《桂林岩溶地质》之四

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中国地质科学院岩溶地质研究所

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内 容 简 介

本专著系地质矿产部下达给岩溶地质研究所的《桂林-阳朔地区岩溶发育规律和改造利用的研究》科研项目中的课题之一。本研究成果比较全面地、系统地记述了桂林地区第四纪冰川遗迹的宏观特征和微观特征。根据冰碛物的展布和结构特征，砾石和石英砂颗粒表面结构特征，冰蚀地形残迹及表面构造特征，植物孢粉、粘土矿物、同位素$\delta^{18}O$值以及含水层特征等大量实际材料，论述本区第四纪冰川遗迹及冰期划分；以冰川气候地层学的观点对本区第四纪地层划分对比；从第四纪气候演变分析岩溶发育的一些规律。本书不仅在第四纪研究方面有新的进展，而且对华南地区第四纪以来气候环境的研究有重要的科学参考价值。

序　言

广西桂林是以岩溶地貌发育、景观奇特而驰名中外的风景名胜地区，素有"桂林山水甲天下"之赞语。由于它处在北半球中低纬度、低海拔的亚热带气候环境，在这里发现第四纪冰川遗迹，并进行深入研究工作，无论在理论上或实践上都有着极其重要的意义。

早在四十年代初期，在驾桥岭东坡以及桂林附近的冰川遗迹就被发现了。由于所处纬度偏南，海拔亦低，有的地质、地理工作者表示怀疑和反对。桂林之南六塘一带，冰川泥砾构成岗阜，为底碛、侧碛形成的特殊地貌。当时李四光教授曾有疑虑，笔者等陪同他亲临六塘等地进行现场观察。这些泥砾呈砖红色，毫无层次，砾石大小悬殊，多为棱角、次棱角状，成分较复杂，主要来自六塘以西驾桥岭地带的早泥盆世岩层。泥砾分布地区与砾石源地中间尚有一条泥盆纪灰岩低山相隔，不少砾石具有擦痕、其移徙最大距离达三十余华里，这种泥砾堆积和其他有关现象非冰川作用是难以说明其形成的。

这些令人费解的"特殊"现象，尽管使人惊奇、怀疑，但必定是客观存在的事实。这些事实，如果说它不是由于冰川作用，那么究竟受什么作用，在什么样的自然环境下形成的？这就需要多做一些深入实际的工作才能给以合理的解释。以往限于条件，未能更深入的进行研究。后来，有些地质工作者在广西又相继发现过一些冰川遗迹。

近几年来地矿部岩溶地质研究所王克钧等同志，在填制桂林地区1:5万第四纪地质图时，发现大量的第四纪冰川遗迹，并采用多种测试、鉴定方法，获得了微观方面的一系列古冰川气候信息。对不同成因类型的沉积层进行了对比、划分。以冰川地质学

的观点和研究方法，系统建立了区域第四纪地层序列。首次提出了"桂林冰期"。这无疑是一项重要的研究成果。对探讨岩溶发育区的第四纪古气候、古生物、古人类及地理环境演变等方面，有着重要的意义。

桂林这样的地区能否发生过冰川，确实是一件大事，值得令人深思，应该特别谨慎对待。目前，对桂林存在第四纪冰川遗迹尚有争议。不同的学术观点只会促进研究工作更深入的进行，大有利于第四纪冰川科学的发展。

本书的正式出版，将会给第四纪冰川地质工作的开展和交流起到一定的积极作用。同时对岩溶地质学、地貌学、气候地层学、水文地质工程地质学、生物地层学以及环境地质学等方面的研究具有重要的参考价值。

孙殿卿

1987年3月2日

Introduction

Guilin region Guanxi Province is famous both in China and abroad for its scenic beauty and developed karst landshaft as well as peculier spectacle. It is praised as:"the mountains and the rivers in Guilin are the fines under heaven".The foundings of Quaternary glacial remains in this region and profound investigation on them have great importance both in theory and prectice, because the fact that Guilin region is situated in the subtropical climate circumstances at middle–lower latitude of northorn hemisphene and has lower altitude.

The vestige of vanished glaciers were discovered both at the east slope of Jiachaoling mountains and near Guilin City as early as in the begining of 1940's. However the foundinps of glacial vestige were seriously doubted and repudiated by some geologists and geographers because of its south latitude and lower altitude of the place. The boulder clay of brick–red colour recognized in Liutan own and adjucent area, south of Cuilin City, where they compose a chain of undulating hillocks the pecular landform consist of ground and lateral moraines. At that time pf J. S. Lee had doubted about their origin and he himself made field observations accompanied with the auther in Liutan and adjucent area, south of Liutan, The mentioned boulder clay of brick–red colour is chaotically accumulated with gravels of quite different size and composition being oriented randomly. The gravels are mostly angular and subangular in shape. They derived mainly from lower part of Devonian age occurring on the upper part of Jiacholin mountains, west of Liutan. The locality where the boulder clay present now is as far as 15 km from the original source area, needlet to say they were saparated by a vast zone of lower hills composed of Devonian limestone. There some striated gravels have been recognized in the mentioned boulder clay.

The boulder clay accumulation in Liutan and relevant natural phenomenon can not be explained its origin other than glaciers!

This unintelligible "special phenomenon"is a real present there objectively, though it is curious and doubtful, it is to say that was not formed by glacial process then the boulder clay was moved by what mechanism and under what kind of natural condition.In this case the reasonable explanation concerning the origin of the boulder clay can be gaven only after a profound field investigation

and experiment work. Before liberation the profound investig-ation could not be carried out owing to the conditions limited.However after the foundation of P. R. C many new evidence for glaciations have been recognized one after another in Guanxi province.

In recent years a great amount of evidence concerning the glacial vestiges have been discovered by Wang Kejun and his coworkers of Karst Institute, Ministry of Geology and Mineral Resources, when they carried the Quaternary geological mapping survey in Guilin Region at scale 1:50 000. The samples taken from the sediments were examined with multible advanced tecknical approachs, including electro-microscopic scanning. As result a series of information about the glacial paleoclimate have been oftaine. The sediments of different origin are classified and correlated each with other.As result the systematic regional Quaternary stratigraphic sequence for Guilin Region is established from the point of glaciogeological view, and "Guilin Glaciation"has been proposed firstly. The report must be considered as an important study result, which will have great importance for inquiry into the Quaternary paleoclimate in the region, where the karst phenomenan are quite developed, for the fauna and paleoanthropology, as well as the evolution of the paleogeographical environment. Whether present there glaciers or not in such region as Guilin is a large problem, which is worth to beconsidered deeply and treated seriously. At present the Quaternary glacial remains recognized in the place is debated seriously and the different point of thesis may promote the profound investigation, that will be benefit for the development of Quaternary glacio-geological science.

The book, that will be formally published, will certainly play positive role for development of glacial geology and exchange opiniens among schoolers. Besides this it will serve as good reference document for karst geologyg,eomorphology, climatostratigraphy, hydrogeology, engineering geology, biostratigraphy and environmental geology.

Sun Dianging
March 2, 1987

前　言

桂林是我国锦绣河山上镶嵌着的一颗明珠，无论是它的山光水色，奇峰异洞，或者是它的多彩多姿的岩溶地貌景观，在国内外都负有盛名，吸引着大批中外游客和地学工作者来此参观考察。特别在近年来，随着我国社会主义四化建设事业的突飞猛进，亲临桂林进行岩溶科研以及关心岩溶区国土整治的海内外学人更显增多，这样就使与桂林岩溶的生成和发展密切相关的第四纪地质研究逐渐活跃起来。基于这一原因，本课题成为1979年地质矿产部下达给岩溶地质研究所的《桂林-阳朔地区岩溶发育规律和改造利用的研究》项目中的一个课题。为了完成这一科研任务，作者等在历时约四年的研究工作中，首先进行路线地质观察，北至苗儿山南麓的九屋、金石、大溶江、金沙冲；东至海洋山西北坡的五里峡、兴安以及海洋山西坡的高上田、大境；西南至驾桥岭东北坡的六塘、南边山等地。在此基础上选择桂林-灵川地段进行重点研究，其中完成1:5万第四纪地质填图250km^2，测制剖面17条约16000m，采集大量标本和岩样；同时进行了同位素$\delta^{18}O$值，差热、古地磁、孢粉、扫描电镜等各种测试研究。取得了大量的、系统的第四纪冰川遗迹的宏观和微观资料，建立起"桂林冰期"。对争论已久的桂林第四纪冰川问题，有了较大的进展。同时，全面地调查了本区的冲积层、洪积层和残积层及其展布状况，划分成因类型，建立起地层层序，以及气候演化对岩溶发育的影响等都进行了研究。这不仅对研究本区岩溶发育规律、工程地质和地下水资源评价提供了重要的资料依据，而且对华南地区第四纪以来的地质作用和气候环境演变的探索都有重要的理论意义。

1985年3月，中国地质科学院在北京主持召开评审会议，聘

请中国科学院学部委员孙殿卿、贾兰坡研究员和高级工程师袁道先、周慕林、殷万倜以及陆春榕、潘建英、黄汉铎、邓自强等同志组成评审委员会，对本课题研究成果进行评审，一致认为本成果在目前我国岩溶区第四纪冰川地质研究方面，是一个难得的、有独特见解的报告。认为本科研成果达到国内先进水平，验收通过，并建议公开出版，以便向国内外交流。

本课题在研究过程中，黄炯明同志参加部分野外调查工作。附图由本所绘图室清绘，同时得到本所有关处室以及陈云程同志等的协助。还得到中国地质科学院地质力学研究所、地质研究所、天津地质矿产研究所、广东地矿局地质研究所和中心实验室、广西石油勘探开发指挥部化验室、中国有色金属工业总公司矿产地质研究所、广西地矿局区测队和水文队等单位的协助。蒙高级工程师周慕林、于浩然和黄炯明、潘建英同志审阅本书全稿，提出许多宝贵的修改意见。英文摘要蒙郭永志同志翻译，周慕林同志审校。在此一并深表谢忱。

在研究过程中得到孙殿卿教授的关怀，孙先生不顾七十五岁高龄，于1984年5月专程到桂林实地考察和指导，使研究工作顺利完成，衷心感谢。

原地质部华北地质研究所所长、学部委员王曰伦教授，生前对桂林第四纪地质研究工作十分关心，教益甚多，致以崇敬和怀念。

本书全文由王克钧执笔龙少廷和全顺兴参加部分野外和室内工作。

目　录

CONTENTS

Abstract

I. REGIONAL GEOGRAPHY AND GEOLOGICAL SETTINGS

1. Geographical position

The region studied is situated on the south slope of Nan-ling Range (110°15′ E—110°25′E and 25°11′N—25°25′N). The Yue-cheng-ling Range stands on the north of the area, and its highest mount called as Miao-er-shan is at 2142 m above sea level. The Hai-yang-shan mountain extends in the east and is as high as 1936 m, while the Jia-qiao-ling mountain on the south- west side, is at 1247m. The general topographic relief is characterized by the fact that the center part of the studied area is a depression, surrounded by mountains in the north, east and south-west sides, while the famous river Li-jiang flows through the region. The karst landscape is quite developed in the area under consideration, that makes the area famous all over the world, and creates"the more beautiful mountains and rivers in Guilin City than any other places".

2. The geological settings and geomorphic features

The studied area is situated tectonically in the west section of Nanling latitudinal structural zone, namely in the inner side of east limb of Guangxi 'ıllı' shape structure, and belongs to Guilin arc shaped structural subzone of eastern Guangxi longitudinal structural zone. Further more the area is also situated in between the Fu-chuan river(in the east)and Da-yao-shan mountains(in the west) longitudinal structural subzones. The top of the arc-shaped structure is located in the area from Mu-dong, Lin gui county, to Nan-xu, Lingchuan county. The arc-shaped structure consists of arc-lineal parallel folds and a set of thrust faults, projecting to the west. Due to the basement structural control and epigenetic structural disturbance the fold crest lines are curved and wavely fluctuated. The

anticline is approximately parallel to the syncline, that are alternatedly changed with each other.In general the anticlines are more narrow than the synclines, that are more gentle and wider. The distribution of the strata in the studied region is controlled by tectonic structures, and the stratigraphy exposed on the land surface are as follows: Lower Devonian, mainly consists of violet-red and violet sandstone and siltstone; the Middle Devonian, is mainly of violet-red, violet and grey-yellow, yellow siltstone and fine sandstone, interlayered with iron-bearing sandstone; the Upper Devonian are mainly composed of limestone and dolomite, the Lower Carboniferous consists mainly of shale and limestone intercalated with sandstone and silicolites. Due to the influence of lithological character, tectonic movement and climate change, on the basis of geomorphological formation and development, the region may be divided geomorphologically into erosion-denudation type, erosion-solution type, solution type and accumulation type.

II. THE STUDY HISTORY OF QUATERNARY GEOLOGY

The Quaternary stratigraphy in the mentioned region is quite developed, that attracts great attention of many geologists and scholars, who made field investigations in the region, mainly these are the J. S. Lee, Sun Dian-qing and Xu Yu-jian, DingSu, Zeng Zao-xuan, Zhou Mu-lin, Pan Jian-ying, Chen Wen-jun, Wang Nai-liang and geologists of Hydrogeological Team, The Region-Survey Team, Guangxi Geological Bureau and some scholars of geologico-geographical department of Beijing University.

The outstanding geologist J. S. Lee in 1940 made a general view on the glacial vestiges and remains in Northern Guangxi Aut.Rgn,he pointed out that there indeed exist the boulder-clay of glacial origin near Huang-sha-he river and on the tableland of west bank of Xiang-jiang river. The boulder-clay covered by red clay, may be originated not beyond the scope of Yue-cheng-ling mountains, and north of Yue-cheng-ling—the west section of Nanling range. Further more, the glacio-fluvial gravel is spreading far away along Li-jiang, south west of Huang-sha-he river.The famous geologist Prof.Sun Dian-qing and Prof. Xu Yu-jian published their paper "The primary observation on the Quaternary glacial vestiges and remains in Guangxi Region".In 1957, Prof.Sun pointed out in the paper "The Outline of the Quaternary Glacial remains in China" that, "On the east slope of Jia-qiao-ling mountain, the glacier flowed down to the piedmont of the mountains, where the glaciated deposits constitute a complete set of ice

lobate landforms, that may be best seen near Liu-tang village."He also said that the provenance area of boulder-clay of glaciated origin was at the top of the high mountains, and it is postulated that, the glacier during the glaciation flowed to the north-east through Lang-cun, Shuang-feng-qiao, Liu-tang village and then stopped at Da-zhong-xu village. Thus the ice flow left two set of hill ranges, consisting of tills that interruptedly extend to north-east. There after, many geologists and scholars have also made field investigations on Quaternary geology of the area under consideration. For example, the geologists of Hydrogeological Team of Guangxi Geological Bureau stated that there exist moraines and tills spreading in Guilin City. The scholars of Geology-Geographical Department of Beijing University made an investigation in 1978 and carefully studied the violet-red boulder-clay.As result of their study they considered that the mentioned red boulder-clay deposit do not constitute wide and continuous terrace, but often shows as the interrupted and isolated hill range, spreading both on the alluvial plain outside the river valley and on karst developed plain. They tend to explain these gravel deposit as the proluvial deposit resulted from sudden high tide flood, that break down the river dam.

In 1985, with the studying of the various surface textures of the quartz sand grains in the quaternary clay near Guilin, Mr. Yuan Dao-xian, Dr. M. M. Sweeting and others considered that, the quartz sand grains of the boulder clay in Guilin are derived from the sandstone of middle Devonian and have been transported from the slope of Yaoshan mountain without the help of wind or water, thus they must be gravity-fed, most likely as a solifluction deposit.

III. THE QUATERNARY GLACIAL REMAINES AND VESTIGES

The debate about present the quaternary glaciation here or not has Lasted about half a century.In order to profoundly research the Quaternary Geology of the studied region, the author have made a systematic field investigation and domestic examination of the Quaternary deposits through the geological survey on the scale 1:50000. As result of the mentioned above investigation several lines of evidences for the presence of Quaternary glaciation have been obtained, these are as follows,

1.The distribution characteristics of boulder-clay of glacial origin

The Quaternary glacial deposit in the studied area has an independent dispersed style in geomorphological field, that quite differ from alluvial and deluvial