工程地质学报 2010, 18(5) 631-644 DOI:
ISSN: CN:

灾害地质

汶川地震触发文家沟高速远程滑坡-碎屑流成因机理分析

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摘要:

文家沟高速远程滑坡-碎屑流位于映秀—北川断裂带与灌县—安县断裂带夹持的文家沟向斜断块中,地震断裂的强烈活动引起的振动效应是形成滑坡的先决条件。滑坡源区顶端与文家沟沟口高差约1360m,突兀山体下临深切峡谷的地形使地震动荷载在山脊部位的放大效应显著,并直接导致坡体破坏; 滑坡源区的地震动加速度3分量峰值分别为$a_{EW}=2.4g$,$a_{NS}=2.3g$,$a_{UP}=1.2g$。D_2gn观雾山组石灰岩斜坡具有强度渐进式分层结构,坡体表层以下约50m内的结构相对松散的残坡积层~新鲜岩体上部无法抵抗地震纵横波的周期性拉压与剪切耦合作用,被切割成为初始滑体; 滑体在第八级台地边缘高位剪出后,在文家沟上游地区最高滑移速度约介于93m $\cdot s^{-1}$~122m $\cdot s^{-1}$之间。滑体上部的干碎屑流在两处路径转折端瞬间压缩沟谷内的圈闭气体,形成明显的"气垫效应",滑体下部泥石流底层液化和颗粒有效动摩擦系数随剪切速度增大而减小的效应都是导致碎屑流体高速远程滑移的关键; 同时,碎屑物流通过程中还伴有明显的岸坡铲刮与翻越效应、以及树木摧削效应。汶川地震后截至2009年9月,降雨诱发碎屑堆积物形成多次泥石流,反映了地震地质灾害的链生性和长期性。

关键词: 汶川地震 文家沟 高速远程 滑坡-碎屑流 成因机理

FORMATION MECHANISM OF WENJIAGOU HIGH-SPEED AND LONG-RUNOUT DEBRIS AVALANCHE TRIGGERED BY WENCHUAN EARTHQUAKE

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Abstract:

The seismic geological context,morphology,formation mechanism and evolution of Wenjiagou high-speed and long-runout debris avalanche are introduced. The debris avalanche was located at Wenjiaogou syncline block between Yingxiu-Beichuan fault and Guanxian-Anxian fault of which severe activity provides precondition for the debris avalanche. It is 1360m high from the peak of debris avalanche source area to Wenjiagou valley mouth; seismic load shows remarkable amplification effect at the ridge due to the terrain of towering hill with deep valley at the foot,and directly results in the landslide. The peak values of ground motion acceleration in 3 directions in the ridge are $a_{EW}=2.4g, a_{NS}=2.3g, a_{UP}=1.2g$($g$: the acceleration of gravity). The Guanwushan formation(D_2gn) limestone slope has layered structure with progressive strength. About 50m below the slope surface is loose structural Q^{el+dl}~upper part of fresh rock,which is cut into initial landslide mass results from the tension-compression and shear coupling effect due to seismic P-wave and S-wave. The sliding mass shear out from edge of the 8^{th} platform; the maximum traveling velocity of sliding mass is accelerated up to 93~122m $\cdot s^{-1}$ in Wenjiagou valley upstream. Trapped air inside of the valley is compressed by upper part of landslide mass,the dry debris flow,at 2 turnings of Wenjiagou valley; distinct "air cushion effect" is generated. Besides,the bottom layer of debris flow is liquefied; effective dynamic friction coefficient is decreased with increasing of shearing velocity; all of these effects lead to the high-speed and long-runout traveling of debris flow. Simultaneously,the valley slope is scraped and crossed; the trees are cut as debris flow passes. After Wenchuan earthquake,up

to Sept. 2009,rainfall has triggered several debris flows,which indicates the continuity and long-term nature of seismic geohazard.

Keywords: Wenchuan earthquake Wenjiagou High-speed and Long-runout Debris avalanche Formation mechanism

收稿日期 修回日期 网络版发布日期

DOI:

基金项目:

973计划项目课题专题(NO.2008CB425803):汶川地震重大次生山地灾害风险管理系统研究; 中国地质调查局项目(NO.1212010914025):龙门山及邻近构造带地震工程地质调查评价; 国家"十一五"科技支撑课题(NO.2006BAC04B05):地质灾害风险评估技术研究

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