新疆资源开发综合考察专著丛书

新疆第四纪地质与环境

中国科学院新疆资源开发综合考察队

中国农业出版社

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内 容 简 介

本书为中国科学院新疆资源开发综合考察队“新疆自然环境变迁研究组”，于1985—1989年对新疆考察研究成果的全面系统总结。全书共分11章，主要内容包括：新疆地区第四纪地质概况和若干代表性剖面的沉积层序和岩性地层、几个钻孔岩芯的磁性地层研究、第四纪年代学、第四纪生物地层学、第四纪沉积的元素地球化学和有机地球化学、第四纪沉积矿物学、第四纪冰川与环境、沙漠与沙漠化、新疆新构造运动以及第四纪时期的环境演变等。

本书可供地质、地理、地球化学、第四纪地质、水文工程地质及环境等科技工作者和有关高等院校师生参考。并可作为新疆地区经济建设和自然环境保护方面的科学依据。

中国科学院新疆资源开发综合考察队
科技成果编辑委员会

《新疆第四纪地质与环境》编委会

序

新疆是我国面积最大的一个省区，土地辽阔，草原广袤，日照充足，光热资源丰富，盆地虽降水稀少，高山却能依靠夏季雨量和冰雪融水，形成众多河流灌溉田野，为发展大农业提供了优越的自然条件。另一方面，新疆蕴藏着丰富多样的能源与矿产资源，既有广泛分布的油、气与煤炭，又有丰富的金属、非金属矿产，为发展工矿业提供了充足的动力和原材料。因此，从资源条件看，新疆具有工农业综合发展的雄厚物质基础，完全有可能建成我国重要的生产基地和一个相对独立的经济区域。

但是，由于新疆地处我国西北边陲，远离祖国经济发达地区，开发程度低，经济基础差，底子薄，资金、人才短缺，加之交通运输线长、气候干旱、水源不足等，成为开发新疆的不利条件和限制因素。

1983年5月和8月，中央领导同志先后视察新疆，提出了开发新疆和整个大西北，使之成为21世纪我国一个最重要的基地的战略设想。为了贯彻落实党中央的战略部署，根据中国科学院开发新疆科研工作的要求，本着科技工作面向经济建设的方针，中国科学院组织院内有关研究所，国家有关部、委的科研、生产部门、高等院校，会同新疆有关科研、生产单位，包括农、林、牧、渔、水、土、气、工业、交通、能源、环境、经济等专业的250名科技工作者，于1985年成立了“中国科学院新疆资源开发综合考察队”，围绕中央提出的“三个基地”（即畜产品基地、经济作物基地、石油能源基地），“五个重点行业”（即农牧业、石油和石油加工业、食品和纺织工业、动力工业、建材工业），“一个命脉、一个动脉”（即水和交通运输）的构想，在以往各部门的工作基础上，自1985—1989年，深入开展了以“新疆资源开发和生产布局”为中心课题的综合考察研究工作。旨在通过综合评价自然资源、自然条件与社会经济条件，搞清新疆的资源开发潜力、环境容量与经济发展方向，勾绘出20世纪末和21世纪初的生产力发展布局远景，明确建设重点和时序，为编制开发新疆的长远规划提供科学依据。考察队围绕上述中心课题，进行了以下8个方面的研究，即：

1.水土资源合理开发利用和水土平衡；

2.农业合理布局和商品生产基地建设；

3.能源需求预测和能源资源开发利用；

4.工业发展方向与工业基地布局；

5.交通运输发展方向和运网合理布局；

6.综合经济区划；

7.环境变迁和重点地区（及城市）开发后对环境的影响；

8.国民经济远景发展战略预测。

为了满足新疆编制“七五”发展规划，作为这项研究工作的第一步，考察队于1984年

7、8月间，组织了各方面专家，在中国科学院近30年对新疆调查研究工作的基础上，针对新疆农业自然资源开发利用与农业生产中的问题，撰写了《关于新疆农业发展的若干建议》，及时提供新疆自治区编制规划参考。

1985年是考察工作的第一年，考察范围主要在北疆地区，考察重点放在天山北坡地区（乌鲁木齐—石河子—奎屯—克拉玛依）和伊犁地区。

1986年考察范围主要在南疆地区。考察队应新疆维吾尔自治区主要领导同志和科委的要求，并配合自治区脱贫致富工作，重点考察了喀什、和田、克孜勒苏三地州。

1987年，考察队重点考察了东疆吐鲁番地区、哈密地区，南疆阿克苏地区、巴音郭楞蒙古自治州、库车县，天山中段山地，天山北坡核心区和北疆艾比湖等地区。

1985—1987年，考察队共计编写出包括《以北疆为主的新疆资源开发和生产布局的若干建议》、《关于新疆伊犁地区资源开发与工农业生产的若干建议》、《新疆维吾尔自治区喀什、和田、克孜勒苏三地州经济发展战略研究报告要点》在内的150余篇年度综合性、专题性考察研究报告、简要报告，75期研究简报，及时为新疆拟定发展规划方案提供了科学依据。同时，也为考察队的最终总结打下了良好的基础。

上述考察研究工作，由中国科学院-国家计委自然资源综合考察委员会主持。3年中，参加考察研究工作的有中国科学院-国家计委地理研究所，中国科学院武汉水生生物研究所、广州地质新技术研究所（原地球化学研究所广州分部）、新疆生物土壤沙漠研究所、新疆地理研究所、新疆分院开发办公室、地质研究所、沈阳应用生态研究所、南京地理与湖泊研究所、自然科学史研究所，国家计委能源研究所、综合运输研究所，林业部规划设计院，中国社会科学院工业经济研究所，铁道部铁道科学研究院，新疆农业科学院经济作物研究所、现代化所、园艺所，新疆计委，新疆经委，新疆社会科学院经济研究所，新疆建设兵团勘测设计二分院、一分院，新疆气象局气象科学研究所，新疆水利厅，新疆畜牧厅，新疆农业厅，新疆林业厅，新疆煤炭厅，新疆交通厅，新疆财政厅，新疆水产局，新疆统计局，新疆电力局，新疆石油管理局，新疆民航管理局，新疆环境保护研究所，新疆经济研究中心，乌鲁木齐铁路局，北京大学，东北林业大学，南京大学，新疆八一农学院，新疆石河子农学院等50余个单位（参加单位不分先后顺序）。

1988年开始，在队长石玉林，副队长李文彦、沈长江、毛德华、伯塔依、周嘉熹、康庆禹、郭长福等同志的领导下，全体考察队员将3年来所搜集的资料加以分析整理，经过集体研究讨论，编写出《新疆资源开发与生产布局》、《新疆区域经济发展战略研究》、《新疆水资源合理利用与供需平衡》、《新疆土地资源承载力》、《塔里木河流域农业自然资源合理开发和治理》、《新疆畜牧业发展与布局研究》、《新疆种植业资源开发与合理布局》、《新疆森林资源评价及生产建设布局》、《新疆水生生物与渔业》、《新疆能源需求预测与能源资源开发利用》、《新疆工业发展与布局》、《新疆经济系统投入产出分析》、《新疆交通运输发展方向与运网合理布局》、《新疆经济区域划分及发展战略》、《新疆生态环境研究》、《新疆国民经济发展战略研究》等16部新疆资源开发综合考察报告集。同时，还将编写完成《新疆植棉业》、《新疆种植业》、《新疆第四纪地质与环境》等科学专著。这些考察报告集与科学专著是在中国科学院和新疆维吾尔自治区党委、人民政府的领导，新疆兵团和自治区各厅、局的支持以及各参加单位的大力协作下编

写完成的，是全体考察队员辛勤劳动获得的硕果，是集体智慧的结晶。这些成果的出版，无论对制订新疆长远发展规划，还是对全国区域发展战略均具有重要的实际意义。同时，对多学科面向经济建设综合考察方法的理论化与规范化以及对地学、生物学、资源科学、环境科学、经济学等有关学科的发展，也有所裨益。

周立三

1989年3月

前　言

《新疆第四纪地质与环境》是中国科学院新疆资源开发综合考察队中由中国科学院广州地质新技术研究所主持的“新疆地区晚更新世以来自然环境变迁和发展趋势研究”课题，在1985—1989年对新疆考察研究基础上的全面系统总结。

认识自然环境的过去，无疑是预测未来环境不可缺少的依据。第四纪时期，尤其是晚更新世以来连续堆积的地层是研究冰期与间冰期气候，干旱期与偏湿期的波动，以及由之引起的古水文网、古植被、古土壤、古文化、古沙漠等一系列变化及其与现代环境关系的最理想的研究客体，因为这套堆积物距今年代较新，保留的自然环境过程的记录最清楚、最完整。

中国科学院广州地质新技术研究所“新疆自然环境变迁研究组”于1985年5—7月对北疆进行了考察，考察了天山北麓，伊犁盆地，北部湖区（艾比湖、艾里克湖）和塔城盆地（图2-1考察路线图）的黄土和第四纪地质，测量了若干有代表性的黄土剖面和湖区典型地质剖面，并采集了有关样品；考察了古尔班通古特沙漠西部及西南部（莫索湾附近）的沙丘，测量了典型沙丘剖面；考察了柴窝堡，仓房沟，天池的第四纪地质，测量了晚更新世具有代表性的剖面，观察了挽近地质历史时期天山冰川活动遗迹，采集了有关样品。

1986年6—8月，重点考察了南疆的喀什，和田及克孜勒苏柯尔克孜三地州。对天山南麓，昆仑山北麓和塔里木盆地西缘和南缘进行了第四纪地质和地貌的考察，收集第四纪时期气候，环境变迁的信息。通过南疆的考察，对策勒达玛沟，和田约特干遗址，叶城柯克亚，于田克里雅河康苏拉克等6个有意义的更新世和全新世沉积剖面做了较细致地观察和测量，并采集了供年代测量和物质成分分析的样品。

1987年，在前两年工作基础上，对北疆艾比湖和南疆和田地区进行了补充考察和采集样品，着重了解艾比湖演化的地质历史和发展趋势。在柴窝堡湖边打了500m深钻孔（与施雅风牵头的乌鲁木齐河流域水资源研究课题配合），对钻孔岩心进行了系统描述和采样。室内全面开展了古地磁，放射性碳同位素和铀系法年代测定，孢子花粉，介形类，粘土矿物，重矿物，氧碳同位素，元素地球化学和有机地球化学等项分析测试。探讨乌鲁木齐——柴窝堡地区第四纪以来的古气候、古环境演变和深层水文地质条件。

3年来，先后参加考察的成员包括：中国科学院广州地质新技术研究所文启忠、郑洪汉、黄宝林、乔玉楼、林绍孟、向明菊、史继扬、余素华、骆祥君、黄仁良、李海涛；中国科学院地球化学研究所李海滨，中国科学院新疆生物土壤沙漠研究所金昌柱和中国科学院地质研究所刘嘉麒等（共19人次）；沙漠考察是与新疆生物土壤沙漠研究所周兴佳、樊自立、钱亦兵等共同完成的，3年考察共计行程22000km，采集供各项分析测试的样品约2200块。

每年考察结束，立即转入各项分析实验和资料整理。参加室内分析测试工作的，除上

述野外考察成员外，还有中国科学院广州地质新技术研究所李华梅、卢良才、沈承德、姜漫涛、王俊达、高三玫以及地球化学研究所刘高魁，新疆生物土壤沙漠研究所吉启慧等同志。

每次考察结束，我们及时向“新疆资源开发综合考察队”队部提交了考察小结，并在分析和资料整理基础上，于1986年和1987年，先后提交了两份阶段性考察研究报告，其中“北疆晚更新世以来自然环境变迁与生产建设布局”阶段报告由文启忠、郑洪汉编写；“南疆地区晚更新世以来自然环境变迁”报告由文启忠、乔玉楼编写。在以上阶段报告基础上，于1988年，由文启忠、乔玉楼撰写了本课题的总结报告——“新疆晚更新世以来气候环境变迁及其对现代自然生态环境的意义”，汇集于新疆资源开发综合考察队环境组编写的《新疆生态环境研究》专集中。然而，由于文集的篇幅和学科间专业的限制，有关第四纪地质及其环境变迁方面的资料不能充分予以反映。为此，特撰写本科学专著。

本书的内容包括有（1）新疆地区第四纪地质概况和若干重点剖面岩性地层的描述；（2）新疆地区第四纪沉积的磁性地层学和年代学研究；（3）新疆第四纪生物地层学研究；（4）新疆第四纪沉积物地球化学和矿物学研究；（5）古冰川与环境；（6）沙漠与沙漠化；（7）新疆新构造运动；（8）第四纪时期的环境演变等。

参加本书撰写的除我队环境组部分成员外，还邀请了从事新疆第四纪地质研究多年，具有丰富经验的科技工作者：中科院冰川冻土研究所郑本兴；新疆地矿局第一水文地质大队张鸿义、沈才雄；新疆地震局冯先岳、吴秀莲等。全书内容提纲由文启忠拟定后，分别由下列同志执笔：前言：文启忠；第一章：沈才雄、张鸿义；第二章：文启忠、乔玉楼；第三章：李华梅；第四章：第一节乔玉楼，第二节黄宝林、卢良才；第五章：第一节林绍孟，第二节金昌柱；第六章：第一节余素华，第二节向明菊、史继扬；第七章：第一节钱亦兵，第二节刘高魁、文启忠；第八章：郑本兴；第九章：周兴佳；第十章：冯先岳、吴秀莲；第十一章：文启忠、乔玉楼。全书由文启忠最后定稿，乔玉楼协助全书的定稿。

新疆面积广，第四纪沉积类型多，厚度也大，我们对它的研究还是很初步的，有很多工作尚有待继续进行，并且有些问题还是探索性的，其中难免有错误和不当之处，敬请读者批评指正。

整个考察研究工作是在中国科学院新疆资源开发综合考察队的统一领导下进行的，故本专著也是考察队的最终成果之一。本工作得到施雅风、刘东生、涂光炽教授的指导和谢先德、付家谟、欧阳自远教授等的关心和支持。考察过程得到新疆维吾尔自治区人民政府，生产建设兵团的关怀和支持，并得到中国科学院开发新疆科研工作办公室，中国科学院地球化学研究所和广州地质新技术研究所，新疆生物土壤沙漠研究所，新疆地理研究所，新疆地质矿产局水文地质大队领导及同志们的支持与帮助，使工作得以顺利进行。新疆资源开发综合考察队郭长福副队长审阅了全文并提出了宝贵意见。书内插图系由中国科学院地球化学研究所黄万才完成。于此一并致谢！

编　者

1993年10月

QUATERNARY GEOLOGY AND ENVIRONMENT OF XINJIANG REGION, CHINA

ABSTRACT

The book "Quaternary Geology and Environment of Xinjiang Region" is a comprehensive summing-up in Quaternary geology and environment of Xin jiang Region based on the research carried out from 1985–1989 by the research group "Natural environment changes" of the comprehensive investigating team of Chinese Academy of Sciences for exploiting resourses of Xinjiang Region. 12 representative geological sections were detailly measured and investigeted after travelling over 20000 km and spending three summers from 1985–1987 for the field work. 16 person-times took part in the field work and over 2200 samples were collected from the sections. The sections mainly are Ganqu of Lake Aibi, bore hole section of Lake Caiwopu, Kansu loess section of Xinyuan County of Hedian, sand dune of Valley Celedama and so on. The datings of C-14, paleomagnetism and TL, analyses of spore-pollen, clay minerals, heave minerals, geochemical elements and organic materials, isotopes of oxygen and carbon, studies of vertebrata and Ostracoda fossils were performed.

Based on the studies of Quaternary sediments, such as loess-paleosol serpes, lacustrine, fluvial, glacial sediments and aeolian accumulation, a scheme of Quaternary stratigraphic chronology in Xinjiang Region was propounded. The history of the environmental evolution during Quaternary period, especially, on the various time scales since 730 ka, 400 ka 120 ka and 12 ka B.P., respectively, was investigated accouding to the climatic and environmental informations obtained from Quaternary sediments. The informations are the reliable basis for the detection of climatic evolution in the future. Our studies on the desertification, seismic calamity and aridity as well as the effect of Quaternary environmental changes and the present ecological environment provided a scientific basis for protecting natural environment of Xinjiang Region.

I. Quaternary chronology and the devission and comparation of stratigraphy in Xinjiang Region

A complete Quaternary stratium including Early, Middle and Late Pleistocene series and Holocene series exists in the region in the light of the data from drill cores and natural sections. Paleomagnetic result of Bore hole CK-1 with a depth of 500 m in Caiwopu basin shows that Brunhes and Matuyama chrons and Olduvai subchron (at 470-475 m deep, 1.67-1.87 Ma B.P.) were recorded. The Bore hole W_{48} located at upper reaches of River Wulumuqi pierces whole Quaternary system throught to the Tertiary red bed and the boundary between Gauss and Matuyama chrons (2.4 Ma B.P.) was found at the depth of 447 m of the hole. We would take the depth and the age of 2.4 Ma as the Quaternary bottom in Xinjiang Region. In CK-1 the beds of diluvial sands and graits bellow the depth of 123 m (corresponding to the boundary between Brunhes and Matuyama chrons) belong to Early Pleistocene and can be compared with the Xiyue Formation (conglomerate) which is extensively distributed in Xinjiang Region. The Kongsulake conglomerate rock on the terrace of River Keliya in Yudian area has the same age.

A complete Middle Pleistocene series was exporsed in the CK-1. It is composed of three alluvial and diluvial beds and two lacustrine beds H_4 and H_5 sandwiched inbetween. Brunhes-Matuyama boundary (0.73 Ma B.P.) is taken as the bottom of Middle Pleistocene while the lacustrine bed H_3 on the top of the series as the boundary between Middle and Upper Pleistocene series.

The bed H_3 at depths of 34.6-42.4 m in the bore hole CK-1 corrsponds to the oxygen isotope stage 5 in the deep sea core and its ages were estimated to be from 75-140 ka, it was the last interglaciation time. The strata above H_3 are composed of two alluvial-diluvial beds and a lacustrine bed H_2 interbedded, they correspond to the oxygen isotope stages 4, 3 and 2, respectively.

A representative Middle Pleistocene loess section is located at Kansu of Xinyuan County in Yili basin. Kansu loess section with a thickness of 22 m includes five loess beds and four paleosol beds, they occure alternatively in the section. The TL ages of the lower parts of the loess beds are 74 ± 6 ka, 140 ± 12 ka, 170 ± 20 ka, 290 ± 23 ka and 390 ± 33ka B.P., respectively. The ages and characters of the section can be compared with those of the upper part of Lishi loess in the middle reach of Yellow River. The greyish brown paleosol with a C-14 age of 24 ka found in the Niuqiuanzi section of the northern side of Mt. Tianshan corresponds to the bed H_2 in bore hole CK-1. The loess beds above and bellow the paleosol bed can be compared with the oxygen isotope stages 2 and 4 of deep sea core, respectively.

A perfact Holocene series in Xinjiang Region is exposed in Ganqu section at the southern margin of Lake Aibi. The upper part of the section consists of three brick-red silt-clayeg sand beds (burned beds) interbedded two grass peat beds and a blue-grey mild clay bed. The lower part of the section includes.three blue-grey mild clay beds and three black muddy clay beds alternatively interbedded.The thickness of the section is 460 cm.The third peat bed aged 11880±500 a in the bottom of the section is taken as the bottom of Holocene. The section can be detailly subdevided into three parts: Early, Middle (upper and lower) and Late Holocene series.Their boundary ages are 8.5, 6.5 and 2.0 ka B.P.respectively.

II. Quaternary environment change of Xinjiang Region

During the time from the Late Tertiary to the Early Quaternary the climate in Xinjiang Region became dryer and dryer because of uplift of the Qing-zhang Plateau.In Mt.Tianshan area occured glaciation in the Early Quaternary when the global climate was rapidly getting colder.The Mt.Tianshan area was controlled by glacial-periglacial climate. The uplift of Qing-Zhang Plateau changed atmospheric circulation. Caiwopu area became a interior basin.

A alternating climate of arid to moist and cold to warm with different intensity and time scale occured in the basin on the basical arid background.

Five alluvial-diluvialb eds and four lacustrine beds deposited in CK-1 since 730 ka B.P.represent five marked arid-moist, cold-temperate (or warm) climatic fluctuations.They are: 730-550 ka,cold-arid; 550-400 ka, temperate-moist; 400-300 ka, cold-arid; 300-200 ka, temperate-moist; 200-120 ka, cold-arid; 120-75 ka, temperate-moist; 75-12 ka, cold-arid (including a moist-temperate interstadial stage from 30-23 ka) .Bed H_5 was formed in a shallow water environment and the climate at that time was the most temperate in the region and it can be compared with Holstein interglacial stage of North Europe.The "Beijing Man" of Zhoukoudian area was living during the time.

The loess-paleosol series at the kansu section of Xinyuan County completely recorded the history of climatic and environmental changes since 400 ka B.P. The five loess beds in the section correspond to five reletive cold and arid climatic stages, whereas the four paleosol beds recorded four reletive moist climatic stages. This evolutional history coincides with that recorded in the typical loess section of Luochuan area in the middle reaches of Yellow River, but developmental degree of paleosol in Kansu section is not as good as in Luochuan loess, it means that the warm and moist degree in

Kansu area was weaker than in Luochuan at that time.

A continuous lifting of entire Qing-Zhang Platcau and the areas around it during the late period of Late pleistocene speedded up aridity of Xinjiang Region, but on the arid background there still existed moist climatic fluctuations, There were four moist stages at least since 120 ka B.P. Stage 1, 120-75 ka, the first paleosol bed S1 in Kansu section of Yili basin and Lujiaowan section at the northern foot of Mt. Tianshan as well as the bed H3 in the bore hole CK-1 of Caiwopu basin recorded this period. During that time, Eem interglaciation of North Europe occured, the paleosol bed beneath Malan loess bed in the middle reaches of Yellow River was developed, the lacustrine sediment in Lake Shati in Sahara of Africa was formed; Stage 2, 30-23 ka B.P., the moist climatic stage was recorded by the greyish brown paleosol bed SL (C-14 age; 24 ka B.P.) in Niuquanzi loess section at the north foot of Mt. Tianshan and the bed H2 in CK-1 (C-14 age; 23 ka B.P.). This period belongs to a interstadial stage of the last glaciation and can be compared with the lacustrine sedimental time in Lake Ateria in Sahara. The greyish brown paleosol bed in the middle part of Malan loess in the middle reaches of Yellow River was also formed in the period. The lacustrine bed H2 and the alluvial-diluvial beds above and below it can be compared with the sediments formed during the early stage, full stage and late stage of Weichselian glaciation in North Europe, respectively; Stage 3, 15-13 ka B.P., paleosol was extensively developed in Xinjiang Region, such as the paleosol beds on the alluvial fans of River Muzati, on the alluvial plain of River Yierqiang and on the drift sheet of Bogeda Peak. They recorded anincrease of temperature during the late stage of the last glaciation; Stage 4, the moist stage, occured in the middle time of Holocene.

The bottom age of Holocene in Xinjiang Region is 12 ka B.P. During the early Holocene the climate was arid-cool, in the middle Holocene(8000-3000 a B.P.), under the control of global climate, a reletive warm and moist climate in Xinjiang Region appeared and it can be compared with warm-moist Atlantic period in North Europe. During that time, in Xinjiang Region two times of higher lake level have been recorded, 8400-7300 a and 6000-3400 a B.P. in Lake Aibi, for instance. Meanwhile two terraces of Lake Caiwopu were developed extensively, the C-14 ages of them are 7695 ± 200a and 3830 ± 70 a B.P., respectively. The periods when the two higher levels of the lake occured correspond to those of higher temperature in the globe. Professor Zhu Kezheng pointed out that the annual average temperature during that time was 2℃ higher than that today, in the center area of Mt.

Tianshan the temperature was 1℃ higher than today and moisture and precipitation increased obviously. A yellowish-brick-red bed formed due to burning of natural fire at 6600 a B.P. indicates a arid climate during the global temperate climatic time.

After the warm-moist time of the middle Holocene, the climate tended to arid, lakes were shrank in Xinjiang Region. Since 4000 a B.P. the lake level rose again and the first terrace was formed (the age ranged 3000-2700 aB.P.). Spore-pollen assembly characterized by Betula with less Salix and Ulmus shows a cool-moist climate. During the time, paleosol beds bearing carbon or humus, peat were developed. The glaciers in Mt. Bogeda extensively expended so called a "new glaciation precession".

Since 2000 a B.P., the climate was further arid, the glaciers in mountains were gradually retreated, the lakes in the plain of the region were shrank and dried up further, the wind was getting stronger and desert was extended. The loam bed in Sitizi loess section and the first grass-peat bed in the Lake Aibi represented the last cool-moist climatic event before the formation of present arid clime-environment.

Based on those mentioned above, a climatic sequence since 12 ka B.P. was primarily summarized as follows: 12-10 ka, from cool-moist to cool-arid; 10-8 ka, temperate and arid; 8-7 ka, temperate and moist, lake transgression; 7-6 ka, temperate and arid; 6-4 ka, temperate and moist, lake transgression; 4-3 ka, temperate and arid; 3-2 ka, cool and moist, new glacial precession; 2 ka to the present, temperate and arid, as the present climate of Xinjiang Region. Comparing the climate of South Xinjiang with that of North Xinjiang, the climate of South Xinjiang is dryer.

Thus it can be seen that since Holocene the climate changes in Xinjiang arid area were different from those in the eastern monsoon area, meanwhile the paleoclimate not only has cold-arid, warm-moist fluctuations with a time scale of 10000 years but also has cold-moist, warm-arid, temperate-moist and temperate-arid fluctuations with a smoller time scale.

III. The main problems in geological environment of Xinjiang Region

1. desertification.

The desert area of Xinjiang Region is more than 420000 km^2 that is about one fourth of the region, the living desert area of it is about 380000 km^2. The present desertified land was rapidly extended and incresed 8600 km^2 since last 100 years due to extension of irrigated oases, deterioration of the vegetation in desert and the rivers, which originally flowed into the desert, now do not flow into it any more. The desert is harming the oases, the

s'tuation is grim.

The areas where desert is strongly developing are: (1) the western and southern parts of Zhuhgeer desert where dunes are re-activating, (2) the areas around Takelamagan desert, especially the southern margin, dunes are extending, (3) the areas where rivers and lakes disappeared.In Xinjiang Region there are 16 areas where the desertification situation is grim.

2.Seismic calamity.

Seismic activity in Xinjiang Region is frequent because of strong neotectonic movement. Since AC 1600, there are 73 earthquakes stronger than magnitude 6 , among them 19 earthquakes are stronger than magnitude 7, 3 stronger than magnitude 8.Since 1970, there was a earthquake stronger than magnitude 6 every one or two years. A magnitude 7 earthquake occured in Wuqia County of Kashi destrict in August of 1985 and people there suffered heave losses.Pamier area in the Region is the only intermidiate-focus earthquake area in China.The earthquake prediction should be strengthenned.

3.The aridity of Xinjiang Region.

As descripted above, weakenning of pedogenesis in the loess-paleosol series from older to younger in the last 400 ka indicates that the climate was getting dryer and dryer. The information recorded in the lake sediments also shows the same tendency: the fluctuation amplitude of arid-moist and cold-temperate climate was smaller and smaller.

The cold high atmospheric pressure in Siberia-Mongolia area and the monsoon cycle in China were strengthenned because of the further up-lift of the whole Qing-Zhang Platean and the mountain areas around it since the late time of Late Pleistocene. Therefore, the climate in Northwest China could be continuously dryer in the future. The further aridity in Xinjiang Region in the last 2000 years results in the gradual regression of the mountain glaciers, contraction and dried up of the lakes, reduction of the diluvial and alluvial sedimentations in forelands and plains, strengthenning of wind-force and expanding of desert area.

IV.The implication of Quaternary environmental change in present natural ecological environment.

The climatic general trend to the aridity is not changed in Xinjiang Region since the late Pleistocene eventhough there were the fluctuations of glacial, interglacial, arid and moist climates.The environment inside oases is improving due to resent constraction, but meanwhile the environment in the most areas outside oases is getting worse because of lack of water supply and destruction of the vegetation.It is important at present to rationally use