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Development Mechanism of Moraine Debris Flows in Parlung Zangbo Basin, Southeast Tibet, China

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Located in the north of the Great Bend of Yarlung Zangbo River, the Purlung Zangbo basin is the largest distribution area of marine glaciers in China. Here is one of the most serious sections for geological disasters in the Sichuan-Tibet transportation corridor, which poses a serious threat to the planning and construction of the Sichuan-Tibet Railway and Expressway and other important infrastructures. In order to assess the risk of geological disasters along the proposed Sichuan-Tibet Railway, more than 80 typical moraine landslides, glacier collapsed debris flows, and glacial lake breakouts in the basin were selected through remote sensing interpretation and field verification, which were carried out ground investigation and geotechnical properties tests in detail. The main types, material sources and key influencing factors of the moraine geological hazards are analyzed by in-situ tests of large-scale straight shear, double ring penetration, matrix suction, dynamic penetration and indoor sample testing methods such as consolidation compression, triaxial shear, and OSL dating, combined with regional temperature, rainfall, multi-stage remote sensing images and geological mapping data. Finally, the starting mechanism and disaster scale of loose moraine are preliminarily simulated by combining the water and thermal product index method and FLOW 3D numerical analysis software. The results show that the physical and mechanical properties of moraine have good statistical relations with its water content, void ratio and clay content. The natural density and compression modulus are negatively linear related to the void ratio, while the vertical permeability coefficient and the free expansion ratio show a quadratic relationship with clay content, and also the shear strength and compressive strength are binary relationship with void ratio and moisture content. The permeability, consolidation degree and free surface characteristics are the key parameters affecting the stability of moraine slope. Moraine located in three depositional positions (the front of modern glacier tongue, the middle reaches of glacial valley and the bank slope of main river) has different starting modes, which are "shoveled-scraped and migration type", "erosion and blocking-burst type", and "unloaded and permeated type". When it intersects with the main traffic lines, different countermeasures and application should be adopted: avoidance by bridges or tunnels, slope reinforcement, and cutting or subgrade.

