The Primary Study of Origin of Mountain Movement in Wenchuan Earthquake

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SUMMARY:
In the afternoon of 12 May 2008, a M8.0 earthquake happened at Wenchuan, China. There is a series of phenomenon which were clearly different with mountain collapse, landslide at the same time with the earthquake, such as great mountain fragmentation, move and high temperature eruption of underground material. In this paper, we put attention on several mountain move and cast phenomenons, and after data studying and the site investigation about five peculiar earthquake phenomenons, we even compare the result with nearly strong motion data. We prove that the so-called "high speed and long runout landslide" condition can not be created only by the earthquake wave and the local geological conditions. We analyse the reason with seismogeology and conclude the main cause of such earthquake companion phenomenons is the combined effect of earthquake and the fast expansion of the underground gas, then we study the principle and condition of the gas storage based on the local geological circumstance.

Keywords: Mountain body move gas explode

1. INTRODUCTION

The rupture of 5.12 WenChuan Earthquake is along the main central fault zone of LongMen mountain. Its length is 300 km from YinXiu in WenChuan to QingChuan and edge of GanSu and ShanXi province, and its width is 10-15 km. On the side of LongMen Mountain ridge which is closed to ChengDu plain, there are many craggedness peaks and valleys and the obliquity of most of them are near to 80-90 degree .This geology condition has generated a lot of landslide which is dense, zonal-distributed and clustered in LongMen Mountain fault zone. At the same time, there are some indicative ruptures in the zonal-distributed which are called "point of burst". The "point of burst" has been discovered few before, so the name is new, and it is also a lively description of earthquake by the people who suffered earthquake. How to explain these strange phenomenons is a question that earthquake researchers must answer.

According to the traditional landslide theory such as studying XieJiaDianZi, we think that landslide has experience four steps which is fierce action starts cast, fast impact to fly, scrape to slowdown chipping flow and stack to bury. (Shengrui Su et,al.) But after researching the acceleration record, we think that there is no high acceleration, so the high speed and long runout landslide would not form. Especially there was no high epicenter from strong-earthquake-motion record on the phenomenon of flying move of huge mountain bodies around and in epicentre area which is different from generic landslide.

Therefore, we had several investigations, and analysed the ocean environment of LongMen mountain before Jurassic relating with numbers of trap structure in Chuanxi Sinking now, and also existing a great deal of extremely-high-pressure natural gas in the hugely thick layer which is 3 km under ground. We have discovered the extreme-high-pressure gas underground expanded fast while earthquake happened and poured out after cutting the bottom layer quickly at plane channels such as underground cranny, fault plane and so on.

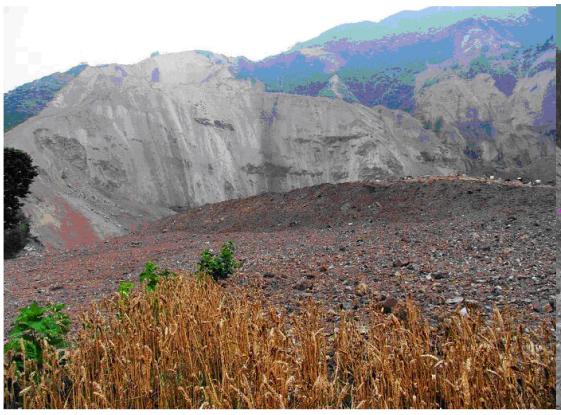

Figure 1. Klipe of Chenjiaba

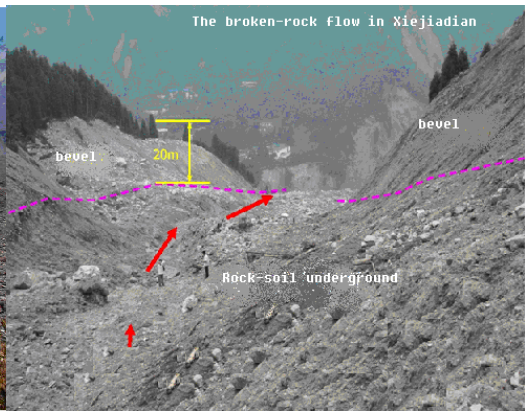

Figure 2. The broken-rock flow extrude from underground and fly away in Xiejiadian

2. EXAMPLES

2.1. Klipe of Chenjiaba

A serious landslide happened in Taihu village of Qiangzu country in Chenjiaba of Beichuan county(The Institute of Crustal Dynamics, China Earthquake Administration, 2009). Longdonggou is a stream which wriggled among mountains before the earthquake. A hill in the southeast fly to the north of Longdonggo when the earthquake happened and formed a huge talus creep. The thickness of the talus creep is more than 100 m, and buried another villige under it. The location in the front of what in figure 1 (see fig.1) was a broad flat before. Now the soil stack is from the gap of the peak on the up left of the picture, and it was also fly to rush here by magma with several kilometers.

According to Xiao Fan who is the chief engineer of local geologic survey team in Bureau of Geology and Mineral Resources of Sichuan province, the gas from the landslide had little relation with geothermy and may related to natural gas in shallow layer underground. “Earthquake changes geologic construction and brings on new crannies, so there may some natural gas came from shallow layer.”

2.2 “Turn ground over sky” of Xiejiadianzi in Pengzhou

There was also a strange phenomenon happened in Xiejiadianzi in Pengzhou which was called “Turn ground over sky” by the local people. When the earthquake happened, the people felt the shake of ground and saw a thick wraith of black smoke rose from buildings in Xiejiadianzi and covered all the sky soon. The whole village seemed to be blasted and soon slurry and rocks jumped to sky and poured to river bottom with destroyed buildings. About 48 families which were one third of all village were swallowed by the earth. Debris flow with huge granite, gritstone, shale, limestone and so on piled out from underground and fly to move everywhere which was about 40 thousand square meters and 10 million cubic meters, and brought on a bevel with vertical altitude is more than 20 m. The casualties are about 100 while there were farmland and village before (see Fig. 2).

2.3 Rock Eruption of Daguangbao in An County

Rock eruption of daguangbao in An county is the most typical in such a lot of rock eruption and cast move. According to our live investigation (Figure 4). A hill body with length 4km, width 1.6km and thickness 0.34km was cast for about 2km. The cast body is about 950 billion cubic meters and the altitude reduce 680m, so the energy was big enough. A great deal of cast body formed a klippe which altitude is 1000m beyond 2000m of Daguangbao (Runqiu Huang, 2008a).

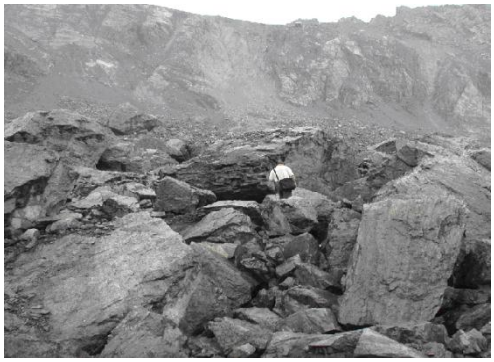

Figure 3. The writer surveyed in Daguangbao（2009.6）

The phenomenon of tress explosion at stress concentration points of the fault zone are tentatively called “Turn ground over sky”. Longmenshan town in Pengzhou, Xiejiadianzi and Qingchuandong estuary, especially Qingchuandong estuary is the most typical exmaples in our investigation. East River, red Township, Qingchuan County is located in the Longmen Shan fault northeast to the end, and only 300km from the epicenter Yingxiu. Lots of energy from Yingxiu spread to Qingchuan though Beichuan. Several extrusion thrust faultings and nappe constructs intersected in the East River, which resulted in stress concentration and the energy released in an instant as an explosion-like destruction. The large number of geotechnical pieces of gravel from the ground were out of the projectile, and formed a thick 30-50m accumulation of its destructive which energy was as the atomic bomb explosion. It made the beautiful village East esttuary disappeared from the earth, and all buildings were destroyed with burying on the spot death of more than 800 people.

2.4. Conclusion of Characters of the Earthquake

Feature 1: short time and intensive burst point

The central fault zone of Longmen mountain which started from the epicenter Yingxiu, teared into the Qingchuandong esttuary like a tear papers in a short time of more than 90 seconds. While there have been about 15 burst point in main central fault of Longmen Mountain, such as the epicenter of Yingxiu, Yin Changgou Beichuan, Chenjiaba, East river estuaries and so on. The local geological features has undergone a major change.

Feature 2: Rare Strange Phenomenon

In this earthquake, A peculiar phenomenon appeared which was rarely seen before. It is that surface geological disasters such as eruption, ground bloom and other happened at a lot of burst point accompanied by strong explosions.

Characteristics: a large number of odor

Feature 3: A Lot of Smelly Odor

Witnesses of the earthquake described that there were a lot of abnormal odor at many burst points, such as coke smell and pungent taste. The odor was from rocks in the high-speed collapse, and rub against each other, or gas released on the ground.

Features 4: Great Dust and Darkness

In our investigation, many witnesses described to our members: "the day came to a sudden dark, and no light." Yong belief that this situation was actually brought from a large amount of dust generated by the burst point.

Features 5: High-speed and High-feature Rupture

Rapid rupture from the epicenter northeast riched a speed at 2 to 3 km per second, and the trajectory was very long, some landslide movemens were seven up to 10 km. Many burst points were very different in altitude, and thus the rocks of eruption were mainly the metamorphic rocks

and volcanic rocks. The entire rupture can be described as high location, high-speed and long distance.

Features 6: small acceleration records

In the 478 acceleration records in the Sichuan earthquake, the maximum horizontal peak ground acceleration is only 957.7gal, the maximum vertical acceleration is 948.1gal. Such a small acceleration values is far enough to cause any object of the jump phenomenon.

Macroscopic investigation of the Wenchuan earthquake found a large number of phenomena such as rock burst, eruption, fly-shift, etc. They showed a significant character of expand stress source, which is very different from movements in traditional couple stress source (double couple or a single couple) after the earthquake. Especially disaster situations also showed the characteristics of the constructed of many non-couple source. This may indicate that, in addition to the fault activity in the Wenchuan earthquake, accompanied by many other factors that together triggered to produce the big earthquake disaster.

3. EXPLANATION ABOUT THE EXPLOSION THEORY OF GAS

Simple fault action always generates uplift, down throw and landslides, and simultaneity blasting sand and water is also common. The level of disaster is usually proportional to the altitude, slope and density of rocks, the higher, the more steep and the looser will cause the more severe disasters. But most of the disasters from Wenchuan earthquake occurred in the valley gorge below elevation 1500-2000m; and concentrated in the range of 20 ° -50 ° slope, and the largest disasters were not in loose sandstone, but the carbonate rocks. Thus, the earthquake disaster is not a simple process of fault activity, and the most possible reason is concurrent explosion of combustible material. It can be seen from Figure 4 that the Longmen mountain fault zone is of the marine deposits, and has generating coal, oil and gas background (Wang, et, al. 2008).

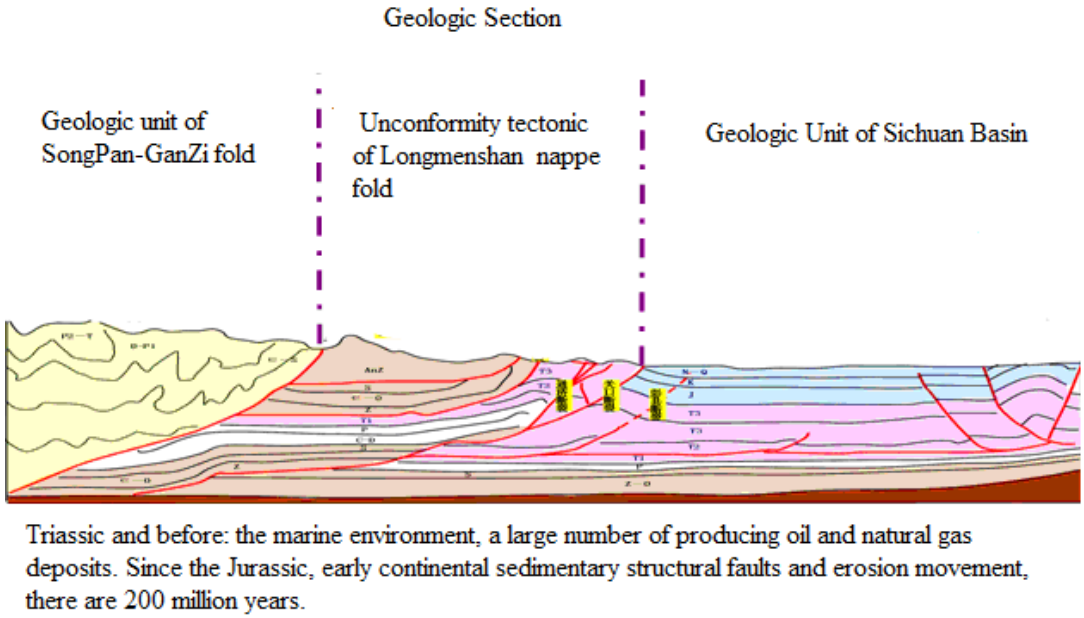

Figure 4. Longmenshan tectonic zone have the geological background of the presence of petroleum

The Sichuan Basin is one of China's three major gas production area, and has proven to have 1.2 trillion cubic meters of natural gas. There are a large number of trap structures in Chuanxi hollow in the front of the Longmen Mountain. Thick bottom layer below 3 km contains a large number of extreamly high pressure natural gas.

We can consider that there are a number of large-scale of closed circle (slit hole) structure which is press-and-extand type in the local region of the Longmen Mountain fault zone, and they sealed the high-pressure natural gas to form a high-pressure airbags. At the same time, the adjoining rock distort continuously and has saved a great deal of elastic deformation. They are located in the central fracture of Yingxiu, Jiufeng mountain in Pengzhou, Hongbai in Mianzhu, Gaochuan- Xiaoba in An County, Beichuan city, Kwai River, Chenjiaba, Qingchuan Nanba and East estuary and other places. Longmen Mountain fault zone has long been a regional extrusion of northwest - southeast direction, so that the high pressure airbag seam can not be bigger, but the natural gas in pressed layer is constantly pushed into the capsule. This makes the natural gas increase, so and the pressure, the effect to surrounding rock and the elastic deformation. The gas capsules are related to the extremely high pressure layer natural gas under 2000-3000m in Triassic system (below) in Chuanxi hollow and Longmen mountain. high-pressure strata of gas associated with or connected. Deep drilling on the latter's formation pressure measurements based on the oil, it is estimated that the pressure of the sealed gas capsule 100-200MPa.

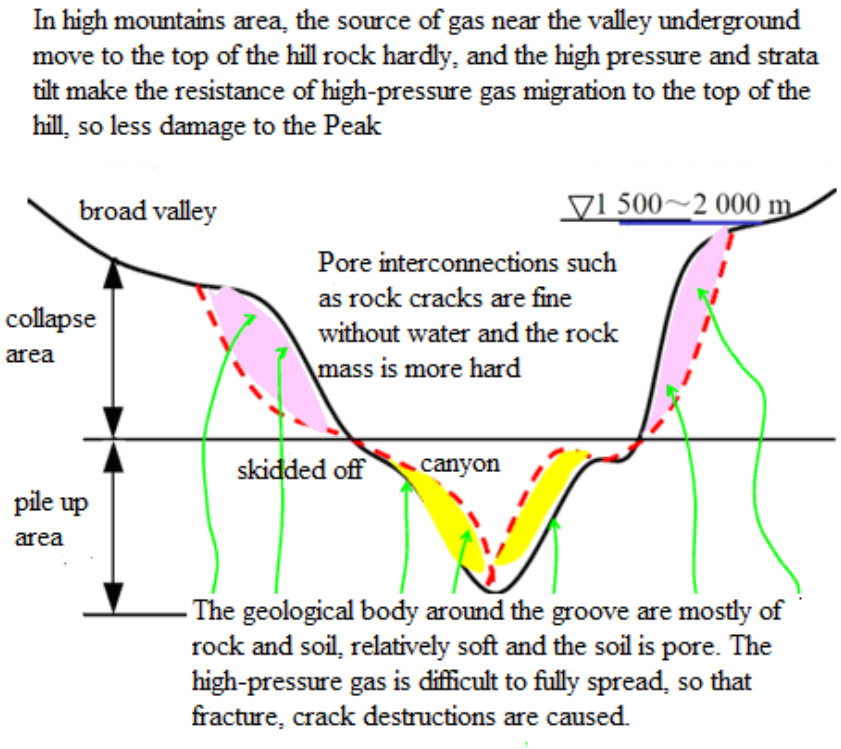

Figure 5. A sketch map of the high-pressure gas make the upper rock break and spout it out to the surface of the earth

Part of the centralized high-pressure gas rushed to the top and fractured and squeezed the rock and got out of the ground (see Fig 5), and it brought these phenomena, such as the ground opening, closing, and flowering, mountain collapse, landslide, rolling stones and ground bulging, uplifting and split of riverbed terraces caused by rock burst and ejections, also resulted in the "klippe", as well as a variety of disaster characteristics described in this paper.

4. CONCLUSION

The Indian plate collided with the Eurasian plate from south to north, while the collision region arched to form the Tibetan Plateau. The Tibetan Plateau moved to the northeast at the same time with uplifting, ant it squeezed the Sichuan Basin slipping to northeast. Since the Wenchuan earthquake occurred in the southeast of the Tibetan Plateau and the magnitude was 8.0, but the fault was not

active before. Although the Plate extrusion was lines and section shape, the energy release of vibrations on the ground was from a point underground as spherical wave when the earthquake happened, and all the other associated energy (sound, light, electricity and heat) almost broke out from the point, which makes us doubt.

Before the earthquake, 25 stations with broadband seismographs were established by the MIT researchers in the western Sichuan and had monitored local crustal activity more than a year. Professor Luo Aideng in the research team pointed out that although they researched the data, but no one foresaw any big earthquake. Luoai Deng said, "This earthquake is a bit unusual". The boundary which is the very “unusual” geological condition between the Sichuan Basin and the Tibetan plateau is steep. The elevation is even about 3500 meters only in the area of 50 km^2. This widely elevation difference make a tremendous geological pressure, which is also the reason of the earthquake.

There are huge closed stitch structures distribute bead-like along part of the imbricate nappe fault of Longmenshan and unconformable contact region. Very thick Triassic marine sedimentary strata can continue to produce natural gas, the gas can be a continuous cycle of input to filling these large closed stitch. With the accumulation of time and the gas inside the closed stitch, the pressure increase continually. At last, the gas make a sudden rupture of rock, so that those associated phenomena of this earthquake happened on the imbricate nappe fault and unconformable contact surface.

All in all, the earthquake process is a complex geological activity, It is instructed by the structural features and earthquake characteristics in the post-earthquake that, the high-pressure airbags which formed in the long geological age under Longmen Shan structural fault are very active in this earthquake, and it is one of the important factors of the disaster.

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