TUNNEL CONCEALED KARST CAVE JOINT DETECTION BY TUNNEL SEISMIC AND TRANSIENT ELECTROMAGNETIC

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The water-rich giant karst cave is the risk source of tunnel construction in the karst area. To reduce the risk of tunnel construction, it is necessary to accurately explore the spatial distribution range of the karst cave in the direction of advance and both sides of the tunnel. Reflection seismic and transient electromagnetic (TEM) are the primary geophysical tools for tunnel advanced prediction, they have strengths and weaknesses. The tunnel seismic can only describe the boundary interface between cave bodies and surrounding rock in the direction of advance. Although the TEM method can detect the spatial distribution range of cave bodies, the inversion results depend on the initial resistivity model. The single method is insufficient to describe the spatial distribution of cave bodies. To overcome the shortcoming of a single method, we developed tunnel seismic and TEM joint detection of karst cavern and established a complete data processing flow. The tunnel seismic migration profiles can describe the interface between the karst cave and surrounding rock in the direction of advance. We put forward a reasonable initial model: 1) The layer's thicknesses are determined by the impedance interface from the tunnel migration data; 2) The initial resistivity values are determined from the pilot holes and prior geological data. Comparison of the inversion results of different initial models of tunnel face horizontal line data proves that the proposed initial model method can reduce multi-solution, save calculation time, and improve inversion accuracy. The multi-directional TEM inversion profiles can describe the spatial distribution of the giant cave. Combined with the results of tunnel seismic and TEM, the interpretation errors can be reduced, and the extension of the karst cave can be delineated. Later excavation results also verify the accuracy of the prediction results.