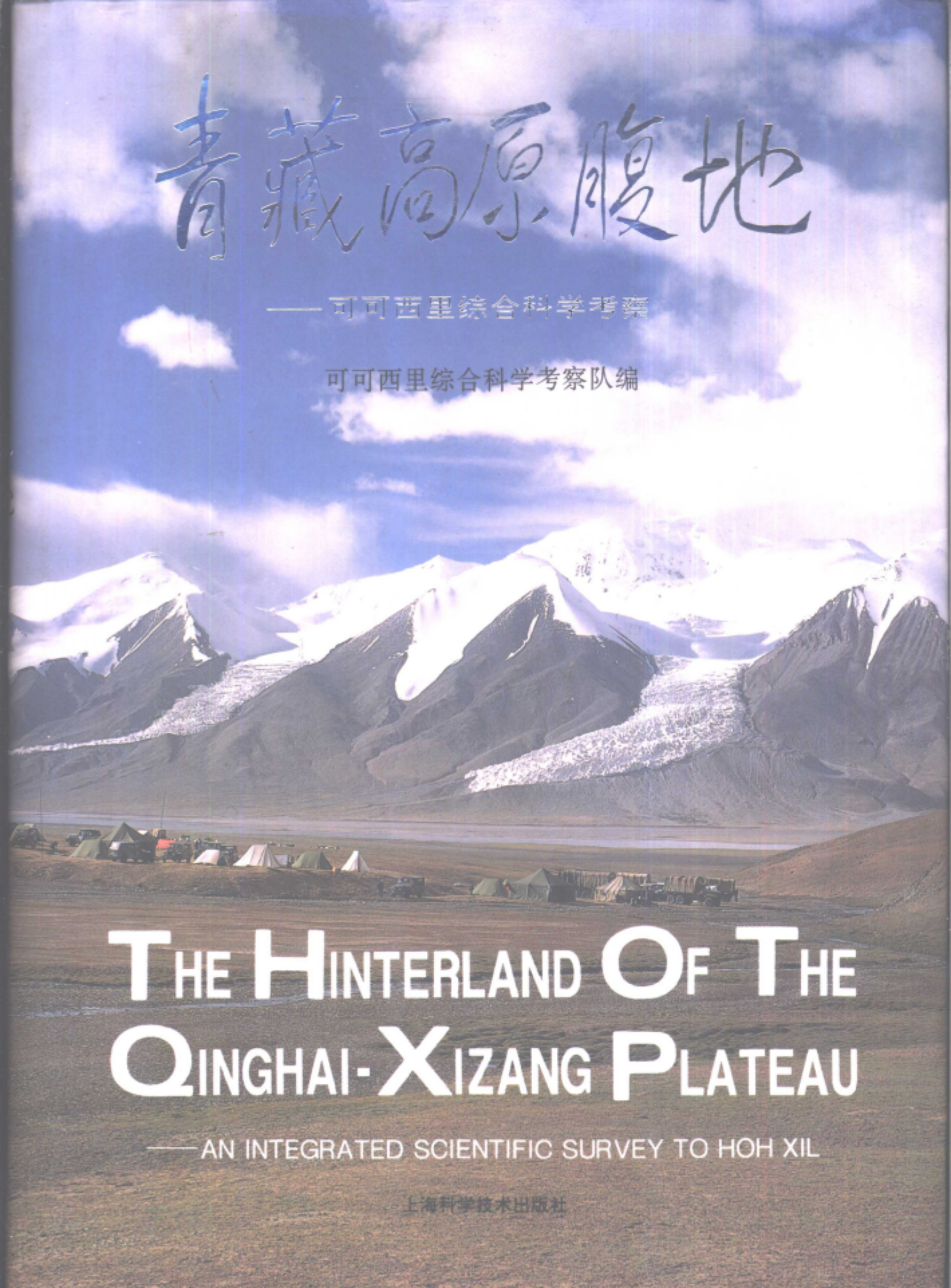


青藏高原腹地

——可可西里综合科学考察

可可西里综合科学考察队编

THE HINTERLAND OF THE QINGHAI-XIZANG PLATEAU

——AN INTEGRATED SCIENTIFIC SURVEY TO HOH XIL

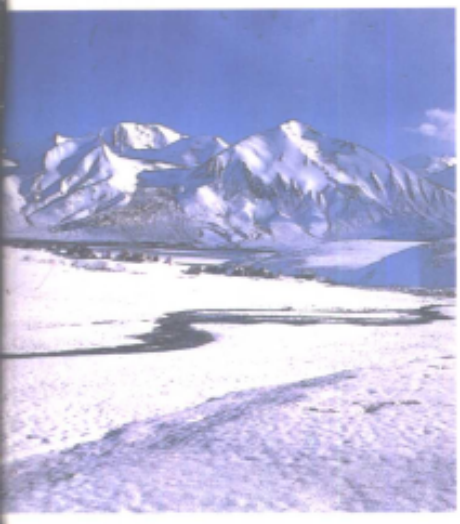
上海科学技术出版社

青藏高原腹地

THE HINTERLAND OF THE QINGHAI-XIZANG PLATEAU

——可可西里综合科学考察

——AN INTEGRATED SCIENTIFIC SURVEY TO HOH XIL



THE HINTERLAND OF THE QINGHAI-XIZANG PLATEAU
—AN INTEGRATED SCIENTIFIC SURVEY TO HOH XIL

青藏高原腹地

——可可西里综合科学考察

青藏高原腹地
——可可西里综合科学考察
可可西里综合科学考察队编
上海科学技术出版社出版、发行
（上海瑞金二路 450 号）
新华书店上海发行所经销　　上海华顿包装彩印有限公司制版
开本 889×1194　1/16　印张 7.25　插页 4
1994 年 10 月第 1 版　　1994 年 10 月第 1 次印刷
印数　1—1,000
ISBN 7-5323-3730-8/N・55
定价：230.00 元

（沪）新登字 108 号







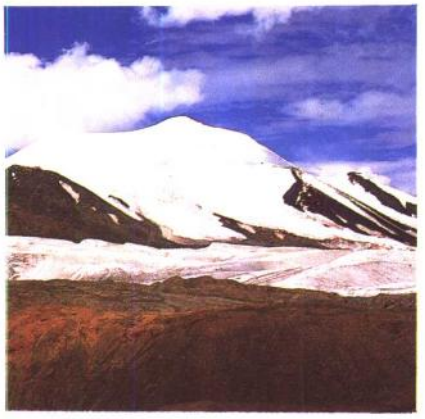

新疆维吾尔自治区
昆仑
可可西里
西藏自治区
唐古拉
冬布勒山
乌兰乌拉山
祖尔肯乌拉山
格拉丹冬
6860
太阳湖
6056 乌兰山
勒斜武担错
6102
东岗扎日
6305 岗扎日
月亮湖
饮马湖
可可西里湖
天台山
5647
汉台山
5713
西金乌兰湖
移山湖
5963
岗盖日
乌兰乌拉湖
5689 多索岗日
跑牛河
豌豆湖
雪莲湖
波涛湖
岗钦扎什
6137
诺多错
如木钎错
米提江占木错
6621 格拉丹冬
6513 姜根迪如岗日 6543
89°
90°
91°
36°
35°
34°

可可西里综合科学考察路线图

可可西里位置图

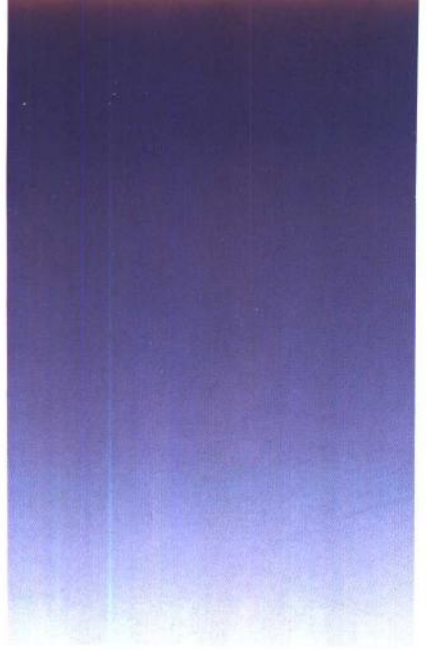
图例

- 考察宿营地
- 可可西里综合科学考察路线
- 熔岩方山和残留火山锥
- 高温沸泉
- 现代冰川
- 湖泊和河流
- 公路
- 省界



目 录
Contents

序 2
Introduction
前言 4
Preface
一、地质演化话沧桑 10
Geological Evolution
构造演化和新的发现 10
Tectonic Evolution and New Discoveries
火山、地震和地热活动蓬勃 22
Volcano,Earthquake and Geothermal Activities
二、独特的自然地理环境 30
Peculiar Natural Environment
完整的高原平台 30
Complete Plateau Tablelands
寒冷的世界 35
A Frozen World
千湖江源 55
Innumerable Lakes and River Sources
奇异的自然景观 63
Fantastic Landscapes
完好的原始生态环境 66
Primitive Ecological Environment
三、生物的多样性 68
Biological Diversities
高寒植物种种 68
Alpine Plants
高原野生动物的乐园 81
Wild Animals
众多的珍稀昆虫 94
Insects
四、艰难的考察历程 98
Strenuous Fieldwork



序 Introduction

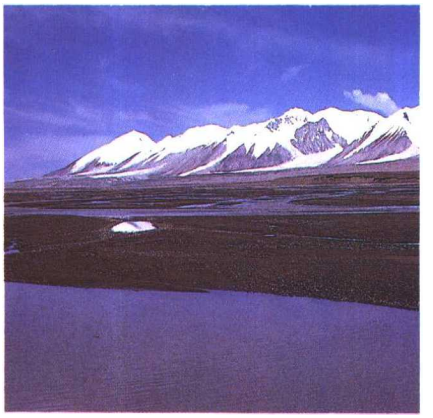
青藏高原独特的地质构造、自然环境和生物区系，历来是世界上地学、生物学研究的热点，也一直受到我国政府和自然科学家们的关注。从50年代起，我国有关部门及科学研究机构就分别多次组织了对青藏高原的科学考察。1973年，中国科学院组织的青藏高原综合科学考察队，先后对西藏自治区、川西、滇北的横断山区、喀喇昆仑—昆仑山区，进行了大规模的多学科的综合科学考察，其考察和研究成果已陆续出版，公诸于世。

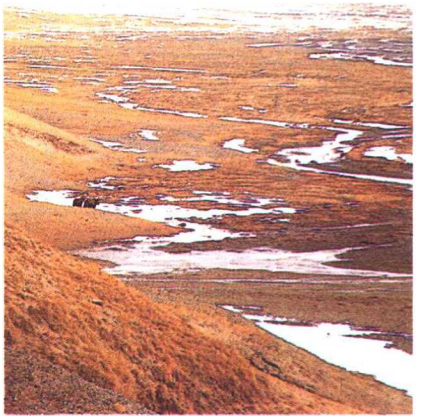
可可西里地区位于青藏高原腹地，迄今仍为无人居住区，自然环境恶劣，又无交通，因而成为青藏高原综合科学考察中遗留下来的最后一块空白区。

在国家和地方有关部门的支持下，可可西里综合科学考察队对这一地区进行了艰苦的野外考察和室内分析研究，取得了卓越的成绩。现在出版的这本画册和将要出版的四部专著，将有助于更加全面、深入地认识青藏高原的地质、地理特征和分界规律，生物的多样性和演化，也有助于读者对青藏高原的一般了解。对这一地区自然资源的开发利用和保护也极有价值。

对青藏高原的研究远未完成，尚有许多科学问题有待进一步探索。我寄希望于年青的地学、生物学工作者继续对青藏高原进行研究，为彻底揭示青藏高原的科学奥秘而努力。

1993年10月





The Qinghai-Xizang Plateau is considered as one of the key areas in studying geology, geography and biology with its special geological characteristics, natural conditions, fauna and flora, and has attracted a great deal of attention from the Chinese government and the scientific circle. Since the 1950s, China has organized several multi-disciplinary integrated surveys on Qinghai-Xizang Plateau. The Integrated Scientific Survey Team to Qinghai-Xizang was established by The Chinese Academy of Sciences(CAS) in 1973. After that, large-scale multi-disciplinary comprehensive scientific surveys have been carried out in Xizang, Mts. Hengduan (North Yunnan and West Sichuan) and Karakorum-Kunlun. The relative results from the surveys and research work on the plateau have recently been published.

Hoh Xil, a large and uninhabited area, is located at the hinterland of Qinghai-Xizang Plateau and was regarded as the last unknown area in the comprehensive scientific survey of the Qinghai-Xizang Plateau. Supported by the State and local departments, The Integrated Scientific Survey Team to Hoh Xil has done extensive fieldwork and research and analysis, and has achieved significant results,compiled four monographs and a collection of photographs, which reflect the geological and geographical characteristics, the different geographical environments, the diversity and evolution of fauna and flora, will help the readers to gain background about the plateau. It is valuable for the utilization and protection of natural resources in Hoh Xil.

The research of Qinghai-Xizang Plateau is by no means finished. There are still a great number of important problems which require further investigations. I do hope more and more young scientists will continue to explore the unknown and bring to light the hidden treasury of information.

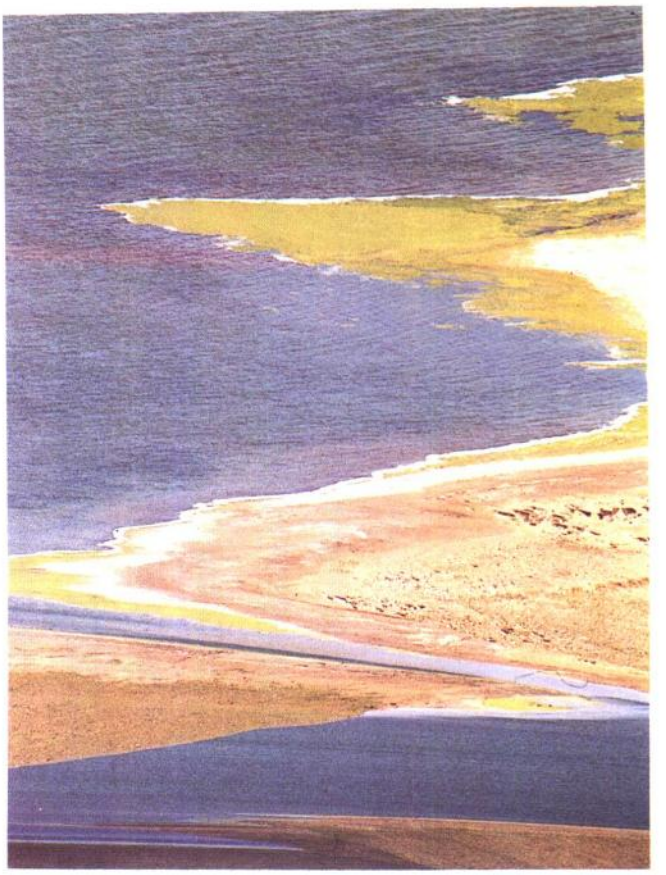
Sun Honglie October, 1993

前言 Preface

青海省可可西里地区位于北纬33°22′～36°00′，东经89°30′～94°00′，地处青藏高原腹地，包括了昆仑山以南、唐古拉山以北、青藏公路以西的青海省西南部广大区域，面积约8.3万平方公里。西、南与西藏自治区毗邻，西北角与新疆维吾尔自治区相连，行政区划归青海省海西蒙古族、藏族自治州和玉树藏族自治州管辖。

青海可可西里地区地势高亢，平均海拔在5000米以上，气候寒冷、空气稀薄，自然环境恶劣，广大地区至今仍为无人区，有“人类禁区”之称。该区由于受人类活动的干扰较小，大部分地区仍保持着原始的自然状态，其特殊的地理位置、地壳结构和自然环境以及特有的生物区系组成等，一直为国内外科学界所关注。本世纪50～60年代，青海地质局、中国人民解放军总参谋部测绘局等部门曾对这一地区进行过不同比例尺的区域地质填图和地形图测绘工作，此外再未进行过任何专业的科学考察，一直是我国在地学、生物学研究领域中了解最少的地区之一。

1988年，国务委员、国家科学技术委员会主任宋健同志在青海视察时，在听取了青海省及有关部门的汇报后，提出了在青海可可西里地区建立自然保护区和进行综合性科学考察的设想。这一设想得到了有关部门的重视。鉴于对该地区进行科学考察意义重大，条件又特别艰苦，经协商，由国家科委、中国科学院、国家环境保护局和青海省人民政府共同集资重点支持，对该地区开展综合科学考察。同时由国家科委、中国科学院、国家环保局和青海省人民政府共同组成了先后以青海省省长宋瑞祥、副省长班玛丹增为组长，中国科学院副院长孙鸿烈、国家环保局副局长金鉴明为副组长的青海可可西里地区综合科学考察领导小组，领导可可西里地区综合科学考察工作。中国科学院和青海省共同组织成立了以武素功为队

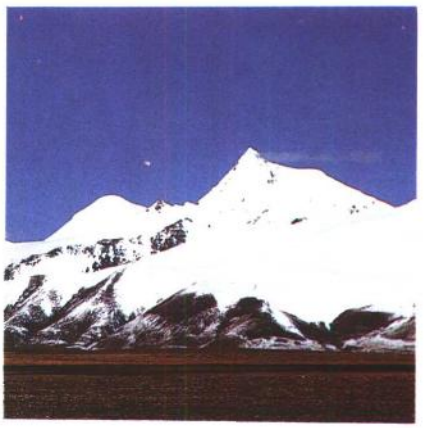
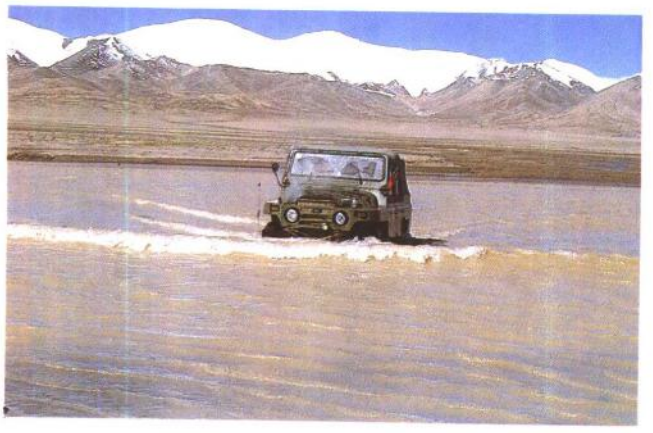


长，张以弗、李炳元、温景春、丁学芝为副队长的可可西里综合科学考察队，具体负责实施开展该项目的考察与研究。考察队重点开展了以下四个方面的研究：可可西里地区地质特征和演化，晚新生代以来青藏高原隆起对自然环境的影响；可可西里地区动植物区系的特征、形成及高原隆起对生物区系演变的影响以及人类对高原的适应；可可西里地区环境特点、区域分异及演化；可可西里地区自然资源（矿产、土地、动植物资源等）开发利用前景的评价与自然保护。其任务是通过对该地区的综合科学考察，较全面地积累基本的科学资料，填补“空白”，为阐述青藏高原的隆起、环境演变、生物区系形成演替及资源开发利用与保护等地学、生物学中重大理论问题的深入研究提供科学依据，并为建立青海可可西里自然保护区进行可行性研究。为了完成上述任务，考察队的组成包括了地质、地理、生物等27个专业。参加考察的68名队员，分别来自中国科学院自然资源综合考察委员会、昆明植物研究所、地理研究所、地质研究所、植物研究所、动物研究所、南京土壤研究所、南京地质古生物研究所、兰州冰川冻土研究所、青海盐湖研究所、西北高原生物研究所和青海省的地质科学研究所、气象科学研究所、环境保护研究所、地理研究所、高原医学科学研究所、地震局、草原总站、林业厅野生动物保护办以及新华社、人民画报社、民族画报社、青海省电视台、解放军84504部队等单位。

考察队在青海省人民政府和省科委的关怀、支持和青海省有关部委及格尔木市等单位的大力协助下，于1989年5月首先完成了对可可西里地区的预考察，并在此基础上制定了考察计划。经过充分准备，考察队于1990年5～8月间对可可西里地区进行了多学科的综合科学考察。在近一百天的艰难历程中，考察队员克服了高山缺氧和恶劣自然条件带来的重重困难，爬山涉水，风

前 言 Preface




餐露宿，艰苦奋斗，团结协作，圆满地完成了野外考察工作，积累了丰富的第一手资料，揭开了这片“神秘国土”的奥秘。对该地区的地质和地理特征，自然区域分异规律，生物区系的组成，自然环境的演化等方面有了全面的认识。我们从全体考察队员拍摄的照片中精选出 200 余幅，编成这本画册，全面、形象地反映了可可西里地区的地质、地理概貌和生物的多样性，以及艰难的考察历程。希望它能够帮助读者对可可西里这片神秘国土有一个初步的了解，并有助于人们对这一地区的深入认识。

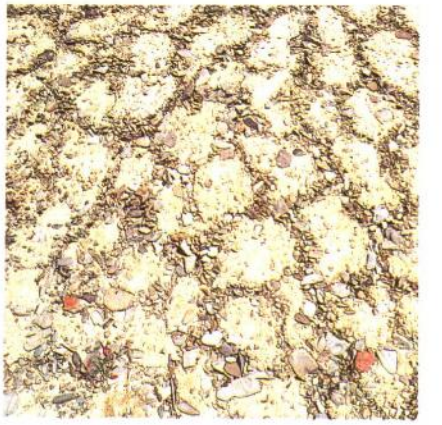
青海可可西里地区综合科学考察和成果出版工作，自始至终得到了各参加单位的大力支持和帮助，在此我们谨表示衷心的感谢。

由于我们的水平有限，加之野外工作时间的限制，本书尚存在许多不足之处，欢迎广大读者批评指正。

可可西里综合科学考察队

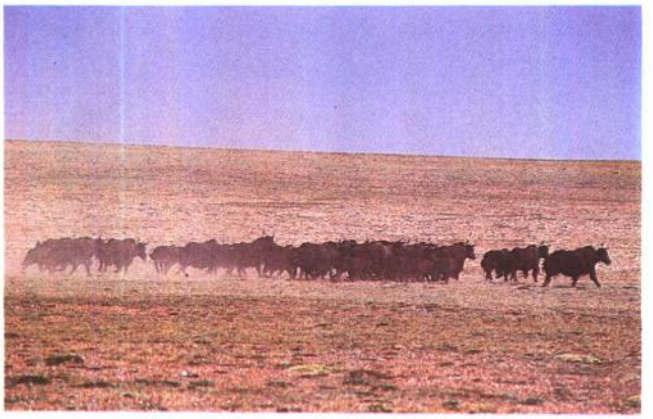
Hoh Xil in Qinghai Province is situated at 33°22′~36°00′ north latitude and 89°30′~94°00′ east longitude, in the hinterland of the Qinghai-Xizang Plateau, covering the southwestern part of Qinghai Province, south of the Kunlun Mountains, north of the Tanggula Mountains and west of the Qinghai-Xizang Highway. The 83000 km² area is chiefly composed of Mount Hoh Xil, which borders on Xizang and links to Xinjiang Uygur Autonomous Region in the northwest corner. Administratively it belongs to Haixi Mongolian and Tibetan Autonomous Prefecture and Yushu Tibetan Autonomous Prefecture.

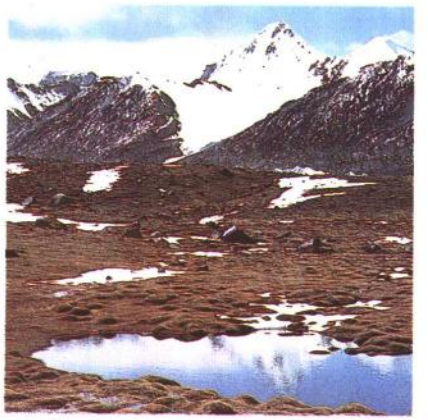
The average altitude of Hoh Xil is greater than 5000m above sea level. With a cold climate, thin air



makes it an inhospitable area, most of it is uninhabited and considered as a 'forbidden area' which preserves its primitive natural status with little interference from human activities. The special geographical location, crust structure, natural environment as well as fauna and flora have always been of great concern to scientists at home and aboard. In the 1950s～1960s, Qinghai Geological Bureau and the Cartographical Bureau of the Headquarters of the PLA General Staff conducted geological mapping and topographical survey in Hoh Xil. Since then, there has been no further investigation. It is one of the last blank areas for geological and biological researches in China.

In 1988, Song Jian, the State Councilor of the State Council and Director of the State Science and Technology Commission, put forward a tentative plan to establish a natural reserve and to conduct comprehensive scientific survey in Hoh Xil after hearing the report of the Qinghai provincial departments during his inspection tour of Qinghai Province. The plan was valued by many other departments in China. In view of the great significance and difficult fieldwork, the State Science and Technology Commission, the Chinese Academy of Sciences, the State Environmental Protection Bureau and the Qinghai Provincial People's Government coordinated to raise funds and support a comprehensive scientific survey in this area. The above four departments jointly set up a committee responsible for this survey, headed consecutively by Song Ruixiang, former Governor of Qinghai Province and his deputy Banma Danzhen and Sun Honglie, Vice-president of the Chinese Academy of Sciences and his deputy, Jin Jianming, Deputy-director of the State Environmental Protection Bureau. The Chinese Academy of Sciences and Qinghai Province jointly set up a comprehensive scientific expedition team headed by Wu Sugong, Zhang Yifu, Li Bingyuan, Wen Jingchun and Ding Xuezhi. Its work covered the following aspects: 1) Geological features and

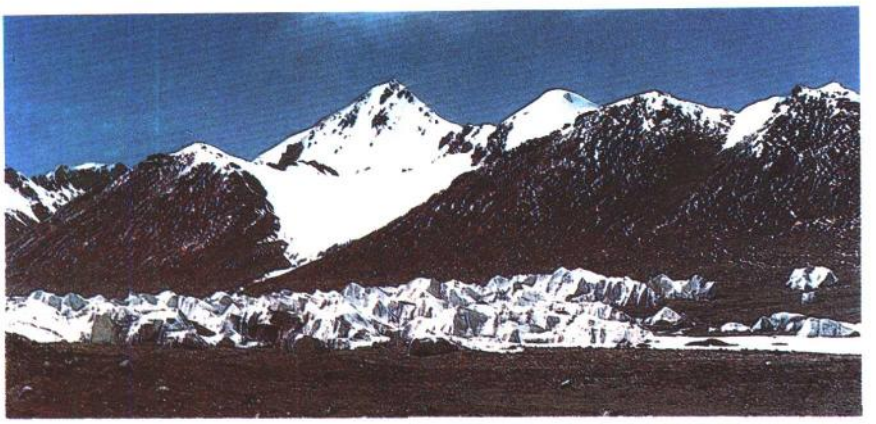




evolution in Hoh Xil and the influence of the upheaval of the Qinghai-Xizang Plateau on the natural environment since the late Cenozoic Era; 2) The characteristics, formation, evolution of the flora and fauna and humanity's adaptation in Hoh Xil as a result of the upheaval of the Qinghai-Xizang Plateau; 3) The environmental features, regional differentiation and evolution in Hoh Xil; 4) The prospects of the utilization and protection of natural resources in Hoh Xil. From this surveys, more basic scientific data would be collected in this unknown area to examine some important theories such as the upheaval of the Qinghai-Xizang Plateau, environmental evolution, the origin and evolution of the fauna and flora, as well as the exploration and protection of natural resources, and to do feasible studies on the establishment of a natural reserve in Hoh Xil. Therefore, 68 investigators in 27 different specialties from the following institutions are employed by the expedition team:

Integrated Survey Commission of Natural Resources, CAS; Kunming Institute of Botany, CAS; Institute of Geography, CAS; Institute of Geology, CAS; Institute of Botany, CAS; Institute of Zoology, CAS; Nanjing Institute of Soil Science, CAS; Nanjing Institute of Geology and Paleontology, CAS; Lanzhou Institute of Glaciology and Geocryology, CAS; Northwest Plateau Institute of Biology, CAS; Qinghai Institute of Salt Lake, CAS; Institute of Geological Science, Qinghai Province; Institute of Meteorological Science, Qinghai Province; Seismological Bureau of Qinghai Province; Wildlife Management Office, Forest Bureau, Qinghai Province; Qinghai High Altitude Medical Sciences Institute; Qinghai Institute of Geography; Qinghai Institute of Environmental Protection; Qinghai General Station of Prairie; Xinhua News Agency; People's Pictorial; Minzu Pictorial; Qinghai TV Station and PLA 84504 Unit.

With the support of the Qinghai Provincial Govern-



ment, the Provincial Science and Technology Commission and other departments, the expedition team arranged a preliminary investigation in Hoh Xil in May 1989 and conducted a multi-disciplinary survey from May to August 1990. The investigators overcame the inhospitable climate and completed the fieldwork. They accumulated the first hand data to help unveil the mysteries of this 'magic land'. It is, of course, helpful to understand the geological and geographical features, the fauna and flora, the evolution of the natural environment in the hinterland of Qinghai-Xizang Plateau. On this basis, we have selected 200 photographs from all the investigators and amassed this collection of pictures. We hope this photographic record can reflect the geological and geographical characteristics, the biological diversity and the difficult fieldwork in Hoh Xil, and help the amateur and scientists to get a general idea about this 'magic land' and arouse their interest to make a thorough research in Hoh Xil.

We hereby convey our heartfelt gratitude to all those who have given us such generous support.

We also welcome criticism from readers.

The Integrated Scientific Survey Team to Hoh Xil

一、地质演化话沧桑

Geological Evolution

构造演化和新的发现 Tectonic Evolution and New Discoveries

打开中国地质图，在青藏高原腹地，不难发现在巍巍昆仑山与唐古拉山之间有一片相当空白的地区——可可西里，其北部以近东西向的深大断裂为界与中国地块相邻接；南面的乌兰乌拉－夏仑曲断裂将地质学家称谓的古特提斯缝合系分为南北两部分：北为可可西里造山带；南为北羌塘地块。

为了探索青海可可西里地区的地质奥秘，我国的构造地质、地层古生物、岩石地球化学和地震地质等学科的专家，在1990年对该区进行综合科学考察时，在岗齐曲、西金乌兰湖至移山湖一带发现了具有洋壳性质的蛇绿混杂岩，其基质是千枚岩，有大小不等的辉长岩、辉绿岩、枕状玄武岩、块状玄武岩、苦橄岩、放射虫硅质岩、灰岩、大理岩等岩块杂乱地散布在千枚岩基质中，并在其中的硅质岩中发现大量的放射虫和海绵图针化石，其时代确定为早石炭世—早二叠世。这是目前该区发现的最老地层。它的发现证明，早在3亿年前可可西里地区就已经是古特提斯海的一部分了。显然，从晚石炭世洋壳就开始向北俯冲了，至早二叠世末—晚二叠世初，古特提斯海基本闭合，发生了不太强烈的造山运动，即海西运动，遂使昆仑山及其以北的广大地区隆起成陆，并形成褶皱，伴有岩浆岩的侵入；而昆仑山以南的可可西里地区则表现为增生楔变形。此后，晚二叠世—早三叠世本区处于相对稳定的滨海和浅海环境，沉积了一套由石英砂岩和灰岩组成的稳定型沉积地层，不整合在上述蛇绿混杂岩之上。其中的灰岩层中发现有双壳类、腕足类、有孔虫、䗴和钙藻等化石，其时代确定为早三叠世。到中、晚三叠世又发生了大规模的海侵，在西金乌兰湖—苟鲁山克错以北到昆南大断裂之间形成了厚约上万米，由砂岩、粉砂岩、板岩、灰岩，上部夹火山岩的巨厚复理石建造，其中发现有双壳类、腕足类、水枞和有孔虫等化石，时代属晚三叠世。三叠纪末（距今约1.95