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Numerical simulation of deep-hole resistivity anomaly caused by drilling construction in Xinfengjiang geoelectric station

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Historically, Xinfengjiang reservoir area was the epicenter of the famous reservoir-induced earthquake with magnitude 6.1 in 1962. As part of the earthquake precursor networks in Guangdong, the resistivity observation with deep-hole electrodes was carried out at Xinfengjiang geoelectrical observatory [1]. Deep-hole resistivity anomaly was observed in this geoelectric station nearly before the Ms3.2 earthquake occurred on May 15th, 2015 in Dongyuan country which located nearby the Xinfengjiang reservoir. Schlumberger array is used in this deep-hole resistivity observation, it has two measuring channels(horizontal and vertical), they share a measuring electrode with burial depth 90m. Field survey indicated drilling construction had been carried out since late March to build other measuring channels, by comparing the measurement value curves with the construction progress, the preliminary judgment tends to believe it is the drilling construction which interfere in geoelectric observation. This pattern(Figure 1) appeared every time during the several boreholes' construction.

In order to verify this inference, on the basis of some geological and hydrological information around the station, a series of three-dimensional finite element models of measuring field were constructed to analyze the disturbance caused by the drilling construction [2]. According to the electric sounding curves of this area, the models were set to be 4 layers with corresponding resistivity value. The alloyed bit with drill pipes together is a good conductor, as a low-impedance anomalous body in the observation area, it will absorb more current in comparison with other area [3].

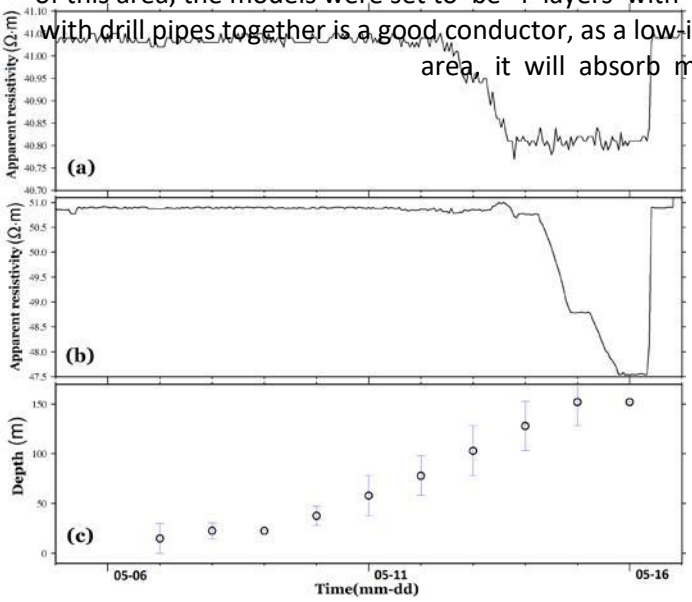

Figure 1: Progress of the drilling construction(c) and the apparent resistivity value of horizontal(a) & vertical(b) measuring channels

The simulation results show that the interference effect turns prominent when the drilling depth reaches about 100m, and with depth growing from 100m to 150m, the drilling construction affects the observation value seriously. In addition, the horizontal channel is affected earlier while the vertical channel later, whereas the amplitude of variation on the vertical channel is much more than on the horizontal channel.

Another determinant factor is the horizontal distance between the drilling hole and the measurement channel. The interference effect on horizontal and vertical channel disappears when the distance is more than 30m and 60m, respectively. This simulation result could guide us to determine the scope of protection from drilling construction in earth resistivity measuring area.

References:

[1] Liu C.M.et al. (1994) South China Journal of Seismology 14 (3):40-45

[2] Xie T et al. (2013) Progress in Geophysics 28 (2):727-734

[3]Du X.B (2010) Science in China (D) 40(10):1321-1330