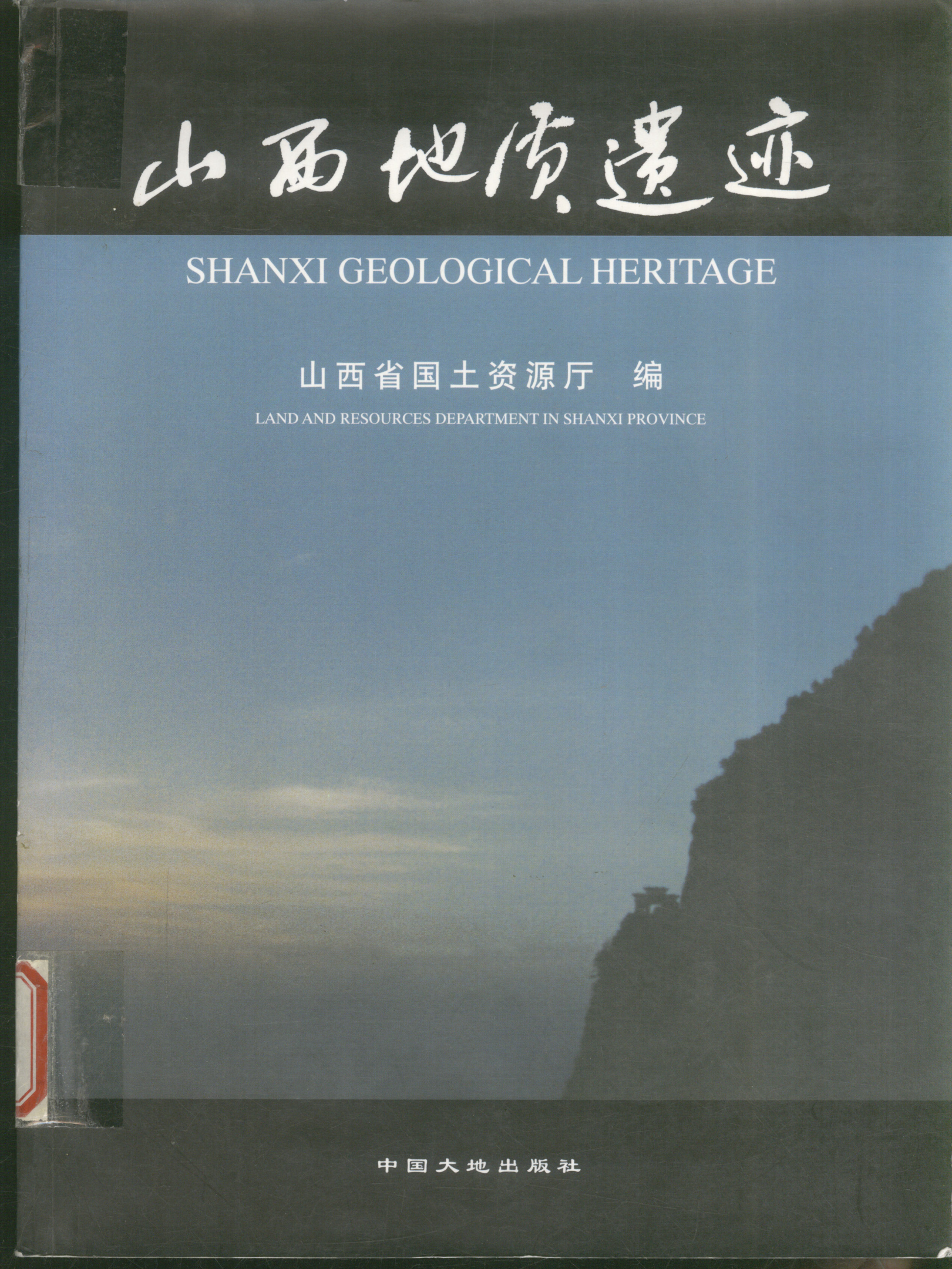
山西地质遗迹

SHANXI GEOLOGICAL HERITAGE

山西省国土资源厅 编

LAND AND RESOURCES DEPARTMENT IN SHANXI PROVINCE



中国大地出版社

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·北　京·

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《山西地质遗迹》编委会

序

翻开这本图册，从浓烈的山野气息当中，在大自然的粗犷、深幽、隽秀和奇崛背后，在喟叹大自然鬼斧神工和神奇造化的同时，我心中油然而生一份欣喜、一种肃穆：欣喜的是大自然把这么多的宝贵财富馈赠给了三晋大地，而肃穆则源于自己肩负着保护它们的神圣职责。因为这本图册中所反映的，不是普通的自然风光或旅游胜地，而是已经存在了亿万年的地质遗迹。

我们所讲的地质遗迹，是指在地球演化的漫长历史进程中，由于内外力的地质作用，形成、发展并遗留下来的珍贵的、不可再生的地质自然遗产。其主要类型包括：有重大观赏和重要科学研究价值的地质地貌景观，有重要价值的地质剖面和构造形迹，有重要价值的古人类遗址、古生物化石遗迹，有特殊价值的矿物、岩石及其典型产地，有特殊意义的水体资源，典型的地质灾害遗迹等。由于自然分布的不均衡性，以及我们工作程度的限制、技术水平的局限，这本画册中所反映的地质遗迹，并没有涵盖所有的类型，其典型性也可能表现得不够充分；但是，借助这本不算很精致的画册，以及简略的文字说明，无论你过去是否接触过这一方面的资料，你完全可以对山西省境内主要地质遗迹有一个初步的了解。浏览此书，您能有此一得，我们即十分欣慰。

这本已经编撰完成的画册，没有达到完整、准确、科学系统地反映出这些地质遗迹的构造(结构、规模、形式)、成因、演化及其规律，仅是概要地叙述了我们现阶段对这些地质遗迹的认识，因此此书只能定位为科学普及读物，以便为更多的人认识、了解、保护这些地质遗迹提供初步的指导和帮助。我们深知，同我们每个人的生命、甚至整个人类社会的历史相比，这些地质遗迹是不可再生、难以再造的，对其认识、保护和利用必须始终秉持谨慎、科学的态度。因此，在向社会各界奉献出这本画册的同时，我们诚恳地呼吁广大有识之士，与我们一道来关注、支持、参与地质遗迹保护工作，与我们一道来科学认识、精心呵护、合理利用地质遗迹。有更多的同志能起而立行，参加到地质遗迹保护工作中来，是我们编撰此书的最大心愿。

李水宏

2001年初冬于北京

FOREWORD

When I open the pictorial handbook, what meet my eyes are roughness, depth, magnificence and grandeur of nature through the tang of mountains. When I emit my exclamations and sights about of nature, an ecstasy of joy and solemnity well up in my heart; I am joyful because nature makes a present of valuable treasure to Shanxi Province, whereas solemnity is meant that I shoulder sacred responsibility of protecting nature. The reason is that the book depicts not common natural sightseeing or tourist attractions but geological traces for hundreds of millions of years.

The geological traces are rare, non-renewable geological natural heritage from geological function, formation and development as a result of endogenic and exogenic process. The basic types are as follows : geological and geomorphological feature with important value of appreciation and scientific research, geologic section and structural features with great value, relics of the ancients and traces of paleobiofossils with significant value, specially valuable mineral, rock and its typical sources, specially meaningful water resources, traces of typical geological hazard and the like. Owing to unbalanced natural distribution and to our limited working level and technical level, the book has not covered all the types of geological traces and the typicalness is not enough sufficient. Nevertheless, we hope the book will provide you with a preliminary understanding of important geological traces in Shanxi Province with the aid of not much of an exquisite pictorial handbook and brief caption, whether you have ever read related materials or not.

The book merely depicts rough understanding of geological traces at present stage. Therefore, we only put the book in a popular science readers place in order to make more people know, understand and protect the geological traces offering initial instruction and help. We know clearly the geological traces are non-renewable, difficult to make again in comparison with everyone's life and even with human history. For the reason, we must take cautious and scientific attitudes towards its recognition, protection and utilization. Therefore, the book is dedicated to people of all walks of life. In the meanwhile, we sincerely hope a wide range of insightful people pay close attention to support and participate in protection of geological traces. Let's understand scientifically, protect carefully and utilize properly geological traces together. Our best wish is that more people take part in the protection of geological traces.

Li Yonghong
Beijing
Early winter, 2001

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The index of geological traces of Shanxi Province

山西省地质遗迹概况

地质遗迹是地球在漫长的地质历史演化过程中，由内外动力地质作用形成发展所遗留下来的不可再生的地质自然遗迹。山西省是地质遗迹大省，地质遗迹具有数量多、分布广、级别高的特点。据初步统计，省内共有有价值的地质遗迹351处，其中国家级(I级)地质遗迹48处，省级(II级)地质遗迹144处，县级(III级)地质遗迹159处，分布在全省80多个县市。

山西地质历史悠久，从太古界到新生界除了志留系、泥盆系外均有出露，其中五台山区25亿～18亿年的五台群、滹沱群、太原西山3.5亿～2.5亿年的石炭系、二叠系及晋南、晋西6500万年至今的新生界地层均可作为我国的代表性剖面，并以其地层发育完整、所含化石丰富而闻名中外地学界。

构造活动强烈频繁、岩浆活动十分活跃，是山西地质的又一特点。在32亿～18亿年前的早寒武纪阶段，全省各大山区都发生了5期构造运动，其中长城系与熊尔群之间的王屋山运动为山西省所特有。前寒武系各山区均经历3～4次褶皱，五台山区为我国叠加褶皱和叠加相变的典型地区。吕梁运动由我国著名地质学家李四光在吕梁山命名，燕山运动席卷全省，新生代汾渭裂谷多次活动，裂谷两侧地热异常。全省太古宙有4～5次古老英云闪长岩浆侵入，元古宙辉绿岩墙出露广泛，吕梁山区西部紫金山出露的燕山期碱性岩是我国东部面积最大的碱性杂岩，新生代又有巨厚的繁峙玄武岩和著名的大同火山群。

山西生物化石丰富。滹沱群中的叠层石、长城系常州沟组石英砂岩中的蠕虫遗迹均属全国低层位，石炭二叠系中的华夏植物群，是我国作为洲际对比的重要标志。中生代以来就有锯齿龙、肯氏兽脊椎动物繁衍，第三系地层中有世界最古老的灵长类化石，第四系中有丁村人发现，下更新世的西侯度古人用火遗迹，被称为华夏第一火。

我国最大的大陆板块裂谷——汾渭裂谷，从北到南贯穿全省，形成大同盆地、忻州盆地、太原盆地、临汾盆地及运城盆地，山西境内全长600余公里。裂谷东西两侧基岩山体与盆地间的相对高差达400～1000m，盆地中新生界厚度达1000～5000m，盆地边缘新构造断裂发育，一系列大型泉水和温泉沿断裂分布。

山西地处黄土高原，西部黄土地貌发育齐全。在漫长的地质历史时期，各种内、外动力地质作用塑造出一系列奇特的山岳、峡谷、急流、泉瀑、岩溶、奇石、黄土地貌景观。

总之，山西省的地质遗迹蕴涵了极高的科研价值和观赏价值，她的形成得益于山西得天独厚的地质条件与悠久深厚的文化底蕴，她的合理保护与开发必将为全国乃至全世界地质科学的研究与普及、人们文化素质的提高提供基地，同时可为山西旅游业的进一步发展提供自然景观的精品。

Survey of geological traces of Shanxi Province

Geological traces are non-renewable geological natural heritage from geological function, formation and development as a result of endogenic and exogenic process in a long geologic evolutionary history. Shanxi province is a big province of geological traces in China, and the geological traces are characterized by their large quantity, extensive distribution and high grade. According to the preliminary statistics, there are 351 valuable geological traces in Shanxi province, among which national geological traces (grade I) are 48, provincial geological traces (grade II) 144 and county geological traces (grade III) 159. These geological traces are distributed in 80 counties or cities.

Shanxi Province has a long geological history, all strata from Archean erathem to Cenozoic erathem outcropped except Silurian system and Devonian system, in which Wutai group (2800~2500 Ma.) and Hutuo group (2500~1800 Ma.) in Wutai Mountain region, Carboniferous and Permian system (350~250 Ma.) in Taiyuan Western Mountain area and Cenozoic erathem (from 65 Ma. to now) in southern and western Shanxi Province can be taken as the typical geologic section of China. They are well-known in geoscience of the world for their well-developed strata and rich fossils.

The crustal movements and magmatic activity in Shanxi Province are frequent and strong. There were 5 tectonic movements in Precambrian system (3200~1800 Ma.) in each mountain region, in which the geological trace of Wangwushan movement occurred between Changcheng system and Xionger group is peculiar to Shanxi province. There were 3 ~ 4 stronger foldings in Precambrian system and Wutai Mountain region is the typical area of superimposed fold in China. Luliang crustal movement was named by famous geologist Li Siguang. Yanshan movement was widespread in whole province. Cenozoic Fen-Wei rift valley has rifted several times strongly, both sides of the rift are of geothermal anomalies. During Archeozoic era, there were 4 ~ 5 times quartz-mica diorite injections. Proterozoic era diabase dike outcropped widely. Alkaline rock outcropped widely in Zijin Mountain of Luliang Mountains is the largest alkali complex in the eastern part of China. There were thick Fanzhi basalt and famous Datong volcanic cluster in Cenozoic group.

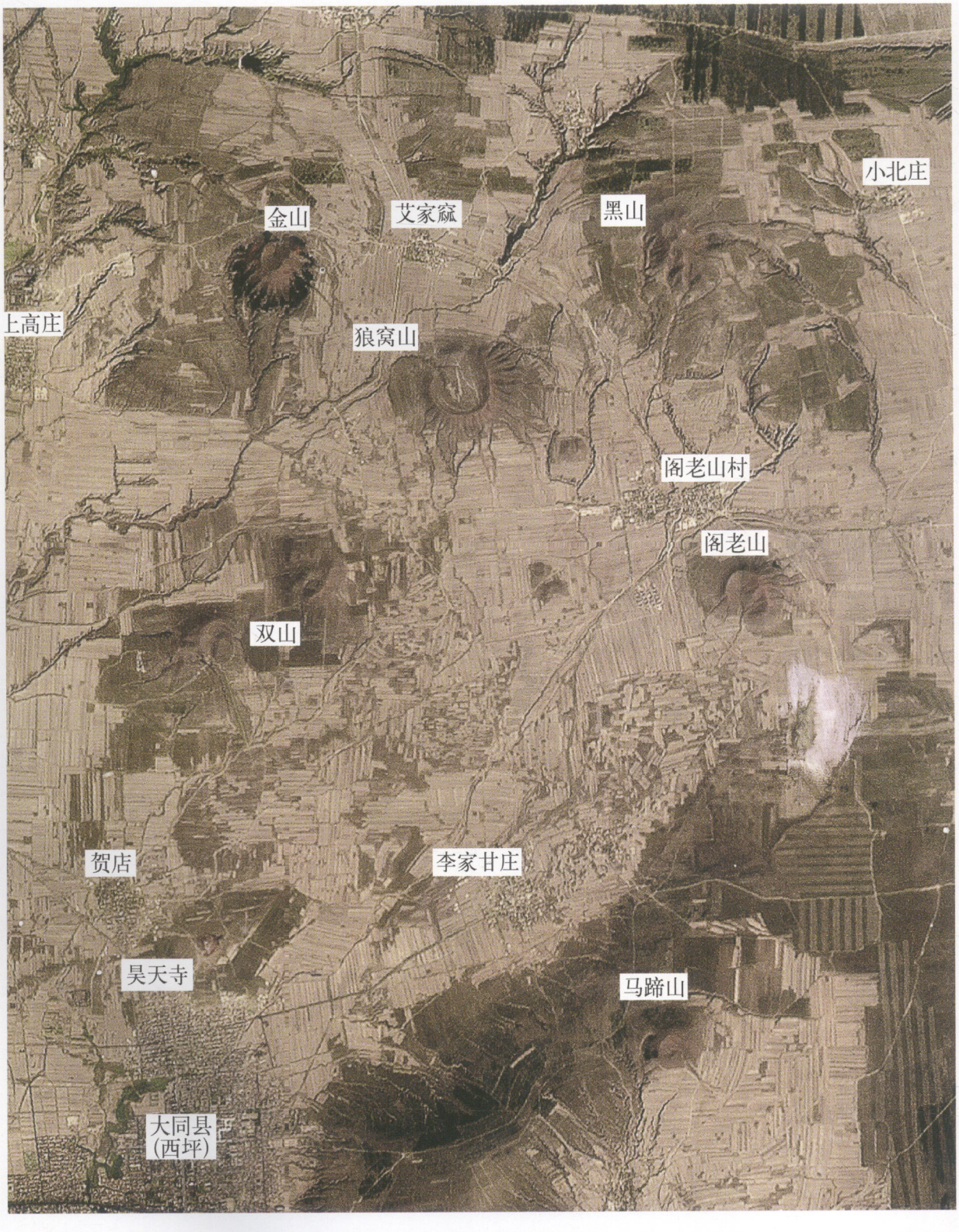
Shanxi Province is rich in paleobiocoenosis. Stromatolite in Hutuo group and worm traces in Changzhougou quartzose sandstone formation, Changcheng system, are all in lower position in countrywide. Cathaysian plant community in Carboniferous system can be taken as important marks of international stratigraphic correlation. Since Mesozoic era, vertebrate community as Pareiasaurs and Kannemeyeria has multiplied. The oldest fossils of primate community in the world were found in Tertiary system. Dingcun Man during Quaternary period is famed throughout the world. There are the traces of fire-using left by Xihoudu ancients in lower Pleistocene epoch, which is called as the first fire of China.

The biggest continental plate rift in China, Fen-Wei rift, runs through the whole province from north to south and forms Datong basin, Xinding basin, Taiyuan basin, Linfen basin and Yuncheng basin. It is more than 600km within the boundary of Shanxi province. The relative elevation between the both sides of the rift and the basins amounts to 400 ~ 1000m, and the thickness of Cenozoic group in the basins reaches 1000 ~ 5000m. Neotectonic faults developed at the edge of the basins, and a series of large-scale springs and thermal springs are distributed in the faults.

Shanxi Province is located at loess plateau. Loess landform developed completely in western Shanxi. In a long geologic history, endogenic and exogenic geological processes formed a series of singular geomorphologic landscape in Shanxi province, such as mountains, canyons, rapid flows, spring and waterfall, karst, singular rocks and loess landform.

In a word, the geological traces of Shanxi Province have the highest values of scientific research and admiration. Their formation benefited from the distinctive geological condition and profound cultural basis of Shanxi Province. Rational development and protection of the geological traces will provide the basis for researching and spreading the geoscience and improving the artistic appreciation of the people all over the world, and also provide the best natural landscapes for the further development of the Shanxi tourism.

大同火山群卫片　Satellite Photograph of Datong Volcanic Cluster



大同火山群

Datong volcanic cluster

大同火山群是我国著名的新生代火山群，位于大同县西北黄土丘陵中，面积160余平方公里，由著名的金山、黑山、狼窝山、阁老山、昊天寺、双山、马蹄山等十余座火山所组成。火山呈截顶圆锥状，一般高百米左右，直径500m左右，有的保留火山口凹地。它们由火山渣、火山弹及浮石状熔岩流堆积而成。喷发时间距今几万年前(更新世)。黄土丘陵上可见到旧石器、鸵鸟蛋壳化石碎片。

Datong volcanic cluster, a very famous Cenozoic volcanic cluster, is located in the northwestern loess hills of Datong County. It consists of several famous volcanoes, Such as Jinshan, Heishan, Langwoshan, Gelaoshan, Haotian temple, Shuangshan and Matishan, which are accumulated by scoriae, volcanic bomb and pumice lava flow. They are truncated cone in shape, about 100m in height and 500m in diameter, some of which continue to have depression of crater. Volcanic eruption took place several ten thousand years ago (Pleistocene epoch). Shards of ancient stone implement and ostrich eggs fossil may be found in loess hills.

纺锤状旋转火山弹
Spindle-shaped rotational volcanic bomb

馒头状火山弹
Bread-shaped volcanic bomb

含瘤火山弹
Nodular volcanic bomb

火山弹与熔岩流

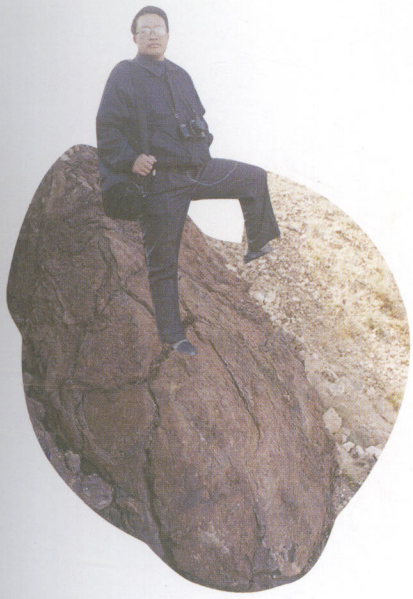
炽热的岩浆喷出高空，在空气中边运动边冷却，掉落地面就成为火山弹。当运动方式以旋转为主，形成纺锤状火山弹；扭曲为主形成“S”形火山弹；滚动为主，形成球状火山弹；当落到地面尚未凝结，就与地面碰撞形成半环形、褶皱形火山弹。当火山弹较小，表面迅速冷却就形成边缘致密、核心多气孔的火山弹；当火山弹很大(如大于1～2m)，内部热气排放力强，就相反形成外部多孔内部致密的火山弹。

岩浆成熔岩流出地表时，边流动边冷却，当地表崎岖不平，熔岩就会不断扭曲，而呈具绳状冷凝表皮，当地表较平整时，熔岩两侧冷却比中心快，所以流速中心快于两侧，就形成弧端向前凸张裂隙，称舌状构造。

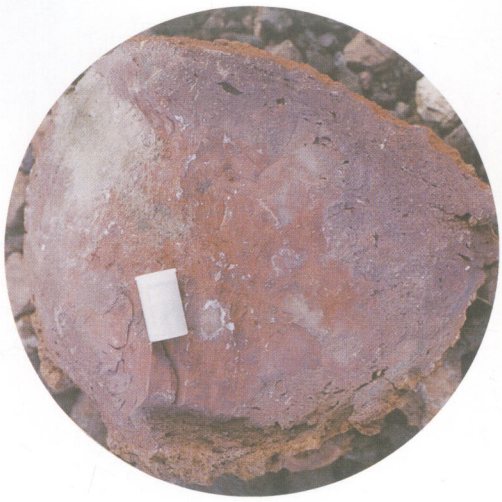
半环状火山弹　Semi-cyclic volcanic bomb

犄角状火山弹　Horn-shaped volcanic bomb

舌状熔岩流　Lingual lava flow



巨型椭球状火山弹　Mega-ellipsoidal volcanic bomb



外层气孔核心致密火山弹结构

Volcanic bomb with the texture of compact inner core and vesiculate outer layer

S 型旋转火山弹

S-shaped rotational volcanic bomb

褶皱型火山弹　Folded volcanic bomb

Volcanic bomb and lava flow

A mass of liquid of lava had been heaved violently into the air during a volcanic eruption. It might spin, twist and roll during flight and cool into spindle-shaped, S-shaped or rounded shape with pointed ends volcanic bombs. If a bomb is still plastic when it strikes the surface, it would be distorted into semi-cyclic and folded shape. Small bombs have vesiculate core and compact chilled border zone, and the large one (Greater than 1 ~ 2m in diameter) has compact inner core and vesiculate surface.

The vesicle in a bomb resulted from expansion of the gas that was dissolved in lava. In fact, lava had been molded when it flew out at the surface. Ropy lava formed at the rugged and rough surface and lingual lava appeared at the smooth surface.

(火山弹采自大同火山群)

(Volcanic bombs were collected from Datong volcanic cluster)

(熔岩流照片摄自阳高县西窑村东南山坡)

(Lava flow pictures were taken in the southeastern hillside of Xiyao Village, Yanggao County)

外层致密内层气孔结构

Volcanic bomb with the texture of compact outer layer and vesiculate inner layer

表面绳状熔岩流　Ropy lava flow

外层致密核心气孔火山弹结构

Volcanic bomb with the texture of vesiculate inner core and compact outer layer