



## Celebrating Anderson's faulting centenary

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E. M. Anderson (1905) based his theory of faulting on three premises: (1) rupture is controlled by a Coulomb criteria, (2) the vertical is a principal stress direction near the Earth surface, and (3) rupture occurs on the most favorably oriented plane for rupture within isotropic rocks. W. Bucher (1920, 1921) seems to have independently reached similar conclusions a few years later.

The first of these premises, introduced by Coulomb (1776), has barely suffered the passing of time and remains the most common working hypothesis on faulting.

The validity and limitation of the second premise can be directly assessed from widely available earthquake focal mechanisms databases such as the Harvard Centroid Moment Tensors (Frolich, 2001).

The third premise was quickly found to be often inadequate because of anisotropy due either to layering or to pre-existing fractures. Theory therefore had to focus on the reactivation of planes of weakness and made use of the information contained in the slip direction, which is assumed to be that of the applied shear stress on the slip plane (Wallace, 1951; Bott, 1959; McKenzie, 1969).

The three original tectonic regimes have then been extended to include the stress tensor aspect ratio  $(S1-S2)/(S1-S3)$  because this ratio is one of the controlling factors of the shear stress direction, the other factors being the principal stress orientations. Within this framework, the transition between the three original tectonic regimes, thrust, wrench and normal, can be shown to be continuous and to allow for oblique slip even within strict Andersonian conditions. In the more general case of fault reactivation with a vertical principal stress, oblique slip is the rule but its orientation is bounded towards dip slip by the rake guide that depends on the tectonic regime and fault plane strike only (Fry, 1992, 2003; Celerier, 1995). This in turn suggests that

the two dimensional strain analysis proposed by Breddin (1956) can be adapted to the analysis of stress from reactivated faults.