中国典型滑坡

LANDSLIDES IN CHINA-SELECTED CASE STUDIES

殷跃平　主编

Editor-in-Chief Yin Yueping

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内 容 提 要

《中国典型滑坡》是一本以照片形式反映我国典型滑坡的画册，包括了顺层滑坡、第三系泥岩滑坡与崩塌、黄土滑坡、风化层与堆积层滑坡、地震与冰雪型滑坡及堰塞湖、水库滑坡、矿山滑坡与崩塌、城市与道路建设滑坡等8大滑坡类型。通过精选照片的展示形式，以简要文字阐述了它们所处地理位置、地质环境、形态结构特征、稳定性、灾害程度以及防治工程等内容。本画册收录了近年来我国发生的非常具有典型意义的滑坡，例如西藏易贡滑坡(2000)、湖北秭归千将坪滑坡（2003）、四川宣汉天台乡滑坡(2005)、青海阿尼玛卿山滑坡（2005）等。本画册也收录了我国历史上非常著名的滑坡，例如陕西西安翠花山滑坡(公元前780)、重庆黔江小南海滑坡(1856)、宁夏海原地震滑坡（1920）、四川岷江叠溪滑坡(1933)等。针对三峡库区移民迁建工程的地质灾害防治，本画册还收录了大量的滑坡及防治工程实例，并提供了若干利用滑坡体综合整治与土地利用的实例。

本画册可供从事地质灾害研究和地质、地震、水电、公路、铁路、矿山、国防工程的生产、科研人员以及有关院校师生参考。

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前　言

由国际土木工程学会土力学与岩土工程分会、国际岩石力学与工程学会和国际工程地质与环境协会联合主办的第10届国际滑坡与工程边坡会议于2008年6月30日至7月4日在西安举办。这次会议是全球滑坡和工程边坡学术界的一次盛会。应大会组委会主席陈祖煜教授之约，由我主持编著《中国典型滑坡》画册，用图片方式向世界展示我国典型的滑坡特征。

2004年，当陈祖煜院士告诉我要出版此画册的想法时，我原本以为这是一件难度不大的事。因为，国土资源部开展了全国1500多个山区丘陵县、市的地质灾害调查，我和我的同事们也长期从事全国范围的滑坡调查、勘察、防治与研究，手中握有大量的资料。但是，实践起来后方感难度颇大。我国的滑坡类型繁多，千差万别，如何通过这一画册向世界同行展示，争论激烈。最后，吸收了Varnes对滑坡的广义分类方案，并结合我国的滑坡分类习惯，不强调学科分类的完整和严谨，也不刻意追求画面的艺术效果，而是从专家的视角，利用手中的普通相机，呈现我国典型的滑坡形态特征，并力求从滑坡结构、灾害及防治等角度加以充实。

《中国典型滑坡》画册按照顺层滑坡、第三系泥岩滑坡与崩塌、黄土滑坡、风化层与堆积层滑坡、地震与冰雪型滑坡及堰塞湖、水库滑坡、矿山滑坡与崩塌、城市建筑和道路滑坡等8种类型，通过精选照片的展示形式，以简要文字阐述了它们所处地理位置、地质环境、形态、结构特征、稳定性、灾害程度以及防治工程等内容。本画册收录了近几年来我国发生的非常具有典型意义的滑坡，例如西藏易贡滑坡(2000)、湖北秭归千将坪滑坡（2003）、四川宣汉天台乡滑坡(2004)等一系列滑坡，也收录了我国历史上非常著名的滑坡，例如四川岷江叠溪滑坡(1933)、重庆黔江小南海滑坡(1856)等。针对三峡库区移民迁建工程的地质灾害防治，本画册还收录了大量的滑坡及防治工程实例，并提供了若干利用滑坡体综合整治与土地利用的资料。

《中国典型滑坡》画册终于出版了。感谢编著组的同事们，为了获取滑坡的资料付出了非常艰辛的努力。几乎每一张图片背后都有非常动人的故事。编著组强调画册不是简单的照片罗列，因此在本画册编著过程中专门考察了大多数滑坡，提供了大量第一手资料。例如，西藏、青海地质环境监测站等单位的专家多次深入氧气稀少、交通不便的高寒地区，获取了不同时期的第一手资料。

感谢全国的同行们，没有大家的无私帮助，根本不可能如愿。在西藏、青海、新疆、甘肃、陕西、宁夏、山西、云南、四川、重庆、贵州、湖北、浙江、江西、辽宁等地收集资料时，从省（区、市）国土资源厅（局）到地方政府和各级国土资源部门，他们都为我们提供了非常便利的交通和安全保障。

感谢美国伊利诺大学Alberto S. Nieto教授、清华大学张建红博士、华中科技大学汪华斌博士。他们牺牲了宝贵的休息时间，提供了非常流畅、贴切的英文翻译。

最后，特别要感谢中国科学院院士陈祖煜教授，他亲自策划了本画册的编著，并自始至终给予了无私指导。

殷跃平

2007年10月

PREFACE

The 10th International Symposium on Landslides and Engineered Slopes (10th ISL), to be held from June 30 to July 4, 2008 in Xi'an, China, is one of the most important activities of the Joint Technical Committee on Landslides and Engineered Slopes (JTC 1) under the International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE), International Society for Rock Mechanics (ISRM) and International Association on Engineering Geology (IAEG). In memory of this unique chance of hosting this Symposium, I was assigned by the Chinese geological and geotechnical communities to coordinate and technically edit a photo album entitled "Landslides in China - Selected Case Studies", in an effort of best illustrating typical and disastrous landslides in China.

Landslides include diversified gravitational mass movements that are triggered by earthquakes, rainfall, volcanic eruptions and human activities. This natural hazard has brought painful damage to inhabitants living in hilly and mountainous terrains, escarpments and river valleys around the world, especially in the developing countries. China has recently completed a landslide survey that covers 1500 counties in hilly regions with the financial support provided by the Ministry of Land and Mineral Resources. My colleagues and I have collected a large amount of data. However, it seems not an easy task while editing this volume under the coordination of Professor Chen Zuyu, Chairman of 10th ISL. Landslides include various and complicated types, some of which are unique, completely different from those in other countries. Of utmost concern is the framework of this book that could best classify and illustrate Chinese landslides with varied types and complex geological features, so that this Album can best benefit our international peers. To bridge the gap between Chinese and international practice, this book adopts the landslide classification criteria proposed by Varnes (1978), which feature is emphasizing the movement characteristics and material types of a landslide. Due considerations of Chinese traditional experience for landslide classifications are also given. The photos contained in this Album are taken by geologic experts using ordinary cameras, aimed at presenting the diversified landslide morphology and characteristics with sufficient descriptions of geological structures and approaches for hazard mitigations. The academic rigorousness and architecture impact of this book have been considered of secondary importance.

In this book, landslides are selected into eight types: (1)landslides on dipping beds; (2) mudslides and falls in Tertiary materials; (3) landslides in loess; (4) landslides in weathered and colluvial materials; (5) avalaches and damming induced by earthquake and snowmelt; (6) landslides induced by reservoir filling; (7) landslides and rockfalls induced by mining; (8) landslides induced by urban development and highway. Most photos shown here were taken by experienced engineers working on landslide investigation and mitigation projects, with limited concern on their artistic effects. Informations about these landslides are focused on their geographical location, geological conditions, structural characteristic, stability status, hazard potential and mitigation approaches, etc. It is worthwhile to note that several historical landslides are included, e.g., the Yigong landslide in Tibet (2000), the Qianjiangping landslide in Zigui of Hubei Province (2003), and the landslide at Tiantai Town in Xuanhan of Sichuan Province (2004), etc. Several disastrous landslides triggered by earthquakes are also presented in the album, for example, the Diexi landslide which dammed the Mingjiang River in Sichuan Province in 1933, and the landslide dam created in the Qianjiang River of Chongqing City in 1865. In addition, case studies on landslide mitigation programs in the Three Gorges Reservoir have provided useful information on comprehensive landslide prevention and management approaches and land use, planning and development strategy.

This album was produced by individuals who, in spite of their demanding workload, volunteered their time and talents to offer their contributions. The organizing committees and the future users of this volume are indebted to the members of the editorial board for their efforts. Most sincere appreciation is expressed to all those who contributed information in the forms of data, photographs, ideas and advices, without which this album could not have been made possible. Thanks go to my colleagues from the Geological Environment Monitoring Stations in Tibet and Qinghai, etc., who circumvented many difficulties to get valuable photos under severe natural conditions such as lack of oxygen, inaccessible high-latitude and permafrost regions. The support on transportation facilities and security from local government in many counties and provinces is gratefully acknowledged. To list all of the contributors would be impossible; and to mention some of them would be unfair to the others.

I express my gratitude to Professor Alberto S. Nieto from the University of Illinois in USA for his time on English editing of this book, associated with Dr. Zhang Jianhong at Tsinghua University and Dr. Wang Huabin from Huazhong University of Science & Technology.

Special thanks go to Professor Chen Zuyu, Academician of China Academy of Science, for his great contribution and help in producing this photo album.

Yin Yueping
China Geological Survey
October, 2007

1. 顺层滑坡

Landslides on Dipping Beds



LANDSLIDES ON DIPPING BEDS
LANDSLIDES ON DIPPING BEDS
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LANDSLIDES ON DIPPING BEDS
DIPPING BEDS

四川宣汉天台乡特大滑坡

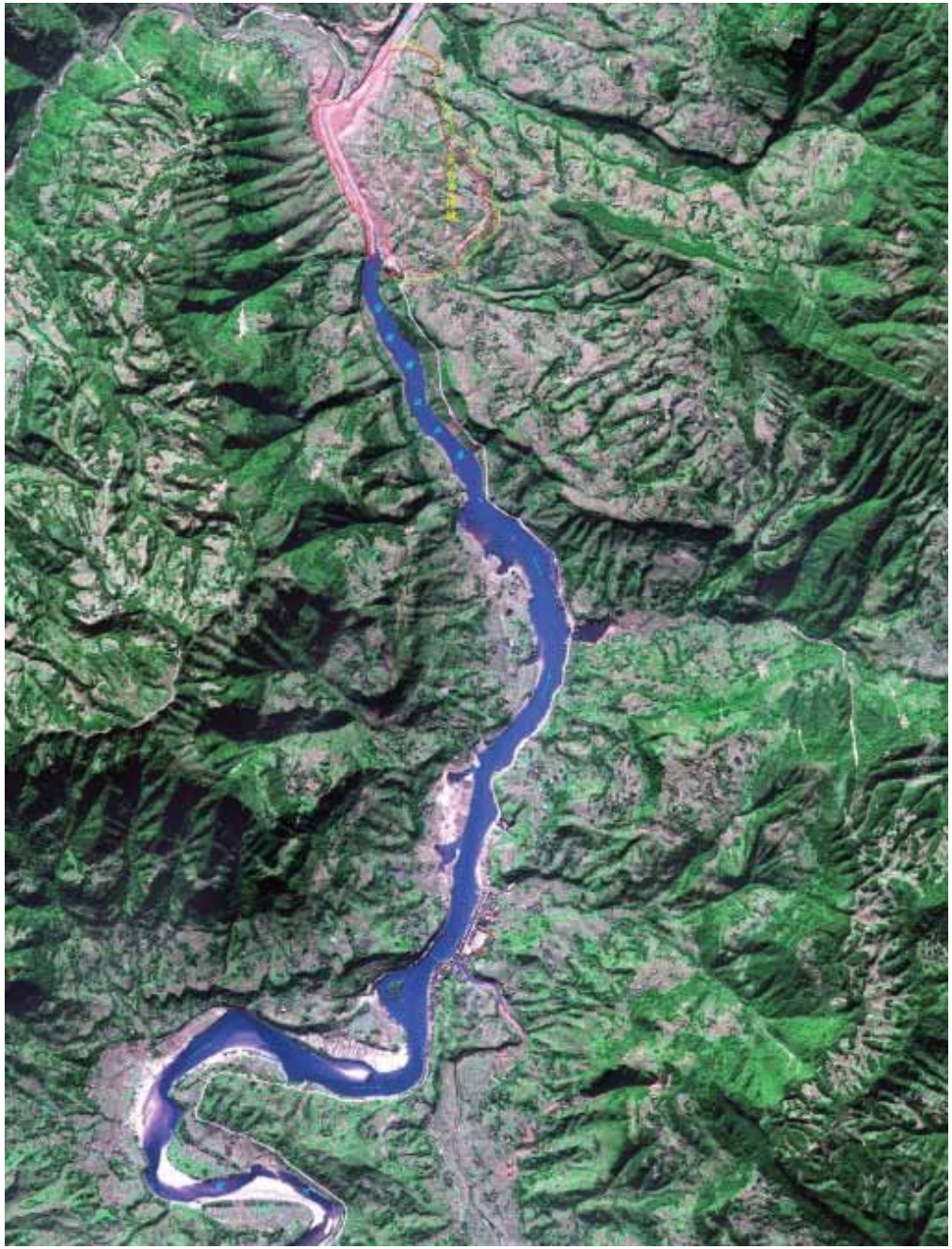
Large Scale Landslide at Tiantai Village, Xuanhan County, Sichuan Province



滑坡发生于2004年9月5日，暴雨诱发。1255人受灾，摧毁房屋2983间，毁田1097亩。属基岩顺层滑坡，平面形态呈“圈椅”状，纵长950～1200m，横宽1400～1600m，面积1.2km^2。滑床以砂岩为主，后陡前缓的折线形，前部顺层滑动，坡度5°～7°，后部切层，坡度渐变为20°～40°，主滑方向95°。滑体以紫红色粉质粘土夹泥岩块石和泥岩碎裂岩体为主，厚度一般为7～49m，平均厚度23m，滑体总体积2500万m^3，其中约210万m^{3}堆积物冲入前河中。

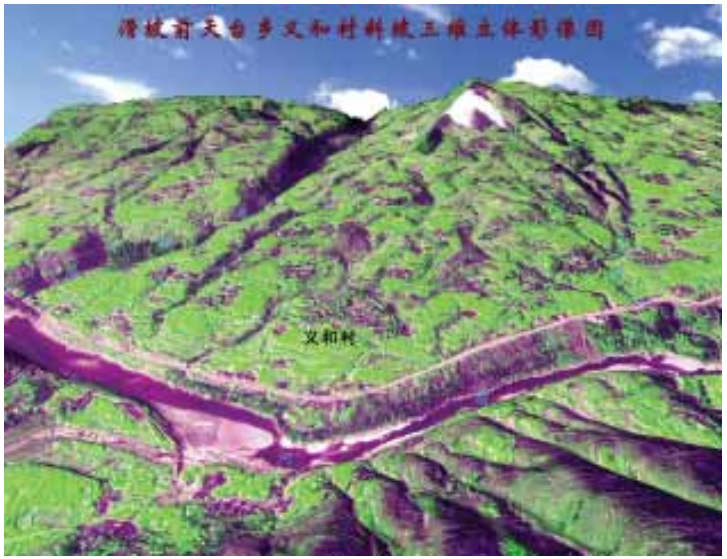
The Tiantai landslide occurred on September 5, 2004, due to heavy rainfall, 2983 houses and 1097 Mu of farmland were destroyed; 1255 persons suffered damage. It was lobate shaped in plane view with dimensions in 950-1200 m long, 1400 -1600 m wide, 23 m thick. The basal bed is a sandstone layer dipping 5°- 7° at the toe and 20°- 40° near the crest. The landslide has a volume of 25 million m^3; is made up of purple-red silty clay with intercalations of mudstone. About 2.1 million m^3 of sliding materials caused the damming of the river.

·四川宣汉天台乡特大滑坡·

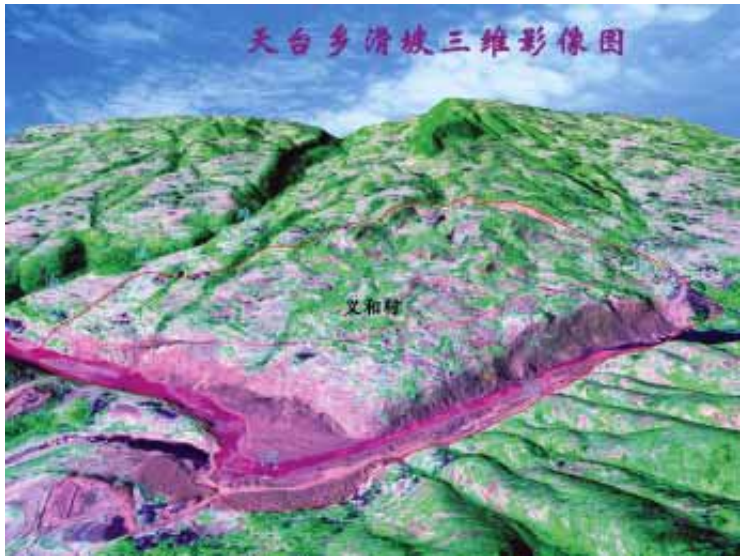


滑坡及堵江回水遥感影像
Image showing landslide dam and impounded water

（本照片由王治华提供）



滑坡前“ 3D ”遥感影像　Oblique image before sliding



滑坡后“ 3D ”遥感影像　Oblique image after sliding

滑坡前部冲入前河中，抬高河床23～28m，造成河道严重堵塞，形成回水长 15km、库容 5800 万 m^3 的堰塞湖。淹没上游五宝场镇及沿河两岸共 8 个村 5770户，农田4930亩，紧急转移受灾群众19 360人。

The landslide dammed the river and water level rose 23-28 m creating an impoundment 15 km long and 58 million m^3 in volume. Eight villages were flooded and 19 360 persons were evacuated.



滑坡淹没上游村镇　Submerged village due to landslide impoundment

（本照片由赵松江提供）

（本版遥感影像由中国国土资源航空物探遥感中心提供）

・四川宣汉天台乡特大滑坡・



滑坡前缘剪出入江, 地下水沿滑带渗出
Groundwater discharge along sliping zone



滑坡剪出滑入江, 形成滑坡坝体
The sliding mass fell into and dammed the river



入江滑坡体形成堰塞湖
Landslide debris sliding and damming river



滑坡体前缘概貌
View of landslide accumulation



滑坡下伏滑床砂岩呈层状碎裂岩体，富水性好
Laminar sandstone at the base of the sliding mass initially large amount of water



滑坡体孤丘
Sliding isolated pinacle



滑坡下伏滑床为砂岩泥岩互层结构
Interbedded sandstone and mudstone at the base of the sliding mass

(本照片由赵松江提供)



滑坡柱体
Sliding isolated pinacle



残留滑坡柱体显示滑坡原厚度和结构
Residual pillar showing the structure and thickness of landslide



滑坡变形拉裂, 树木歪斜
Trees tilted due to sliding



滑坡变形拉裂形成醉汉林
Drunk trees due to sliding



稻田水渗入滑坡体, 促进了滑坡的变形拉裂
Water seepage from rice field increased deformation and cracks



滑坡变形拉裂, 稻田下陷成地堑
Rice field subsidence due to sliding



稻田被毁, 田水入渗促使滑动加剧
Rice field destroyed by sliding, resulting in water seepage and exacerbating landsliding



池塘被毁, 池水入渗促使滑动加剧
Sliding destroyed this pond, then water seepage worsened sliding

(本照片由赵松江提供)

三峡工程重庆库区云阳老县城五峰山滑坡

Wufengshan Rockslide in Old Yunyang Town, Chongqing, Three Gorges Reservoir



云阳老县城滑坡: 老县城坐落在西城滑坡体上, 后山为五峰山滑坡
Yunyang Town is located on the Xicheng landslide and the Wufengshan rockslide can be seen behind

滑坡发生于 2001 年 1 月 17 日，从高程 607.7m 顺层下滑，沿 570m 高程处剪出，并带动老滑坡残体碎块石土顺层下滑，堆积于 380～410m 高程上。体积 3 万 m^3 左右。危及1.2万余人生命财产安全。滑坡原岩为遂宁组第二段中厚层石英粉岩夹薄层泥岩，地形坡度及岩层倾角近于一致，为 48°～54°，层面裂隙及纵横向节理裂隙发育，前缘临空条件好，且前缘 360m 左右高程有地下水溢出。

滑坡发生后，当地政府迅速组织有关单位进行应急处理，确保了春节和汛期期间人民生命财产的安全。

Wufengshan rockslide occurred on January 17, 2001, and had a volume of 30 000 m^3. The translational rockslide is made of inclined bedding Tertiary quartz sandstone with intercalations of weathered mudstone. The bedded rockmass is fractured and weathered, and the groundwater is discharged at the toe zone of the landslide, endangering over 12 000 persons.

The Wufengshan rockslide has been controlled, and the town has been relocated.



五峰山滑坡对老县城 1.2 万余人生命财产构成严重威胁
The Wufengshan rockslide endangering over 12 000 persons below



五峰山滑坡转化为泥石流，对下部居民构成威胁
The rockslide became a debris flow, endangering houses



五峰山滑坡沿单斜岩层顺层滑动
The Wufengshan rockslide moving along stratified layer



五峰山滑坡后缘　Landslide rear



五峰山滑坡表层植被茂密, 形成厚达数米的易滑体
Extensive vegetation covers the rockslide which is several metres thick



单斜地层由泥岩和砂岩互层构成
Monoclina rockmass is made up of alternating sandstone and mudstone



滑坡浅表层形成风化卸荷带
Stress relief weathered zone



“三明治”边坡对上部建筑物构成威胁
“Sandwich” layering slope that endangered buildings



浅表层岩土体蠕滑下形成“马刀树”
Tilted trees due to shallow creep of materials



浅表层岩土体下伏隔水岩层，雨季易形成顺层滑动
Shallow landsliding easily takes place in rainy season along surficial impermeable rock



采用钢筋砼抗滑拦挡桩防治滑坡碎屑流危害县城
Reinforced concrete pile and defense net prevented the landslide and debris from reaching the town





滑坡体堆积于斜坡上, 对下部县城构成威胁
Rockslide accumulates on the slope and severely endangers the old Yunyang Town, Chongqing



在拦挡工程前缘铺设废旧轮胎减缓碎屑流撞击桩
Old tyres applied for mitigating the crash to piles



拦挡工程下部居民处于安全之中
Lives are now protected by engineering work



斜坡上的滑坡堆积体转化为碎屑流
Sliding mass accumulated on the slope becomes debris flow

三峡库区单斜顺向坡远眺

Overview of Inclined Bedding Slope in the Three Gorges Reservoir



云阳－奉节沿故陵向斜两翼发育一系列滑坡,包括旧县坪、宝塔、藕塘等巨型滑坡
Huge scale inclined bedding landslides are distributed along the Gulin syncline between Yunyang and Fengjie, such as Jiuxianping, Baota and Ou'tang landslides



奉节藕塘巨型滑坡
The huge scale Ou'tang landslide, Fengjie, Chongqing



奉节藕塘巨型滑坡前缘反倾平台
Backtilted toe of the Ou'tang huge landslide





岩层顺层下滑, 田水沿裂缝入渗, 加剧岩体失稳
Sliding on dipping beds; water penetrates fractures, exacerbating landsliding



云阳旧县坪巨型滑坡
The large scale Jiuxianping stratified landslide



云阳旧县坪巨型滑坡前缘
Backtilted accumulation at the toe
of the Jiuxianping large landslide

2.第三系
泥岩滑坡与崩塌

Mudslides and Falls in Tertiary Materials



MUDSLIDES AND FALLS IN TERTIARY MATERIALS
MUDSLIDES AND FALLS
IN TERTIARY MATERIALS
MUDSLIDES AND FALLS IN TERTIARY MATERIALS
MUDSLIDES AND FALLS IN TERTIARY MATERIALS

青海尖扎康阳－夏藏滩滑坡群全貌

Kangyang–Xiazangtan Landslide Cluster in Jianzha County, Qinghai Province



位于黄河公伯峡库尾，尖扎县西10km黄河右岸。其中，康阳滑坡长3100m，宽3300m，厚100m，体积约10.23亿m^3。由第三系紫红色泥岩构成，滑坡高差约500m，可划分为9级平台。滑坡超覆于黄河III级阶地卵砾石层上。由于滑坡前缘切脚修路，2005年滑坡体局部复活滑动，体积约数千万立方米。

Kangyang landslide is located on the right shore of the Gongboxia Gorge Reservior, in the upper reaches of the Yellow River. The landslide is one of the largest in China; it is 3100 m long, 3300 m wide, 100 m thick and has a volume of 1.023 billion m^3. The landslide is made up of Tertiary purple-red mudstone. The landslide consists of 9 terraces with a total height difference of about 500 m from crown to toe. In August, 2005, the accumulation lobe was reactivated by highway slope cutting, disrupting millions of cubic metres of landslide materials.



第三系泥岩 (N) 超覆于第四纪阶地 (Q) 之上, 滑带明显
Tertiary mudstone overlying the Quaternary terrace (intercalation with gravel)



康阳滑坡滑带结构及产状明显
Structure and strike of shear zone of the Kangyang landslide



康阳滑坡西部因前缘开挖失稳滑动, 公路形成大量纵张裂缝
Longitudinal cracks along road due to slope cutting at the toe of the Kangyang landslide, Jianzha, Qinghai



新滑坡前缘堆积体纵张裂缝发育, 形如脚趾
Radial cracks in front of landslide, note toe-like shape



新滑坡体上形成大量土林
Soil pillars (“forest-like”) on the reactivated landslide accumulation



因前缘开挖失稳滑动, 公路毁坏
Road destroyed at the toe of the landslide due to road cut



新滑坡体滑覆在黄河Ⅱ级阶地上
Landslide overlying flat land

青海西宁北山林家崖滑坡区

Linjiaya Landslides, Beishan, Xining, Qinghai Province



青海西宁市北山林家崖滑坡区远眺
Overview of Linjiaya landslide zone visible on pictures background
from the northern side of Xining City, Qinghai Province



第三系泥岩中膏盐溶蚀后，形成错落型滑坡
Backtilted (rotated) sliding due to gypsum dissolution in Tertiary mudstone



第三系泥岩滑坡后形成泥石流物源
Abundant potential mudflow material provided by Tertiary mudstone landslide



第三系泥岩泥石流沟谷坊防治工程
Stepped check dams built to reduce erosion



第三系泥岩中膏盐厚达数米, 构成滑坡或崩塌的底面
The gypsum in Tertiany mudstone has a thickness of several meters and forms the base for the landslide



第三系泥岩中富含膏盐。溶蚀后, 形成大量空洞
Caves due to gypsum dissolution in Tertiary mudstone



第三系泥岩被数组节理切割, 卸荷裂隙发育
Stress relief unloading vertical cracks in Tertiary mudstone



第三系泥岩被数组节理切割风化卸荷形成危岩体
A column will subside and rotate backward due to undercutting or the crushing of a gypsum layer



第三系泥岩被数组节理切割。下伏膏盐溶蚀后, 形成规模较大的滑坡
Large rotational landslide caused by fractured mudstone failure after gypsum dissolution at the landslide base



西宁市周边第三系泥岩错落型滑坡
The backtilted (rotated) slide mass is clearly seen



第三系泥岩边坡开挖后, 卸荷裂隙发育, 稳定性差
Abundant stress relief (unloading) fractures developed after slope cutting in Tertiary mudstone, Qinghai Province



第三系泥岩边坡加固工程
Stabilized engineered slope in Tertiary mudstone

3.黄土滑坡

Landslides in Loess



LANDSLIDES IN LOESS

LANDSLIDES IN LOESS

LANDSLIDES IN LOESS

LANDSLIDES IN LOESS

LANDSLIDES IN LOESS

甘肃兰州皋兰山滑坡*

Gaolanshan Landslide in Lanzhou, Gansu Province



皋兰山滑坡全貌　Overview of Gaolanshan landslide

位于兰州市中心区的南侧，相对高差600余米。皋兰山北坡形成一系列滑坡。其中，皋兰山滑坡规模最大、最危险，具有多级和多次活动特征，由3个次级滑坡区组成，即1号滑坡区、2号滑坡区和3号滑坡区，总体积约2056万 m^3。直接威胁山下的兰州市区安全。

The Gaolanshan landslide is located on the southern side of Lanzhou City. The landslide consists of three sub-landslides, and is 20.56 million m^3 in total volume, with multi-layers and multi-activities.The landslide height difference is about 600m that is directly endangering the district below.



皋兰山滑坡及下部居民区
Gaolanshan landslide is endangering buildings below



滑坡及下部居民区远景
Overview of landslide and affected zone below

* 本滑坡照片由赵成、余志山提供



1 号滑坡及前缘建筑物
No.1 sub-landslide and endangered buildings



1 号滑坡后部
Rear of the No.1 landslide



1 号滑坡前缘建筑物密集分布
Numerous buildings in front of the landslide



1 号滑坡前缘抗滑桩支挡工程, 确保建筑物安全
No.1 landslide was stabilized by retaining piles at the toe



2 号滑坡前缘形成反倾平台
Backtilted platform in front of No.2 landslide



2 号滑坡后缘植被良好
Dense vegetation on the rear of No.2 landslide



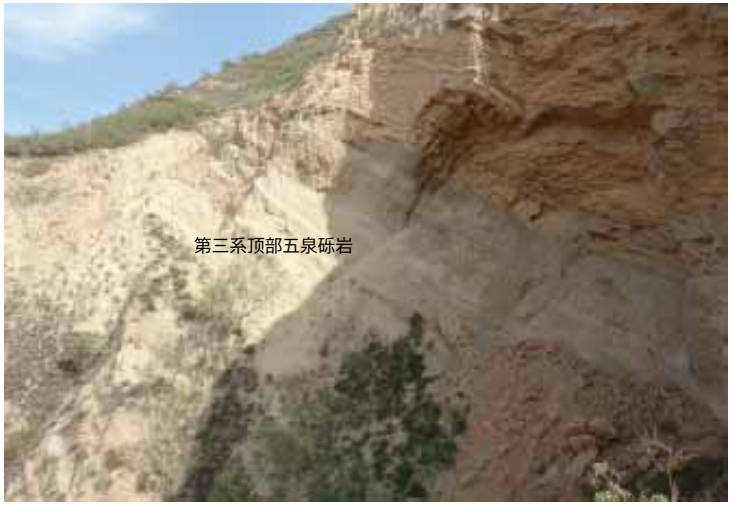
3 号滑坡和老狼沟滑坡前部
No.3 landslide and the lobe of Laolanggou landslide



3 号滑坡体上人工植被良好
Dense vegetation on No.3 landslide



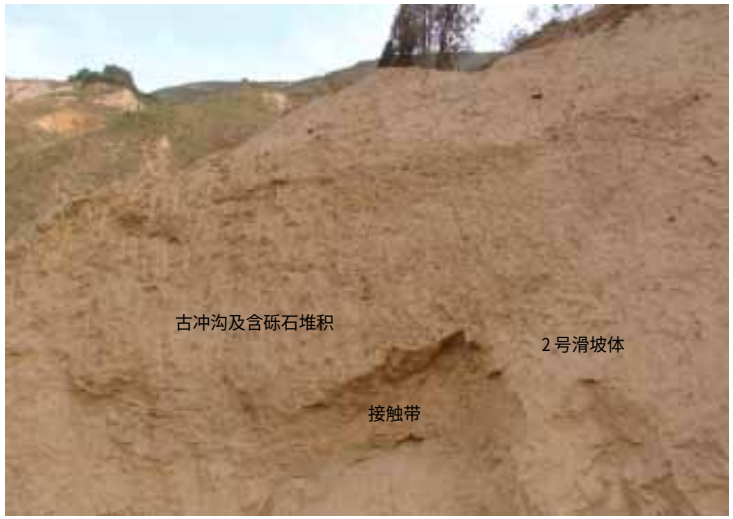
2 号滑坡体上黄土岩溶发育
Loess karst in No.2 landslide



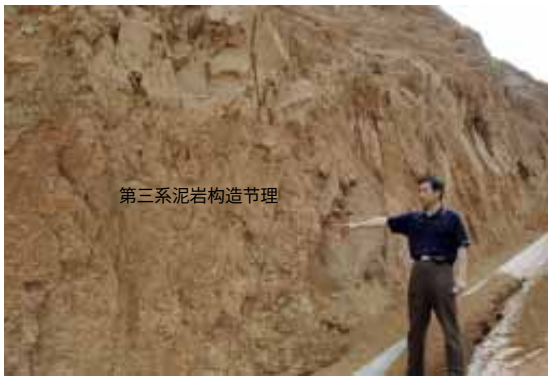
滑坡下伏基岩地层结构
Bedrock structure under the landslide



2 号滑坡体上黄土体冲沟和天桥
Loess trench and bridges in No.2 landslide



2 号滑坡上部古冲沟及含砾石堆积物, 表明滑坡为古滑坡
Scars and gravel deposit in upper No.2 landslide indicating ancient landslide activity



皋兰山滑坡下伏的第三系紫红色泥岩
Tertiary purple-red mudstone under the Gaolanshan landslide



第三系泥岩夹砂岩中构造节理发育
Joints in Tertiary mudstone interbedded with sandstone



位于皋兰山滑坡东侧的老狼沟古滑坡
Ancient landslide near the eastern side of the Gaolanshan landslide

甘肃永靖黑方台黄土滑坡群

Heifangtai Loess Landslide Cluster in Yongjing County, Gansu Province



黑方台焦家－扶河桥滑坡带远景 (由于古土壤隔水, 上部土地浇灌后, 沿黄土与古土壤形成滑带)
Overview of Heifangtai landslides (Jiaojia-Fuheqiao)

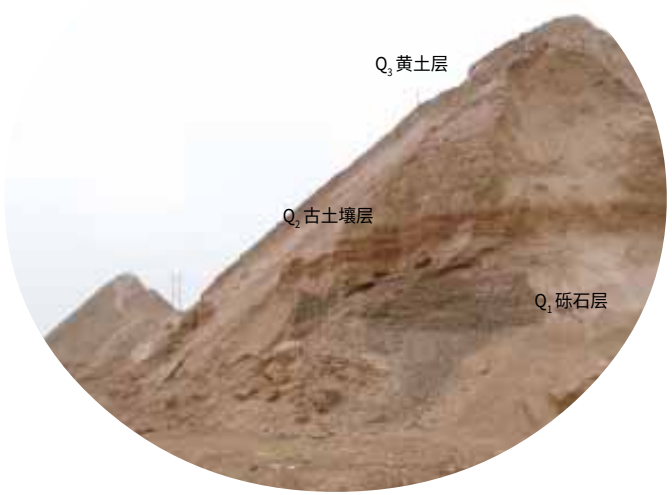
位于甘肃永靖盐锅峡镇，地处黄河和湟水交会处的黄河左岸，其台缘从湟水入黄河口的湟水桥头至盐锅峡大坝，东西长约10.7km，南北宽13km，台塬面积约 13.7km^2，为黄河Ⅳ级基座阶地。台面较为平坦，呈典型的黄土台塬地貌形态特征。台地高出周围地形 100～133m。黑方台边坡地带共发育 35 处滑坡，滑坡总体积 4605.6 万 m^3。黑方台滑坡可分为黄土滑坡和黄土－基岩滑坡两种类型。共发育 21 处黄土滑坡，总体积 1304.7 万 m^3；发育黄土－基岩滑坡 14 处，总体积约 3300.9 万 m^3。

The landslide cluster is located in Yanguoxia Town, Yongjing County, Gansu Province, on the left shore of the Yellow River. Landslides occurred along the margin of the loess mantle (terrace) which has a length of 10.7 km along E-W direction, a width of 13 km along S-N direction, 13.7 km^2 in total area. This is the terrace IV of the Yellow River with a height of 100-133 m above the river. There are 35 landslides, about 46 million m^3 in total volume, which are classified into loess and loess-bedrock landslides.



黑方台黄土台塬斜坡前沿沿黄土与古土壤接触带形成滑坡

Slope along the margin of the Heifangtai loess terrace (mantle). Landslide occurred along the contact zone of loess and ancient soil



黑方台黄土台塬地层结构 (由于古土壤隔水, 上部土地浇灌后, 沿黄土与古土壤形成滑带)

Typical sliding-prone formation of Heifangtai loess mantle; landslide occurs frequently due to the presence of an impermeable ancient soil, following irrigation at the surface



黄土直接与砾石层接触, 地下水易于渗漏, 斜坡稳定性好

When loess is directly in contact with gravel layer, ground water from irrigation drains easily and the slope is stable



黑方台黄土台塬边滑坡
Landslide scarp at the margin of the Heifangtai loess mantle



黑方台黄土台塬边滑坡拉裂缝
Landslide crown cracks at the margin of the Heifangtai loess mantle



黑方台黄土台塬边大面积座滑
Large rotational subsidence at the margin of the loess mantle



黑方台黄土台塬农田灌溉渠系
Irrigation system on the loess tableland, the Heifangtai tableland



黑方台黄土台塬农田漫灌, 易于渗入地下
Broad irrigation is easy to seep



黑方台黄土台塬边溶蚀冲沟
Karst trench in the margin of the loess mantle



黑方台黄土台塬边地下水集中溢出, 构成滑带
Groundwater strong discharge that is easy to slip



黑方台焦家－扶河桥滑坡带
The Jiaojia-Fuheqiao landslide zone, Heifangtai, Yongjing County, Gansu Province

甘肃永靖黑方台黄茨滑坡

Huangci Landslide, Heifangtai Loess Mantle, Yongjing County, Gansu Province



1996 年滑动后的黄茨滑坡 (滑坡呈三级叠瓦状台阶斜列)
Huangci landslide after the sliping in1996［3 steps (terraces) obliquely arranged]

(本照片由王恭先提供)

位于黑方台南缘，上覆厚层黄土的顺层岩石滑坡,主滑方向为 SE30º 左右，直指黄茨村，危及 63 户 300 余人安全。滑坡前缘宽约 300m，后缘宽约 500m，长 370m，体积近 600 万 m^3。该滑坡于 1995 年 1 月 30 日发生大规模滑坡，由于成功预报，未造成人员伤亡。2006 年 5 月 14 日，再次复活，体积 320 万 m^3，153 间房屋被毁，道路中断。

Huangci landslide is located at the margin of the Heifangtai loess mantle.The landslide is made up of loess and bedded mudstone, 300-500 m wide, 370 m long and 6 million m^3 in volume. The landslide started on January 30, 1995, endangering 300 persons. No death was claimed because of successful prediction. Since May 14, 2006, the landslide reactivated, involving 3.2 million m^3, 153 houses were destroyed and traffic was interrupted.



2006 年 5 月黄茨滑坡再次滑动, 毁坏房屋和田地
Reactivation of landslide in May of 2006. Houses and farmland were destroyed



黄茨滑坡形成三级叠瓦状台阶
(2006 年 6 月)
The Huangci landslide consists of three rotational slides (slumps)



黑方台黄茨滑坡地下水丰富
The backtilted (rotated) slide mass is clearly seen and the obstruction of overland flow has led to the formation of a pond



黑方台黄茨滑坡岩土结构 (地下水沿黄土与泥岩接触带溢出)
Groundwater discharge along contact between loess and mudstone



黄茨滑坡后缘形成多级陡坎
Main and secondary scars of the Huangci landslide



黄茨滑坡后缘
Main scar and unstable mass of the Huangci landslide



黄茨滑坡体中部陷落前部滑坡脊远景
Overview of graben and ridge in the main mass of the Huangci landslide



黄茨滑坡体中部陷落前部形成滑坡反向陡坎
Graben in the main mass and reverse scars at the toe of the Huangci landslide



黄茨滑坡体中形成多级陡坎和裂缝
Multiple scars and transverse cracks of the Huangci landslide



黄茨滑坡体中部陷落前部形成滑坡脊
Graben and ridge in the main body of the Huangci landslide



黄茨滑坡前缘逆冲剪出
The toe of the Huangci landslide overlying original ground



黄茨滑坡呈叠瓦状结构
The Huangci landslide has produced overridden structure (Quartenary loess) on the top of cretaceous mudstone



黄茨滑坡前缘剪出口 (菜地出现逆冲陡坎)
Pressure ridge at the toe of the landslide



黄茨滑坡前缘地面出现鼓胀裂缝
Pressure cracks at the toe of the landslide



滑坡前缘反翘剪出, 毁坏民房和道路
Backtilted sliding mass and destroyed houses



滑坡前缘反翘剪出
Backtilted slide and pressure ridge of the Huangci landslide



滑坡前缘反翘剪出, 毁坏民房和道路
Backtilted slide and destroyed houses



滑坡前缘堆积, 毁坏民房
Accumulation lobe and destroyed houses



滑坡前缘鼓胀裂缝发育
Bulge and transverse cracks at the toe
of the landslide



滑坡前缘反翘剪出, 毁坏民房和道路
Backtilted slide and severed transportation

陕西延安宝塔山滑坡

Baotashan Landslide of Yan'an City, Shaanxi Province



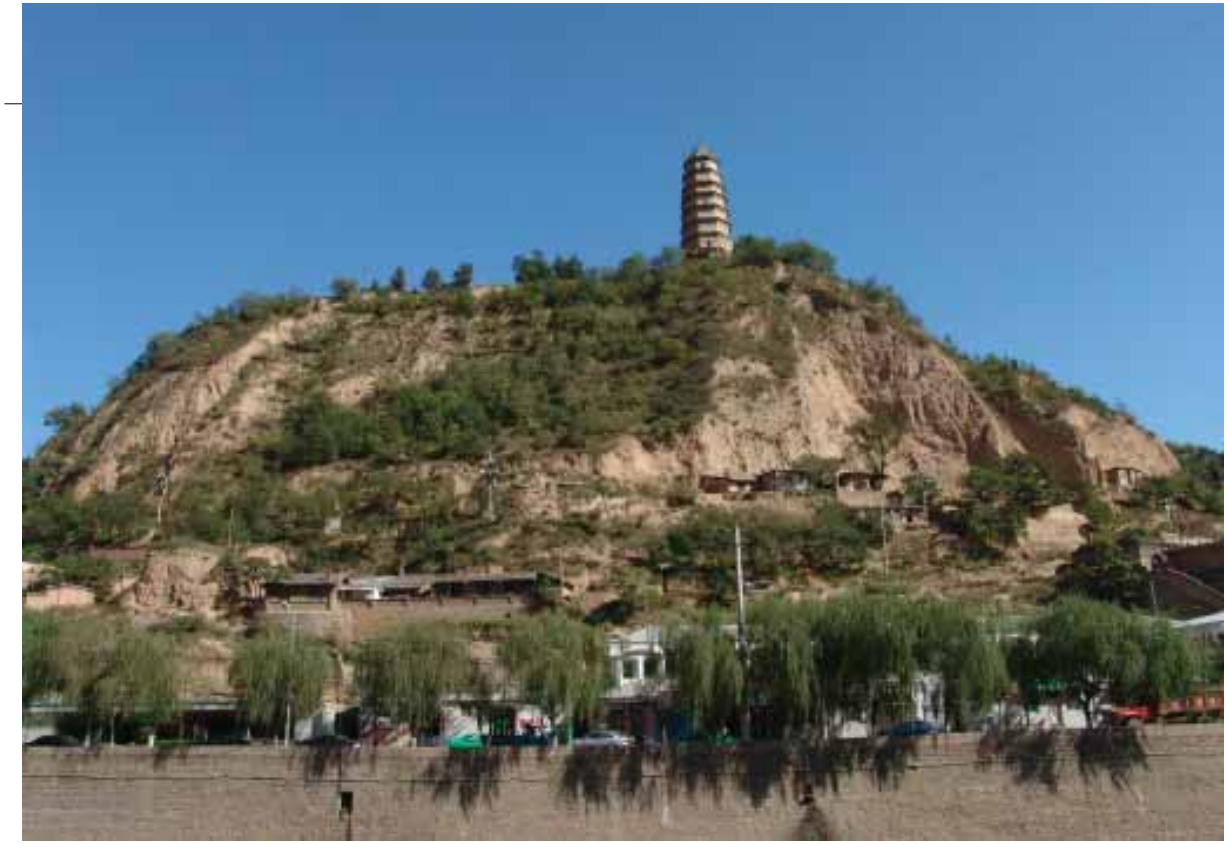
陕西延安宝塔山滑坡远眺
Overview of the Baotashan landslide of Yan'an City, Shaanxi Province



宝塔山的窑洞远眺
Overview of cave dwellings in Baotashan



在宝塔山滑坡下部的窑洞和居民
Cave dwellings and citizens under the Baotashan landslide



陕西延安宝塔山滑坡
The Baotashan landslide of Yan'an City, Shaanxi Province



宝塔山黄土下部为稳固的延安组砂岩
Stable Yan'an Group sandstone under the Baotashan landslide



宝塔山滑坡顶部被硬化, 减低了降雨入渗
Reducing seepage into the Baotashan landslide with a hard top (low permeability) surface



宝塔山滑坡侧壁
Lateral shear of the Baotashan landslide



宝塔山滑坡后缘及植被
The scarp of the Baotashan landslide and vegetation



宝塔山滑坡后缘局部塌滑
Some raveling of the scarp



加固后的宝塔山滑坡后缘壁
Reinforcement on the scarp of the Baotashan landslide

陕西延安柳林菜秧沟黄土滑坡

Caiyanggou Landslides, Liulin, Yan'an City, Shaanxi Province



延安柳林菜秧沟黄土滑坡 (右面还分布一滑坡)
Overview of one of the Caiyanggou landslides, Liulin, Yan'an City, Shaanxi Province
(The other not visible, is on the opposite slope right hand side of the photo)

位于杜甫川河南岸南北向支沟菜秧沟东侧。滑坡体长150m，宽200m，厚3m，体积9万m^3，为小型滑坡。底部出露有10m厚的灰色中厚层砂岩，自上而下为晚更新世黄土和中更新世黄土。滑坡正对面另一侧沟岸上还发育有一相似的滑坡，其坡脚也同样存在因为建设而可能失稳问题。

The Caiyanggou landslides are located at the eastern Caiyanggou of the Dufuchuan River. They are small landslides, 150 m long, 200 m wide, 3 m thick and 90 000 m^3 in volume. The landslides are made of Pleistocene loess. The two landslides are unstable for slope cutting.



菜秧沟黄土滑坡全貌
Closer overview of one of the Caiyanggou landslides, Yan'an City, Shaanxi Province



菜秧沟滑坡对面另一滑坡
Overview of the second Caiyanggou landslide

(本版照片由张茂省、校佩喜提供)

陕西延安川口乡偏桥滑坡

Pianqiao Landslide of Chuankou Village, Yan'an City, Shaanxi Province



延安川口乡偏桥滑坡远景　Overview of Pianqiao landslide of Chuankou Village, Yan'an City, Shaanxi Province



滑坡剪出口　Shear zone of landslide



滑坡遥感影像　Remote sensing image showing the landslide

位于川口乡偏桥村南黄土峁北坡，长280m，宽800m，厚8m，体积约179.2万m^3，属大型黄土滑坡。推测沿中更新世黄土和上三叠统瓦窑堡组页岩，泥岩砂岩互层的接触面剪出，在滑坡前缘的出露土体中可见扰动土内卷入的与剪出口处相同的三叠统瓦窑堡组砂岩。目前该滑坡基本稳定。

This Large loess landslide is 280 m long, 800 m wide, 8 m thick and about 1.8 million m^3 in volume. The shear zone is distributed between Pleistocene loess and Triassic shale. The landslide is stable.

陕西延安冯庄乡任家沟滑坡

Renjiagou Landslide, Yan'an City, Shaanxi Province



陕西延安冯庄乡任家沟滑坡
Renjiagou landslide, Yan'an City, Shaanxi Province

位于冯庄乡任家沟村。前沿地层为晚更新世黄土，未见底部基岩出露。滑体长约100m，宽128m，厚约7m，体积10万m^3，后壁呈典型的圈椅状。可见两级平台：一级平台栽种有果树；二级平台被居民顺地势整平之后作为宅基地使用。滑体上还发育两条呈纵向延伸的冲沟。

The material in front is Late Pleistocene loess and there is no bedrock exposed. The landslide is 100 m long, 128 m wide, 7 m thick and 70 000 m^3 in volume. There are two terraces in the back: No.1 is used for farmland; No.2 is used for housing.



陕西延安冯庄乡任家沟滑坡远景
Another overview of the Renjiagou landslide

(本版照片由张茂省、校佩喜提供)

陕西延安蟠龙镇李崖尧滑坡

Liyarao Landslide, Panlongzhen Village, Yan'an City, Shaanxi Province



陕西延安蟠龙镇李崖尧滑坡
Overview of the Liyarao landslide, Panlongzhen Village, Yan'an City, Shaanxi Province

位于河谷东岸，底部出露 5m 厚层砂岩，不整合接触中更新世和晚更新世黄土，在临近河谷处夹有厚度约 1m 的河流相砾石层。后壁坡长 20m，冲沟极为发育。滑坡长约 250m，宽 500m，厚 8m，体积约为 100m^3，属大型滑坡。滑体前缘紧邻河谷，其上现住有两户居民。目前滑体整体状况基本稳定。

The landslide is located on the eastern shore of a river valley; 5 m of sandstone are exposed at the base. The landslide involves Late Pleistocene loess which lies unconformably over the sandstone. The backscar and a system of gullies are significantly developed. The toe of the landslide is located adjacent to the river valley.



滑坡体中有一排窑洞, 后缘壁冲沟发育
Cave dwellings in the landslide

陕西延安枣园镇芋子滩滑坡

Yuzitan Landslide, Zaoyuan Village, Yan'an City, Shaanxi Province



陕西延安枣园镇芋子滩滑坡远景
Overview of the Yuzitan landslide, Yan'an City, Shaanxi Province



滑坡体中的节理　Joints in the landslide



滑坡后部落水洞
Sinkholes in the crown of landslide

(本版照片由张茂省、校佩喜提供)

陕西延安杨崖滑坡

Yangya Landslide, Yan'an City, Shaanxi Province



陕西延安杨崖滑坡全景 (滑坡与移民新村、黄延高速枣园隧道)
Overview of the Yangya landslide, Yan'an City, Shaanxi Province

位于枣园镇杨崖村东侧，因公路占地移民工程开挖坡脚而形成。滑坡长约40m，宽约80m，厚3～5m，坡度约45°，滑动面在原老滑坡体中的黄土内部。

The Yangya landslide is located on the eastern side of Yangya Town, 40 m long, 80 m wide, 3-5 m thick. The landslide has been reactivated due to slope cutting for housing.



前缘场平切坡建房, 老滑坡局部滑塌
Some sliding due to slope cutting for housing



新滑坡前缘纵张裂缝发育
Radial cracks at the toe of the Yangya landslide

(本版照片由张茂省、校佩喜提供)

陕西延安河庄坪小沟李河滑坡

Lihe Landslide at Hezhuangping Village, Yan'an City, Shaanxi Province



延安河庄坪小沟李河滑坡
Overview of the Lihe landslide at Hezhuangping Village, Yan'an City, Shaanxi Province

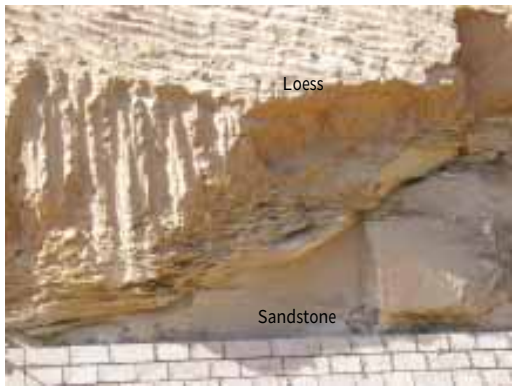
位于沟谷北侧斜坡上，原始坡度 35°，斜坡底部为 10～15m 厚的厚层砂岩，自下而上有中更新世和晚更新世黄土。滑坡体长 80m，宽 200m，厚 5m，体积约 8 万 m^3，为小型滑坡。在前缘边坡上可见剪节理。



滑坡体中的剪切节理
Shear zone within the landslide



黄土沿砂岩顶部剪出，滑带明显
Sliding along the top of sandstone



滑坡滑带片理发育
Basal shearing and slabbing in the landslide

陕西延安吴旗宗湾子村石油子校黄土滑塌

Shiyouzixiao Loess Fall, Zongwanzi Village, Yan'an City, Shaanxi Province



黄土滑塌毁坏窑洞
Cave dwelling destroyed by loess fall

滑塌发生于2002年7月25日。滑塌体高约20m，宽15m，平均厚约2m，体积约600m^3。砸毁窑洞3孔，造成17人死亡。被毁窑洞修建于1992年。由于人工开挖坡脚，盲目削坡，形成高约25m、坡度约80°的高切坡。2002年7月24～25日的连续降雨量高达83mm。坡顶边缘排水渠集水及降水入渗诱发滑塌。

This fall occurred on July 25, 2002. It was about 20 m high, 15 m wide, 2 m thick and 600 m^3 in volume. The cave dwelling was excavated in 1992, creating an artificial slope of 25 m high and with a slope angle of 80°. The fall was due to heavy rainfall (83 mm) and caused 17 deaths.



黄土滑塌毁坏窑洞, 17人死亡
Loess fall destroyed the cave dwelling, caused 17 deaths

(本版照片由宁社教提供)

陕西洛川黑木沟黄土标准剖面及滑坡

Standard Profile and Landslides at Heimugou, Luochuan, Shaanxi Province



陕西洛川黑木沟黄土后缘崩塌
Loess Fall in the Heimugou, Luochuan County, Shaanxi Province

陕西洛川黑木沟出露的黄土古土壤地层序列连续完整，是我国乃至世界上的标准黄土地层剖面。同时，崩塌、滑坡现象较为典型，是研究第四纪环境及滑坡的典型地区。已被国土资源部批准为国家地质公园。

The Heimugou trench of Luochuan County is a typical zone of loess outcrops; and also a standard section in China, or even in the world, for successive and complete Quaternary deposits. The zone has been set up as a national geopark that provides a good opportunity for environment geology studies and education.



陕西洛川黑木沟马兰黄土 (Q_3) 被覆在离石黄土 (Q_2) 和午城黄土 (Q_1) 之上
Malan loess (Q_3) overlying the Lishi (Q_2) and Wucheng (Q_1) loesses in the Heimugou trench

·陕西洛川黑木沟黄土标准剖面及滑坡·



马兰黄土中垂直节理发育, 稳定性差, 窑洞大多修建在离石黄土中
Vertical fractures in Malan loess (Q_3). The cave dwellings have been constructed in Lishi loess (Q_2)



黄土中大型节理, 溶蚀后形成溶洞
Loess karst cave developed along large fractures in the Heimugou trench, Luochuan, Shaanxi Province



黄土中溶洞发育, 并在地面形成土林
Loess pillars (loess "forest") and karst caves, Luochuan, Shaanxi Province



陕西洛川黑木沟第四系黄土 (Q) 与第三系红色泥岩 (N) 接触关系
Contact relationship between Quaternary loess and purple-red Tertiary mudstone in the Heimugou trench



基岩表层风化片理发育, 在上覆黄土重力作用下, 形成帚状破裂
Fractures in weathered sandstone due to loess mass overloading



黄土边坡高达 40m
Artifical loess slope, 40m high,
Yan'an City, Shaanxi Province



黄土与基岩接触带风化片理发育
Broken and weathered contact zone between loess and bedrock



黄土与基岩复合边坡
Complex slope of loess and rigid rock, Yan'an City, Shaanxi Province



甘肃洮河岸边第四系 (Q)黄土－第三系 (N) 泥岩顺层滑坡
Loess landslide along Tertiary bedded mudstone at the shore of the Tao River, Gansu Province

(本照片由吴玮江提供)



黄土与第三系红粘土接触, 上部出现崩落
Fall at the contact zone between loess and red Tertiary mudstone



黄土坐落在稳定基岩平台上
Loess mass is located on stable bedrock platform

陕北黄土窑洞及滑坡*

Cave Dwelling and Landslides in North Shaanxi Province



古黄土中的窑洞
Cave dwelling in ancient loess



黄土窑洞风光
Cave dwelling in loess



兴建房屋黄土边坡滑塌
Loess fall induced by housing development



黄土滑塌推压新房
Loess fall crushed new house



滑塌土体毁坏窗户
Windows damaged by fall

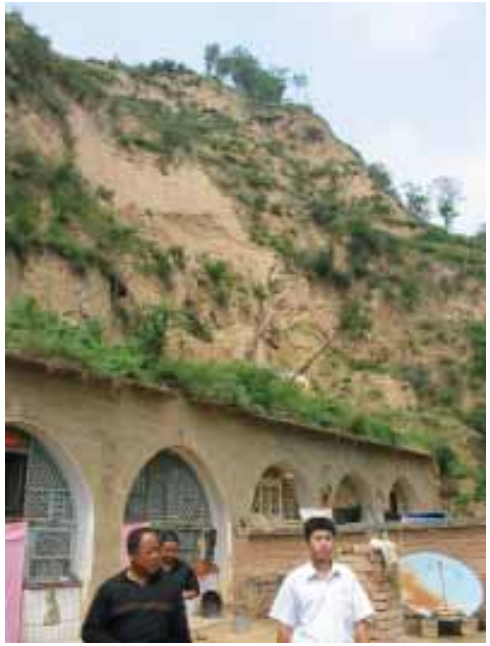
* 本滑坡照片由张茂省提供



黄土中的窑洞远景 (上部窑洞出现裂缝)
Overview of cave dwellings in loess (some fractures occurred above the upper caves),Yan'an City, Shaanxi Province



黄土窑洞
Cave dwelling in loess



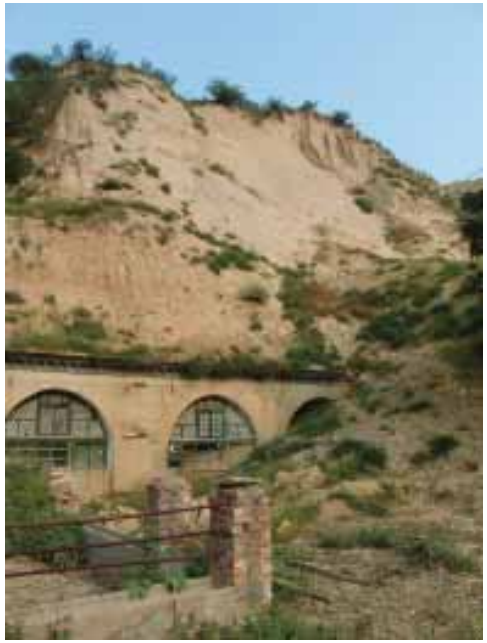
窑洞上部的黄土滑坡
Loess landslide above the cave dwelling



被节理切割的黄土柱下座, 毁坏窑洞
Fracture bound columns in loess collapsed and destroyed the dwelling



黄土窑洞
Cave dwelling in loess, Yan'an City, Shaanxi Province



滑坡掩埋窑洞
Cave dwelling buried by loess landslide

新疆伊犁新源巴特巴克特萨依沟滑坡泥石流

Tesayigou Slide/debris-flow in Xinyuan County, Xinjiang



滑坡溯源侵蚀, 向下形成转化泥石流
Retrogressive landslide converting into debris flow, Xinyuan County, Xinjiang

为复合类型，由滑坡转化为泥石流，发生于 2005 年 6 月 12 日。距沟口 2.3km 泉水溢出带东侧山体发生滑坡，沟谷内分布较多沼泽湿地，滑坡移动沿途两岸产生滑坡、崩塌的物质与沟谷中大量淤泥汇入形成泥石流。泥石流堆积体长约 2.5km，土方量约 1520 万 m^3。滑坡－泥石流区地势平坦。下伏古生界石炭系火山碎屑岩，上部表层覆盖第四系黄土。沟谷上游泉水出露较多，滑坡体位于泉水溢出带，受冬季融雪和降水多次发生滑坡，土体饱水，呈液化状态，滑动中带动两侧沟岸产生次级崩塌、滑坡并带动沟谷内大量淤泥汇入形成泥石流。泥石流速度一般为 4～10m/h。

This complex slope movement began as a slide and became debris flow. It occurred on June 12, 2005. The landslide started at a spring discharge zone. The debris flow has a length of 2.5 km, 15.2 million m^3 in total volume. It developed swamps and induced lots of secondary landslides. The complex landslide involved Quatenary loess resting on clastic sedimentary rock of Caboniferous age.



巴特巴克特萨依沟滑坡转化为泥石流全景图 [由东向西拍摄, 泥石流由北向南 (右向左)运动, 全长 2.5km]
Overview of mudslide converting into mudflow, with a length of 2.5 km, Xinyuan, Xinjiang



泥石流堆积区前缘
The toe zone of earth flow



泥石流铲动沟谷两侧形成滑坡
Secondary landslides induced at the two sides of the debris flow



泥石流中部流通—堆积区 (由西北向东南拍摄)
The debris flow moving through different topography

(本版照片由宫小平提供)



滑坡区地势平缓, 是良好的牧场
The zone of the debris flow is low-relif, rich livestock farmland



滑坡逐渐向源掏蚀, 物源区土体结构均匀、富水
Retrogressive erosion by landslding and the material is water-bearing



泥石流呈塑性流动
The debris flow moving

(本版照片由宫小平提供)

新疆伊犁新源加郎普特滑坡

Jialangpute Landslide in Xinyuan County, Yili City, Xinjiang



滑坡及堰塞湖全景
Overview of the Jialangpute landslide and damming of lake, Xinyuan County, Xinjiang



滑坡后缘及黄土与基岩接触全景
Landslide scarp showing the contact between loess and bedrock

(本照片由宫小平提供)

滑坡发生于2003年5月11日，为黄土滑坡。滑坡东西长约1km，南北最大宽度约0.6km，面积66万m^2，体积约960万m^3。滑坡由东向西进入主沟转向南顺则克台沟向下移动近6km，在主沟内形成高815m、宽80 120m的堆积物。滑坡体堵塞河流形成水面面积为11万m^2、最大水深达13m、蓄水量约90万m^3的滑坡堰塞湖。滑坡后壁高40～90m，下方有多处泉水出露，下部出露有棕黄色泥岩和砾岩。黄土与下伏基岩之间的不整合面构成现代滑坡的滑动面。

This landslide occurred on May 11, 2003; it is 1000 m long (EW), 600 m wide (NS) and is 9.6 million m^3 in volume. The accumulation lobe of the loess landslide dammed a river and a lake was formed with a storage of 900 thousand m^3 and a depth of 3 m. The main scarp is 40-90 m high and there are springs at the bottom of the scarp.



滑坡体中后部堆积物质主要为黄土
The crown scarp, the back and the mid-sections of the landslide are loess



滑坡坝中部形成冲沟, 为湖水下泄通道
Trench in the Jialangpute landslide dam



堰塞湖岸边形成黄土滑塌
Loess slump and fall at the lake shore due to water rising, Xinyuan County, Xinjiang



滑坡堰塞湖全景, 湖中房屋被淹
Overview of damming of lake. Houses were submerged

新疆伊犁巩留黄土滑坡

Loess Landsliding in Gongliu County, Yili City, Xinjiang



新疆伊犁巩留黄土滑坡, 由披覆在基岩山地的第四系风成黄土构成
Quatenary loess landsliding in Gongliu County, Yili City, Xinjiang



新疆伊犁巩留浅层黄土滑坡和泻流
Loess landsliding in Gongliu County, Yili City, Xinjiang

4.风化层与堆积层滑坡

Landslides in Weathered and Colluvial Materials



LANDSLIDES IN WEATHERED
AND COLLUVIAL MATERIALS
LANDSLIDES IN WEATHERED
AND COLLUVIAL MATERIALS
LANDSLIDES IN WEATHERED AND COLLUVIAL MATERIALS



农村居民切坡建房, 上部风化带富水, 边坡稳定性差
Slope cutting by housing development induced landsliding of water-rich weathered materials in Jiangxi Province



农村民房后坡失稳滑塌
Landslide behind house, Ji'an, Jiangxi Province



边坡未加防护, 危及民房
Slope failure endangering houses, Ji'an, Jiangxi Province



农村民房后坡滑塌
Landslide behind a house, Jiangxi Province



切坡未加支护, 风化强烈, 稳定性差
Slope sliding in residual material



滑坡毁坏民房
A village house destroyed by landslide in Jiangxi Province



滑坡冲入民房
Landslide crashed into the house



广西贺州金秀土石碎屑流
Numerous and simultaneous hill slides that generated debris flows along creeks, Hezhou, Guangxi



广西贺州温泉景区滑坡
A landslide at a hot spring resort, Hezhou, Guangxi

(本版照片由何小明提供)



陕西紫阳浅表层土流 (下伏板岩、千枚岩)
Shallow earth flow (overlying schist) Ziyang, Shaanxi Province



陕西紫阳浅表层土流隐患区
Potential hazard of shallow earth flows, Ziyang, Shaanxi Province



陕西紫阳碎屑流－泥石流
Debris flow, Ziyang, Shaanxi Province



陕西紫阳浅表碎屑流
Debris flow, Ziyang, Shaanxi Province



福建顺昌际会乡坡积层滑坡 (累计降雨量 520mm, 2005 年 6 月)
Landslide in weathered materials, Jihui Village, Shunchang, Fujian Province (Rainfall 520 mm, 2005-06)



福建宁德洋中镇泻流 (2 小时降雨量 300mm, 2005 年 10 月)
Debirs flow in Yangzhong Town, Ninde, Fujian Province (Rainfall 300 mm in 2 hours, 2005-10)



福建建瓯新区坡积层滑坡 (累计降雨量 140mm, 2005 年 6 月)
Landslide in weathered materials, New Jian'ou Town, Fujian Province (Rainfall 140 mm, 2005-06)



福建将乐大源乡泥石流 (占道行洪区的房屋不得不开通出口, 2005 年 6 月)
Opening excavated in a wall to allow the debris to flow, Jiangle, Fujian Province (2005-06)

(本版照片由何永金提供)



云南德钦碎屑流
Debris landsliding, Deqin, Yunnan Province



江西遂川堆子前镇碎屑流
Debris landsliding near Duiziqian Town, Suichuan, Jiangxi Province



云南新平哀牢山碎屑流
Debris landsliding near Ailao Mt., Xinping, Yunnan Province



云南新平水塘镇金厂村芭蕉树滑坡 (转变为泥石流)
Sliding becoming debris flow, Jingchang Village, Xinping, Yunnan Province



云南新平水塘镇南达村后山坡积层滑坡危及村庄
A colluvial landslide endangering Nanda Village, Xinping, Yunnan Province



云南新平水塘镇南达村后山坡积层滑坡 (死 15 人, 2002 年 8 月)
The landslide killed 15 people, in Nanda Village, Xinping, Yunnan Province (2002-08)



浙江诸暨次钨镇大路山滑坡
Dalushan landslide at Ciwu Town, Zhuji City, Zhejiang Province



浙江诸暨次钨镇大路山滑坡后缘整体下座
The scarp showing the mainbody displacement



浙江诸暨次钨镇大路山滑坡治理工程 (前部)
Retaining wall and modification of the landslide front



浙江诸暨次钨镇大路山滑坡治理工程 (后部)
Modification of the middle and rear of the landslide



丹巴红军桥堆积层滑坡
Hongjunqiao colluvial landslide in Danba County, Sichuan Province



丹巴梭坡滑坡, 位于大渡河左岸, 滑坡体上碉楼出现倾斜, 局部出现后缘贯通错落
Suopo landslide on the left shore of the Daduhe River. Ancient watchtowers are tilting and sliding



丹巴梭坡滑坡全景
Overview of the Suopo landslide in Danba County, Sichuan Province



丹巴美人谷甲居藏寨坐落在滑坡体上
The Tibetan Jiaju village is located on the Jiaju landslide
in the Meiren valley of Danba County, Sichuan Province



美丽的甲居藏楼
Beautiful Tibetan village house on the Jiaju landslide



甲居滑坡前缘堆积体
Accumulation zone, Jiaju landslide



甲居滑坡前缘及大渡河上游之金河
The Jiaju landslide is on the shore of Jinghe River, a branch of the Daduhe River



甲居滑坡全貌 (镜头朝南东, 金河下游)
Overview of the Jiaju landslide, Danba, Sichuan Province



甲居滑坡前缘被江水淘刷, 加上公路开挖, 稳定性差
The Jiaju landslide is moving due to road construction and river erosion



滑坡体常成为居住场地
Ancient landslide has created gentle topography that has been used as the site for village



中路乡美丽的藏寨坐落在古滑坡体上
The beautiful Tibetan village is situated on ancient landslide, Danba, Sichuan Province



位于大渡河上游边的丹巴美人谷藏寨楼群, 坐落在基岩上
Scenery of Tibetan village located on bedrock at the Daduhe River, Danba



位于四川泸定桥上游 1.5 km 大渡河左岸的四湾滑坡, 体积近 1 亿 m^3

Siwan landslide, 100 million m^3, on the left shore of the Daduhe River, 1.5 km upstream from the Luding bridge, Sichuan Province (Looking upstream)



四湾滑坡滑冲到大渡河右岸, 被一级阶地超覆, 显示曾发生堵江事件

Siwan landslide pushed up to the right shore of the Daduhe River. It covered the river terrace thus showing the damming history



四湾滑坡前缘堆积体及大渡河

The front of Siwan landslide at the left shore of the Daduhe River (Looking downstream)



大渡河上游分布的二云片岩形成易滑地层
Mica schist widely distributed in the upper reaches of the Daduhe River that is prone to sliding



四湾滑坡原岩为二云片岩, 富含石榴子石, 受构造强烈挤压, 较为光滑
Siwan landslide material consists of garnet and mica-bearing fragments crushed by tectonic processing



四湾滑坡及后缘滑床
Siwan landslide and main scarp