

# 中國嵩山地質公園導游手冊

Field Trip Guidebook to Mount Songshan Geopark, Henan, P. R. China.



中国·河南  
HENAN CHINA



总策划: 吴聚财

General Planner:Wu jucai

策 划: 翟晓宾 弋群立

Planner:Zhai xiaobin Yi qunli

编 辑: 耿三有 张延楼 刘瑞峰 程胜利

Editor:Geng sanyou Zhang yanlou Liu ruifeng Cheng shengli

文 字: 符光宏 宋国洪

Characters:Fu guanghong Song guohong

翻 译: 张建平

Translator:Zhang jianping

设 计: 黄 艺

Designer:Huang yi

摄 影: 赵洪山 景正君

Photographer:Zhao hongshan Jing zhengjun

# 前 言

## Foreword

嵩山地质公园位于河南中部，面积464平方千米，以出露连续、完整的地层剖面 and 三个前寒武纪构造运动形成的不整合面而著名，有地学百科全书之称。出露有36亿年以来的太古宙、元古宙、古生代、中生代和新生代地层；是发生在距今25亿年的嵩阳运动、18亿年的中岳运动和5.43亿年的少林运动的命名地。三个不整合界面及其上覆底砾岩均十分清楚。更兼历史古迹众多，庙宇、道观、佛塔、书院、钟鼓相闻，是中国历史上佛、儒、道三大宗教荟萃地，是中华民族远古文明发祥地之一。地质遗迹和人文景观相映成趣，是地学考察、旅游观光的胜地。

The Mount Songshan Geopark is Located in the northern part of Henan Province, Central China. It covers an area of 464km<sup>2</sup>. The Mount Songshan Geopark is famous for its complete outcrop of stratigraphic sections and the boundaries of angular unconformities formed by three Precambrian tectonic movements. The Archean, Proterozoic, Paleozoic, Mesozoic and Cenozoic strata are well exposed. The Songyang Orogeny of 2.5Ga, the Zhongyue Orogey of 1.8Ga and the Shaolin Orogeny of 543Ma were named after localities in the area. The boundaries of angular unconformities and basal conglomerates are very distinguishable. So it is referred to as a "textbook of geological history."The area is also an assembly point of three major religions in China-Buddhism, Confucianism and Taoism-and one of the birthplaces of Chinese ancient culture, where one can hear the sound of ancient bells and drums, and view many historical relics and ancient academies of classical learning. The geological and cultural sites form a delightful contrast, making the area an ideal tourist attraction.



# 嵩山地质博物馆

The Songshan Mountain Geological Museum



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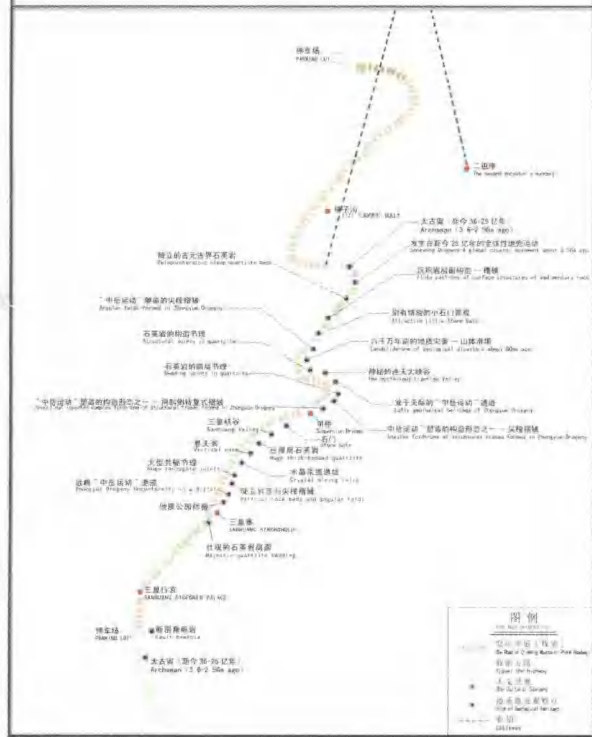
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让我们一起走进嵩山地质公园  
*Let's together walk into Mount Songshan Geopark*

## 嵩山地质公园三皇寨景区游览示意图

Sanhuangzhai Scenic Area of Mount Songshan Geopark Tour sketch map



## 嵩山地质公园三皇寨景区简介

三皇寨景区位于登封市城西玉寨山，北接少林寺景区，面积23平方公里。连天峰是景区屋脊，海拔1512.6米，山势巍峨，峰峦叠嶂，陡峭险峻。

景区内良好地保存着太古宙（距今36-25亿年）花岗岩系和古元古代（距今25-18亿年）滨海——浅海沉积地层。“中岳运动”（距今18亿年）发生时巨大的温压效应，使玉寨山成为轴向近南北，轴面西倾，向东倒转的复向斜褶皱山，三皇寨景区游览路线即在西部倒转翼上。复向斜两侧郁郁葱葱的低岭沟谷由太古宙组成，古元古界构筑了复向斜槽部壁立千仞、雄伟险峭、鳞次栉比的高山峻峰。大型同斜倒转褶皱、尖棱褶皱多处可见；“中岳运动”不整合界面遗迹举目可及；构造剥蚀形成的大峡谷幽深险峻使人惊心动魄，陡立岩层架起的峰丛地貌妙趣横生令人心旷神怡，峰岭苍茫茫，深涧水叮咚。大自然的鬼斧神工把玉寨山雕凿成无与伦比的华夏奇观。

三皇寨以供奉天皇、地皇、人皇而得名。踏上三皇寨景区游览之路，奇峰、绝壁、摩崖、怪石、峡谷、深涧、石门、悬洞、清泉、瀑布、激流、碧潭、密林、苍松、山花、红叶、飞禽、走兽、云海、迷雾、古寺、幽宫、栈道、吊桥汇聚一线，绝妙的景色使人赏心悦目，若置仙境。领略古、奥、雄、奇、险、艳、秀、绝、神、幽的特色，如痴如醉。探索地球沧桑变迁的奥秘，终生难忘。

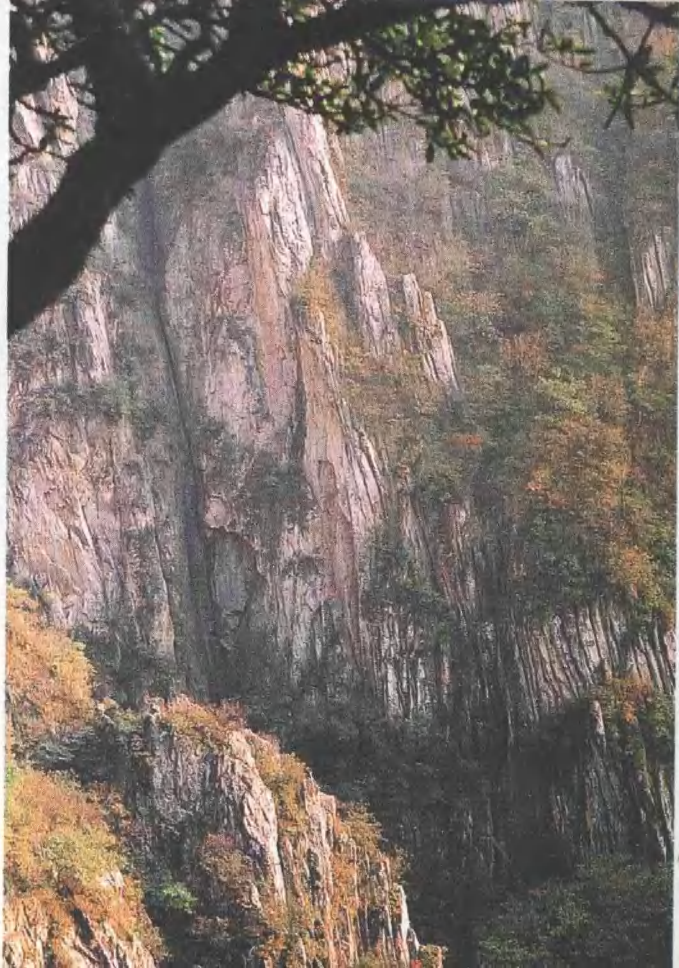


## Introduction to the Sanhuangzhai Scenic Area

The Sanhuangzhai Scenic Area is in the Yuzhai Peak, west of Dengfeng City. This Area, with an area of 23km<sup>2</sup>, is to the south of Shaolin Temple Scenic Area. The highest crest is the Liantian Peak, with an elevation of 1,512.6m. This peak is majestic, lofty and precipitous.

The Archaean granite greenstone series (3.6~2.5Ga ago) and Proterozoic neritic rocks (2.5~1.8Ga ago) are well preserved in this area. The powerful T-P effect of the Zhongyue Orogeny (1.8Ga ago) made the Yuzhai Peak an inverted synclinorium, and the tourist route is on the west inverted wing of the fold. The lower ranges and valleys at the two sides of this synclinorium are composed of Archaean strata, and the lofty and steep crests are composed of Paleoproterozoic rock. The huge homoclinal folds and angular folds are widely spread. The unconformity of Zhongyue Orogeny is clear. The deep and precipitous valleys formed by structural denudation are so impressive and the steep and vertical peak clusters are so marvelous. You will be moved by the nature power.

Along the tourist route, you can see the numerous peculiar peaks, steep cliffs, cliff inscriptions, odd stones, deep valleys, stone gates, vertical caves, clear springs, flying waterfalls, green ponds, dense forest, ancient temples and other miracles. You will feel that it is a real fairyland.



## 太古宙（距今 36-25 亿年）

花岗绿岩系成员之一——斜长角闪片麻岩

斜长角闪片麻岩是从普通角闪石和斜长石为主的具片麻状构造的变质岩石。含少量石英、黑云母、铁铝榴石、绿帘石、透辉石等。该岩石是来自地幔的基性岩浆在海底形成基性火山岩后，经距今 25 亿年发生的地壳运动——“嵩阳运动”的温压效应改造，产生中深变质而成。

片麻状构造：呈定向排列的片状和柱状矿物，较规则的分布在粒状矿物中，共同构成“片麻理”，即为片麻状构造。



### Archaean (3.6~2.5Ga ago)

One of granite greenstone series-amphibolite gneiss

The amphibolite gneiss is a metamorphosed rock mainly composed of common hornblende and plagioclase, with a few of quartz, biotite, almandite, epidotite and diopside. The original rock was submarine basic volcanic rock from the mantle. Under the T-P effect of Songyang Orogeny about 2.5Ga ago, the original rock was metamorphosed and became the amphibolite gneiss.

Gneissic structure means that the sheet and columnar minerals are regularly arranged in certain orientation in rock.



## 发生在距今 25 亿年的全球性地壳运动 ——嵩阳运动的不整合接触界面遗迹

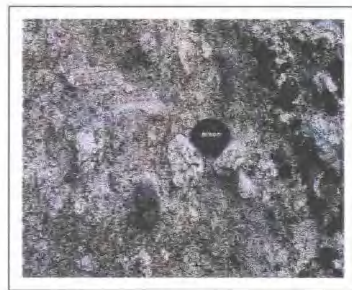
山体陡壁与崩塌巨石之间的植被复盖地带即为地壳运动界面遗迹的通过部位(照片1)。界面以西为25亿年前海底的花岗绿岩系;以东为距今25-18亿年间滨海——浅海环境形成的碎屑沉积。该界面是划分太古宇与元古宇的界线。

距今18亿年发生的地壳运动——“中岳运动”时,来自东西向的巨大挤压力和高温效应使嵩山地区产生强烈褶皱,玉寨山成为倒转复向斜山。此处位于倒转复向斜西翼,故为倒转层序。

碎屑沉积底部的砾岩层(照片2),是地壳隆升和沉积间断的重要佐证。



照片 1



照片 2

### Songyang Orogeny-A global crustal movement about 2.5Ga ago

The plant-covered boundary between the steep cliff and collapsed piles indicates this Orogeny. To the west of this boundary, it is the submarine granite greenstone series about 2.5Ga ago, and to its east, it is dominated by the neritic clastics deposited about 2.5~1.8Ga ago. This unconformity is a boundary between the Archaean and Proterozoic.

During the Zhongyue Orogeny about 1.8Ga ago, the E-W-oriented extrusion stress and high T-P effect made the Songshan mountain area strongly folded, and the Yuzhaishan Peak became an inverted synclinorium. This site is at the west wing of the inverted synclinorium.

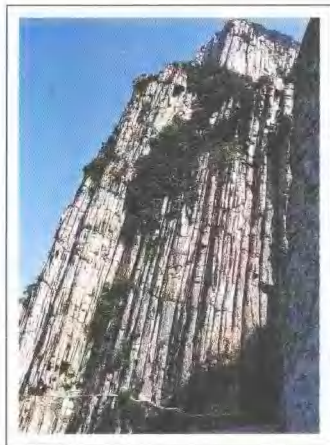
Photo 2 shows the basal conglomerate, which indicates the uplifting and interruption in deposition.

## 陡立的古元古界石英岩

石英岩是由石英砂岩经区域变质作用而形成。岩石中石英含量大于85%，含少量长石绢云母、绿泥石、磁铁矿等。岩石具粒状变晶结构和块状构造，有时具条带状构造。

此处陡立的石英岩，形成于滨海——浅海环境，成岩年龄距今25——23亿年，“中岳运动”使其褶皱造山，成为近直立的岩层，再经后期多次构造运动的改造，剥蚀等，形成当今壁立千仞，陡峭险峻的奇特地貌景观。

三皇寨景区内的石英岩， $\text{SiO}_2$ 含量多数在95%以上，是良好的玻璃原料，因在地质公园范围内，禁采。



### Paleoproterozoic steep quartzite beds

The quartzite is formed from the quartzose sandstone through regional metamorphism. The quartz content is over 85%, with a few of feldspar, didymite, chlorite and magnetite. The original quartzose sandstone was deposited in littoral and neritic environment about 2.5~2.3Ga ago. The Zhongyue Orogeny made it be folded and become vertical. After the post-multiphase tectonic movements and denudation, the magnificent, precipitous and steep landforms have been formed.

The quartzite in this scenic area, with  $\text{SiO}_2$  content over 95%, is good material for glass industry. After the establishment of the geopark, the quartzite mining is strictly forbidden.





## 沉积岩层面构造——槽模

槽模又称“流痕”，是沉积岩下层面因水体流动所形成的冲刷痕迹。即具定向流动的水流在底部尚未固结的沉积物表面冲刷形成的沟穴，又被上复沉积物充填而成。

照片中扁长对称，长轴彼此平行的槽模，上游一端高而陡且轮廓清楚，下游一端倾伏，并逐渐消失在层面上，显示了沉积时的流水方向（箭头指向）。

### Flute cast-one of surface structures of sedimentary rock

The flute cast is a kind of scouring marks formed by directed flowing current on the surface of non-consolidated sediments. As the deposition goes on, these marks are filled by overlying sediments, so the flute casts are formed.

As shown in the photo, these paralleled flute casts could indicate the flowing direction from the high, clear and steep end to the gentle end (as indicated by arrow).







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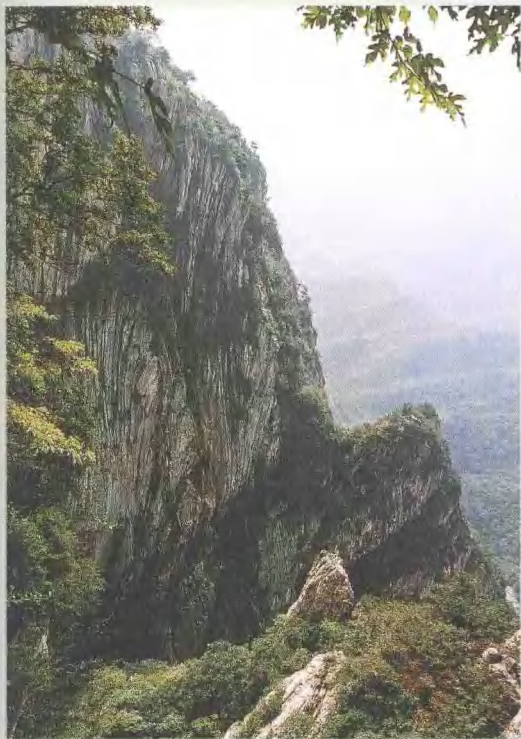
观

## 别有情趣的小石门景观

小石门东侧为山体，西侧为悬崖，崖边的陡立岩层受重力作用下垂而层面变缓。构造剥蚀作用使门洞处的岩石被带走而形成小峡谷，峡谷西侧的缓倾斜岩层沿垂直层面的节理面下滑，依靠在东侧陡立的岩层面上，形成别有情趣的小石门自然景观。

## Attractive Little Stone Gate

The east side of the Little Stone Gate is the mountain body, and a cliff on its west side. The steep rock beds become gentle under the gravity effect. The rocks under the Gate were transported by the long-term denudation. Here becomes a small gorge. The gentle slope rock beds on the west side slip downward along the joint surface (vertical to bedding) on the steep vertical rock beds on the east side. This Little Stone Gate is quite attractive.



### “中岳运动” 雕凿的尖棱褶皱

在距今18亿年前后，嵩山地区发生了被称为“中岳运动”的地壳运动，来自东西方向的强大的温、压效应使以前沉积的地层褶皱成山，形成走向近南北、轴面西倾，向东倒转的复式褶皱——复背斜和复向斜。并在复背斜与复向斜的转换部位出现尖棱褶皱和大型平卧褶皱，成为世间独有的珍稀地质遗迹。这些地壳运动的神力所雕凿的地质地貌奇观，成为世人游览和探索地球奥秘的宝地。

尖棱褶皱：两翼较平直，转折端呈尖顶的褶皱。

### Angular folds-formed in Zhongyue Orogeny

The Zhongyue Orogeny was happened in Songshan mountain area about 1.8Ga ago. Under the powerful E-W-directed stress and high T-P effect, the pre-depositional strata were folded, and the S-N-oriented inverted complex folds-anticlinoria and synclinoria were formed. The angular folds and huge recumbent folds are occurred at the transitional zone between the anticlinoria and synclinoria. These folds are the precious geological heritages, which indicate the powerful stress of crustal movement.



### 六千万年前的地质灾害——山体滑塌

在距今0.65亿年前后，刚经历过“燕山运动”（距今2-0.65亿年间）浩劫的中国大陆，又发生了“喜马拉雅运动”，此次地壳运动使嵩山向上隆升，震荡的应力作用使岩层陡立，节理发育的山体沿节理面裂解，脱位下滑，形成山体滑塌。

照片中斜靠在小山头上的小山头，即为滑塌的山体。

### Landslide-one of geological disasters about 60ma ago

The Himalayan Orogeny was taken place around 65ma ago. This orogeny made the Songshan mountain area uplifted. During the uplifting process, some landslides along the joint surfaces would be occurred in joint-developed hills.





## 石英岩的构造节理

构造节理：在构造运动作用下形成于岩石中的节理。常成群、成组出现。与嵩山地区的褶皱及断层构造等有一定成因联系和组合关系。

照片1：走向节理

节理延伸方向与岩层层理走向一致的节理。此处多条走向节理近于平行地成组出现。

照片2：“X”节理

又称“共轭节理”，是一个节理系统，与压缩变形相关，即岩石在同一应力作用下沿共轭剪切面产生的交叉剪节理。据“X”节理可判定构造运动的主应力轴向。



照片2



照片1

## Structural joints in quartzite

The structural joints are formed due to the structural movements, commonly occurred in groups or sets. The joints in Songshan mountain area are closely related to the folding and faulting of different ages.

Photo 1 shows the sets of strike joints, which are extending along the rock bed strike.

Photo 2 shows the sets of X-shaped joints. The X-shaped joint is also called the conjugated joint, it is a joint system, related to the compressional deformation. The X-shaped joint could indicate the direction of main stress axis of structural movement.





## 神秘的连天大峡谷

距今2-0.65亿年间,发生在中国大陆上的“燕山运动”使嵩山地区形成了以断裂为主的构造形迹。玉寨山(少室山)与峻极峰(太室山)之间的唐窑——中岳庙断裂带,把原本与少室山并肩而坐(二者为一体)的太室山向北西推移了三公里,断裂带两侧在剪应力作用下形成近于平行的多组裂隙,沿裂隙的岩层受机械破坏后丧失其连续性和完整性,后在隆升过程中经风化、剥蚀,破碎岩块被洪水带走,逐渐演化为峡谷,连天大峡谷就是这样形成的。

连天大峡谷属延伸方向与构造走向近乎正交的“横谷”类型,深度大于宽度且谷坡陡峻,谷脑昂首而座的连天峰(海拔1512.6米)是嵩山地区的最高峰,风景如画的峰谷地貌和壁立千仞上“镶嵌”的珍稀地质遗迹,共铸了世间一绝。

## The mysterious Liantian Valley

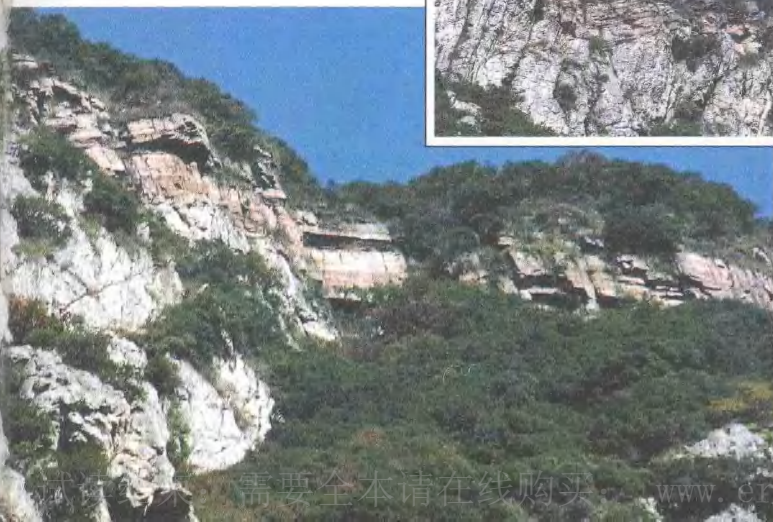
During the Yanshanian Orogeny (200~65ma ago), the fracturing structural traces are dominated in the Songshan mountain area. The Tangyao-Zhongyuemiao fault zone between the Yuzhaishan (Shaoshi) Peak and Junjie (Taishi) Peak pushed the Taishi Peak 3km northwestward. Many sets of paralleled fractures are occurred on the both sides of this fault zone. Through the long-term weathering and denudation, the broken rocks were gradually transported by flooding water. So the Liantian Valley was finally formed. This valley extends in the direction vertical to the structural strike, its depth is larger than the width, and the valley slopes are steep and precipitous. The valley starts from the Liantian Peak with an elevation of 1,512.6m, the highest one in the Songshan mountain area. The scenery here is marvelous.



## 耸于天际的“中岳运动”遗迹

站在连天大峡谷南坡向北仰望，耸立于天际的玉寨山大寨峰峰顶，于近乎直立的灰白色石英岩之上，平卧着一层层灰红色石英岩层，二者构成高角度不整合接触，其接触界面，即为发生在距今 18 亿年被称为“中岳运动”的地壳运动遗迹。

界面之下直立的灰白色石英岩层，属古元古界嵩山群，距今 25-18 亿年，上覆的灰红色缓倾斜石英岩层，属中元古界马鞍山群（距今 18-14 亿年），二者的不整合界面遗迹耸于天际，又构成世间一绝。



### Lofty geological heritage of Zhongyue Orogeny

Standing on the east slope of Liantian Valley, you can see that the horizontal red quartzite just overlies on the nearly vertical grayish white quartzite at the top of Dazhai Peak. The vertical grayish white quartzite belongs to the Paleoproterozoic Songshan Group-Complex (2.5~1.8Ga ago), and the horizontal red quartzite belongs to the Mesoproterozoic Maoyanshan Group-Complex (1.8~1.4Ga ago). This angular unconformity is a boundary between the Paleoproterozoic and Mesoproterozoic, it is called the Zhongyue Orogeny in geology.