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Mechanism and control measures of a large deformation across the granite alteration zone in An Ping Tunnel

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Abstract: Due to its special formation process, the physical and mechanical properties of granite alteration zone change significantly. This zone is highly susceptible to geological disasters such as collapse, catastrophic mud and water bursting. When crossing through the contact zone of the granite and the sandstone, although the embedded depth was as shallow as 5 m and the supporting structure was in good condition, the pilot heading of An Ping Tunnel rolled sideward suddenly, and the arch crown settlement was as large as 1.5 m, resulting in accessible surface collapse and a lot of mud squeezed out of the tunnel bottom, as shown in Figure 1. Analysis of the deformation indicates that the accident occurred due to several reasons such as shallow burial depth, low overburden pressure, large deformation, special deformation form, and complicated composition. Through analysis of its engineering geological characteristics and rock and soil experiments, we found that the large deformation accident occurred in the main belt of altered granite and sandstone. The effects of alteration not only led to the loosening and breaking of rock and increase in its porosity, but the metasomatic and thermal contact alteration also led to the alteration of hard minerals, such as quartz and feldspar, into hydrophilic soft minerals, such as chlorite, kaolinite and montmorillonite, resulting in further reduced rock strength, increased dilatibility, and enhanced water yield capacity. During the later phase of superimposing, under the effects of rock and soil weathering and groundwater erosion, the bearing capacity of the tunnel base rock was extremely low. The tunnel excavation and stress adjustment disturbed the original rock, which triggered the large deformation. Understanding the mechanism of the accident, we effectively controlled and prevented the deformation by draining groundwater, grouting surrounding rock, and strengthening the parameters of initial support, which ensured the tunnel passed the alteration zone successfully. The mechanism analysis and positive experience in controlling the large deformation in our study could shed light on similar projects.



Figure 1: Large deformation

