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鲜水河断裂带炉霍段的震后滑动与形变

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Post-seismic slip and deformation on the Luhuo segment of the Xianshuihe fault zone

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摘要 1973年2月在鲜水河断裂带炉霍段发生了*M*7.6地震破裂.自那以来,先后在炉霍县虾拉沱布设了若干横跨该地震断层(
裂带)的地壳形变观测系统,包括断层近场的短基线、短水准、蠕变仪、人工构筑物等,以及断层近-远场的GPS观测站.利用
统的长期观测资料,本文分析了鲜水河断裂带炉霍段的震后滑动/变形及其时、空变化特征,并建立起解释这些特征的动力学
明:(1)1973年地震后的头5年,地震断层在虾拉沱场地表现为开放性质,近场的断层震后滑动以无震左旋蠕滑为主,速率达到
mm/a,且伴有微量的拉张性蠕动作用;1979年以来,左旋蠕滑速率由5.3 mm/a逐渐减小到2.27 mm/a,减小的过程呈对数
此阶段断层面已逐渐重新耦合、正朝闭锁的方向发展,并伴有部分应变积累.(2)1999年以来,地震断层两侧远场的相对左旋
率为10 mm/a,远大于同时期断层近场(跨距40~144 m)的左旋蠕滑速率0.66~2.52 mm/a;远-近场位移/形变速率的显著
在地震断层两侧各宽约30 km的范围,显示出这是与大地震应力应变积累—释放相关的断裂带宽度.(3)结合动力学背景与深
本文对这里断层的震后位移/变形及其时、空变化的机理进行初步解释,要点是:震后约5年之后,由于逐渐增大的断层滑动/摩
地壳脆性层中的断层面由震后初期的开放性质逐渐转向重新耦合、并朝闭锁的方向发展,但其两侧地块深部持续的延性相对
浅部脆性层发生相应的弹性位移/变形.(4)可估计再经历15~25年,研究断裂段将完全"闭锁",即进入积累下一次大地震应力
闭锁阶段.

关键词: 鲜水河断裂带 1973年地震破裂 跨断层形变测量 GPS测量 震后滑动/变形

Abstract: An *M*=7.6 earthquake ruptured the Luhuo segment of the Xianshuihe fault zone, Sichuan, in
1973. Since then, several cross-fault (across the 1973 rupture) deformation observation systems have b
up at Xialatang site in Luhuo County, including a system of short baselines and short leveling, a set of cr
meters, an artificial construction, and some GPS geodetic stations near to or far from the fault. By using
observation data from these systems, this paper studies the characteristics of post-seismic slip/deforma
their temporal-spatial variations for the Luhuo segment of the Xianshuihe fault zone, and builds a geodyn
model to explain the characteristic features. Our study mainly shows that (1) in the first five years follov
1973 earthquake, the earthquake fault at Xialatang site behaved as an open one and the post-seismic sl
mainly aseismic left-lateral slip (creeping) at an average rate of 10.27 mm/a along with slight tensional c
From 1979, however, the creep rate has been slowing down gradually from 5.3 mm/a to 2.27 mm/a follov
logarithmic function, suggesting that during this period the fault plane has been tending to re-couple anc
gradually with some strain having built-up. (2) Since 1999 the rate of relative left-lateral
displacement/deformation at far-fields on both sides of the fault segment is estimated to be 10 mm/a, m
greater than the near-fault (40 m to 144 m across the fault) left-lateral creep rates of 0.66 mm/a to 2.5
the same stage. Also, such significant differences of the near- and far-fault displacement/deformation ra
along an about 2×30-km-wide zone centered along the fault segment, indicating the width of the seismo
fault zone associated with the stress/strain build-up and release during major earthquake cycles here. (3
Combining with information of geodynamic background and deep crustal structure, the authors try to exp

mechanism of the post-seismic fault slip/deformation and its spatial-temporal variation for the studied fa
segment. Key points of the explanation are as follows: Starting from the 5th year after the 1973 earthqu
fault plane in the brittle upper crust, which was open in the earlier post-seismic stage, has been tending
couple and re-lock as a result of gradual increasing slip/friction resistance on the fault plane. In the deep
however, the continuous ductile relative motion between the two sides of the fault keeps dragging the b
upper crust to produce elastic displacement/deformation. (4) It can be estimated that the studied fault s
will entirely "re-lock", enter the stage of inter-seismic locking, and re-build up stress/strain for the next r
event in the next 15 to 25 years.

Keywords: Xianshuihe fault zone The 1973 earthquake rupture Across-fault deformation survey GI