Available online at www.sciencedirect.com
ScienceDirect
Tectonophysics 426 (2006) 31 – 59
TECTONOPHYSICS
www.elsevier.com/locate/tecto

Fracture analysis in the south-western Corinth rift (Greece) and implications on fault hydraulic behavior

Luca Micarelli *, Isabelle Moretti, Manon Jaubert, Hakim Moulouel

Institut Français du Pétrole, 1-4, av. de Bois Préau, 92852 Rueil Malmaison, France

Accepted 7 February 2006
Available online 9 August 2006

Abstract

This paper reviews the data concerning the fracture network and the hydraulic characteristics of faults in an active zone of the Gulf of Corinth. Pressure gap measured through fault planes shows that in this area the active normal faults (Aigion, Helike) act, at least temporarily and locally, as transversal seal. The analysis of the carbonate cements in the fractures on both the hangingwall and the footwall of the faults also suggests that they have acted as local seals during the whole fault zone evolution. However, the pressure and the characteristics of the water samples measured in the wells indicate that meteoric water circulates from the highest part of the relief to the coast, which means it goes through the fault zones. Field quantitative analysis and core studies from the AIG-10 well have been performed to define both regional and fault-related fracture networks. Then laboratory thin section observations have been done to recognize the different fault rocks characterizing the fault zone components. These two kinds of approach give information on the permeability characteristics of the fault zone. To synthesize the data, a schematic conceptual 3D fluid flow modeling has been performed taking into account fault zone permeability architecture, sedimentation, fluid flow, fault vertical offset and meteoric water influx, as well as compaction water flow. This modeling allows us to fit all the data with a model where the fault segments act as a seal whereas the relays between these segments allow for the regional flow from the Peloponnese topographic highs to the coast.
© 2006 Elsevier B.V. All rights reserved.

Keywords: Gulf of Corinth; Pirgaki fault; Helike fault; Aigion fault; Damage zone; Fault core; 3D fluid flow modeling

1. Introduction

Fault zones are usually characterized by one or more relatively narrow zones of intense deformation, referred to as the fault core, surrounded by a wider zone of deformed rock, referred to as the damage zone, that grades outward into non-deformed (intact) host-rock or protolith (e.g. Chester and Logan, 1986; Chester et al., 1993; Caine et al., 1996). Many authors have pointed out an inward intensification of fractures, subsidiary faults, cataclastic particle size reduction and mineral alteration toward the fault core (Linn et al., 2001; Du Bernard et al., 2002; Billi et al., 2003; Hammond and Evans, 2003; Micarelli et al., 2003), as well as a preferred orientation of subsidiary faults and fractures (Hesthammer et al., 2000; Cello et al., 2001; Micarelli et al., 2002a; Wilson et al., 2003). These features result in the structural domains of a fault zone acquiring different

* Corresponding author. Now at: BEICIP-FRANLAB, 232, Av. Napoléon Bonaparte, BP 213, 92502 Rueil-Malmaison, France.
E-mail address: lucamic@inwind.it (L. Micarelli).

0040-1951/$ - see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.tecto.2006.02.022

hydraulic behavior, that finally depends on the fault geometry and the strain history (e.g. Caine et al., 1996; Micarelli et al., 2005). Fault zone hydraulic behavior is a key issue for various domains of the earth sciences including seismic hazard, security of the water supply and waste storage and oil exploration. An intense activity of the scientific community is thus focused on this issue. An impressive data collection, including monitoring has begun, and numerous techniques have been developed to characterize the fault zones.

The Corinth Rift Laboratory (CRL) has been installed in the south-western part of the Gulf of Corinth with the help of the European Community, to understand the relationships between faults, fluid flow and strain in a seismic zone (Moretti et al., 2002). Faults have been studied and monitored in an area approximately 30 × 30 km wide around the city of Aigion (Fig. 1). Surface captors, seismometers, strain meters, extensometers, tide-meters, tilt-meters are now working. Fluids are monitored in terms of flow rate and chemistry in two selected aquifers (Pizzino et al., 2004). Two wells have been drilled and measurements have been done in surface as well as at various depths, especially with accelerometers and pore pressure transducers (Pitilakis et al., 2004). The drilling of the AIG-10 well (location in Fig. 1), intersecting the Aigion fault at 760 m in depth, allowed the recovery of a 100 m long core (Cornet et al., 2004a). Borehole images have been collected through the fault zone down to 1000 m (Daniel et al., 2004). An overview of the first results of the project can be found in the special issue of the C.R. Geoscience published by Cornet et al. (2004b).

The present paper focuses on the fracture network, regional and near the Quaternary and active Pirgaki, Helike and Aigion fault zones, through carbonated series. A quantitative approach to the fracture spatial distribution and the characteristics of fracture networks has been achieved. In addition, thin section analyses allow us to

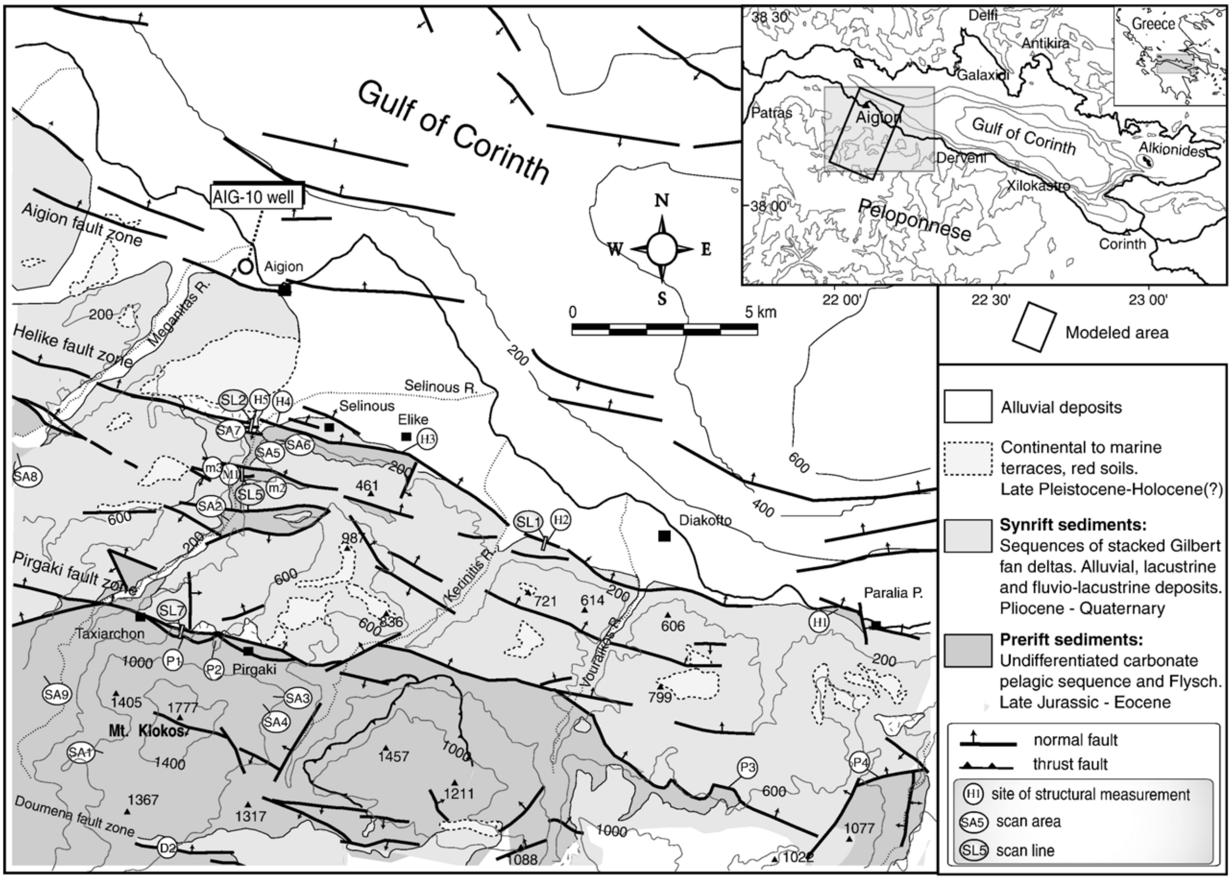

Fig. 1. Simplified geological map of the south-western sector of the Gulf of Corinth (based on Ghisetti et al., 2001; Micarelli et al., 2003; Moretti et al., 2003a). Active and Quaternary, approximately N100 striking fault zones are shown. Map also shows the main survey sites of this study, for scan area, scan line and microstructural sampling. Inset shows the location of the Gulf of Corinth and the zone modeled for the fluid flow.

Download English Version:

https://daneshyari.com/en/article/4695059

Download Persian Version:

https://daneshyari.com/article/4695059

Daneshyari.com