Available online at www.sciencedirect.com

ScienceDirect

Procedia Structural Integrity 6 (2017) 316–321

Structural Integrity Procedia

www.elsevier.com/locate/procedia

XXVII International Conference "Mathematical and Computer Simulations in Mechanics of Solids and Structures". Fundamentals of Static and Dynamic Fracture (MCM 2017)

Determination of Fracture Tectonics of Rocks by Reconstruction of Stresses and Analysis of Displacements

Sidelnik A.[a]*

[a] *Peter the Great St.Petersburg Polytechnic University (SPbPU), Russia, 195251, St.Petersburg, Polytechnicheskaya, 29*

Abstract

This report presents an algorithm for determining fault tectonics based on the calculation of stress inversion. The inversion model of stress is a tool that allows not only to reveal the presence of discontinuities, but also to determine their spatial orientation and to evaluate the influence on the stress field.

Peer-review under responsibility of the MCM 2017 organizers.

Keywords: inversion model of stress, geomechanics, fractures, discontinuities, displacement

Introduction

Exploration and extraction of oil reservoirs requires consideration of the features of geological structure, in particular, the anisotropy of the void space represented by a network of fractures. The reconstruction of the stress field is a tool for studying the patterns of fracture development in rocks and assessing the tectonic evolution of the region.

Discontinuities that occurred at different stages of the formation of the oil field are the main source of heterogeneity in the stress field, what is extremely important for drilling wells and for hydraulic fracturing.

Input data

In order to restore the direction of paleostresses, it is necessary to know the orientation of the discontinuities in space.

* Corresponding author. Tel.: +7-931-318-9186 (A. Sidelnik)
E-mail addresses: Sidelnik.AV@gazprom-neft.ru (A. Sidelnik)

Peer-review under responsibility of the MCM 2017 organizers.
10.1016/j.prostr.2017.11.048

Input data for reconstruction are 3-D seismic, electrical microimager, core sample and information about lost circulation (figure 1).

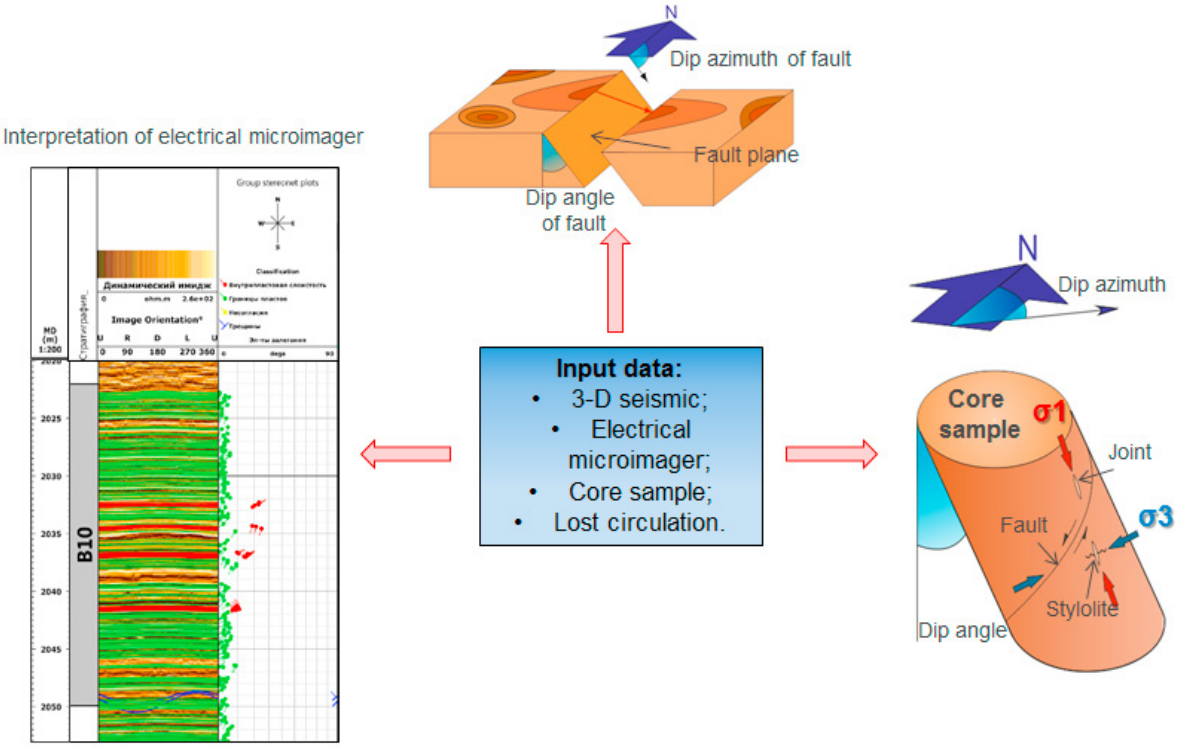

Figure 1. Input data for the reconstruction of paleotectonic stresses by the method of stress inversion

3-D seismic data include orientation of the discontinuities (dip angle, dip azimuth, strike azimuth) and their geometry. Electrical microimager data carry information about orientation of fractures in well. Core data are photographs of the core in daylight and ultraviolet light, a study of the mineral composition of the substance filling the joints and stylolites.

Using all the available information about fractures in a specific volume of rocks, it is possible to determine the axes of principal stresses.

Algorithm of calculation of inversion model

Initially, as the input data discontinuities interpreted from seismic data appear.

The basis of the definition of a tectonic driver is information about the orientation of the discontinuity relative to the principal components of the stress tensor. By the nature of the fracture, the discontinuities are divided into three types: joints, faults and stylolites [4,5].

If the type of the fault used as input data is known, then, by scanning all possible relationships between the principal stresses and comparing their directions with the orientation of the fault, it is possible to determine the tectonic driver that is most likely for a given orientation of the fault. As a result, the probability distribution of the azimuth of maximum horizontal stress and the stress ratio is obtained (figure 2).