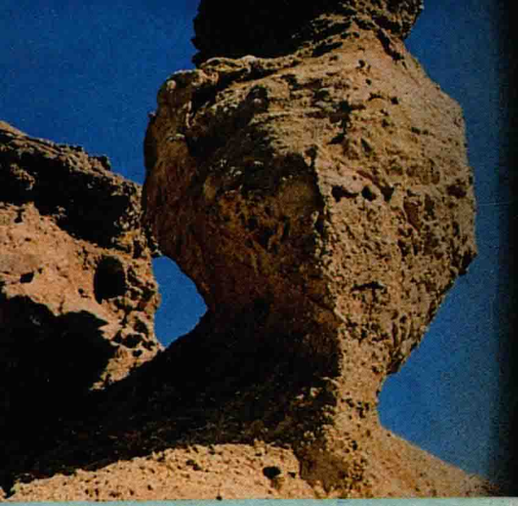
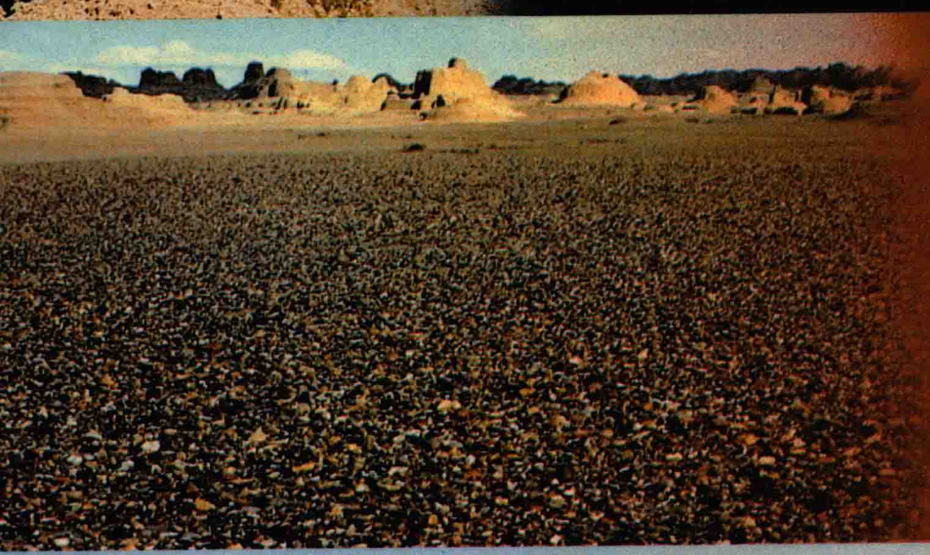
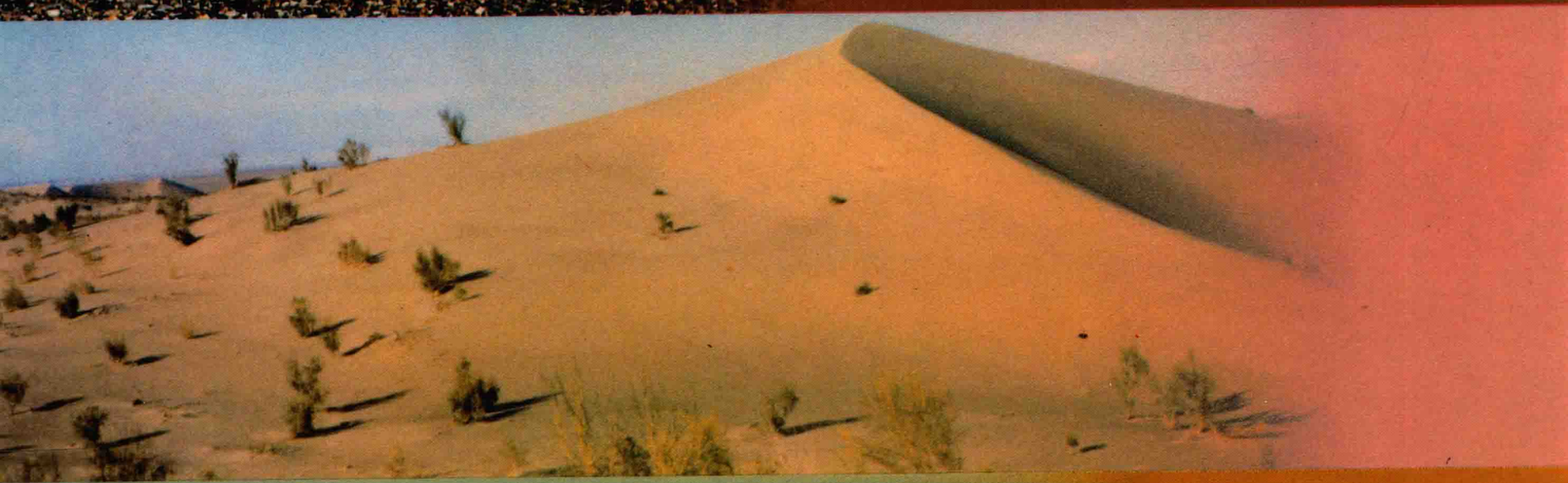


岩漠·砾漠·沙漠·黄土

ROCK DESERT
GRAVEL DESERT
SAND DESERT
LOESS





岩漠·砾漠·沙漠·黄土

rock desert·gravel desert sand desert·loess

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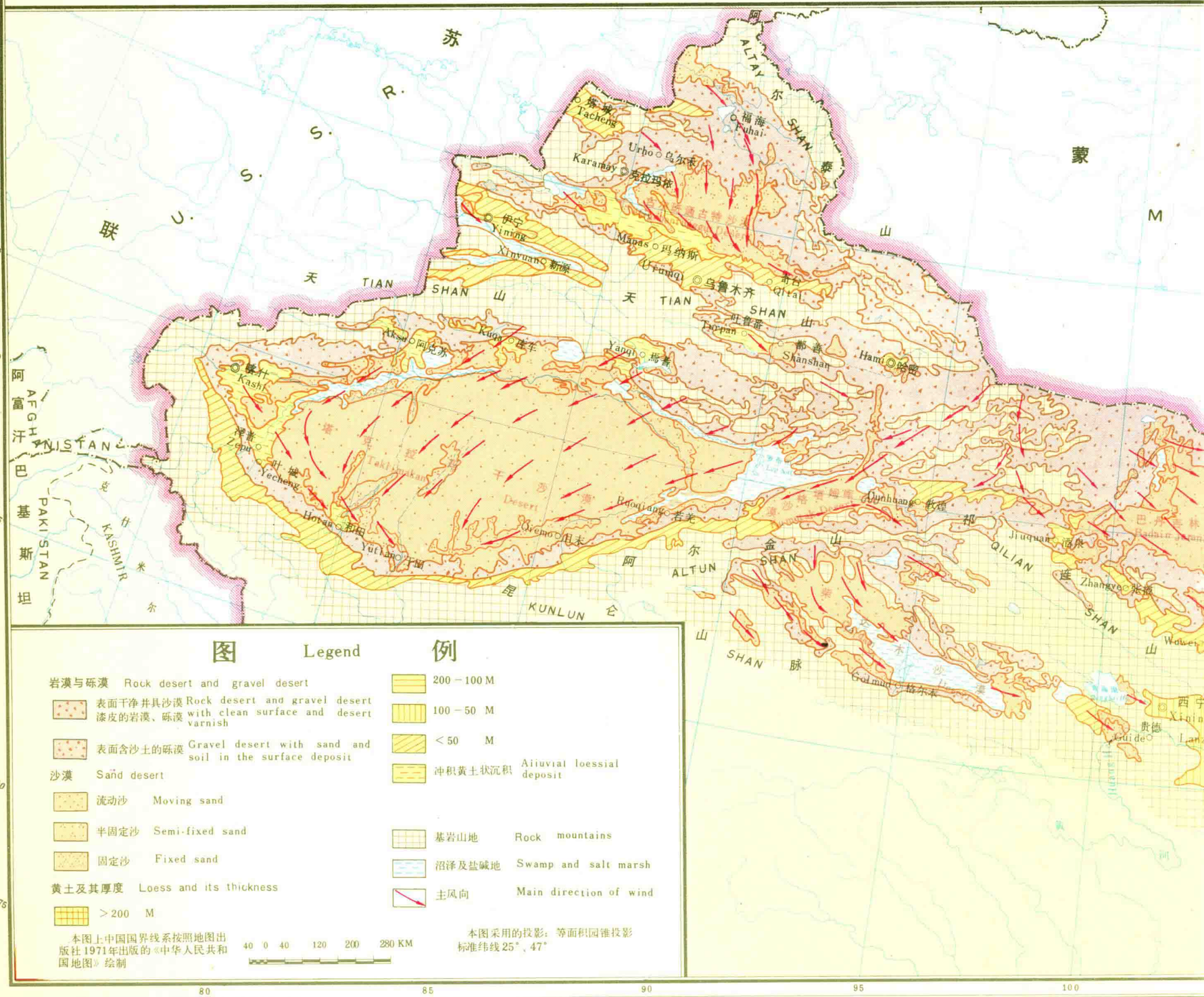
中国岩漠、砾漠、沙漠及黄土分布与主

MAP OF RELATIONSHIPS BETWEEN DISTRIBUTION OF ROC
DESERT, SAND DESERT, LOESS AND MAIN WIND DIRE



图例 Legend

岩漠与砾漠 Rock desert and gravel desert

- 表面干净并具沙漠漆皮的岩漠、砾漠 Rock desert and gravel desert with clean surface and desert varnish
- 表面含沙土的砾漠 Gravel desert with sand and soil in the surface deposit

沙漠 Sand desert

- 流动沙 Moving sand
- 半固定沙 Semi-fixed sand
- 固定沙 Fixed sand

黄土及其厚度 Loess and its thickness

- ＞200 M
- 200－100 M
- 100－50 M
- ＜50 M
- 冲积黄土状沉积 Aiiuvial loessial deposit
- 基岩山地 Rock mountains
- 沼泽及盐碱地 Swamp and salt marsh
- 主风向 Main direction of wind

本图上中国国界线系按照地图出版社1971年出版的《中华人民共和国地图》绘制

40 0 40 120 200 280 KM

本图采用的投影：等面积圆锥投影
标准纬线25°、47°

风向关系图

K DESERT, GRAVEL CTION IN CHINA

引　言

我国西北部、北部及东北部，在东经75°～120°，北纬35°～50°之间的广大地区，分布着大面积的岩漠、砾漠、沙漠和黄土。这一带气候干燥，风力强劲。东经106°以西，年降水量在200毫米以下，是大沙漠分布地区；东经106°以东，年降水量为200～400毫米，沙漠范围小。在荒漠东南的黄土高原，雨量较多，年降水量在250～500毫米之间，是黄土分布地区。深处我国内陆的荒漠及黄土地区，南部有高山及高原作屏障，属季风气候区，深受西北与东南季风的影响，风向及风力随地区和季节的不同而不同。冬季部分地区受蒙古高压的影响，在东经96°附近形成北北东——南南西向气流辐散线。辐散线西部气流经河西走廊西部祁连山与天山之间的星星峡——安西一带的孔道流入南疆中部克里雅河附近的气流辐合区，形成塔里木盆地东部和河西走廊西部的北北东风系；辐散线东部气流顺高原北缘呈西北风流经我国干旱地区的中部和东部。夏季，副热带高压北移，西风又受到帕米尔高原的阻挡，发生偏折，一支流过帕米尔高原山口进入塔里木盆地西部，另一支经过准噶尔西部各山口进入北疆，所以夏季北疆及南疆西部风向呈西北向或西向。柴达木盆地及贺兰山以西的宁夏、甘肃境内各荒漠及黄土地区多西北风，而贺兰山以东的干旱及半干旱地区因受东南季风的影响，多东南风。除上述大气环流风系外，还有一些局部的地方性风系，其范围不大，影响较小。风力作用是我国干旱半干旱地区特别是荒漠地区的主要地质营力。沿盛行风向依次有规律的分布的岩漠、砾漠、沙漠及黄土就是风力长期吹蚀、搬运和堆积作用的产物。

我国岩漠、砾漠、沙漠和黄土的分布面积共达1,913,400kmk^2，约占我国领土面积的20.2%，其中岩漠和砾漠分布面积为569,500km^2，沙漠为712,900km^2，黄土为631,000km^2，另外还有一些沙化地。全区地貌景观可分为岩漠带、砾漠带、沙漠带及黄土带。其中沙漠带又可分为固定沙丘带和流动沙丘带，黄土带又可分为高原黄土和山麓黄土两个亚带。对这样广大面积的干旱半干旱地区进行地质、地理及生态系统的研究，对这个地区的工、交、农、林、牧业等方面的建设和发展，具有重大的实践意义和学术意义。

对于我国荒漠和黄土的研究早在2,300年前就有记载。《禹贡》一书曾对中国黄土的土质及分布作了记载。距今2,100年左右，“丝绸之路”通行以后，我国不少学者与商贾来往于由长安经敦煌再经楼兰到西域的荒漠古道，不断认识和改造荒漠，开展农垦，创建了地下井渠——坎儿井。2,012年前班固在《前汉书》中提出了中国黄土的风成概念。1,647年前的《晋书》中，对新疆沙漠有详细记述。1,583年前晋代高僧法显所著的《法显传》中，描述了新疆东部库姆塔格沙漠和罗布泊风蚀凹地的自然景观。1,400年前郦道元在《水经注》一书中，论述过黄土，并对新疆楼兰古城的屯田及水利形势作过记述。1,401——1,364年前，地理学家裴矩在他的著作《西域记》中，对当时高昌(吐鲁番)以东的戈壁沙漠，颇多记述。1,386——1,318年前唐僧玄奘在其名著《大唐西域记》中，对塔克拉玛干南部的气候、植被、水系、风沙、土壤及农业等，都作过很多描述。800年前沈括在《梦溪笔谈》中，对黄土地貌作了详细的描述。古代诗人如岑参和王之涣等的诗句中，有不少关于戈壁和沙漠气候的诗句。西方的一些地质地理学者，对我国荒漠和黄土的研究是在十九世纪末期开始的。如美人R·庞培莱（1866）、瑞典人斯文·海定（1870——1900），德人F·von李希霍芬（1868——1872），俄人H·M·普尔日瓦尔斯基（1875——1879）及B·A·奥布鲁切夫（1892——1919），英人M·A·斯坦因（1900——1901、1906——1908、1913——1916、1930——1931）等。1928——1933年中瑞科学考察团以及1931年以后中国学者袁复礼、黄汲清及李承三等，都对新疆的地质、地理进行过深入的研究。上述的研究者都发表过许多专门的论著。

对我国荒漠及黄土有目的和系统的研究，是在1949年解放后开始的。干旱及半干旱地区的工业、农业及交通建设的发展，促进了对这一带的地质、地貌、土壤、植被、水文及气候等研究的全面开展。参加研究的单位和人员，包括全国有关科学研究、高等教育及生产单位的不同专业的大批人员。对荒漠的分布、形成机理、地貌、气候及风沙防治等方面做了大量工作，取得了丰硕的成果，发表了不少论文和专著，并成立了专门研究机构，进行深入研究。在黄土研究方面，对黄土地貌、地层划分、物质成分及结构特征、物理力学性质及成因诸方面都进行了深入研究，出版和发表了不少专著和论文。

戈壁、沙漠及黄土是干旱半干旱地区的特殊地质地貌现象，在我国西北发育典型。它们不但生成环境相似，而且在分布上也有密切的联系。为了把这些典型现象系统记录下来，丰富我国地质地理资料，我们编摄了这本图册，供有关教学、科研和生产工作参考应用。

INTRODUCTION

The vast regions of northwest, north and northeast China, between 75°—120° east longitude and 35°—50° north latitude, are distributed with rock deserts, gravel deserts, sand deserts and loess, where the climate is dry and the wind strong and freqent. To the west of 106° east longitude the region is covered by large deserts, with an annual precipitation below 200 mm, while to the east of 106° east longitude the annual precipitation amounts to 200—400 mm, and the deserts are smaller in extent. On the Loess Plateau southeast of the deserts, the rain is comparatively plentiful, averagely 250—500 mm per year. The desert and loess areas situated in the hinterland of the country, with high mountains and plateau as their southern protective screen, belong to the monsoon type of climatic region, where the direction and force of the wind vary in different areas and different seasons under the influence of the monsoon coming from the northwest or from the southeast. In winter, the anticyclone from Mongolia makes an impact on some of the areas, forming a radiating line of air-flow round 96° east longitude in NNE-SSW direction. To the west of the radiating line, the air-flow passes through the narrow passage along the Xingxing Gorge — Anxi terrain between the Qilian and Tianshan Mountains in the western part of the Hexi Corridor, and moves into the converging area near the Keriya River in the central part of south Xinjiang, forming the NNE wind system in East Tarim Basin and West Hexi Corridor; while to the east of the radiating line the air-flow in the form of northwest wind passes along the northern border of the plateau over the central and eastern arid and smei-arid regions of China. In summer, the subtropical anticyclone moves northward, and the west wind at the same time is held back by the Pamirs, turning one way into the west Tarim Basin through the gap in the plateau of Pamirs and the other way into north Xinjiang through the individual gaps of the west Junggar. Therefore in north Xinjiang and in the western part of south Xinjiang the wind blows northwestward or westward in summer. In Qaidam Basin and the deserts and loess areas of Ningxia and Gansu west of the Helan Mountains, the wind usually comes from the northwest; while in the arid and semi-arid areas east of the Helan Mountains, southeast wind often prevails under the influence of the southeast monsoon. In addition to the wind system of the atmospheric circulation, there also exist some local wind systems,

which are of smaller scales and have little influences. Wind action is the main geological agent in the arid and semi-arid regions, especially in the deserts. Along with the direction of the main wind force there are regularly distributed in sequence rock desert, gravel desert, sand desert and loess, which are the products of wind erosion, transportation and accumulation in the long period of time.

The coverage of rock, gravel and sand deserts as well as loess totals 1,913,400 km^2, approximately accounting for 20.2% of the country's territory. Among them rock and gravel deserts cover an area of 569,500 km^2, sand deserts 712,900 km and loess 631,000 km^2, plus some sandy areas. In terms of geomorphological landscape, the whole region may be classified into belts of rock desert, gravel desert, sand desert, and loess. The sand desert belt may be subdivided into fixed and drift sand-dune belts, and the loess belt into two sub-belts: loess plateau and loess piedmont. It is of great practical and academic significance to make a comprehensive study of the vast arid and semi-arid regions in the light of geology, geography and ecological system for the development and construction of industry, agriculture, animal husbandry and communications there.

The study of China's deserts and loess was recorded in history as early as 2,300 years ago. The properties and distributions of loess in China were described in "Yu Gong" - one of the ancient works on geography. 2,100 years ago when "Silk Road" was opened to traffic, a lot of Chinese scholars and business men were travelling along the old sandy road from Changan - Dunhuang - Loulan to the Western Regions. Therefore the deserts were studied, reformed and reclaimed gradually. One of the achievements at that time was the construction of the Care, a local type of water - collecting well system. 2,012 years ago, Ban Gu, one of the great ancient Chinese historians, put forward in his work "The History of West Han Dynasty" the concept of aeolian loess. The deserts in Xinjiang were also described in detail in "The History of Jin Dynasty" 1,647 years ago. In "An Autobiography of Fa Xian" by the noted Buddist monk himself in Jin Dynasty (1,583 years ago) gave a minute description of the natural landscape of the eolian depressions in Kumutak Desert and Lop Nur in east Xinjing. 1,400 years ago, "Shuijingzhu" (a geography book with annotations on the "Classic of Water System") by Li Daoyuan dealt with loess and made a record of how the garrison troops and peasants, under the orders of the rulers, had opened up the wasteland, grown crops and built water conservancy facilities near the ancient city of Loulan in Xinjiang. Geographer Pei Ju in his work "Sketches of the Western Regions", written 1401-1364 years ago, described a great deal about the Gobi Desert east of the Gaochang (Turpan). Another book worth notice is "Travels throughout the Western Regions", written 1,386-1,318 years ago by the great Buddhist Monk Xuan Zhang in Tang Dynasty, in which the author gave a lot of descriptions of the south Taklimakan Desert, such as its climate, vegeta-

tion, water system, wind-drift sand, soil, farming, etc. More detailed descriptions of loess geomorphology were also made in "Mengxi Bitan" ("Study Notes of Dreaming Stream Garden") by Shen Kuo some 800 years ago. In addition to the above mentioned, there were quite a few ancient poets, for example Cen Shen and Wang Zhihuan, who had left their verses in history in toning the Gobi Desert and its natural conditions. As for the western scientists in the field of geography and geology, they began their studies on China's deserts and loess region at the end of the nineteenth century, for instance, R. Pumpelly (American, 1866), Sven Hedin (Swedish, 1870–1900), F. von Richithofen (German, 1868–1872), H. M. Przewalsky (Russian, 1875–1879), B. A. Obruchev (Russian, 1892–1919), M. A. Stein (British, 1900–1901, 1906–1908, 1913–1916, 1930–1931). And in 1933, a Sino-Swedish Scientific Expedition went to Xinjiang for physiogeological investigation. The Chinese geologists Yuan Fuli, Huang Jiqing and Li Chengsan have made since 1931 detailed studies in the physiography and geology of Xinjiang. All the above researchers have made significant contributions to the study of deserts and loess in their academic papers and works.

However, only after 1949 when China was liberated did we begin to study the deserts and loess purposely and systematically. The development of industry and agriculture as well as communications in the arid and semi-arid regions has stimulated the investigation and research work in the aspects of geology, geomorphology, soil, vegetation, hydrology, climate, etc., in these regions. A great number of personnel of different specialities from various scientific research institutes, institutions of higher learning and production units of the country have taken part in the study of desert, its distribution, formation mechanism. geomorphology, and climate, as well as the measures for the prevention and control of sandstorms. Much effort has been made and fruitful results have been achieved. There have been also a great many academic thesis and books published, and special institutions established for the purpose of further studies. In the facet of loess study, further approach have been made to a lot of treatises and works published on loess, its geomorphology, stratigraphical divisions, constituent materials and structure characteristics, physicomechanical properties, genesis, etc.

The Gobi and other deserts, and loess are geological and geomorphological features peculiar to the arid and semi-arid regions and typically developed in northwest China. They are not only similar in the environment of their formation, but also closely related to each other in their distributions. In order to make a systematic record of these natural phenomena and enrich the information of physiography and geology of China, we have a series of photographs taken and compiled to form this album, which, we suppose, may provide some references for the readers in their teaching, scientific research and production.

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Ⅲ　黄土

黄土塬
黄土梁
黄土峁
黄土阶地
冲　沟
黄土墙
黄土桥
黄土柱
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The storm is coming
Farm in the desert
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Salinized land in the desert
Salt deposits in the dried Lake Manas
Crack in the dried lake Manas
Lake Ailan located in the northern part of the Gurbantunggut Desert
Part of plants in sand regions

3 LOESS

Yuan
Liang
Mao
Loess terrace
Gullies
Loess wall
Loess bridge
Loess columns
Loess gorges
Columnar loess joint
Loess funnel
Loess sinkhole
Loess collapse
Loess landslide
Sketch of loess section in China
Loess deposit over the denudated plane of the Gansu Stage
Loess deposit over the Pliocene red bed
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Reddish-brown fossil soil in Middle Pleistocene loess
Re-leaching of calcareous substances in the reddish brown fossil soil
The fifth layer of reddish-brown fossil soil in Middle Pleistocene loess
Late Pleistocene loess and fossil soils in it
Holocene loess
Loess distributed on the northern piedmont of the Kulun Mts.
Loess distributed in Ürümqi, Xinjiang
Loess distributed on the northern piedmont of Tian Shan Mts.
Microtextures of loess under scanning electric microscope

岩漠、砾漠及这些地区的风蚀现象

ROCK DESERTS GRAVEL DESERTS AND DEFLATION PHENOMENA IN THESE REGIONS

我国西北的新疆东部，准噶尔盆地以西地区及甘肃河西走廊西部，气候特别干旱，风力强劲，而且大风频繁，是我国典型风蚀地貌最发育的地区。根据基础岩层的不同，可分为两类：一是以基岩为基础的岩漠，另一种是以山麓洪流、河流及风化作用形成的砾石堆积为基础的砾漠。岩漠及砾漠总面积达569,500km²，约占岩漠、砾漠、沙漠和黄土总面积的29.3%。

岩漠及砾漠地带具有特殊的自然条件。一是气候极端干燥，温差大，温度变化强烈。最高温度一般在30°～40℃之间，最低温度为－30°～－40℃，平均年温差在35°～55℃之间，绝对年温差可达60°～85℃，日平均温差在20°～30℃左右。年平均降水量在200毫米以下，最干燥的地区年降水量只有5毫米左右，而年平均蒸发量多达2,000～3,000毫米，空气湿度极低，在这样的气候条件下，机械风化盛行。在基岩出露的地段，岩石不断风化剥落，经重力及偶而的暴雨搬运，岩石碎屑散布在基岩缓坡上或山麓地带，形成角砾状砾漠。在基岩丘陵起伏的地区，风化碎屑覆盖面积更大。强烈的机械风化，使基岩表面不断地剥落，地形渐趋平缓，丘陵面积增大，岩漠逐渐扩大。二是风大而频繁。风速一般在4米/秒以上，最大风速可达40米/秒，全年风日都在50～100天以上。尤其是一些基岩山口，风力更强。强风区出现在中苏和中蒙边境附近。如北疆阿拉套山口（准噶尔门）全年有155天出现8级（风速≥17.2米/秒）以上的大风，最大风速常超过40米/秒，能吹起直径为2～3厘米的砾石。有时大风可持续24天之久。托里的老风口的大风常把汽车吹翻。由乌鲁木齐通往吐鲁番的达坂城附近的天山山口，8级以上的大风有时持续19天，这一带古生代岩层的迎风面被风吹蚀形成连片的坑洞，洞径最大者达2米左右，洞深约3～4米。克拉玛依的乌尔禾及托里到克拉玛依之间的成吉思汗山也是著名的强烈风蚀地区。这些地区的基岩经风长期吹蚀、雕刻成一系列典型的风蚀地貌。如乌尔禾出露的白垩纪吐谷鲁组和老第三纪乌伦古组产状水平的砂岩泥岩被风吹蚀后，残存的基岩有的群蜂簇拥，有的孤岛矗立，景观奇异，宛若古城堡遗迹，所以取名“风蚀城”。风的吹蚀能量是相当大的。就是在风力较弱的楼兰附近，有人实测出在一块面积为775km²的地面上，每年有3,000～4,000m³的沙粒被风吹走。

岩漠主要分布在山地和丘陵地区，其组成物质多为粗大风化岩块及平缓的基岩露头，地面波状起伏，水土缺乏，植被极少。新疆东部、河西走廊西部及柴达木盆地等地区的雅丹地形相当发育。这一带大致与主风向平行的长条风蚀残丘和风蚀槽地，一般高差几米，分布广泛。在柴达木盆地西北部，第三纪砂泥岩所构成的许多短轴背斜构造的方向与这里盛行的西北风相一致，软硬相间的岩层经强烈的机械风化和风蚀，形成一系列西北——东南向的风蚀丘陵、垄岗及槽地，一般高差约10～50米，长度为10～100米。在风力较弱的荒漠东部地区同样发育着明显的风蚀地貌。内蒙古伊克昭盟的西北部多风蚀凹地，略呈椭园形，也有簸箕状者，作西北向延伸与主风向一致，最大者深10余米，宽约700～800米，长约1公里，周围坡度一般

为4°～20°。在这里还有风蚀孤山，是由断裂形成的东西向地垒经风蚀形成者。在山崖的迎风面多风蚀坑洞，大者直径1～2米，小者几厘米，深在1米以内。岩漠地区多见小型风蚀地貌，如蘑菇石、风蚀坑、风蚀洞、风蚀残丘等。新疆成吉思汗山的花岗岩经风吹蚀及机械风化，形成园形坑洞，最大坑深约1～2米，直径2米以上，这些坑洞往往互相穿通。在克拉玛依吐孜沟的侏罗纪砂岩的崖面上，有很多蜂窝状风蚀坑，坑口直径一般20～30厘米，坑深10～30厘米，它们相互贯通，连成一片。岩漠地带还有两个显著特征：其一是露出地表的岩石和砾石表面涂着一层厚约一毫米的光亮油黑色的沙漠漆皮；其二是风棱石相当普遍，多呈三棱形，表面十分光滑，无黑色沙漠漆皮，表明它们正在不断地经受着被风吹来的沙粒的磨蚀。

砾漠又称戈壁，分布在山麓平原地带。砾漠的物质成分主要是砾石并夹有沙土。在大型盆地如准噶尔、塔里木和柴达木盆地周边，在一些山系的山麓地带如阿尔金山和祁连山北麓，都分布着大面积的砾漠。砾漠的物源地区是山地。山地岩石碎屑经流水搬运出山后，随着流水的面状分散，流速减小，搬运的物质沉积在山麓地带。在成因上，这些山麓堆积主要有冲积和洪积两种。冲积砾石可分布较远，但多呈线状，面积有限。暴雨是荒漠地区的主要降水方式，而且集中在夏季。暴雨形成的洪水，流量大，流速猛，山坡和山谷的碎屑极易被冲走，沉积在山麓地带，形成大面积的洪积扇，其组成物质砾径大而分选差。山体的不断上升使得这些山麓堆积不断推向山前平原。山麓堆积的分布还受第四纪以来气候演变的影响。间冰期开始时，大量冰融水的冲刷堆积会使山麓砾石层加厚，分布范围加大。山体的上升加上水流的间歇加大，造成山麓地带大面积分布的洪积——冲积平原，这种平原的组成物质由山麓到盆地中心逐渐变细，其沙粒物质被风吹运形成沙漠，粗大砾石遗留原处形成砾漠。砾漠地区由于雨量极少，水流侵蚀作用轻微，地面切割微弱，地形起伏不大。形成砾漠的砾石层厚度一般越近山麓厚度越大，祁连山麓的戈壁砾石层最厚可达600～800米。根据砾漠的表面色泽，可把砾漠分为黑色砾漠和灰色砾漠。黑色砾漠多分布在新疆准噶尔盆地西北部和新疆东部等地，由于气候干燥多风，砾石堆积的表层，经风力吹蚀，沙及土状物质被吹扬运走，仅粗大的砾石残留地表，其下即为砾石夹沙土的原生堆积，暴露地表的砾石表面有黑色漆皮，砾漠呈黑色。灰色砾漠分布在风力减弱的山麓地带，如天山、昆仑山及祁连山等大山体的北麓。这类砾漠由于风力未能把砾石堆积表面的沙土物质全部吹走而混杂其中，不如黑色砾漠中者那样干净，砾面还不断地经受着风沙的撞击而难以形成沙漠漆皮，砾漠表面保留着原生堆积的色调，色浅呈灰蓝。有些地区如内蒙古伊克昭盟鄂托克旗北部一带，白垩纪砾岩、砂岩和泥岩组成的产状平缓地层，砂泥物质被风吹走，砾石残留原地，形成砾漠。甘肃安西到新疆东部之间的低山丘陵山麓，堆积了不少风化角砾，表面有黑色漆皮，属残积成因的黑色砾漠。