中国活断层研究专辑

阿尔金活动断裂带

国家地震局《阿尔金活动断裂带》课题组

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序

阿尔金活动断裂带是亚洲大陆内部一条令人瞩目的巨型断裂带。它自青藏高原的西北部斜切西昆仑山经苦牙克、安迪尔河、车尔臣河切入阿尔金山地，往东沿索尔库里谷地经党河、疏勒河延至甘肃玉门镇一带。主体部分长达1600公里，呈北东方向延展，它以其巨大的规模和极其醒目的线性形象引起了国内外地学界的重视。巨大的阿尔金活动断裂带由多条断层组成，是沿许多先存断层或构造边界发展起来的。它分割了塔里木盆地和柴达木盆地，有着极为强烈的新活动，成为高耸的青藏高原西北部的自然边界。它形成与发展的过程与青藏高原的隆起有着密切的联系。对这一巨大断裂带的研究有助于了解中国大陆内部的新构造运动及变形，深入认识青藏高原的形成和发展。是研究大陆内部地球动力学的一个重要构造形体。但是由于这一断裂带位于新疆、西藏、青海和甘肃四省区交界的偏僻山区，地旷人稀，交通不便，工作和生活条件困难，故一直缺乏大规模的系统研究工作。近年虽开始围绕这一地带开展了一些专题考察和研究工作，但有关这条断裂带的新活动方面的系统调查还是一个空白。1983年国家地震局在武汉召开的规划全国活断层研究工作的会议上我提出了组织一次较大规模的对阿尔金活断层现场调查研究的倡议，并正式列入项目计划。1985年由新疆地震局等多个单位专家组成的研究队伍开始了这项十分艰苦但很有意义的野外考察。五年来通过大量的现场和室内研究工作，围绕着断层的新活动这一研究主题取得了丰富的第一手资料，本书就是这次系统调查研究的总结。这本专著共分九章，包括阿尔金活动断裂带的区域环境、第四纪年代学、几何学、运动学的特征，沿断裂带的古地震、地震破裂带及断裂带的现代活动和构造应力场等多方面的论述。广泛应用了地质学、地震学、原地应力测量、构造物理模拟和数值模拟等国内外研究活断层的新方法获得了大批可贵的新资料。讨论的问题涉及断层活动的强度、方式、活动速率、上新世以来的水平位移量等。沿断裂带发现和揭露出了一大批古地震遗迹，地震破裂形变带总长度逾千公里，充分显示了这条断层的高度活动性，证实了在本世纪以来很少发生大地震的阿尔金断裂带是一条曾有过强烈地震活动的活断层带。这些结果为从更长的时间尺度认识中国大陆内部强震活动的图象增添了新的科学依据。

《阿尔金活动断裂带》这一专著是中国活断层系列研究的成果之一，内容丰富，资料翔实。编制的1∶10万分之一的断裂带活断层图第一次以图件形式展示了阿尔金活动断裂带全面的具体的活动面目，图上大量的实际材料是研究阿尔金活动断裂带的重要基础依据。反映断裂活动特征的大量照片可给读者增添直接印象。这本专著的编辑出版仅是阿尔金活动断裂带研究的一个重要的阶段性总结。它将对进一步研究阿尔金断裂带和青藏高原北部一带的地质、环境、地震工程和危险区划等方面发挥重要的作用，而且对研究活动构造、地震和板内地球动力学等方面的问题也将是一部很有价值的参考文献。

丁国瑜

1991年8月

FOREWORD

The Altun active fault zone is a notable huge fault zone in the Asian continent interior. It extends from the northwestern part of Qinghai–Xizang Plateau, cutting obliquely Kunlun Mts, passing through Kuyak, Andir River, Qargan River and Altun mountain region, and eastward stretching along the Horkor Valley and then across Danghe and Shule rivers into Yumeng Town of Gansu Province. The master part of the fault zone 1600 km long extends in northeast direction. Its large extent and strikingly linear manifestation on the surface has attracted the attention of the world geoscientists. The Altun fault zone is composed of several faults developed along the preexisting faults or the boundaries between structures. It separates the Tarim Basin from Qardam Basin, shows very strong recent movement, and becomes a natural boundary of northwestern part of the high–rising Qinghai–Xizang Plateau. The process of its formation and development is closely related with the uplifting of Qinghai–Xizang Plateau. Thus, research of this great fault zone is helpful for understanding neotectonic movement and deformation in the China continent interior and for deeper revealing the formation and development of Qinghai–Xizang Plateau because it is an important tectonic configuration in geodynamics of the continent interior. This fault zone has not been investigated extensively and studied systematically because it lies in a remote, immense underpopulated and ungetatable mountain region with severe conditions on the boundary between Xinjiang and Xizang regions and Qinghai and Gansu provinces. But the recent movement along this active fault zone is still a scientific gap remaining to be systematically investigated although the zone has been investigated from individual topics in the last years. During the Meeting on Research of Active Faults in China held by the State Seismological Bureau in Wuhan in 1983, I put forward a proposal on organization of extensive field investigation on the active Altun fault zone and it was formally placed as a project in the research program. This difficult but significant field investigation was started in organization of a research team of experts from Seismological Bureau of Xinjiang Region and other institutions in 1985. A large number of field and laboratory works for the project performed during five years produced abundant firsthand data and materials on the recent movement along the fault zone. This book as a monograph deals just with the results of the systematical investigation and research on the fault zone. The monograph consists of nine chapters concerning the regional environment for the Altun active fault zone, geochronology of Quaternary system, geometry, kinematic characteristics, paleoseismic events along the fault zone, seismic rupture zones, recent movement and tectonic stress field on the fault zone and other related aspects. A mass of valuable data were obtained using new geological and seismological methods, in–situ stress measurement, tectonophysical and numerical modellings in the research of the active fault zone. The problems given in this monograph are concerning with intensity, mode and rate of the movement and horizontal displacement along the fault zone since the Pliocene. A many of paleoseismic traces were found and exposed along the fault zone. Total length of seismic rupture and deformation zones exceeds a thousand of kilometers, showing sufficiently a high activity on the fault and indicating that the Altun fault zone in which no or less earthquakes occurred during this century is

an active fault zone in which strong earthquakes occurred in the past. These results provide a new scientific basis for understanding a picture of high seismic activity in the China continent interior in a more longer time span.

The monograph The Altun Active Fault Zone is one of the results of serial researches on active faults in China. It is abundant and content in data and materials. A map of active faults of the zone at a scale 1:100 000 first illustrates a whole picture of the fault activity in graphic form. A large number of new real data given in the map provides an important, essential basis for research of the Altun active fault zone. Many photos show readers a direct impression on the characteristics of the fault activity. The preparation and edition of the monograph is an important stage of summarizing the data and materials collected during investigation and research on the Altun active fault zone. These data and materials well play an important role in further study of geology, environment and earthquake engineering and seismic risk zonation of the Altun fault zone and northern part of Qinghai–Xizang Plateau and is a valuable reference for research of active tectonics, seismicity, intraplate geodynamics and other aspects.

Ding Guoyu

August 1991

前　言*

阿尔金活动断裂带是国家地震局作为中国活动断裂系列研究的重点断裂之一，以承包合同方式将综合性考察研究任务先后下达给新疆、甘肃、青海省(区)地震局，国家地震局地壳应力研究所和地质研究所等五个单位。在1985—1988年连续四年大规模野外考察、室内分析测试研究的基础上，我们将研究最终成果撰写成这本专著，奉献给对阿尔金活动断裂带感兴趣的国内外地学界同行参阅利用。

阿尔金活动断裂带是亚洲大陆内部一条举世瞩目的巨型左旋扭动构造，它西起西藏自治区北部的郭扎错，东至甘肃省西部的宽滩山，全长1600公里，由一系列断层组成，总体呈北东东方向延伸，为直线状构造。它是青藏高原西北部的一条自然边界，极为醒目地斜切昆仑山，分隔塔里木盆地和柴达木盆地，截断祁连山，在我国西部大地构造演化中占有重要位置。因此，研究阿尔金活动断裂带，对于认识断层活动及形成机制、地震成因、板内运动学和区域现今地球动力学等方面具有重要意义，一直为中外地学界所关注。

阿尔金活动断裂带位于新、藏、青、甘四省区交界的偏僻山区。在50年代前基本上是地质工作的空白区。随着国民经济建设的发展，50年代后期，石油部门和地矿部门曾在个别路线进行过普查找矿工作，1968年青海地质局区测队在冷湖以西进行了黑山河幅1∶20万区域地质调查和矿产普查工作，1970年新疆有色冶金局在若羌县茫崖附近进行了1∶10万区域地质调查与普查找矿工作。1979年起，新疆地质局区调队对若羌县索尔库里幅和巴什考贡幅进行了1∶20万区域地质测量填图，并对且末幅和柴达木幅部分地区开展了1∶100万地质填图工作。1979年新疆地震局为鉴定新（疆）青（海）铁路线地震基本烈度，初步研究了阿尔金活动断裂带吐拉至茫崖段的活动性，调查了1924年$7\frac{1}{4}$级地震的影响场。1981年国家地震局兰州地震研究所对阿尔金活动断裂带东北段进行了现场考察，研究断层的活动性和地震活动。1984年以来，吕太乙、邢成起、陈国星等研究了断层东段的几何学特征和活动性。地质学家李四光（1973）、张文佑（1974）、P.Molnar和P.Tapponnier（1975、1976，1977）、刘和甫（1980）、丁国瑜（1982）、潘桂棠（1984）和张治洮（1985）曾先后对阿尔金活动断裂带的形成发展、平移幅度和构造意义等方面进行过讨论。

按照1983年6月于武汉召开的中国活动断裂科研工作会议精神，开展了对阿尔金活动断裂带的综合研究，主要的研究工作是：

(1) 利用遥感技术对卫星影像和航空照片进行系统判读和测量，并通过实地检验，查明断裂带的展布、几何形态、结构组合与分段特征；

(2) 野外地震地质综合考察，实测跨断裂带大剖面，选择典型地段进行大比例尺地震地质填图。研究断裂带形成、演化、活动特点，特别是第四纪以来断裂活动方式、活动强度与活动速率；

(3) 对新沉积物进行^{14}C、热释光、孢粉分析，对断层泥石英颗粒进行电镜扫瞄，结合微地

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* 戈澍谟执笔。

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貌分析，确定断裂新活动年代与活动性质；

(4) 调查断裂带上的历史强震，在野外设临时地震台用轻便地震仪或 DR-200 型数字地震仪观察断裂带现代活动状况；

(5) 研究古地震标志和古地震形变带，开挖探槽查明断裂带近代活动，研究大震复现期；

(6) 在断层构造分析、介质特性研究的基础上，结合震源机制、水系分析资料，进行物理的和数值的构造模拟实验研究，借以认识区域构造应力场和区域构造动力学状态；

(7) 利用靠近断裂带的石油钻孔，进行钻孔崩落法原地应力测量，了解地应力分布；

(8) 在断裂带两侧的塔里木盆地和柴达木盆地进行系统的古地磁测量，了解地质历史时期古纬度和极移曲线的变动情况，结合区域构造分析，探讨阿尔金断裂带的运动学问题和区域地球动力学问题。

自 1985 年开始，国家地震局有计划地组织有关单位，先在东、西段，后在中段开展了综合考察研究工作。为了加强阿尔金活动断裂带的系统研究，增进各单位间的协作，使其达到 80 年代活断层研究水平，使整条断裂带的工作进一步深入、统一，遵照国家地震局的要求，在已有工作的基础上，经过充分酝酿协商，于 1986 年 9 月正式成立了国家地震局阿尔金活动断裂带研究课题组（即协调组），课题组由新疆地震局戈澍谟和柏美祥、甘肃地震局李玉龙、地壳应力研究所刘光勋、青海地震局曾秋生、地质研究所郑剑东和震害防御司朱世龙等七人组成，戈澍谟任组长，朱世龙任副组长，负责协调课题研究和专著出版工作。

课题任务分段落、分专题进行。新疆地震局负责索尔库里以西地段的综合考察研究和全带地震活动、构造物理模拟实验；甘肃地震局负责安南坝以东地段的综合考察研究；地壳应力研究所和青海地震局共同承担乌尊硝尔至当金山口之间的综合考察研究，地壳应力研究所并承担钻孔崩落原地应力测量；地质研究所承担区域古地磁专题工作。新疆地震局承担课题考察研究任务的有柏美祥、戈澍谟、胡军、刘景元、向志勇、罗福忠、尹光华、张华卿、钟健、谷青和姚颂民等，承担室内分析研究任务的还有郑福婉、胡方秋、范芳琴、金小玉、王煜、谷建忠、胥颐、寇大兵和阮成雯等。甘肃地震局承担课题考察研究任务的有李玉龙、张必敖、邢成起、何跟巧、廖远模、常秋君、万夫岭、郭玉英、何文贵、向光中、王多杰、吕太乙、罗治江、毛玉平和刘建生，承担室内分析研究任务的还有吕德徽、梁桂培、陈爱玲、李渭娟、邵世勤、孙贵珍、宋玉兰、秦保燕、李亚荣和姚兰予。国家地震局地壳应力研究所承担考察研究任务的有刘光勋、朱德瑜、舒塞兵、谢富仁、王焕贞、于振乾、翟青山、毛吉震、崔占桃，承担室内分析研究工作的还有奚云和魏庆云。青海地震局承担课题考察研究任务的有叶建青、张瑞斌、贾运宏、涂德龙、曾秋生、党光明、林彤、唐健和张治洮。国家地震局地质研究所承担课题考察研究任务的有郑剑东、程国良、黄昭、周春平，参加室内分析研究工作的有白云虹、孙宇航、孙青格和李素玲。国家地震局震害防御司朱世龙承担数值模拟实验研究任务。

四年来野外考察路线长达 10 万公里，解释航片 7500 张，实测跨断裂带地质剖面 6 条，总长 86 公里，实测河谷阶地剖面 13 条，在 14 条跨断层剖面上进行气体测量，实测断错水系数据 2230 个，开挖探槽 51 条，土石方量约 700 立方米；在条件较好的阿克塞和青石峡进行了 1∶50000 断层填图，填图面积约 950 平方公里；采集各种年龄测定、成分及物性参数分析样品 1262 个，其中^{14}C 样 85 个，热释光样 161 个，孢子花粉样 139 个，古地磁样 387 个，构造岩样 129 个，岩石测年样 12 个，岩石全分析样 4 个，岩石物性样 3 个，水样 21 个和气体样

320 个。在此基础上，编制了 1000 余公里长的 1∶10 万活断层与第四系分布图。

在课题研究过程中，国家地震局地质研究所八室、九室，国家地震局地壳应力研究所 ^{14}C 热释光实验室，国家地震局地球物理研究所岩石力学实验室，中国科学院古脊椎和古人类研究所，中国社会科学院考古研究所、兰州大学、同济大学、北京大学和新疆地矿局实验测试中心等有关单位协助完成部分样品测试和分析任务。

为保证课题研究总结工作高质量的完成，国家地震局震害防御司于 1988 年 8 月组织以丁国瑜为组长的专家组，亲赴野外现场进行考察验收与成果验收评议。赴现场考察验收的专家有张裕明、汪一鹏、叶洪、侯珍清、高维明、朱世龙等，朱海之、崔中元、石鉴邦、冯先岳和王克元参加了成果验收与评议。1991 年 3 月 15—20 日国家地震局邀集丁国瑜、马宗晋、邓起东、汪一鹏、韩慕康、赵国光、聂宗笙、高维明、冯先岳、刘百篪等专家对成果作了鉴定。在本书出版时，对关心和支持研究课题工作的国家地震局有关部门，各参加单位领导和专家们表示诚挚、深切的谢意。特别应当提到，国家地震局丁国瑜、葛治洲、李裕澈对本课题组织实施，对专著编写和出版给予热诚帮助。

本专著是多年来五个单位集体工作的主要成果，是参加课题全体人员辛勤劳动的结晶。参加本书撰写的有：新疆地震局柏美祥、戈澍谟、胡军、郑福婉、胡方秋、范芳琴、尹光华、向志勇、罗福忠和刘景元，甘肃地震局李玉龙、邢成起、何跟巧，地壳应力研究所刘光勋、朱德瑜、舒塞兵、谢富仁、翟青山、青海地震局曾秋生、叶建青、张瑞斌，地质研究所郑剑东、程国良，国家地震局朱世龙。戈澍谟承担全书统稿和定稿。书中 1∶10 万活断层图由尹光华、邢成起、何文贵、朱德瑜绘制，1∶100 万区域地质构造图由舒塞兵、尹光华和胡军编制，李胜年、杨继林、丁德轩清绘。在成书过程中得到沈德富、魏若萍、刘志坚、谢瑞民、孟军庆的帮助。

专著初稿完成后，承蒙丁国瑜教授和汪一鹏教授审阅，提出许多有价值的修改意见，在此表示衷心感谢。

PREFACE

The active Altun fault zone is one of the main subjects of the serial researches on active faults in China organized by State Seismological Bureau (SSB). The comprehensive investigation and research on the fault zone were contracted to the seismological bureaus of Xinjiang Region and Gansu and Qinghai provinces, Institute of Crustal Dynamics, SSB, and Institute of Geology, SSB. This monograph is prepared on the basis of final results of our four-year extensive field investigations and laboratory detections, analyses and researches successively performed during 1985–1988. It well be much benefit for geoscience colleagues at home and abroad interesting in the active Altun fault zone.

The active Altun fault zone is a world-famous great sinistral wrench structure. It extends from Gozhaco in the northern part of Xizang (Tibet) eastward to Kuantanshan Mt in the western part of Gansu Province in a total length of 1600 km. The fault zone consists of a series of faults and stretches as a straight-line structure in NEE direction. It represents a natural boundary of northwestern part of Qinghai-Xizang Plateau, strikingly cuts Kunlun Mts and separates Tarim Basin from Qaidam Basin, and bisects the Qiliang Mts. The fault zone is of importance in geotectonic evolution of the western China. Thus, research of the active Altun fault zone is significant for understanding the fault activity and its formation mechanism, genesis of earthquakes, intraplate kinematics and recent regional geodynamics and hence it attracted great attention of the world geoscientists.

The active Altun fault zone lies in a remote mountain region on the boundary between Xinjiang and Xizang regions and Qinghai and Gansu provinces. Geologically it was essentially a blank before 1950s. With increasing development of national economy, geological prospecting for mineral deposits was undertaken by geological and petroleum departments along the individual routes in the late 1950s. A regional geological mapping of Heishan River sheet at a scale 1:200 000 and mineral prospecting were performed in the area west of Lenghu by Regional Geological Survey Team of the Geological Rureau of Qinghai Province in 1968. Regional geological survey at 1 : 100,000 and mineral prospecting conducted by Xinjiang Color Metal Bureau in the area near Mangnai of Ruojiang County in 1970. Regional geological mapping of Horkol and Baxkargan sheets of Ruojiang County at 1:200 000 was conducted by Regional Geological Survey Team of Xinjiang Geological Bureau and geological mapping of Qiemo and Qaidam sheets at 1:100 000 since 1979. For identifying basic seismic intensity along the Xinjiang–Qinghai railway a preliminary investigation of the seismicity along the active Altun fault zone from Tura to Mangnai was undertaken by the Seismological Bureau of Xinjiang Region in 1979 and the area affected by 1924 M = 7 $\frac{1}{2}$earthquake was investigated. Field investigation on the northwestern segment of the fault zone was conducted by Lanzhou Institute of Seismology, SSB, in 1981, the fault activity and seismicity were studied. Since 1984, Lu Taiyi, Xing Chengqi, Chen Guoxing and others studied the geometric pattern of eastern segment of the fault zone and its activity. Geologists Li Siguang (1973), Zhang Wenyou (1974), P. Molnar and P. Tapponier (1975, 1976 and 1977), Liu Hefu (1980), Ding Guoyu (1982), Pang Guitang (1984) and Zhang Zhitao (1985) discussed successively on the formation and development of the active Altun fault zone, amplitude of its strike-slip

movement and tectonic significance and other aspects.

According to a proposal on the Working Meeting on Research of Active Faults in China held in Wuhan in June 1983, a comprehensive investigation and research project was undertaken on the active Altun fault zone from the following main aspects:

(1) Systematic interpretation and measurement of satellite images and aerophotos by remote sensing method and field examination of distribution, geometric pattern, structural combination and segmentation of the fault zone;

(2) Comprehensive field seismogeological investigation, cross fault profiling, and largescale seismogeological mapping of the selected typical fault segments for research of formation and evolution of the fault zone and the nature of its activity, especially the movement pattern, intensity and rate since the Quaternary;

(3) Determination of the age and nature of the latest movement along the fault by using radiocarbon and thermoluminescent datings and palynologic analysis of recent sediments, scanning electron microscopy of quartz grains from the fault gouge in combination with analysis of microrelief;

(4) Investigation of historic earthquakes along the fault zone, and observation on the regime of recent movement along the fault zone by installation of a temporal seismic station network with portable seismographs or DR-200 model digital seismographs in the field;

(5) Study of paleoseismic indicators and deformation zones produced by paleoearthquakes, trenching for revealing recent movement along the fault zone, and study of recurrence interval of great earthquakes;

(6) In order to understand regional stress field and dynamic state of the regional structures, physical and numerical modellings of the fault structure on the basis of structural analysis of the fault zone and the crustal media in combination with focal mechanism of earthquakes and analysis of stream system;

(7) For understanding the distribution of crustal stress, insitu stress measurement in the near-fault petroleum drills using a method of borehole breakoff;

(8) Systematic paleomagnetic measurement in the Tarim and Qaidam basins on both sides of the fault zone in order to understand the migration of paleolatitudes and polar drift curve in geologic history and study of kinematic problem of the Altun fault zone and regional geodynamic problem in combiation with regional tectonic analysis.

The comprehensive investigation and research organized by State Seismological Bureau were undertaken in plane first on the eastern and western segments and then on the middle segment of the fault zone since 1985. In order to systematization of the investigation and research on the fault zone, strengthen the cooperation between the research institutions, and make the research up to 1980s level, a Topic Research Group (i.e. Coordinating Group) on Active Altun Fault Zone under State Seismological Bureau was set up for further deepening and unifying the research works on the fault zone and fulfilling the quality requirements from State Seismological Bureau after a sufficient consultation. The topic group consists of seven members, Ge Shumo (chairman) and Bai Meison from Seismological Bureau of Xinjiang Uygur Autonomous Region, LI Yulong from Seismological Bureau

of Gansu Province, Liu Guangxun from Institute of Crustal Dynamics,SSB, Zeng Qiusheng from Seismological Bureau of Qinghai Province, Zheng Jiandong from Institute of Geology,SSB, and Zhu Shilong (vicechairman) from Department on Protection from Earthquake Hazards, SSB. Ge and Zhu are responsible for research coordinating and the monograph publishing.

The research works were performed by segments and subjects. Seismological Bureau of Xinjiang Region undertook the comprehensive investigation on the segment west of Horkol, seismicity of the whole zone, and tectonophysical modeling of the fault zone. Seismological Bureau of Gansu Province undertook the comprehensive investigation on the segment east of Annanba. Institute of Crustal Dynamics,SSB, together with Seismological Bureau of Qinghai Province undertook comprehensive investigation on the segment from Uzunxiaol to Dangjinshan Mt and in-situ stress measurement by borehole breakoff method. Institute of Geology,SSB, undertook regional paleomagnetic measurement.

Total length of field investigation routes reaches 100 000 km, and 7500 aerophotos were interpreted. Six geological profiles across the fault zone were investigated in a total length of 86km, 13 geological profiles along the river valleys were investigated. Gas detection was made on 14 cross-fault profiles. 2300 data of measured offset streams were obtained, 51 trenches were excavated amounting about 700$m^3$of earth and stone. Geological mapping was performed in an area of 950 $km^2$of Aksay and Qingshixia with more accessible conditions. 1262 geologic samples were collected for geochronological determination, chemical analysis and physical measurement, including 85 samples for ^{14}C dating, 161 samples for thermoluminescence, 139 samples for palynologic analysis, 387 samples for paleomagnetic measurement, 129 samples for structural analysis, 12 samples for geochronological measurement, 4 samples for bulk chemical analysis, 3 samples for physical measurement, 21 water samples and 320 gas samples for chemical analysis. On the basis of these results a map of distribution of active faults more than 1000km long and Quaternary deposits at 1:100 000 was compiled. In the research process analyses and measurements of geologic samples were performed by the Eighth and Ninth laboratories of Institute of Geology, SSB. ^{14}C and Thermoluminescence Laboratory of Institute of Crustal Dynamics,SSB, Rock Mechanics Laboratory of Institute of Geophysics,SSB, Institute of Paleoinvertibrate and Paleoanthropology,Academia Sinica, Institute of Archeology,Academia Sociologica Sinica, Lanzhou, Tongji and Beijing universities and Test and Analysis Center of Xinjiang Bureau of Geology and Mineral Resources.

In order to fulfill the high-quality summarizing the research results, an expert group chaired by Ding Guoyu and organized by Department on Protection from Earthquake Hazards,SSB, took an on-site examination and review of the field findings and then checked and accepted the research results of the performed project in August 1988. Experts Zhang Yuming, Wang Yipeng, Ye Hong and others took part in the on-site examination, check and acceptance of the research results. Ding Guoyu, Ma Zongjin, Deng Qidong, Wang Yipeng, Han Moukang, Zhao Guoguang, Nie Zongsheng, Gao Weiming, Feng Shengyue, Liu Baihu and others invited by SSB made an identification of the research results. In publication of the book a deep, cordial gratitude is expressed to the leaders and experts of the relevant departments of SSB concerning and supporting the research project and institutions taking part in

the research project, in particular to Ding Guoyu, Ge Zhizhou, and Li Yuche of SSB for their enthusiastic help in organization and performance of the project and in preparation and publication of this monograph.

The monograph deals with the multi-year research results obtained by a collective from five institutions and represents the fruit of hard work of the collective performing the research Project. Ge Shumo makes overall planing of preparation of the monograph and finalizes the manuscript. Shen Gefu and Wei Ruoping give help in the process of manusctipt preparation.

The first manuscript of the monograph was reviewed by professors Ding Guoyu and Wang Yipeng. Here a heartfelt gratitude is expressed to them for their many valuable suggestions on revision of the manuscript.

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第一章　区域地质构造环境与阿尔金活动断裂带的形成、演化*

阿尔金活动断裂带是中国西部一条巨型断裂构造，它是青藏高原西北部边界，自西藏北部的郭扎错，经新疆硝尔库勒、阿羌、吐拉，索尔库里、阿克塞至甘肃玉门的宽滩山，断裂总体呈北东东方向延伸，全长1600余公里。在卫星影像和航空照片上有非常清晰的线性显示。它的西段插入昆仑山，将其分为东、西两部分；中段分隔塔里木盆地和柴达木盆地；东段截断祁连山。它以巨大的左行走滑遗迹吸引世人注目。它的演化与区域地质构造环境密切相关。

第一节　区域地质构造

(一) 大地构造背景

我们将于田至玉门地区，阿尔金活动断裂带及其以北的库鲁克塔格东部的赛里克沙依断裂、塔里木盆地东南缘的且末河隐伏断裂带，以及其间一二百公里范围内的一系列北东向、北东东向至东西向断裂和断块，称之为"阿尔金构造系"（图1-1），该构造系的基本属性，李四光（1973）、陈国达（1975）、黄汲清（1980）、李春昱（1980）、张文佑（1984）、杨森南（1985）、马杏垣（1987）等已有论述，提出过许多看法。

板块学说的兴起，对中国区域构造的研究注入了新的活力，在全球岩石圈板块的基础上，地质学家们新的研究，进一步划分出小板块、亚板块、块体、地体……，阿尔金构造系为昆仑-阿尔金晚古生代板块俯冲带的一部分，它是新疆亚板块的南缘与南面的青-藏亚板块的衔接地带。阿尔金活动断裂带是划分新疆亚板块和青-藏亚板块的边界断裂带，它的北侧是新疆亚板块南部之塔里木块体，它的南侧为青-藏亚板块北部之甘-青块体。

在大陆碰撞之后，由于印度洋板块继续往北运动，造成碰撞带以北欧亚大陆板块内部的进一步强烈挤压，在中国大陆西部地区发生了一幕宏伟的构造运动，使一系列刚刚趋于稳定的块体又开始了新的调整。阿尔金断裂带作为块体间的纽带，在这场运动中继承、发展了老的构造断裂，演化成现今的亚板块边界。也正是由于阿尔金断裂带处于这样一个大地构造背景，研究阿尔金断裂带的新活动，是进一步认识中国大陆西部块体运动的重要环节之一。

(二) 区域构造层

阿尔金活动断裂带是不同大地构造块体的边界，各块体在地质历史演变过程中具有不

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* 执笔：胡军、舒寒兵、尹光华，参加本章编写的还有李玉龙、向光中、吕德徽等。

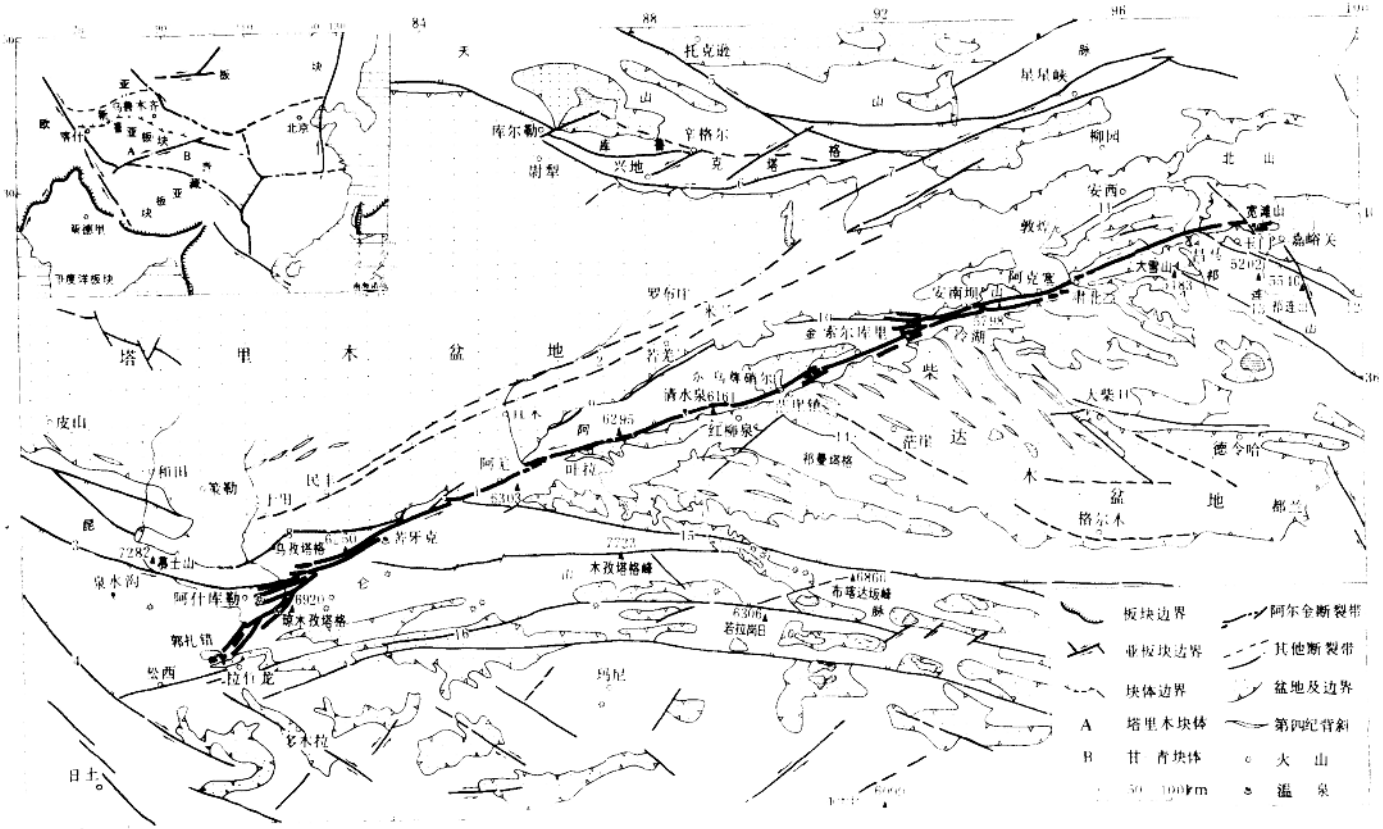

图 1-1 阿尔金活动断裂带区域构造分布图

1. 阿尔金断裂带；2. 且末河断裂带；3. 康西瓦断裂带；4. 阿格勒达坂断裂带；5. 婆罗科努断裂带；6. 兴地断裂带；7. 塞里克沙依断裂带；8. 亚门—柳什断裂带；9. 红尔勒萨依断裂带；10. 红柳沟断裂带；11. 三危山断裂带；12. 北祁连断裂带；13. 托来南山断裂带；14. 祁曼塔格断裂带；15. 阿尔喀断裂带；16. 昆仑南缘断裂带；17. 乌兰乌拉湖断裂带

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