Geophysical Research Abstracts
Vol. 15, EGU2013-2716, 2013
EGU General Assembly 2013

Determination of six parameters of stress tensor from fault-slip data using friction law and relative depths of sites: the case of Cretaceous Gyeongsang Basin, SE Korea

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Fault-slip data permit to determine solely four parameters of stress tensor among six: maximum, medium and minimum principal stress axes (denoted by σ_1, σ_2, and σ_3, whose magnitudes are σ_1, σ_2, and σ_3, respectively) and stress ratio, Φ= $(\sigma_2-\sigma_3)$/ $(\sigma_1-\sigma_3)$. The remaining unknown parameters are k= $\sigma_1-\sigma_3$ and α=σ_3/$(\sigma_1-\sigma_3)$. The paleostress sequence of the Cretaceous Gyeongsang Basin (GB) displays seven events composed of coexisting compressions and extensions with diverse directions, denoted by T_1 to T_7 events. To determine the six parameters, the Yusu site, SW GB and the NW GB area are considered. Firstly, friction line can be deduced from tension fractures on fault planes affected by friction to determine the origin of the dimensionless Mohr diagram, and the resulting ratios $\sigma_1 : \sigma_2 : \sigma_3$. Dimensionless failure envelopes are adjusted to the Mohr failure envelope derived from rock mechanic tests to determine the complete stress tensors. According to the results at the Yusu site, σ_1 of strike-slip episodes have changed from 169 MPa in the T_1 Event through 263 MPa in the T_2 Event to 235 MPa in the Quaternary T_7 Event. Horizontal extensional stress increments ($\Delta\sigma_T$) show a transition from -6 MPa in the T_1 Event through -8 MPa in the T_2 Event to -17 MPa in the T_7 Event. Secondly, a linear relation is found between Φ or 1/Φ and the vertical load in wrench and extensional stress regimes, respectively. In the relation between the stress ratios and vertical load, the slope and intercept of the linear relation result in the horizontal stress increments and depth of paleo-surface, respectively. The T_1 Event consists of coexisting E-W compression and N-S extensional faulting episodes in the NW Gyeongsang Basin. Plots of Φ or 1/Φ against the vertical load display several linear trends: two clusters in extensional episodes, and two or three clusters in compressive episodes. Because horizontal compressive stress increment is assumed to be null in the extensional tectonics, horizontal extensional stress increments are determinable from the slopes of two linear clusters as being -2.5 $\sim$ $-$4.0 MPa. In compressive episodes, the horizontal stress increments are given to be 87$\sim$145 MPa by applying extensional stress increments. Determined depths of paleo-surfaces and those of syndepostional structures illustrate that more than five compressive or extensional episodes have occurred during the T_1 Event in the GB. The Dowon site, NW GB and the Yusu site, SW GB lie in the upper part of the Barremian-Aptian Hasandong Formation. During the T_1 Event, the Dowon site lied in the stress field where σ_1= 165.1 MPa, σ_2= 67.5 MPa, and σ_3= 50.7 MPa. The two methods display the Dowon and Yusu sites lied in the similar maximum stress during the T_1 Event.