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Hydrogeological setting of a footcave system in Guilin tower karst

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In tropical and subtropical area, including China and many Southeast Asia countries, karst is highly developed. Under the influence of rainfall and allogenic water, karst presents as the topography of peak forest. Footcave is the typical karst phenomenon in peak forest plain, referring to horizontal cave develops close to the groundwater table. It usually develops by frequently flooding erosion and corrosion in the foot of karst tower in peak forest plain, basin, and valleys. In the peak forest plain, karst belongs to covered type, with a certain thickness of covered layer. Strong human activities and groundwater exploitation in the plain can induce groundwater pollution and karst collapse; and footcave is the main pathway of groundwater pollution. Footcave plays an important role in groundwater storing and running in this kind of karst topography. However, the hydrogeological character of footcave system is rarely discussed.

With a certain thickness of quaternary layer, karst conduits in covered karst aquifer develop partly. The heterogeneity of karst development makes the existence of preferential flow and concentrated flow. It is hard to determine the groundwater flow path.

A footcave system in Zengpiyan cave ruins of ancient humans was taken as the case to discuss the hydrogeological character. A series of technology was applied in order to understand the karst development and groundwater flow path. They are high density electrical method and geological radar to find the poor geologic unit, such as void or cave; boreholes drilling to detect karst development; hydrochemistry measurement to identify the groundwater source and movement; dye tracer tests to determine the groundwater flow path and its velocity.

The results show cave and karst conduits are developed in the elevation range of 151.0-124.0m. In total, 13 boreholes in 24 disclosed caves, with elevation ranging from 124.2m-158.7m. The vertical extension height of caves is 0.3-17.5m. High density electrical method and borehole drilling show karst development is highest in and around the footcave than where is far away from the footcave. The karst developed zone distributes in NW direction in horizontal, and it is concentrated in the nearby footcave. Dye tracer tests show karst in Zengpiyan is dominated by fissures. Groundwater flows in aquifer where fissures and small conduits are co-existence. Fissures develop in network pattern, but main concentrated runoff zones are exiting in NW-SE orientation. Hydrochemistry analysis indicates that there are five groundwater types in and around Zengpiyan. Groundwater is polluted by sulfate due to the buried coal cinder from an abandoned brick factory. According to the distribution of SO42- in groundwater, groundwater flow path is delineated. Combined the multi-technology applications, groundwater concentrated runoff zone is determined. The transmissivity coefficient of aquifer in this zone was calculated as 9-26 m/s through pumping test, and the groundwater velocity is 10-40 m/d in dry season. Therefore, the hydrogeological model of the footcave is described and the hydrogeology character is understood. They provide scientific basis for flooding control and groundwater pollution prevention and treatment in hydrogeological unit of the footcave system.