10.18686/gme.v2i1.3893

# Research on Prediction of Land Subsidence in Coal Mine Geology

**Hongle Sun, Congwei Zhao, Fengchao Zhang**

**Luwa Coal Mine, Shandong Lutai Holding Group Co., LTD., Jining, Shandong 272000**

***Abstract:*** Coal mining provides strong energy support for the development of modern industry. However, in the long-term coal mining process, there have been serious land subsidence problems, which have a very adverse impact on the local natural environment and native business life. Therefore, the research on the prediction of land subsidence in coal mine geology plays a very important role in the sustainable development of coal mining work. Besides, the research on coal mining technology could minimize the damage to the ecological environment of the mining area and at the same time protect the local infrastructure. In this thesis, the prediction of land subsidence in coal mine geology is briefly explored for further research and reference.

***Keywords:*** Coal mine geology; Land subsidence; Sustainable development

## 1. The prediction model of land subsidence in the mining area

In general, the probability integral method is used to establish the prediction model of land subsidence in mining areas. Besides, the corresponding requirements for land reclamation are put forward according to this model.

(1) The common impact of multi-face mining is forecasted superimposed. First of all, the subsidence of the predicted point of the surface generated when only a single working face is mined is calculated and statistics are carried out, and then the subsidence of multiple working faces calculated respectively is superimposed.

(2) To calculate the expected settlement of the irregular shape mining face, can be calculated by dividing the irregular shape of the working face according to the direction of the coal seam, and dividing it into several rectangular mining faces to replace the original irregular shape mining face.

## 2. Prediction of land cracks

In the process of coal mining, due to the continuous reduction of underground coal reserves, resulting in land subsidence, and when the settlement occurs, the settlement amount and the stress state of each point on the surface are different, destroying the original balance state of the surface. Therefore, in some areas of the subsidence basin, it is often because of the uneven horizontal movement and settlement phenomenon at all points of the surface, resulting in fractures in the basin. Although the fracture is affected by the surface subsidence, it is not formed at the beginning of the surface subsidence, but when the coal mining face gradually expands, the tensile stress on a certain point of the surface reaches the limit bearing state and gradually produces. In the study of coal mine geology, it is often mentioned that the crack critical mining area, refers to the mining area in the mining process of a coal mine so that there is a point in the surface of the crack critical state. The critical mining area of the crack is affected by many factors, including the mining depth of the coal mine, the geological structure of the overlying strata of the coal mine, the mining thickness of the coal mine, and the physical and mechanical properties of the overlying strata of the coal mine and other factors, while the production of the critical value of the surface crack is mainly affected by the physical and mechanical properties of the surface soil. The cutting eye of the working face of coal mining, the boundary of the final mining line, and the surface of the mining face up and down the mountain border once the crack becomes a permanent crack and cannot be closed by itself. Only when the cracks are artificially filled, or the adjacent working face is also mined, or the cracks have experienced a long time of natural action, these permanent cracks will be closed. In coal mining, the cracks above the mining face will advance as the working face continues to advance. In the process of coal mining, if the mined area exceeds the critical mining area of the crack, there will be a crack area above the surface around the goaf. Then, with the gradual increase of the goaf area, the crack area will gradually expand, especially at the border of the mountain and the mountain and the cutting hole. The cracks above the surface of the working face will also move forward with the advancement of mining. At this time, the previously formed fracture area will enter the compressive deformation area due to compressive stress, so that the fracture will gradually close, and new cracks will form outside the fracture area. When the working face continues to advance, the upper crack range of each mining boundary will no longer expand further, and the cracks above the surface will continue to move forward with the advancing process of the working face. When the mining work of the coal mine face is finished, the cracks will only occur in the upper surface around the goaf according to this law.

For coal mining in mountainous areas, the downhill direction of the surface is the sliding direction of coal mining in mountainous areas, and the amount of surface slippage will increase with the increase of surface dip Angle. Therefore, it can be found through analysis that the mountain tops and convex landforms in mountainous areas will produce additional horizontal stretching deformation due to the increase of surface dip Angle. In mountain valleys and concave landform parts, the opposite effect will occur, resulting in additional horizontal compression deformation. Therefore, in the mining of coal mines in mountainous areas, it is often found that mining fractures are easy to form on mountain tops and convex landforms, and the direction of the fractures will keep roughly parallel with the direction of the contour line. In the concave landform part of the mountain area, due to the impact of compressive stress, there are few obvious mining cracks. The above is an introduction to the distribution characteristics of cracks in the process of coal mining in the mountain area. However, in the long-term coal mining work found that not all of the mining methods will produce cracks on the surface, the generation of cracks in addition to the mining conditions related to the coal mine, but also affected by the nature of the surface soil and the thickness of the soil. In the mining area without loess layer and loose accumulation covered by the surface, when the mining depth and thickness ratio is greater than 80, mining width and depth ratio is less than 0.5, generally will not produce cracks on the surface, and in the loess, layer thickness is greater than 50 meters of the surface, under the same mining conditions, there will be obvious surface cracks on the surface.

It can be calculated from the following formula in the process of coal mining above the surface of the crack from the generation to the closure of the time required, namely: The time required for the crack from generation to closure is expressed by T, the maximum width of the crack zone generated on the surface above the working face is expressed by L, and the depth of the advancing of the working face is expressed by V, then the duration T=2 the maximum width of the crack zone/the advancing depth of the working face.

## 3. Impact of surface cracks on the land

In the process of coal mining, cracks vary in size, some of the surface cracks are very large, the depth even up to 20 meters, and the width of the top of the crack between 20 cm and 30 cm, for example, in the loess Plateau and other areas covered by loess, the depth of the crack can reach 10 meters, and some cracks above the surface are very small. After the crack is produced, the soil at the crack is exposed to the air, it will be relatively vulnerable to natural forces such as wind and sun in nature, accelerating the erosion of the soil, resulting in the loss of soil, water, and parent material in the erosion, and the soil fertility is seriously decreased, which is not conducive to the growth of crops and hurts the yield of crops. The extent of land erosion caused by surface cracks will also be affected by many factors, mainly including the characteristics of cracks, size, and their natural environment other factors, can be divided into the following three types of land erosion according to this difference, namely gravity erosion, rill erosion, and ditch erosion.

### 3.1 Rill erosion

For the fine cracks caused by mining, the depth and width are generally relatively small, and the cracks occur in the tilled layer or slightly deep in the tilled layer and parallel to the gob boundary. This kind of fine crack causes water, soil, and fertilizer to run on the agricultural ground, and can also expose newly sown seeds and crop roots, resulting in a lack of seedlings and yield reduction. Due to the small depth and width, it can generally be smoothed by the next tillage.

When there is a crack, the water applied on the surface will quickly invade the crack below the plowing layer, causing loss. In the experiment, choose a point in the land without cracks around and slowly add water, while choosing a point in the soil with cracks slowly add water, the speed and amount of water added in the two places are exactly equal.

### 3.2 Ditch erosion

When there is a large or large crack, it is affected by heavy rain and floods, causing linear erosion of the ground, which is called groove erosion. The main difference between gully erosion and rill erosion is that rill erosion can be suppressed by ordinary farming methods, while gully erosion cannot. The development of gully erosion will continuously cut the ground, resulting in complete fragmentation of the land.

### 3.3 Gravity erosion

In mountainous and hilly areas, cracks produced by mining under the combined action of other stresses, especially hydraulic power, gravity as a direct cause of surface soil movement, known as gravity erosion. The main form of gravity erosion that may occur due to mining cracks in mining areas is a landslide, and its mechanism of action is as follows: (1) Due to cracks, heavy rain and heavy rain, the water invasion range of soil expands, the bulk density of slope soil increases, and the anti-sliding strength decreases; (2) the change of slope shape.

## 4. Conclusion

The sustainable development of coal mining has a vital impact on China's economy, therefore, to promote the good and normal operation of the coal mining industry, we must strengthen the research on the prediction of land subsidence in coal mining geology, to reduce the damage of coal mining to the natural ecological environment, so that it can conform to the important strategic policy of China's sustainable development.

## References

[1] Zhou Chao. Discussion on the causes of uneven settlement of large underground garage foundation and its prevention measures [J]. Research on Urban Construction Theory (Electronic Edition), 2012 (35).

[2] Geng Lingsheng, Cao Lianxin, Wang Guanghui. Journal of Shandong Agricultural University (Natural Science Edition), 2006 (4).

[3] Li Lin, Li Keguang, ZHANG Tao. Detection, identification, and reinforcement treatment of uneven settlement accident of the foundation of an apartment building [J]. Building Science, 2011 (7).