中文摘要

研究活動背斜（active anticline）下伏的盲斷層之主要目標，在於評估與該斷層滑移（fault slip）相關的可能地震危害度。先前的研究認為此類背斜主要是由每次地震時，其下伏盲斷層的滑移，所造成之岩層變形累積而成。基於這樣一個假設，斷層的地震潛能，則可以直接從背斜的幾何形態推知。然而，此類與下伏盲斷層相關的背斜之增長，並非僅與盲斷層的活動有關，例如岩層受水平壓縮時，岩層的拱彎作用（buckling）效應，即可使背斜的振幅放大兩倍或甚至更大。我們建立邊界元素模型（boundary element model），展示在水平收縮及彈性層（elastic layers）層間滑動的條件下，背斜的增長並非僅取決於其下伏盲斷層的滑移量，拱彎作用效應有極顯著的貢獻。在本研究採用的條件下，相較斷層居中型褶皺（fault-cored fold）的振幅，拱彎背斜可為被動背斜（亦即彈性層無層間滑動）的二到五倍大；此外，拱彎背斜之波長，可以緊縮（localized）到僅為被動背斜的一半。我們利用此數值模型對美國西部懷俄明州 Big Horn Basin 的 Pitchfork 背斜進行模擬，結果可符合 Pitchfork 背斜的重要幾何形態特徵，包括背斜的波長寬、兩翼的緊縮（localization）和振幅向上變大的現象，顯示拱彎作用的確為形成該背斜不可缺少的機制。此外，我們也將該模型，運用到 1985 年美國加州中部在 Kettleman Hills 背斜及其同震高程位移的分析，結果顯示該背斜極可能為結合斷層滑移及拱彎作用機制所形成，1985 年的同震高程位移場，亦可用該背斜下伏盲斷層的滑移，透過錯移理論（dislocation theory）的位移解，給予合理的解釋。

ABSTRACT IN ENGLISH

A primary goal of studies of blind faults underlying actively growing anticlines is assessment of earthquake hazard associated with slip on the faults. It is generally assumed that the amount of slip on the fault is directly related to the amplitude of the fold. Under this assumption, the potential for earthquakes on blind faults can be determined directly from fold geometry. However, anticlines grow over slipping reverse faults can be amplified by a factor of two or more by buckling of mechanical layering under horizontal shortening. Studies that attempt to estimate fault slip from fold geometry may therefore overestimate fault slip by a factor of two or

more if the contribution to fold growth from buckling is ignored. We construct boundary element models to demonstrate that fault-cored anticlines in mechanically layered media subjected to layer-parallel shortening are not built solely by slip on the underlying fault. The amplitude of folds produced in a medium containing a fault and elastic layers with free slip and subjected to layer-parallel shortening are 2-5 times larger than the amplitudes of folds produced in homogeneous media without mechanical layering. We compare the model results with data from fault-cored anticlines in the western United States. Pitchfork Anticline on the western flank of the Big Horn Basin in Wyoming likely formed by the combined mechanisms of fault slip and buckling. Geometric features of Pitchfork Anticline such as a localized anticlinal dome shape with tight hinges and amplitude that increases away from the fault tip are characteristic features of buckle folds produced in our numerical simulations. The coseismic uplift pattern produced during the 1985 earthquake on a fault under the Kettleman Hills Anticline and subsurface fold geometry of the anticline inferred from seismic reflection images are consistent with folding produced by the combined mechanisms of fault slip and buckling.