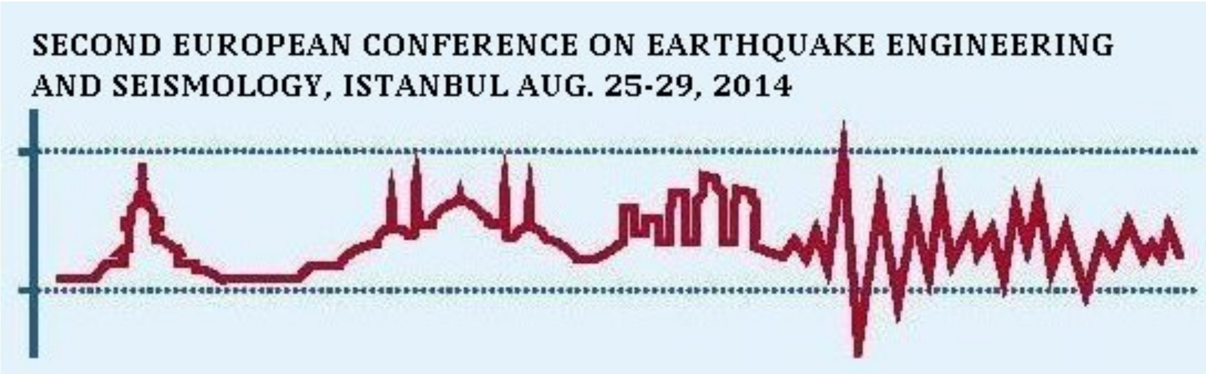

ANALYSIS OF EARTHQUAKE MULTIPLETS IN THE WESTERN CORINTH RIFT (GREECE) DURING THE 2003-2004 SEISMIC CRISIS

Clara DUVERGER[1], Maxime GODANO[2], Pascal BERNARD[3], Hélène LYON-CAEN[4]

The Corinth rift is one of the most seismically active zones in Europe. The seismic activity follows a swarm organization with alternation of intensive crisis and more quiescent periods. In the western part of the rift, the seismicity mainly occurs in a 3-4 km north-dipping layer between 5 and 12 km depth. Recently, a detailed analysis of the microseismicity (multiplets identification, precise relocation, focal mechanisms determination) between 2000 and 2007 in the western part of the Corinth rift has clarified the internal structure of the seismic layer (Lambotte *et al.* 2014; Godano *et al.* 2014). A multiplet is a group of collocated earthquakes with similar waveforms. Several big multiplets underline north-dipping (and some south-dipping) planar structures in the seismic layer with normal fault mechanisms. These structures have been interpreted as (1) the basis of the fault mapped at the surface and (2) a low angle (30°) north dipping structure on which the faults are rooting.

Multiplets are often associated with small asperities and can be seen as repeated ruptures due to transient forcing as silent creep or pore pressure front diffusion. Fluids are already suspected to control the occurrence of the seismic activity in the Corinth rift (Pacchiani and Lyon-Caen 2010, Bourouis and Cornet 2009). Therefore, the detailed analysis of the multiplets is an opportunity to better understand fault dynamics, small earthquake rupture mechanics and coupling with aseismic processes.

In the present study we focus on the seismic crisis that occurred from October 2003 to July 2004 in the western part of the Corinth Gulf. 24 major multiplets were activated during this period, consisting in 411 earthquakes with magnitudes up to 2.9 (b-value = 1.2). The joint analysis of (1) the position of multiplets with respect to faults mapped at the surface, (2) the geometry of multiplets and (3) the fault plane solutions shows that the seismic crisis is probably related to the activation in depth of the Aigion and the Fassouleika faults (Figure 1). In details, 2 multiplets can be related to the Aigion fault, 11 to the Fassouleika fault and the 11 others are located between these two faults. However, the multiplets of the Fassouleika fault have a lower dip (~50°) than the fault dip measured at the surface (~60°).

In a first part, we define the geometry of each multiplet by calculating ellipsoids containing 95% of earthquakes. From the ratio between eigen axes of these ellipsoids, we classify the multiplets in three groups: line, plane and sphere. Moreover, the spatio-temporal analysis of the multiplets shows an overall migration from south-east to north-west. This migration highlights the successive activation of the Aigion fault, the intermediate zone and finally the Fassouleika fault. We demonstrate that this overall migration is potentially compatible with pore pressure diffusion law (Shapiro *et al.* 1997). We also highlight possible intra-multiplet diffusions on 18 multiplets, with diffusivities ranging between 0.001 to 0.4 m^2/s. These analyses show a correlation between the multiplet size and its intra-diffusivity (Figure 2).

[1] Institut de Physique du Globe de Paris, Paris, duverger@ipgp.fr
[2] PhD., Institut de Physique du Globe de Paris, Paris, godano@ipgp.fr
[3] PhD., Institut de Physique du Globe de Paris, Paris, bernard@ipgp.fr
[4] PhD., Ecole Normale Supérieure de Paris, Paris, helene.lyon-caen@ens.fr

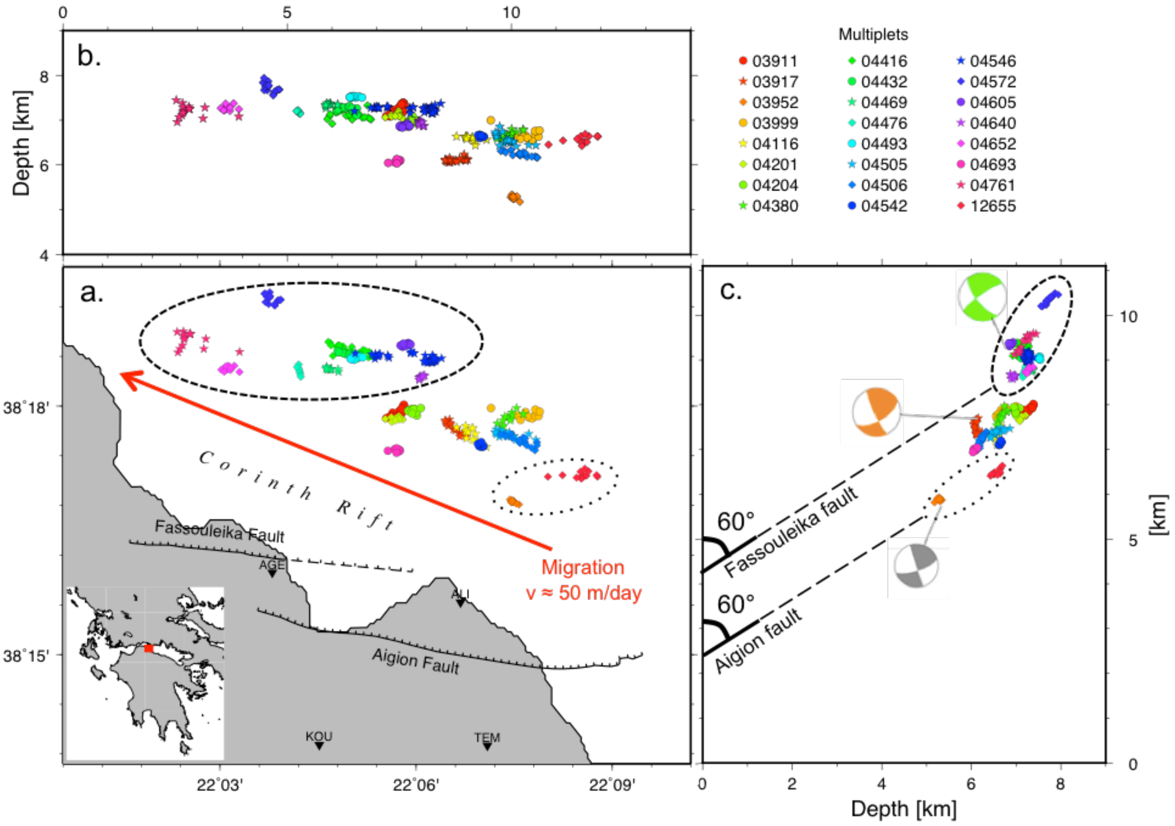

Figure 1: Location of the 2003-2004 seismic crisis. (a) Map of the earthquakes associated to the 24 multiplets activated during this period (colored symbols). Seismicity was recorded by the CRL network (black triangles) and relocated by Lambotte *et al.* (2014). The fault traces are from Ford *et al.* (in preparation). Dotted ellipse indicates multiplets related to the Aigion fault and dashed ellipse the Fassouleika fault. A migration of the seismicity is seen from South-East to North-West during the 10 months of the crisis at a velocity of 50 m/day. (b) West-East cross-section. (c) North-South cross-section with surface fault dips around 60°. The focal mechanisms are from Godano *et al.* (2014).

In a second part, we estimate the source parameters of the 24 multiplets by following a two-step approach based on the analysis of the displacement seismic spectrum. First, the scalar seismic moment and the magnitude are computed from the amplitude measured on the low frequency part (plateau) of the P and S spectrum. Second, the source size is calculated from the P and S corner frequencies. Corner frequencies are determined by inverting spectral ratio (i.e. the ratio between the spectra of two collocated earthquakes). This inversion is performed following Bayesian formalism. We discuss then the results in terms of rupture size, stress drop and scaling law. Surface ruptures of one multiplet are aligned and propagate bilaterally with partial covering rate, possibly showing mechanical interactions. Another multiplets show a high covering rate with repeater behaviour where a same asperity breaks regularly, which could denotes a creep. Moreover, we observe a breakdown of the self-similarity.

Finally, based on the above results, we propose a mechanical interpretation explaining the microseismic activity.

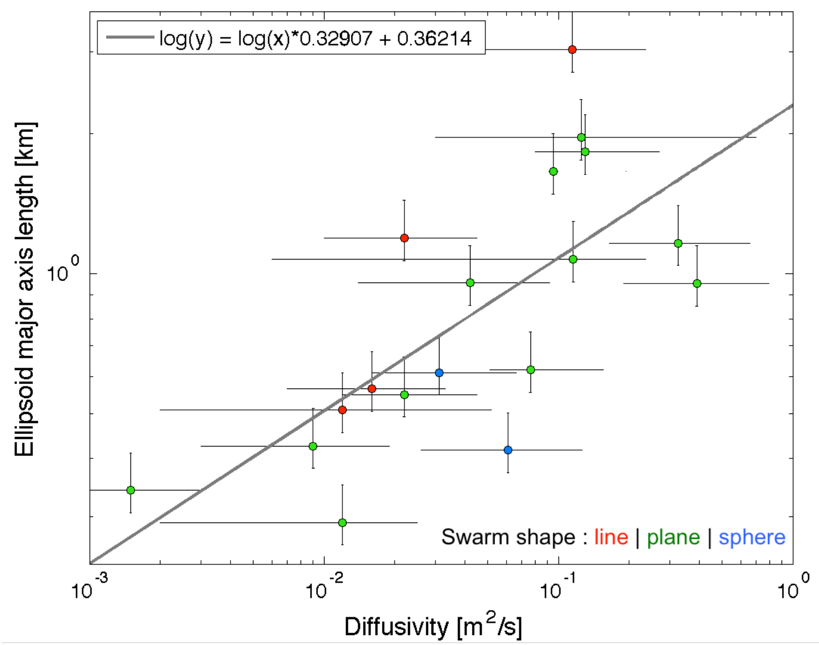

Figure 2: Major axis lengths of multiplet ellipsoids as a function of diffusivity.

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