A Brief Analysis of Cave Types of Danxia Landform in Xinjiang Basin

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Abstract. The Xinjiang basin’s tectonic site properly on the suture where the two plates of Yangtze and Cathaysia collided. It had suffered an evolution history from rift basin to fault basin affected by Movement of Pacific Block since Mesozoic and had deposited a set of huge thick bedded terrestrial facies fragmentary system. There developed amount of Danxia Landforms in the basin with the effects of exogenic geological process. cavernous weathering is the common phenomenon in Danxia Landform areas. The evolution of Danxia cave is controlled by lithologic characters, cleavages and fissures. The siltstone and sandstone and pebbled sandstone interlayers of Upper Cretaceous Chongan Formation are the principal stratigraphic position of forming the caves. It is considered that the devolvement of the caves in the surveyed area frequently results from the synthetic action of multifold external powers, just as the weathering denudation, water currents, and gravitational force.

1. Introduction
The Cretaceous Hongpan of Xinjiang in Jiangxi developed the Danxia landform formed by the Lower Cretaceous Zhoutian Formation, the Upper Cretaceous Tufeng Group Hekou Formation, the Tangbian Formation and the Lianhe Formation thick red conglomerate and conglomerate. Danxia Cave Danxia landform is a common micro-topography, Danxia landform caves in the Xinjiang River is very typical, these caves vary in size, shape, patchwork, constitute a unique Danxia cave landscape, very ornamental and research value.

2. Xinjiang Basin Geological Survey

2.1. Formations
Hekou formation of Guifeng group, Tangbian Formation and Lianhe Formation are the Chengjing formations of Danxia landform. Among them, Hekou Formation and Tangbian Formation are the major Chengjing formations.

Hekou Formation for the foothills Hong an alluvial fan coarse clastic rock built to purple, brick red conglomerate, conglomerate, volcanic clastic and breccia, containing sandstone, medium-fine sandstone, local folder siltstone Blocks, sandstones and siltstones have weaker weathering resistance
and are vulnerable to weathering and erosion. While the conglomerate, glutenite is relatively hard texture, rock thickness, anti-weathering and erosion ability. When sandstone and siltstone of the weaker intercalated sandstone are weathered and denuded, the formation of bedding rock is formed.

Tangbian Formation is a set of red fluvial clastic rocks, mainly composed of brick red fine sandstone, middle-thick purple grained fine sandstone, thin siltstone, calcareous conglomerate with a little powder sandstone, fine sandstone, medium coarse sandstone and gravel fine sandstone.

2.2. Structure
The Xinjiang Basin is located at the collision zone of the two old plates between the Yangtze Plate and the South China Passage, on the south side of the Pingxiang-Shaoxing near east-west fault and on the northwestern margin of the North-Eocene uplift in Wuyishan and the site of the Yingtan-Anyuan deep fault. Due to the influence of north-north uplift in Wuyishan and the near east-west paleo-suture zone in the North Sea-Shaoxing area, the basal structure, the caprock and the Meso-Cenozoic basins in the study area all inherited the general direction of the near east-west direction. The Meso-Cenozoic basins are controlled locally by the north-north eastward fault and its accompanying northwesterly faults. Since the Cenozoic, the NE-trending northeastern structure, especially the Yingtan-Anyuan fault zone, forming a development has an important impact.

The faults in the periphery of the Xinjiang basin are well developed, and the Yanshanian phase is more obvious. According to the distribution direction, they can be mainly divided into three groups: North North East, North West and Near Northeast. Some of them are part of regional faults, while others are large Secondary structure of the fracture. At the same time, affected by the regional faults, the three layers of North-East, North-East and North-West syndeposits are also developed in the red beds of the basin. They cut the red layer and form the Danxia landform landscape under different external forces.

3. The classification of Danxia cave in the Xinjiang Basin
Combined with the previous research foundation, after field investigation and analysis, the classification of Danxia caves in Xinjiang River Basin is shown in Table 1.

3.1. Formed by weathering the main cave
Rock weathering is closely related to rock lithology, structure, structure, sunshine, temperature difference and other factors. The sandstone weathering and flaking weathering of the red layer of the Xinjiang River basin occur along the strata such as siltstone, sandstone and gravelly sandstone, or the joints between the layers and the fractures. The formation of bedding grooves, frontal holes, flat holes and wear hole.

Stratigraphic grooves: thick gravel, medium-thick sandstone, middle-thick sandstone, siltstone or interbedded cliffs, which have different weathered and flaky weathering due to the difference in lithology between hard and soft sandstone, siltstone, etc. Soft rock is denuded by weathering and gradually concave, forming a layer of extended grooves. The formation groove is the initial stage of formation of weathering denudation Danxia caves. Like figure 1.

![Figure 1. Chenbao camp straight groove](image-url)
Table 1. The classification of Danxia cave in the Xinjiang Basin

| Cave size | Cave shape | Features | Typical landscape examples |
|-----------|------------|----------|----------------------------|
| Large single hole (General hole diameter> 10m) | Frontal hole | The top of the cave is curved, the bottom of the cave is flat or inclined toward the cave | Nanyan Temple Buddha Cave, Matsu rock Matsu Temple |
| | Flat hole | The roof is gentle arch, the bottom of the flat | Centenarian rock |
| | Arched hole | The top is arched, the back wall is tall and flat, and the bottom is flat | Buddha Hill arch hole |
| Pierce | Horizontal hole | Passing through the mountain layers, the hole was round or oblate | Puffer fish through the hole, Majiu mountain hole, Longmen Reclining Buddha hole |
| | Vertical hole | Near vertical penetration of rock mass, the hole is roughly oblate | Elephant Trunk Hill piercing |
| | Tiansheng bridge | The top of the flat hole, hole height is greater than the thickness of the rock roof | Guabang mountain Tiansheng bridge, Moon Lake Tiansheng bridge |
| Small single hole (General hole diameter <10m) | Steep slope irregular accumulation | Collapse of the steep slope collapsed pile piled in the slope, rocks supporting each other overhead, forming an irregular space | Blessed door, pull the dragon hole, Loyalty soul stone |
| | Horizontal parallel | A plurality of circular, oblate or irregular-shaped caves arranged close to each other on the cliffs, or connected caves with vertical partitions | Fairy rock, Longmen Lake |
| | Vertical laminated, Beaded | A large number of circular, oblate or irregular caves arranged nearly vertically on the cliffs, or connected caves with horizontal partitions | Paiya Peak, four sound Valley |
| | Spoon-shaped, bamboo shoots | Slippery cliff-shaped, bamboo shoots, arc-shaped hole, the wall with nearly vertical arrangement of small cavities | Dashao rock, Water erosion caves of carp continent |
| | Nesting | Large hole wall embedded with a large number of irregular or irregular holes, the formation of large holes inlaid many small holes in the composite cave | Swan Lake |
| | Stone pot | Frontal hole, flat hole, rock roof distribution round hole | Paiya Peak stone pot hole |
| | Honeycomb caves | Densely arranged along the cliff layers, smaller diameter circular, oval cave | Show flagpole cliff honeycomb cave |
| Groove (Groove depth <groove height, width: height ≥10: 1) | Straight groove | Cliff along the rock extension, flat or irregular shape | Chenzhao camp, Xiangshan bedding grooves |
| | Vertical groove | Vertical to the cliff, with the cliff surface contour was semicircular arc, square | Fairy rock, Paiya peak |
| Rock groove (Groove depth> groove height, width: height ≥10: 1) | Horizontal rock channel | Upward horizontal rock formation extends for a long time, the top of the cave is arc-shaped, the bottom is flat or inclined toward the entrance | Water rock cliff cave, The city of fairies female celestialairy Cave |
| | Tilt rock channel | The forwardly inclined rock strata extend for a long time, the top of the cave is arc-shaped, the bottom is flat or inclined toward the cave | Matsu rock slope rock groove |

Front-shaped hole: the groove continues to sand weathered, flaking, extending to the cliff, the roof is also gradually increased. As a result of the formation of holes earlier than the hole, weathering a long time, denudation, the formation of the top from the outside to the inside, from the central to both
sides of the lower, narrow semi-curved surface, slightly flat hole or hole to the low angle of the slope of the forehead-like caves. Such as figure 2.

Flat holes: The bedding grooves continued to weather and deepened inward along sandstone, siltstone and other rock formations. The top sandstone and pebble sandstone collapsed along the bedding plane, interlaminar joints and fractured gravitational forces due to long-term dangling, formation of the top of the roof and the layer is close to parallel, vertical and horizontal are gentle arched, flat hole flat hole. Like figure 3.

![Figure 2. Namyan-dong (forehead hole)](image2)

![Figure 3. Centenarian rock (flat hole)](image3)

Rock Slot: If sandstone with bedding grooves is developed, the siltstone layer is stable and extended, weathering and peeling along the long-term flake and gravitational collapse, the groove weathering along the sandstone and siltstone to form a horizontal rock groove extending along the soft rock layer or Tilt rock channel. Like figure 4.

![Figure 4. The city of fairies female celestialairy Cave](image4)

Perforation: Perforation of sandstone and gravelly sandstones in thick conglomerates along both sides of the stone wall occurs at the same time as weathered peel-off, water erosion and eventual breakthrough of the rock mass. Such as figure 5.

Tiansheng Bridge: The pier on the stone wall continues to weather and denudate, water erosion and gravity collapse. The cave rock formations are denuded and the piercing holes gradually increase and expand. When pierced cave height is greater than the thickness of the top of the tunnel, it becomes a natural bridge. Such as figure 6.
Honeycomb Cave: The sandstone on the cliff wall, the gravel of sandy conglomerate and the sandy interstitial material are weathered and loosened due to the difference of thermal power. The small dimples remaining after falling off gradually form nearly circular and oval pits honeycomb. Honeycomb caves are mostly densely distributed. Secondary large dimples develop in larger honeycomb caves. Such as figure 7.

3.2. Caves formed by water erosion
The water flow friction and rock erosion, relatively strong on the cliffs, water erosion is an important external force formed Danxia cave.

The level of lateral erosion Cave (groove): the water surface near the cliff exposed anti erosion ability of low sandstone and siltstone strata or joints, fractured parts, long-term erosion by water is concave to form bedding extending lateral erosion level cave (groove).
Vertical grooves: atmospheric precipitation pool at the top of the cliff into the water flow along the cliff straight down, erosion, cutting cliffs, the formation of the same height and cliffs on the narrow, wide under the wide arc at the bottom and near the vertical groove. When the vertical joints or fractures are developed in the cliffs, the water flows along the vertical joints or crevices to form large vertical erosion grooves of square, semicircle and arc shape. Such as figure 9.

Vertical beaded cave group: the linear flow of water flowing down from the cliff, from top to bottom erosion conglomerate, sandy sandstone, siltstone sandstone, siltstone erosion concave. The cliffs along the water surface to form along the sandstone, siltstone sandwich distribution, height and thickness of mezzanine circular, oval, convex mirror and other forms, beaded vertical distribution of cave group. Such as figure 10.

Juxtaposed cave groups: A few linear water flows close to each other on the cliffs, and sandstone, siltstone intercalation, sandstone and siltstone that extend nearly horizontally along the cliff surface of erosion water are eroded and concave, Circles of round, flat oval, undaunted in the middle of the cliff as wide and narrow vertical partitions, constitute a level of juxtaposed caves. Such as figure 11.

Overlapped hole: The vertical flow is absorbed by the surface tension and glutenite on the negative slope, fan-shaped downward along the cliff wall, infiltrating and erosion of the cliff wall. The rock layer swells and shrinks, resulting in sand-like and flaky weathering. Be eclipsed to form an arc-shaped cavity. When the water flow is small, by capillary action of grit conglomerate, the water flow infiltrates into the wall unevenly, and the partially wetted wall expands and contracts, weathering and peeling, and the inner wall of the cave forms a secondary cavity. Rainwater infiltration and flaky weathering are repeated periodically with seasonal rainfall and rainfall. The secondary cavities expand with the enlargement of large caves, forming a set of large cavities with many secondary cavities such as circular, oval or irregular cavities stacked composite cave. Such as figure 12.
3.3. The collapse of the cave caused by gravity collapse

Arched cave: the intersection of the parallel cliff and the vertical cliff's "X-shaped" joints. The lower joints often stratified along the horizontal strata. The fractures weathered and continued to collapse by gravity. Finally, the back wall of the arch-shaped hole, arch-shaped cave, the back wall steep flat. Such as figure 13.

Collapse accumulation cave: under the action of both internal and external motions, the rocks collapse along the joints and fractures by gravitational forces. Collapse of the collapsed rocks piled on the slope, and the rock blocks support each other and form an irregular space and caves. Such as figure 14.

4. Conclusion

Danxia landform in Xinjiang Basin is a well-developed cave with many shapes and diverse genetic types. The development and distribution of these Danxia caves are closely related to the lithology of the cliffs and the orientation of the cliffs. Controlled by lithology, joints and fissures, caves mainly develop in gravel sandstone, sandstone and siltstone intercalations, thickness of rock formation and joints, fissure controlled cavern output scale, weathering and erosion, water flow erosion and gravitational collapse are the major external factors. In addition, the direction of the cliffs, the terrain in the area, etc., also have an important influence on the formation of caves.

In the long course of the formation of Danxia caves, it is mainly based on an external dynamic action or later superimposed on the role of other external forces, or for the transformation of another
external force to change its appearance, and so on. The formation of Danxia caves is often the result of a combination of multiple external dynamic geologic effects.

Acknowledgements
Foundation: National Natural Science Foundation of China (No.41772197); Humanities and Social Science Research Project of higher schools in Jiangxi Province (No.JC1417).

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