Plate boundary zones and dynamics of faults-the effect of higher order deformation and rotation-

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Recent geological and geophysical observations have revealed intriguing unexpected features in plate margins (e.g.,Meyerhoff,1992) and imply large fault systems like the San Andreas Fault (SF) may not be actual plate boundaries. Instead, a new concept of ? late boundary zones is presented that considers rather wide zones rather than narrow limited zones of faults for plate boundaries (Stein and Freymueller,2002). Indeed, GPS measurements show no narrow boundary in velocity fields around SF. In some region, opposite blocks of faults even show situation of locking. Similar situation is found in the northern part of Vietnam along the Red River Fault from the palaeomagnetic study (Takemoto, 2003). Along SF, shear deformation localizes in the vicinity of faults and compessional stress almost perpendicular to faults is dominant, where fault normal compression appears to play more essential role for shear motions along faults. Also, in the Tibetan plateau, strike-slip faults are conspicuous whose strikes are almost normal to the compression due to the convergence of two continents. Conventional arguments assume relative horizontal movements among plates or lateral transport of material to explain shear motions of faults. The other hypothesis attributes strike-slip faulting to rotational motions in the crust based on palaeomagnetic observations (England and Molner,1990). Phenomenologically, rotational motions appear to be the cause for the shear dynamics of faults in such regions. Ordinary elastic and rigid-plastic theories cannot address initiation or generation of such rotational motions and shear deformation along faults from fault normal compressional stress. However, if we take account of the effect of higher order deformation and preexisting external stress appropriately, we can show fault normal compressional stress can produce shear stress and deformation along faults without assuming specific block structures. Accordingly, rotational motions in the crust are quite important in understanding the dynamics of large fault systems in plate boundary zones and palaeomagnetic observations provide quite valuable information for regional tectonics.