Engineering and Technology Journal e-ISSN: 2456-3358
Volume 06 Issue 08 August-2021, Page No.-981-984
DOI: 10.47191/etj/v6i8.01, I.F. – 6.39

Application of Transient Electromagnetic in Detection of Water Accumulation in Broad Coal Mine

Gao Chong[1], Feng Youli[2]
[1,2]school of resources and environment, henan polytechnic university, jiaozuo 454003, china

ABSTRACT: In view of the problem of serious water accumulation and frequent accidents in the coal mine mining area, the distribution range of Yuzhou Shenhuo Kuanfa Mining Coal (hereinafter referred to as Kuanfa Coal Mine) is detected by transient electromagnetic method. The transient electromagnetic emission wire frame is 480m × 480m, frequency is 8Hz, power supply current is 16A. The research conclusion preliminarily determines that the transient electromagnetic and controllable source audio earth electromagnetic method is applicable for the exploration of the mined space area in Yuzhou mining area, and the construction parameters provide a reliable reference for the accurate exploration of the mined space area in Kuanmining area.

KEY WORDS: empty water area; transient electromagnetic; wide coal mine

INTRODUCTION

With the integration of coal resources, because most of the small coal kilns are unplanned mining, and the remaining unmining areas are unknown, leading to the existence of many hidden mining areas[1], among which the old kiln water becomes a major potential danger in the nearby area and adjacent coal seam[2][3]. Transient electromagnetic method can effectively help detect the distribution of water in the mined out area[4][5], which is of great significance and help to the treatment and later coal mining.

1. OVERVIEW OF THE STUDY AREA

Yuzhou Shenhuo Kuanfa Mining Co., Ltd. (hereinafter referred to as Kuanfa Coal Mine) is located in Yuzhou City. The geomorphic unit belongs to low hills, and the relative elevation difference of + 330~ + 421m, is about 90m. The terrain is slow and gully development is conducive to surface water drainage. The exploration area is about 1100m, south-east wide and it is about 850m,. The exploration area is about 0.9242km^2。

2. WORKING METHOD

Transient electromagnetic method (Transient electromagnetic method,TEM) is a time domain electromagnetic sounding method, also known as "pure anomalous field method"[6]. It is a geophysical exploration method that uses the underground field through step waveform electromagnetic pulse excitation by ungrounded return circuit and measures the change of the underground medium to find various geological targets[7][8]. Since pure quadratic field anomalies are observed without a single field background, the anomalies are more direct, have more obvious detection effects, and have a higher fidelity of the original data.

Transient electromagnetic achieves the purpose of finding target geological bodies according to different

Resistivity differences of different locations, different depths and different rock layers, and identifies the nature, buried depth and conductivity of abnormal sources combined with geology and other data. See Fig. 2-1.

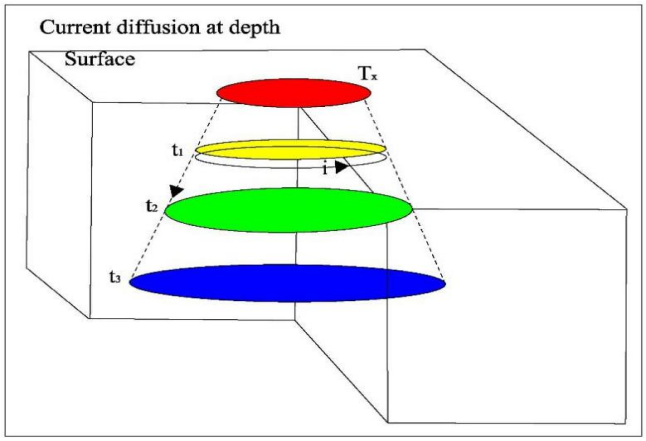

Figure 2-1 Schematic diagram of transient electromagnetic method

3. ELECTRICAL METHOD EXPLORATION TECHNOLOGY TEST

3.1 Emission border size

Due to the large inclination of the exploration area, The burial depth, Therefore, 360m × 360m,480m × 480m are selected for testing, As is seen from Figure 3-1, The emission border of 360m × 360m attenuated near 22, Its effective signal cannot suppress the interference, Basically for the noise signal reflection, The depth information reflection ability is relatively poor; The 480m × 480m wireframe all has 25 signal decay times, Basically can meet the exploration depth measurement requirements, According

to the geological task, identify the water distribution of the fault zone within the working area and the water distribution of the coal seam (roof plate) and the mined space area and the old kiln, Requirements for the interpretation of the possible water-rich areas in the area, Comprehensive construction progress and the requirements of the construction equipment, 480m × 480m.

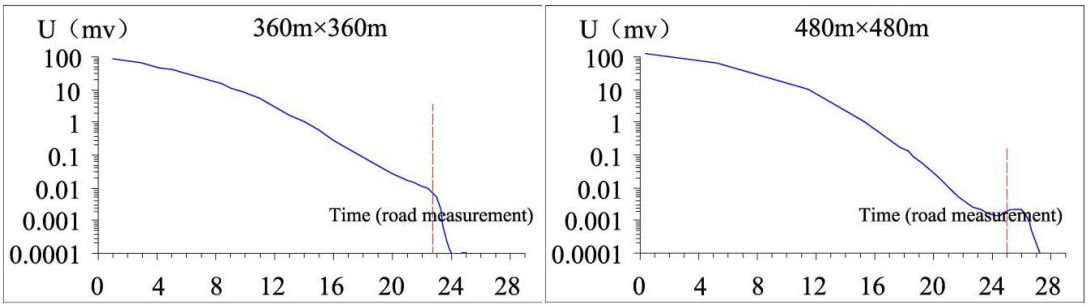

Figure 3-1 Single-point curve of the emission border test

3.2 Emission frequency test

The emission frequency can reflect the coupling degree of the emission signal with the geological body, high frequency with shallow geological depth, and low frequency with the deeper geological body.

According to the geological task of the test area, the buried depth of the measuring area and previous work experience, the emission base frequency is 1Hz, 4Hz, 8Hz, and 16Hz. The test results are shown from Fig. 3-2, after analysis shows 1Hz tail attenuation, poor signal low anti-interference ability, 16Hz curve attenuation, shallow exploration depth and poor depth anti-interference ability. Both 8Hz and 4Hz effective signals reach 25 channels, longer 8Hz sample time, smoother curve 8Hz, and 8Hz is better than the effective data at 4Hz depth, as shown in Figure 3-2

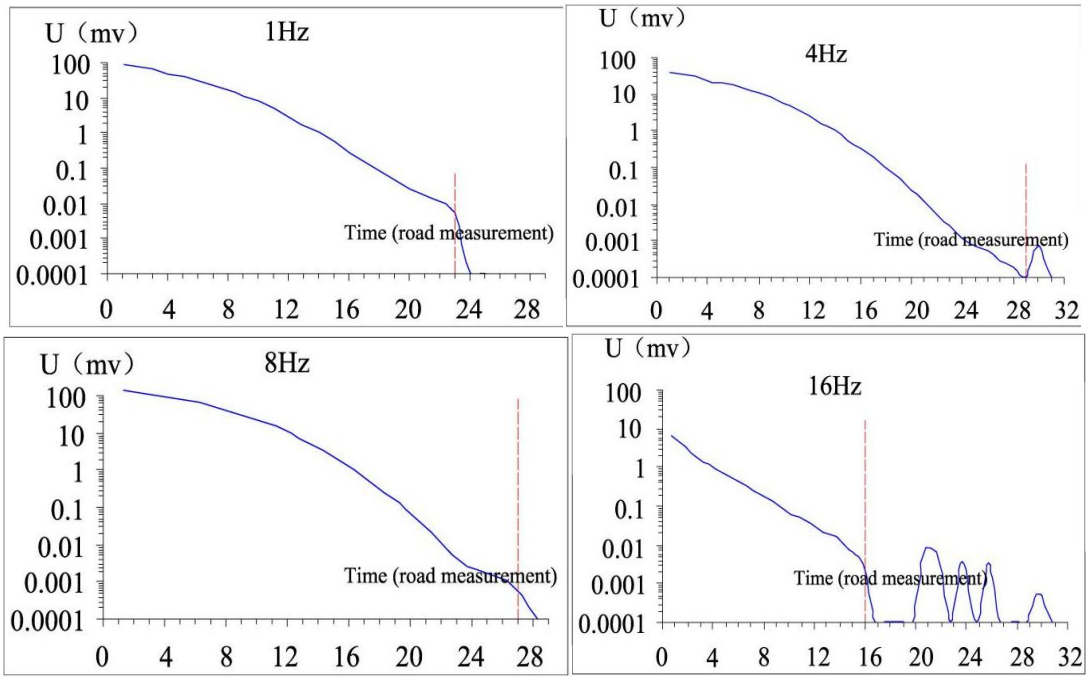

Figure 3-2 Single-point curve of this emission frequency test

3.3 **Emission current test**

When other parameters are the same, the larger current can obtain the deeper geological body reflection signal, while the smaller current obtains the reflection signal of the shallow geological body. When the selection of the emission current, the emitted current can stabilize for a long time to ensure the normal operation of the equipment. Second, the interference factors in the field area should be considered, and the emitted current should have sufficient anti-interference ability to ensure

The good acquisition of the original data.

Combined to the deep buried depth of the target layer in the area, 10A, 15A, 18A, 20A currents are selected for test. The test results are shown from Fig. 3-3, when the emission current is 10A, the signal intensity is low, the serious attenuation curve interference signal after 17, effective attenuation time becomes shorter, 10A,15A effective decay

time reaches 20 channels, serious attenuation curve interference signal, and 18A,20A, attenuation curve is basically consistent.

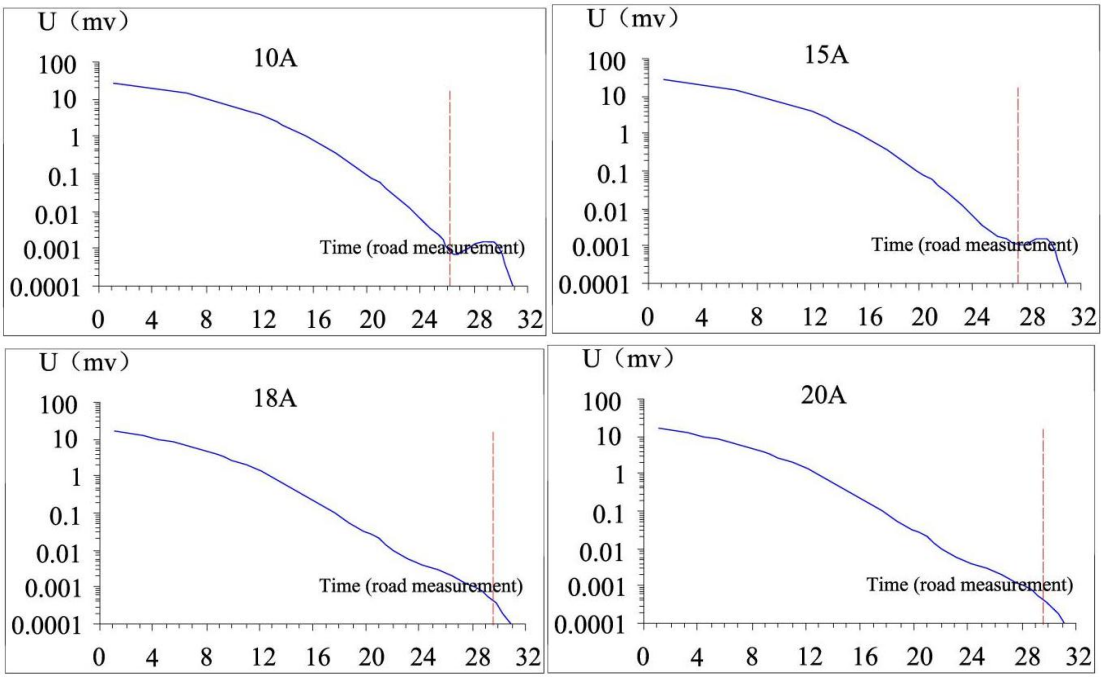

Figure 3-3 Single-point curve of the emission current test

After the above test work, combined with the requirements of this geological task, the method and parameters of the field construction are determined as follows: the emission wire frame is 480m × 480m; frequency is 8Hz; current is 18A.

3.4 Data processing

Transient electromagnetic method observation data is the transient induction voltage of each time window (measuring channel) of each measuring point, which should be converted into visual resistivity and visual depth to explain the data.

The visual resistivity calculation formula is

$$\rho_t = \frac{u_0}{4\pi t}\left(\frac{2u_0 mq}{5tV(t)}\right)^{2/3} \tag{3-1}$$

In the formula, t is the time window time, m is the emission magnetic moment, q is the effective area of the receiving coil, and V (t) is the induction voltage. Visual longitudinal conductance S_τ And view depth h_τ The calculation expression for this formula is:

$$S_\tau = \frac{16\pi^{1/3}}{(3Aq)^{1/3}u_0^{4/3}}\frac{(V(t)/I)^{5/3}}{(d(V(t)/)I/dt)^{4/3}} \tag{3-2}$$

$$h_\tau = \left(\frac{3Aq}{16\pi\,(V\,(t)/I)\,S_\tau}\right)^{1/4} - \frac{t}{u_0 S_\tau} \tag{3-3}$$

In the formula, V (t) / I is the normalized induction voltage, A is the emission return area, and d (V (t) / I) / dt is the derivative of the pair time of the normalized induction voltage.

4. WATER-RICH ANALYSIS BASED ON TRANSIENT ELECTROMAGNETIC MINING AREA

According to the known mining area data, there are 7 gope areas and 4 ponding areas in the exploration area. From the plan analysis (such as Figure 4-1), JS02 and JS04 areas are located near the Cuiping Mountain positive fault and agou positive fault, closely near the weathering zone, there may be Quaternary supplement, the visual resistivity value is low, all at 25 Ω. Around m, JS01 and JS03 areas are located in the south of the exploration area with high overall visual resistivity values greater than 30 Ω. m, apparent resistivity is not obvious, and it is concluded that the control degree is reliable in the water-rich area.

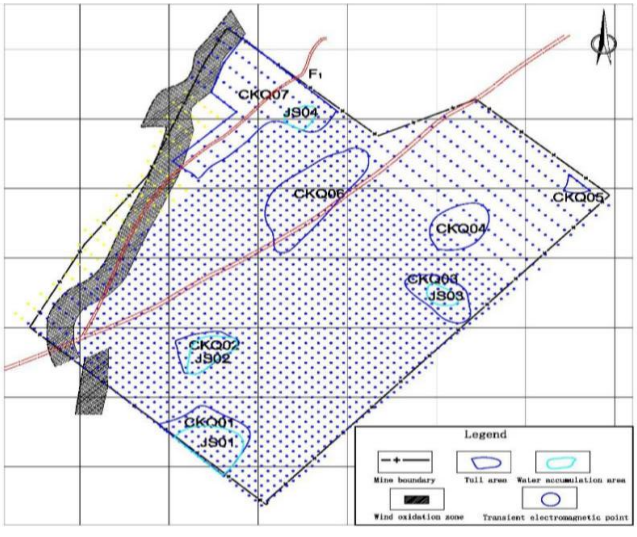

Fig. 4-1 Results of empty wat er accumulation area in exploration area

5. CONCLUSION

According to the characteristics of Yuzhou coal mining area and the applicability of geophysical exploration method, the selection of 480m × 480m, emission frequency is 8Hz, current 18A. Optimize the construction parameters and meet the quality of the exploration and water within the exploration area, which provides a reliable reference for later Yuzhou coal mining.

REFERENCES

1. Wang Haibo, Wang Ziguan. Study on transient electromagnetic method of a well field [J]. Coal Technology, 2021,40 (06): 137-141.
2. Zhao Zhigang. Application of transient electromagnetic method in control water in the mining area of Nanguan Coal Mine [J]. Jiangxi Coal Technology, 2021 (01): 120-122.
3. Li Xuewen. Application of comprehensive exploration technology in mined-space exploration [J]. Coal geology of China, 2015,27 (10): 58-61.
4. Liu waterfall. Application of transient electromagnetic method in water detection in mine mining [J]. Energy and Energy, 2020 (10): 161-163.
5. Tang Zongyuan. Application of transient electromagnetic method in advance detection in a roadway of coal mine [J]. Technology and Enterprise, 2014 (16): 202.
6. Wei Guoqiang, Zhao Hui. Application of mine transient electromagnetic method in boundary detection of old kiln [J]. China Coal Geology, 2021,33 (05): 72-75.
7. Zhu Ling. Application of transient electromagnetic method in coal mine water control work [J]. Energy Technology and Management, 2019,44 (02): 162-163.
8. Ren Yutao. Application and effect of transient electromagnetic method in water detection in the mining area [J]. Henan Technology, 2014 (18): 27-28.