

Analysis on the Development of Geohazards in Linwei District of Weinan City

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Abstract—The study area is located in the east of Guanzhong Basin, and the tectonic system is special, which is controlled by the faults in the area. Under the action of the intense neotectonic uplift movement and the strong erosion of surface water, there are many geological disasters in this area. Through the detailed field geohazards investigation, this paper analyzes and studies the law of the development of logical disasters in Linwei District, and draws the following conclusions: (1) Geohazards are unevenly distributed in time and space, which in the southern is more than in the northern region, and in the western is more than in the eastern in space. During geologic age, geohazards have developed more quickly since the quaternary, especially from July to September in the year. (2) The same geohazards have the character of group, and the differences of formation conditions of geohazards control the types of geohazards.

Keywords—geohazards; formation conditions; character; law of development; Linwei district

I. INTRODUCTION

Linwei District is located in the eastern part of Guanzhong Basic. The basin stands where the four tectonic systems of front arc top and east wing turning point of Qi-Lu-He-Lan epsilon-type, north edge of qin-ling latitudinal direction tectonic, the third subsidence zone of Neocathaysian and perimeter of Longxi roll-up [1-3]. Under the action of the intense neotectonic uplift movement, the rivers are cutting thick bedded loess stratum. Affected by the special geological conditions and modern erosion, the south area, with ravines, complicated terrain and low vegetation cover, cause many geological disasters [4]. For example, the landslide of Gao Cliff of Qin Yang caused 4 dead and 2 injured on 1985; the landslide of He Wang caused 5 dead and 1 injured on 1988; the landslide of Song Jia happened on

2016 is in the stage of accelerated deformation. These disasters seriously threaten the lives and property of the local people. Based on the detailed investigation in the field, this paper analyzes the law of the development of the geohazards, and provides the basis for early warning and the accord prevention of geohazards in the area.

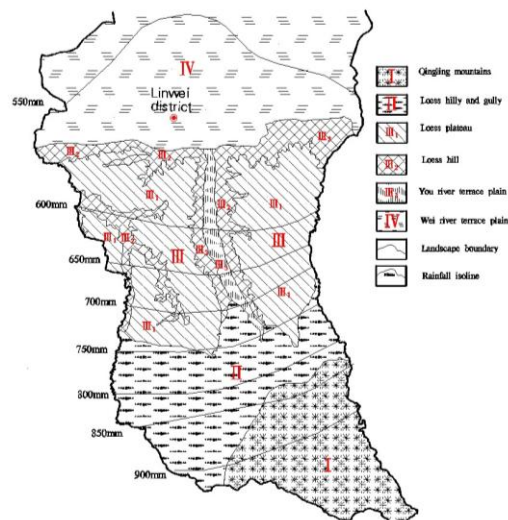


Figure 1. Rainfall contour map of Linwei District

II. TYPE STYLE AND FONTS

The study area belongs to the semi-arid continental monsoon climate; the temporal and spatial distribution of precipitation is uneven. The annual precipitation contour is reduced from south to north and the rainfall accounts for more 50% of whole year on 7-10 month, especially in the south of Qinling Mountains as high as 926.2mm (Figure1).

River system mainly includes You River, Ling River and Chishui River, which flow into Wei River from south to north. The dense upper reaches of these rivers intensely erode the loess and cause serious soil and water loss in this area. The terrain is stepped down from the south to the north and the landscapes in turn by Qinling Mountains, loess hilly area, Loess Plateau and Weihe plain. The main exposed strata have Archean gneiss, Cenozoic granite, Neogene Sediment rock, middle Pleistocene and upper Pleistocene loess (60-120 m thick), Quaternary alluvial silty clay. The survey found three large fault zones which are Weihe fault, piedmont fault of Mount Li and fault of northern edge of Qinling Mountain. These faults divided the Linwei into four zones which have different landscapes.

III. TYPES AND CHARACTERISTICS OF GEOLOGICAL HAZARDS

It is found that there are 5 kinds of geohazards, including landslide, collapse, debris flow, ground collapse and ground fissure, which are total of 83.

Landslides which are total of 39, mainly homogeneous loess landslide and loess interface landslides which are based on the convex slopes. The slope heights are between 20-100m, the angles are between 20-50 degrees. Homogeneous loess landslide takes characteristics as extensive distribution, large slope, sliding fast and small-scale. Due to its feature of suddenness, this kind of landslide has serious harms [5]. Most of the loess interface landslides which inherit ancient landslide frequent occurrence shear-slip. Loess interface landslide, mostly interpreted the ancient, old landslide shear slip, which has clear round-backed terrain, and polygonal-line sliding surface, the back is snapped along with vertical joints of loess, the main sliding surface's angle is smaller, but straighter along soft rock face. Slip mass is in a ladder shape, there are many gullies on both sides, and smaller slide and collapse on frontal part, accordingly forming new free faces [6-8].

Collapses which are total of 32, mainly including sliding collapse and pull-splitting collapse. The slope heights are between 20-40m, the angles are between 75-90 degrees. Pull-splitting collapses is mainly developed in the slopes which exist caves or empty space. Sliding collapses is mainly developed in the slope which exist soft ground at the bottom and joints on the surface.

There are 4 debris flows, mainly including loess mudflow, cross-section of gully is a 'V', it has bigger longitudinal slope, material source mainly is deposited of collapse and landslide. The landform of gully existence is flat; deposition basin and forming region generally are dispersed over different geomorphic unit.

Ground collapses are total of 7, mainly including collapsing of caves and air raid shelter. Along the caves and the trend of air raid shelter, the collapsing has been gradually expanded.

Along the Weihe fault from west to east, Ground fissure, about 5km, width 0.1-0.2cm, gradually pinches up and down gradually, with the movement of the structural movement continues open and close, there is a clear vertical disclation.

IV. ANALYSIS OF THE LAW OF THE DEVELOPMENT OF GEOHAZARDS

The formation conditions of geohazards include meteorological and hydrological, landform, geological structures, engineering rock and soil mass and human activity. Under the control of these conditions, the geohazards have characteristics of distribution of uneven spatial and temporal in Linwei area. Because of the interaction of the mechanism of different types of geohazards and conditions of different formation, the geohazards have special development rules in Linwei District.

A. Spatial Distribution of Geohazards

The distribution of geohazards in Linwei area shows that the spatial distribution of geohazards has the obvious characteristics of asymmetric and gregariousness (Figure2). Geohazards in the south are more than in the north and in the west much denser than in the east on the macro. The zonal distribution of geohazards along with the river system, gullies, fault zones and densely distribute in those zones at parts.

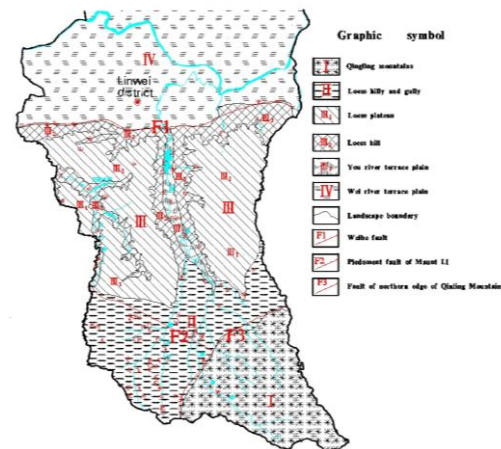


Figure 2. The relationship between the distribution of geohazards and tectonics, landforms in Linwei area

Because of following factions, the distribution of geohazards shows that they are in the south more than in the north. (1) The precipitation of south of researched region is significantly higher than the north. The strength of loess with water sensitivity would reduce, when it come across water. It is easy to develop geohazards. (2) The north of the area is alluvial plain where is flat terrain and almost no conditions of development of disasters. However, the severe erosion of surface and the development of micro landforms which are gullies and cliff proved favorable terrain conditions for the formation of geohazards in the south [9]. (3) The poor consolidation of sandy mud interbed which widely distribute in the south are easy to soften by water. This layer of soft rock is easy to form a sliding zone.

The characteristics of distributions that geohazards in the west are much denser than in the east are controlled by water system and piedmont fault of Mount Li. The piedmont fault of Mount Li and the fault of northern edge of Qinling Mountain converge in the southwest of researched area

where is in the villages of Yangguo and Huayuan. The tectonic activity of the intersection zone is strong and the rock and soil mass is broken. In addition, the new tectonic movement has the control function to the joint and the river distribution direction, and stratum can be selectively eroded under the action of stress field. The river system, which is contorted by the piedmont fault of Mount Li, develops from the southwest to the northeast in the southwestern researched area. Landslides and collapses frequently occur on both sides of the valley by erosion of water [10]. However, valleys in the west of study area are lesser than in the east. Correspondingly, the geological disasters are very few in the eastern area.

B. Uneven Distribution of Geohazards in Time

By the cyclically control and influence of regional tectonic movement, climate and river cutting and other geologic agent, geological disasters in Linwei also had the cyclical changes of active period and quiet period of change in geological history [11]. Especially since the Quaternary, North Alice block south dipping left oblique role continues, the study area stay in long-term neotectonic tectonic movement, the river cutting to southeast, coupled with the area soft rock slope widely distribute, the investigation of the geological disaster almost all occurred in the period.

The law of geological hazards in a year is mainly related to seasonal precipitation and intensity. In 7-9 months, the rainstorm is often, geological disasters of collapse, landslide and debris flow is relatively concentrated in this period of time, and heavy rainfall in a short period of time erosion the loess slope seriously, poured into the cracks so that have no time to discharge the water, hydrostatic pressure, is not conducive to the stability of slope, the large catchment also provides conditions for the formation of debris flows.

C. Geohazards Distribution Characteristics under Different Formation Conditions

It is found that there are some differences in the types of geological hazards under different formation conditions, which lead to the clumped distribution of the same disasters. About 12.4% disasters distribute on active fault zones in Linwei district, in which 60% collapse disaster, this is because the formation of active fault displacement field and deformation field, the formation of steep topography, rock and soil around the complete damage, loess structural joints and vertical joints of common cutting, forming massive rock mass, under gravity, it is easy to occur crack type collapse, lead to collapse disaster near fault fracture is developed. It is easier to develop the landslide in the Loess gully, about % landslide, there are two types valley, V and U type Valley, gully slope at between 30 and 50 degree, because the loess has a very strong vertical nature, not easy to collapse at this angle; the effect of seasonal water erosion in the slope toe, stress redistribute constantly, it is easy to format tensile cracks in the top of the hill, in the rain or induce in earthquake [12-16]. And u develop in the Loess Plateau valley, the reason of the development of landslide is that underground water uplift on tableland irrigation slope, the underlying mud sandstone softening, soil weight increased

and the strength resistance decreased. Debris flows are formed in landscape boundaries, also boundaries of V valley high angle area landslides and frequent phenomenon, there are 21 landslides in 2 Km² in Kang gully, it provides a rich source of material for debris flow, the vertical interval height of the terrain and the narrow channel, abundant rainfall in high altitude terrain, wide catchment area, provides water conditions, the comprehensive effects of these factors make the debris flow is more development. In the area of ground subsidence mainly distributed in the Loess Plateau, the main causes are related with human engineering activities ,cave and tunnel excavation in collapsible loess, lacking of management, so it will happen when the water infiltration and gravity [17]. The only one fissure in the distinct is tectonic ground fissure, distributes along the plateau Weihe fault.

V. CONCLUSION

(1) The distribution of geohazards in LinWei district appears on a diminishing scale from south to the north, on a diminishing density from west to the east, and some geohazards partial dispersed along active fault zones, gullies and river system, and it has intertwined relationship with geomorphic type in this area.

(2) The distribution and the cause of geohazard, geomorphy and lithology are regulated by structure activity, so the specific structure activity is the fundamental elements of geohazard, and others are secondary cause.

(3) The forming process of geohazard restricted the type of geohazard. Due to the different mechanism, the main formation condition of geohazard is different as well. According to analysing the development rule of geohazard, we could provide reasonable references, to some degree, and forecast guidance for what type of geohazard could happen in different area.

(4) The investigation shows that the distribution of geomorph and the river system related with structure activity. Thus the special structure activity is the critical factor to frequent geohazard in this area.

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