Fault nucleation in a lithology marked by structural inheritances: a numerical approach

Pedro C. Pessano[1], Leandro Di Bartolo[1], Carlos E. Ganade[2], Victor Sacek[3], Rafael Monteiro da Silva[3,]
[1]Departamento de Geofísica, Observatório Nacional, [2]Centro de Desenvolvimento Tecnológico, Serviço Geológico do Brasil, [3]Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Universidade de São Paulo

Abstract

Faulting is one of the most important phenomena in structural geology, tectonics, and geodynamics. Understanding their formation and distribution is a matter of great importance not only for the academy but also for the industry, especially Oil & Gas. The study of geological phenomena relies most on field observations, laboratory analysis, data compilation, and correlation, which is not an issue. These approaches are valid and have produced many reliable data and research papers. However, when studying geodynamics, the use of numerical methods are necessary to better understand the evolution of certain event through time. This work presents a numerical approach for fault nucleation and its distribution in a lithology marked by structural inheritances (anisotropic zones). The scenarios were developed in a two-dimensional mesh, in which both x and y coordinates are on the surface (i.e, instead of a regular cross-section, this one depicts a plan view), and where different boundary conditions were applied. To simulate the geodynamic evolution of the lithosphere through time, a thermomechanical code named MANDYOC (Mantle Dynamics Simulator Code) was used. This code uses the extended Boussinesq approximation and the Finite Element Method (FEM) to numerically solve the equations of conservation of mass, momentum, and energy. 2D models in plan view are not the best procedure to investigate faulting, as they only allow the formation of vertical faults. However, we were able to assess the influence of structural inheritances from the very first scenarios, where planes with low cohesion and internal friction were defined, making faults nucleate close to this zone. Also, the rheology of the rock, and the magnitude and the direction of the stress field acting upon it play a fundamental role in defining where faulting will occur.