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二十年来蠕变和短基线观测反映的鲜水河断裂带活动特征

刘冠中^{1,2}, 马瑾¹, 张鸿旭², 王建军², 杨永林³, 王兰^{3*}

1. 中国地震局地质研究所 地震动力学国家重点实验室, 北京 100029;
2. 中国地震局地壳应力研究所, 北京 100085;
3. 四川省地震局测绘工程院, 四川雅安 625000

Study on activity features of Xianshuihe fault zone with fault creep and short baseline observation for the last 20 years

LIU Guan-Zhong^{1,2}, MA Jin¹, ZHANG Hong-Xu², WANG Jian-Jun², YANG Yong-Lin³, WANG Lan^{3*}

1. State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China;
2. Institute of Crustal Dynamics, China Earthquake Administration, Beijing 100085, China;
3. Survey Engineering Institute, Earthquake Administration of Sichuan Province, Ya'an Sichuan 625000, China

摘要

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摘要

利用鲜水河断裂带1990年1月-2009年12月的蠕变与短基线数据,采用小波变换与断层运动学分析方法,获取构造活动产生的断层形变速率.结合近场断层形变测量与GPS资料,分析了该断裂带的分段活动特征及时空演化.结果显示:(1)不同段落断层活动方式存在差异性.鲜水河断裂带分段活动现象显著,以道孚县为界,以北的炉霍、道孚断层走滑量相对较大且活动方式稳定,显示张性和左行走滑;以南的乾宁、折多塘断层活动微弱,走滑量小,且滑动状态复杂,其中,乾宁断层为压性和左行走滑,折多塘断层为微弱的右行走滑.这种分段活动特征可能与断层几何及巴颜喀拉块体内部次级块体的差异运动有关.(2)不同时期断层走滑方式存在交替性.鲜水河断裂带虽以左行走滑为主,但在汶川地震前一些断层段出现过逆向走滑现象.汶川地震前2年,炉霍、道孚断层左行走滑减弱,乾宁、折多塘断层在2007年出现过逆向走滑,至2009年底,逆向走滑区域保持扩展态势.(3)不同测点间距得到的断层错动速率和变形带空间分布特征不同.不同测量方法的分析结果表明,鲜水河断裂带不同段落和跨距宽度的走滑速率有所不同:测点间距18.7~65.1 m的蠕滑速率为0.01~0.78 mm/a;测点间距72~288 m的短基线测量为0.02~2.46 mm/a,点距十几至几十公里的GPS观测为6~11 mm/a;地质滑动速率5~15 mm/a.随测点间距的增加,平行断层的位移速率按对数函数增长,视剪应变率按幂函数衰减.我们推测,大间距测点的数据中既包含了跨断层的错动,也包含了断层两侧块体的分布变形;现今的断层形变测量与地质调查之间的差异,说明断层错动速率在时间上不是常数.

关键词 鲜水河断裂带, 蠕变, 短基线, 分段活动, 逆向走滑

Abstract:

We derive deformation rates of the fault applying wavelet transform and fault kinematics, by using the data of creepmeter and short baseline from Xianshuihe fault zone. Based on these results and combined with GPS observations, we analyze the segmental character and the spatial-temporal evolution of the fault activities. Our study shows that: (1) The fault activity is different along different segments. The segmental activity of Xianshuihe fault zone is significant. In detail, Luhuo and Daofu fault, extending northwest from Daofu County, are tensional and left-lateral, with comparatively larger strike-slip rates, and their motions are more stable than Qianning and Zheduotang fault. While Qianning and Zheduotang fault to the south of Daofu County tend to be locked, and the states of movement are complex, where Qianning fault is compressive left-lateral and Zheduotang fault is right-lateral. The possible causes of this segmentation include fault bending and the differential movements of sub-block in Bayankala active block. (2) The slipping mode of fault alternates during different period of time. Although Xianshuihe fault is a left-lateral strike-slip active fault, nonetheless, there is reverse strike-slip along some segments before Wenchuan earthquake. The left-lateral creep rates of Luhuo and Daofu fault are decreased in the 2 years before $M_S 8.0$ Wenchuan earthquake, and Qianning and Zheduotang fault exhibited right-lateral strike-slip abnormally in 2007. To the end of 2009, the range of reverse strike-slip is still growing. (3) The strike-slip rates observed by different-length measuring lines and the spatial distribution features of deformation

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belt are different. The strike-slip rates of Xianshuihe fault zone are not consistent at different segment and scale by different observing methods. The creepmeters are 0.01~0.78 mm/a (18.7 m to 65.1 m across fault), and short baselines are 0.02~2.46 mm/a (72m to 288 m across fault), however, GPS observations are 6~11 mm/a (dozens of kilometers across fault), and geological survey results are 5~15 mm/a. At increasing distances perpendicular to the fault, the average creep rate on one side of the fault grows following a logarithm function, and the deformation intensity attenuates following a power function. We infer that the far-field displacement includes the deformation or distributed offset of bilateral blocks of fault. At last, the difference between present fault deformation observations and geological survey results indicates that the fault slip rate is not a constant in time domain.

Keywords [Xianshuihe fault zone](#), [Creep](#), [Short baseline](#), [Segmentation](#), [Reverse strike-slip](#)

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About author: 刘冠中,男,1980年生,助理研究员,主要从事地壳变形与构造物理方面的研究.E-mail:lgz365@yahoo.cn

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