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Stress inversion methods: where are we?

Frantz Maerten (1), Mostfa Lejri (1,2), and Laurent Maerten (1)

(1) Schlumberger – MpTC, Parc Euromédecine, 340 rue Louis Pasteur, 34790 Grabels, France, (2) Géosciences Montpellier, Université Montpellier 2, Place E. Bataillon, 34095 Montpellier cedex 5, France

Stress inversion techniques, which consist of inverting paleo or present-day regional stress field(s), are very useful for recovering the type of fault regime (normal, strike-slip, reverse), and to have an idea of the orientation of the maximum principal horizontal stress (if we assume an Andersonian fault regime). Since decades, people try to have a better estimate of these parameters as they give important insights on the tectonic history of a given region on Earth.

In this contribution, we will give an overview of the evolution of these techniques over the past century. Three main methods will be presented with their respective advantages, drawbacks and pitfalls: (1) the ones based on the Wallace-Bott hypothesis (called faultless methods) and which are widely used nowadays due to the simple underlying concepts and ease of use; (2) a restricted mechanical approach which is based on a coupled iterative solver and that uses only fault slip data, and (3) a more general mechanical approach that allows the use of any kind of geological indicators (fault slip, focal mechanism, fracture orientation, GPS, InSAR, deformed stratigraphy, micro-seismicity, ...) and which can recover not only the stress ratio but also the magnitudes of the principal stresses.

For each method, we will provide examples to highlight their advantages and limits, and will do a comparison with the other methods. Finally, pitfalls and recommendations for users will be discussed.