote Sensing, Dept. of Geological Investigation, CGS
Wei Yanguang	Division of Geo-science, Dept. of Science and Technology and International Cooperation, CGS
Li Min	Division of Geophysics, Geochemistry & Remote Sensing, Dept. of Geological Investigation, CGS
Hou Chuntang	Director of Division of Geo-science, China Institute of Geo-Environmental Monitoring

Members Participating in the Project

Comprehensive Research Group:

Qin Xuwen	Yang Jinzhong	Huang Jie	Zhang Zhi	Yang Bin
-----------	---------------	-----------	-----------	----------

Data Processing Group:

Zhang Guo	Hao Yuesheng	Gu Yanqun	Meng Kun	Zhang Ruisi
Gao Pei	Sun Rui	Wang Yuntao	Yang Junjie	Huang Ting
Hao Lina	Lu Li	Zhang Lu	Sun Sheng min	Zhu Xiaoyong

Disaster Interpretation Group:

Chen Youming	Yu Deqing	Xu Jinhai	Liu Tongqing	Huang Yan
Yang Yang	Li Zhen	Jiang Duanwu	Liu Li	Xia Le
Huang Shuchun	Xu Junwei	Zhao Longhui	Li Yingzhen	Qiao Yanxiao
Feng Xianhui	Wang Yuefei	Wang Yahong	Qiang Jianhua	Lu Zhongzheng
Yi Weijun	Wei Yanguang	Li Min	Zhu Jiansheng	Yin Zhiqiang
Ye Lin	Yang Xiaopo	Ji Fang	Ma Shuyu	Wang Xuange
Duan Qin				

Achievement Mapping Group:

Shi Jing	Jiang Huabiao	Peng Bei	Liu Zhi	Tian Li
Jiao Runcheng	Dang Wei	Luan Xuewen	Zhang Zhao	Li Jianfeng
Chen Yong	Wu Zhihui	Zhou Zhiyong	Xu Junqiang	Feng Wei
Yi Dahai	Zhong Jiangwen	Zeng Tao	Li Fengyan	Du Junhai
Gao Xiaomei	Sun Jixiang	Chen Xiaoqi	Xue Haihong	Lin Rangxia
Gu Yuhong	Li Jun	He Juan	Li Yaping	Tong Xuezheng

Responsible Editors:

Peng Shengchao	Guan Yan
----------------	----------

序

地震灾害的发生，通常导致灾区对外交通困难、通讯中断，使灾区的受灾情况不明，难以适时救灾；更为严重的是，地震灾害的发生往往诱发崩塌、滑坡、泥石流和地裂缝等次生地质灾害，使灾区雪上加霜，造成更大损失。利用遥感技术快速查明灾害分布与发育情况，对指导抗震救灾、减少灾区损失具有极其重要的意义。

汶川特大地震发生后，遥感工作者在第一时间利用多个国家、多类型(雷达、光学)、多分辨率(米级或亚米级)、多时相(震前、震后)航天遥感数据，快速调查了川、甘、陕三省60个受灾县(市)次生地质灾害与隐患，为灾区抗震救灾提供了快速、全面的服务。这些成果，再次彰显了航天遥感的优势，表现了国土资源部门广大遥感地质工作者娴熟的应用遥感技术解决地质灾害问题的能力。

作者们在进行灾区次生地质灾害和潜在地质灾害隐患遥感快速调查工作的同时，分析了地质灾害对土地、植被和水资源等破坏情况，实现了遥感图像信息的多学科全方位综合应用。从近600G遥感数据中筛选的典型灾害遥感图像是难得的宝贵资料；对图像准确扼要的分析提升了其科学性，实现了科学传播的目标；“一县一图一报告”能为灾区灾后重建提供参考，潜在灾害的预测可以预防二次灾害的发生，减少损失，有较高的社会效益和经济效益。对于人类生存而言，自然灾害是不可避免的，防灾减灾是必然趋势，作者将影响灾区次生灾害发育主要因子进行了定量和半定量综合研究，所得出的结论具有重要的科学意义和社会实用价值。

本书是国土资源部、中国地质调查局在抗震救灾工作中应用航天遥感技术进行灾区地质灾害遥感调查的最新成果，是反映汶川灾区震后地质灾害状况的最完整的资料之一。本书既是对地质灾害航天遥感快速调查工作方法的开拓，也是对地震次生灾害遥感识别理论和方法的总结，我有幸先睹为快。其公开出版必将进一步推动我国环境灾害遥感、灾害学及相关学科的发展，对我国地质遥感研究、生产和教学都将发挥良好的作用。

左建甘

2008年8月

Foreword

The earthquake usually causes traffic and communication problems in earthquake-hit zones, making the situation unclear to earthquake relief workers. What is worse, it usually induces secondary geological disasters like collapse, landslides, debris flows and ground fissures, which may cause even heavier losses in the earthquake-hit zones. Therefore, finding out rapidly the distribution and development of disasters via remote sensing is significantly important for giving directions in earthquake relief work and reducing losses.

After the catastrophic Wenchuan Earthquake, remote sensing workers promptly did survey the secondary geological disasters and hazards in 60 earthquake-affected counties (cities) in Sichuan, Gansu, and Shaanxi provinces by using multinational space remote sensing data of different sorts (radar and optics), different resolutions (meter-scale or sub-meter scale), and different dates (pre-earthquake and post-earthquake), which provided rapid and all-round service for relief work. This exhibits once more the advantages of space remote sensing and proves the capability of numerous remote sensing geologists from departments of land & resources to solve geological disaster problems by using remote sensing.

While they were doing a rapid survey of secondary geological disasters and potential geological hazards by remote sensing, the authors analyzed the damages of geological disasters on land, vegetation and water resources, realizing multidisciplinary, all-round, and integrated usage of remote sensing image messages. Typical disaster images selected from nearly 600G remote sensing data are precious materials. An accurate and compendious analysis of images has made them more scientific so as to reach the goal of correct message spreading. "One Map and One Report for One County" will provide reference in post-earthquake reconstruction, helping reducing losses and generating high social and economic benefits. Natural disasters are inevitable for human beings and disaster prevention and reduction is an inexorable trend. The conclusion from the authors' quantitative and half-quantitative study of major secondary disaster development factors has important scientific significance and social application value.

This atlas is the latest achievement of remote sensing survey of geological disasters in earthquake-hit zones by China Geological Survey of the Ministry of Land & Resources. It is one of the most complete materials reflecting the condition of post-earthquake geological disasters in Wenchuan. It is a conclusion of methodology of rapid survey for geological disasters via space remote sensing, of identification theory and methodology for earthquake secondary disasters. It's my pleasure to read it first. Its publishing will further promote the development of environmental remote sensing, catastrophology and other relevant subjects in China and exert a good influence on geological remote sensing research, production and teaching activities in China.

Academician *Zhuang Fenggan*

August 2008

前言

2008年5月12日14时28分,我国发生了震惊世界的四川汶川特大地震灾害。中国地震台网测定“5·12”汶川大地震的震级为8.0级,震源深度约为14km,最大烈度达XI度,余震3万多次。地震破坏道路、桥梁等基础设施,毁损房屋、农田等,引发大量的滑坡、崩塌、泥石流、堰塞湖等次生灾害。受灾地区人民生命财产和经济社会发展蒙受了巨大损失。为迅速查明灾区地质灾害分布状况,有针对性地开展抗震救灾活动,国土资源部、中国地质调查局紧急启动了“5·12”地震灾区次生地质灾害航天遥感快速调查工作,组织全国各地的60余名遥感工作者,在50多天时间内利用多个国家、多类型(雷达、光学)、多分辨率(米级或亚米级)航天遥感数据,快速解译了川、甘、陕三省60个县(市)次生地质灾害点与隐患点,通过“一县一图一报告”的形式,及时地为灾情评估、短期避险、应急处置等抢险救灾工作和灾后重建规划提供了重要基础数据和决策依据。

在国土资源部中国地质调查局的组织下,中国国土资源航空物探遥感中心、四川省地质调查院、安徽省地质调查院、湖南省遥感中心、河北省遥感中心、中国地质大学(武汉)、中国地质大学(北京)、武汉大学、中国煤炭地质总局航测遥感局、河南省地质调查院和中国地质环境监测院等单位参加了航天应急调查工作。本着总结、交流灾害应急遥感调查工作方法技术,展示典型地震次生灾害遥感影像特征,推广“5·12”地震灾区次生地质灾害航天遥感应急调查成果应用的目的,我们以“次生地质灾害卫星遥感数据购置及综合解译”成果报告为蓝本,经过多次删减、修改,凝练成本书,她是集体劳动的成果。本书前言、第一章和结语由秦绪文、杨金中、张志撰写;第二章由秦绪文、杨金中、黄洁、张过撰写;第三章由杨金中、张志、秦绪文撰写;第四章、第五章、第六章由黄洁、张志、余德清、陈友明、谷延群等撰写。张瑞丝、高培、焦润成、蒋华标、彭孝、田立、强建华等参与完成了本书相关图件的制作工作。

在项目实施和成书过程中得到国土资源部副部长、中国地质调查局局长汪民,中国地质调查局副局长王宝才、钟自然、张洪涛、王学龙,中国地质调查局基础调查部主任庄育勋,中国地质调查局科技外事部主任叶建良,中国国土资源航空物探遥感中心主任王平,中国地质环境监测院院长侯金武,中国地质调查局发展研究中心总工程师谭永杰等领导的关心和指导,得到中国地质调查局奚晓环副主任、贺颖处长、肖桂义处长、韦延光、李敏等同志的大力帮助。航天遥感数据采集工作得到北京视宝图像有限公司、北京同天视地空间技术公司、北京天目创新科技有限公司等的大力支持。李德仁院士在项目实施过程中给予了无私的帮助。庄逢甘院士在百忙中为本书作序,向读者介绍、推荐本书。科学出版社为本书的出版做了大量工作。谨此致谢。

由于我们的认识水平有限,特大地震次生地质灾害遥感研究涉及学科和研究领域多,书中难免存在不少缺点甚至错误,敬请读者给予批评、指正。书中引用了部分公开出版物和网上资料,这里向有关作者致谢!

Preface

At 14:28, May 12, 2008, an extremely big earthquake hit Wenchuan, Sichuan Province, China, which aroused great concerns in the world. According to China Seismic Network, the earthquake was 8.0 in magnitude, about 14km in focal depth, and XI in its largest seismic intensity, and over 30,000 aftershocks occurred. This earthquake has destroyed infrastructures like roads and bridges as well as houses and farmlands. It has caused lots of secondary geological disasters such as landslides, collapses and debris flows, and formed a plurality of dammed lakes. Great losses have occurred to human life, properties and social and economic development in the earthquake-hit zone. To find out promptly the distribution and development of geological disasters and to evaluate rapidly the earthquake losses so as to carry out earthquake relief works with a clear aim in the “5-12” Earthquake-hit Zones, an emergency survey via space remote sensing of secondary geological disasters has been started by China Geological Survey of the Ministry of Land & Resources, involving about 60 remote sensing experts from all over the country and utilizing multinational space remote sensing data of different sorts (radar and optics) and different resolutions (meter-scale or sub-meter scale). After more than 50 days and nights, the secondary geological disaster spots and risky spots in 60 counties/cities in Sichuan, Gansu, and Shaanxi provinces have been interpreted promptly in the form of “One Map and One Report for One County”, providing in time important basic data and decision basis for earthquake relief works like short-time risk avoidance, emergency reaction, and earthquake situation evaluation and post-earthquake reconstruction planning.

Organized by China Geological Survey of the Ministry of Land & Resources, China Aero Geophysical Survey & Remote Sensing Center for Land and Resources, Sichuan Geological Survey Institute, Anhui Geological Survey Institute, Hunan Remote Sensing Center, Hebei Remote Sensing Center, China University of Geosciences (Wuhan), China University of Geosciences (Beijing), Wuhan University, Aerial Survey Remote Sensing Bureau of China Coal Geological General Bureau, Henan Geological Survey Institute and China Institute of Geo-Environmental Monitoring have participated in this emergency survey. To conclude and communicate the working methods for emergency survey of disasters via remote sensing, to depict the characteristics of remote sensing images of typical earthquake secondary disasters, to promote the application of the achievements from the rapid space remote sensing survey of secondary geological disasters in “5-12” Earthquake-hit Zones, we have extracted a book from the *Report on Satellite Remote Sensing Data Requisition and Comprehensive Interpretation of Secondary Geological Disasters in the Earthquake-hit Zone*. It is achieved with jointed efforts. Preface, Chapter I, and Conclusion are written by Qin Xuwen, Yang Jinzhong, and Zhang Zhi. Chapter II is written by Qin Xuwen, Yang Jinzhong, Zhang Zhi, and Zhang Guo. Chapter III is written by Yang Jinzhong, Zhang Zhi, and Qin Xuwen. Chapter IV, V, and VI are written by Huang Jie, Zhang Zhi, Yu Deqing, Chen Youming, and Gu Yanqun. The whole book has been sorted out by Qin Xuwen and Yang Jinzhong and relevant drawings in this book have been made with the efforts of Zhang Ruisi, Gao Pei, Jiao Runcheng, Jiang Huabiao, Peng Bei, Tian Li, and Qiang Jianhua.

In writing of the book and the working of the emergency survey, we have got kind help from Wang Min, head of China Geological Survey and Vice-minister of the Ministry of Land & Resources, Wang Baocai, Zhong Ziran, Zhang Hongtao, and Wang Xuelong, deputy directors general of China Geological Survey, Zhuang Yuxun, Director of Primary Survey Dept of China Geological Survey, and Ye Jianliang, Director of Science & Technology Foreign Affairs Dept of China Geological Survey. We here sincerely appreciate concern and guidance of Wang Ping, director of China Aero Geophysical Survey & Remote Sensing Center for Land and Resources (AGRS), Hou Jinwu, director of China Institute of Geo-Environment Monitoring, Tan Yongjie, General Engineer of Development Research Center of China Geological Survey and other leaders, vigorous help of Pro. Xi Xiaohuan, He Hao, Xiao Guiyi, Mr. Wei Yanguang and Miss Li Min, strong support of Beijing SPOT Image Co., Ltd., Beijing Earth Observation Inc. and BSEI in remote sensing data acquisition working, selfless help of Academician Li Deren in project implementation process, preface, introduction to readers and recommendation of Academician Zhuang Fenggan for this book from his busy jobs, a great deal of work performed by Kang Gaofeng, dean of Aerial Survey Remote Sensing Bureau of China National Administration of Coal Geology and Science Press for publication of this book.

Because our acquaintance level is finite and remote sensing research fields for earthquake secondary geological disasters is plentiful, it is certain that this book has quite a few drawbacks even errors. We respectfully request readers to afford criticism and correction. We quote partial public publications in this book and here salute the related authors!

图例

Legend

地质灾害分布图

- 崩塌体
- 泥石流
- 河道堰塞点

地质灾害遥感影像图

- 崩塌
- 滑坡
- 泥石流
- 断裂
- 地裂缝

Distribution Map of Geological Disasters

- Landslide and collapse
- Debris flow
- Riverblocked place

Image Map of Geological Disasters

- Collapse
- Landslide
- Debris flow
- Fault
- Ground fissures

目 录

总论 地震灾区航天遥感应急调查概述

第一章 概况	5
第一节 工作区概况	5
第二节 孕灾地质背景	5
第二章 地震次生灾害遥感调查	8
第一节 次生地质灾害遥感应急调查的技术方法	8
第二节 灾区次生地质灾害遥感应急调查成果	12
第三章 次生地质灾害航天遥感综合研究	15
第一节 次生地质灾害的总体分布	15
第二节 次生地质灾害分布规律	17

分论 受灾县(市)次生地质灾害航天遥感调查

第四章 四川省	24
1. 汶川县	24
2. 北川羌族自治县	54
3. 绵竹市	65
4. 什邡市	71
5. 青川县	79
6. 茂县	84
7. 安县	93
8. 都江堰市	96
9. 平武县	100
10. 彭州市	105
11. 理县	114
12. 江油市	117
13. 广元市利州区	121
14. 广元市朝天区	123
15. 旺苍县	124
16. 德阳市旌阳区	125
17. 黑水县	127
18. 崇州市	128
19. 剑阁县	134
20. 松潘县	135
21. 苍溪县	137
22. 大邑县	138
23. 宝兴县	141
24. 汉源县	143
25. 石棉县	144
26. 泸定县	145
27. 洪雅县	146
28. 金川县	147
29. 雅安市雨城区	149

30. 芦山县	151
31. 犍为县	152
32. 康定县	154
33. 乐山市金口河区	155
34. 丹棱县	156
35. 丹巴县	157
第五章 甘肃省	158
1. 文县	158
2. 武都区	164
3. 宕昌县	167
4. 舟曲县	169
5. 康县	172
6. 甘谷县	174
7. 迭部县	176
8. 礼县	177
9. 成县	179
10. 西和县	181
11. 徽县	183
12. 天水市	187
13. 张家川回族自治县	190
14. 武山县	192
15. 秦安县	194
16. 清水县	196
17. 合水县	198
18. 泾川县	200
19. 崇信县	201
20. 两当县	202
21. 灵台县	204
22. 宁县	206
23. 平凉市	208
第六章 陕西省	210
1. 略阳县	210
2. 宁强县	212
结 语	213
英文概要	214
参考文献	215

附表 受灾县(市)重大地质灾害(隐患)一览表

附表1 汶川县	218
附表2 北川县	232
附表3 绵竹市	237
附表4 什邡市	239

附表5	青川县	243
附表6	茂县	247
附表7	安县	249
附表8	都江堰市	251
附表9	平武县	252
附表10	彭州市	255
附表11	理县	259
附表12	江油市	261
附表13	广元市	262
附表14	广元市朝天区	263
附表15	旺苍县	263
附表16	德阳市旌阳区	263
附表17	黑水县	264
附表18	崇州市	264
附表19	剑阁县	265
附表20	松潘县	266
附表21	苍溪县	266
附表22	大邑县	266
附表23	宝兴县	267
附表24	汉源县	267
附表25	石棉县	268
附表26	泸定县	269
附表27	洪雅县	269
附表28	金川县	269
附表29	雅安市雨城区	270
附表30	芦山县	270
附表31	犍为县	271
附表32	康定县	271

附表33	乐山市金口河区	272
附表34	丹棱县	272
附表35	丹巴县	273
附表36	文县	273
附表37	武都区	275
附表38	宕昌县	277
附表39	舟曲县	277
附表40	康县	279
附表41	甘谷县	279
附表42	迭部县	279
附表43	礼县	280
附表44	成县	281
附表45	西和县	282
附表46	徽县	282
附表47	天水市	282
附表48	张家川县	282
附表49	武山县	283
附表50	秦安县	283
附表51	清水县	283
附表52	合水县	283
附表53	泾川县	283
附表54	崇信县	283
附表55	两当县	284
附表56	灵台县	284
附表57	宁县	284
附表58	平凉市	285
附表59	略阳县	285
附表60	宁强县	285

Contents

Pandect The Summary of Remote Sensing Emergency Survey in Earthquake Area	
Chapter 1 General	5
Segment 1 General Situation of Survey Areas	5
Segment 2 Geological Background for Disaster Distribution	5
Chapter 2 Remote Sensing Emergency Survey of Earth- quake Secondary Disasters	8
Segment 1 Technical Methodology for Remote Sensing Emergency Survey of Secondary Geological Disasters	8
Segment 2 Remote Sensing Emergency Survey Results of Secondary Geological Disasters in the Earthquake- hit Zones	12
Chapter 3 Comprehensive Research via Space Remote Sensing of Secondary Geological Disasters	15
Segment 1 Spatial Distribution of Secondary Geological Disasters	15
Segment 2 Secondary Geological Disaster Distribution and Laws Enlightenment	17
 Sub-pandect Remote Sensing Survey of Secondary Geological Disasters in Earthquake-hit Counties/Cities	
Chapter 4 Sichuan Province	24
1. Wenchuan County	24
2. Beichuan Qiang Autonomous County	54
3. Mianzhu City	65
4. Shifang City	71
5. Qingchuan County	79

6. Maoxian County	84
7. Anxian County	93
8. Dujiangyan City	96
9. Pingwu County	100
10. Pengzhou City	105
11. Lixian County	114
12. Jiangyou City	117
13. Lizhou District, Guangyuan City	121
14. Chaotian District, Guangyuan City	123
15. Wangcang County	124
16. Jingyang District, Deyang City	125
17. Heishui County	127
18. Chongzhou City	128
19. Jian'ge County	134
20. Songpan County	135
21. Cangxi County	137
22. Dayi County	138
23. Baoxing County	141
24. Hanyuan County	143
25. Shimian County	144
26. Luding County	145
27. Hongya County	146
28. Jinchuan County	147
29. Yucheng District, Ya'an City	149
30. Lushan County	151
31. Qianwei County	152
32. Kangding County	154
33. Jinkouhe District, Leshan City	155
34. Danling County	156
35. Danba County	157
Chapter 5 Gansu Province	158
1. Wenxian County	158

2. Wudu District.....	164
3. Dangchang County.....	167
4. Zhouqu County.....	169
5. Kangxian County.....	172
6. Gan'gu County.....	174
7. Diebu County.....	176
8. Lixian County.....	177
9. Chengxian County.....	179
10. Xihe County.....	181
11. Huixian County.....	183
12. Tianshui City.....	187
13. Zhangjiachuan Hui Autonomus County.....	190
14. Wushan County.....	192
15. Qin'an County.....	194
16. Qingshui County.....	196
17. Heshui County.....	198
18. Jingchuan County.....	200
19. Chongxin County.....	201
20. Liangdang County.....	202
21. Lingtai County.....	204
22. Ningxian County.....	206
23. Pingliang City.....	208
Chapter 6 Shaanxi Province.....	210
1. Lüeyang County.....	210
2. Ningqiang County.....	212
Brief Conclusion.....	213
References.....	215

Attachment The Characteristics of Major Geological Disasters/Risks in Earthquake-hit Counties/Cities

Attachment 1 Wenchuan County.....	218
Attachment 2 Beichuan County.....	232
Attachment 3 Mianzhu City.....	237

Attachment 4 Shifang City.....	239
Attachment 5 Qingchuan.....	243
Attachment 6 Maoxian County.....	247
Attachment 7 Anxian County.....	249
Attachment 8 Dujiangyan City.....	251
Attachment 9 Pingwu County.....	252
Attachment 10 Pengzhou City.....	255
Attachment 11 Lixian County.....	259
Attachment 12 Jiangyou City.....	261
Attachment 13 Lizhou District, Guangyuan City.....	262
Attachment 14 Chaotian District, Guangyuan City.....	263
Attachment 15 Wangcang County.....	263
Attachment 16 Jingyang District, Deyang City.....	263
Attachment 17 Heishui County.....	264
Attachment 18 Chongzhou City.....	264
Attachment 19 Jian'ge County.....	265
Attachment 20 Songpan County.....	266
Attachment 21 Cangxi County.....	266
Attachment 22 Dayi County.....	266
Attachment 23 Baoxing City.....	267
Attachment 24 Hanyuan County.....	267
Attachment 25 Shimian County.....	268
Attachment 26 Luding County.....	269
Attachment 27 Hongya County.....	269
Attachment 28 Jinchuan County.....	269
Attachment 29 Yucheng District, Ya'an City.....	270
Attachment 30 Lushan County.....	270
Attachment 31 Qianwei County.....	271
Attachment 32 Kangding County.....	271
Attachment 33 Jinkouhe District, Leshan City.....	272
Attachment 34 Danling County.....	272
Attachment 35 Danba County.....	273
Attachment 36 Wenxian County.....	273
Attachment 37 Wudu District, Longnan City.....	275

Attachment 38	Dangchang County	277	Attachment 50	Qin'an County	283
Attachment 39	Zhouqu County	277	Attachment 51	Qingshui County	283
Attachment 40	Kangxian County	279	Attachment 52	Heshui County	283
Attachment 41	Gan'gu County	279	Attachment 53	Jingchuan County	283
Attachment 42	Diebu County	279	Attachment 54	Chongxin County	283
Attachment 43	Lixian County	280	Attachment 55	Liangdang County	284
Attachment 44	Chengxian County	281	Attachment 56	Lingtai County	284
Attachment 45	Xihe County	282	Attachment 57	Ningxian County	284
Attachment 46	Huixian County	282	Attachment 58	Pingliang City	285
Attachment 47	Tianshui City	282	Attachment 59	Lüeyang County	285
Attachment 48	Zhangjiachuan County	282	Attachment 60	Ningqiang County	285
Attachment 49	Wushan County	283			

总 论

Pandect

地震灾区航天遥感应急调查概述

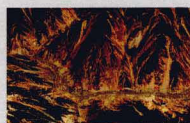


第 1 章 概 况



5

第 2 章 地震次生灾害遥感调查



8

第 3 章 次生地质灾害航天遥感综合研究



15

地震灾区84个受灾县(市)卫星遥感影像图
Remote Sensing Image of 84 Earthquake-hit Counties/Cities

