Recurrence Behaviors of Earthquakes along the Kefallinia Transform Fault, Ionian Sea, Greece

Qi Cheng, Athanassios Ganas, Huang Fuqiong, Chen Yong, and George Drakatos

1) Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China
2) Institute of Geodynamics, National Observatory of Athens, 11810 Athens, Greece
3) Institute of Earthquake Science, CEA, Beijing 100036, China

We examined the whole strong earthquake recurrence behaviors of two fault zones along the Kefallinia Transform, Ionian Sea, Greece, using seismological data and statistical methods. Our data include 29 events with $M > 5.5$ for the period 1636~2003. We found different recurrence behaviors for the Kefallinia Fault Zone (clustering and time-predictable recurrence behaviors) and the Lefkada Fault Zone (near random and non-slip-predictable or non-time-predictable recurrence nature). The different modes may be attributed to: (a) segment interaction along-strike (Kefallinia) by static triggering and (b) the influence of fault systems to the north and east on the recurrence on Lefkada. Within the active periods, earthquake recurrence intervals are distributed in a more dispersed fashion, and can be fitted well by a Weibull distribution. In contrast, the distribution of the quiet periods is relatively less dispersed and difficult to describe by suitable probability functions.

Key words: Historical earthquake; Active fault zone; Earthquake recurrence; Probability distribution; Greece

INTRODUCTION

Mid- and long-term earthquake prediction and seismic hazard assessment usually depend on the knowledge of historical strong earthquake recurrence characteristics. For the study on a single segment of an active fault zone based on reliable historical and instrumental earthquake data, earthquake

Received in August 2007. This paper is part result of the program “Investigation of recurrence modes of large earthquakes along the main seismogenic faults in Greece and in China” (20051696) in the frame of bilateral cooperation between China and Greece in the field of seismology and geophysics sponsored by the Ministry of Science and Technology of China. This program is mainly funded by the NSF40674024 and the NSF40374019.
recurrence behavior usually takes on a relatively simple process, such as time-predictable and quasi-periodic behaviors (Shimazaki and Nakata, 1980; Bakun and McEvilly, 1984; Savage and Cockerham, 1987; Nishenko and Buland, 1987; Wen Yueze, 1999). However, based on ancient earthquake data, study shows that the recurrence behaviors have an irregular and complicated process (Jacob, et. al., 1988; Goes, 1996). Therefore, reliable long historical earthquake data are very important for the understanding of earthquake occurrence. Yi Gaixi and Wen Yueze (2000) studied the earthquake recurrence behavior of a whole intraplate active fault zone and its relation to those on individual fault segments for the first time by using the earthquake data from 11 active fault zones on the Chinese mainland. In this study, we studied the whole earthquake recurrence behaviors of interplate active fault zones in western Greece. The active fault zones include many segments that can independently generate strong earthquakes.

Due to its particular geological structure, western Greece may be considered a “natural laboratory” where many destructive earthquakes have occurred. The area is near a complex plate boundary where strike-slip motion, thrusting and crustal extension coexist within a few tens of kilometers. We focus our attention in the region between Kefallinia and Lefkada of the Ionian Islands in 38°39' North latitude and 20°21' East longitude (Fig. 1) where the main structure is the 100 km-long NE-SW Kefallinia fault which defines the plate boundary. The Kefallinia strike-slip fault (Scordilis, et al., 1985; Kratzi and Langston, 1991; Louvari, et al., 1999) accommodates the relative motion of the Apulia (Africa) and Aegean (Eurasia) lithospheric plates. The geology of the Ionian Sea is characterized by a series of thrusts striking perpendicular to the EES (±30°) compression. This area is part of the Pre-Apulian geotectonic zone which was involved in Quaternary shortening related to the westward propagation of the Hellenic fold and thrust system. The rock types are sedimentary sequences comprising mainly Mesozoic carbonates. Extensional deformation (i.e. Quaternary-Holocene) is superimposed on the Miocene-Pliocene structures. Finally, diapiric movement of Triassic evaporites has affected both the Alpine and the late Cenozoic to Holocene sedimentary sequences (Kokinou and Vafidis, 2003).

The study area was selected for the following reasons: (a) it is an area of high seismicity, (b) it is located at the plate boundary between Africa and Eurasia and (c) there is good seismological and GPS infrastructure. The region of the South Ionian Islands (Lefkada, Ithaca, Kefallinia and Zakynthos) is characterized by a high seismicity rate with earthquake magnitudes up to 7.4 (Papazachos, 1990; Louvari, et al., 1999). This is attributed to the complex crustal deformation resulting from the subduction of the African plate towards the NE and the continental collision of the Apulian platform further to the northwest. The Kefallinia fault zone, KFZ, plays a key role in this geodynamic complexity (Sorel, 1976; Mercier, et al., 1987; Taymaz, et al., 1991; Le Pichon, et al., 1995; Papazachos and Kratzi, 1996; Louvari, et al., 1999) and combines active subduction and continental collision. Its slip-rate is about 20 mm/a according to GPS measurements (Serpelloni, et al., 2005) while, according to seismological data, it is about 3 cm/a (Papazachos and Kratzi, 1996). On August 14, 2003 an $M_w$6.2 strike-slip earthquake occurred offshore of Lefkada Island, (Fig. 1; Papadopoulou, et al., 2003; Pavlides, et al., 2004; Benetatos, et al., 2005). The earthquake caused a lot of injuries and material damage, but no loss of human life. According to NOA (National Observatory of Athens) the epicenter was located 8 km offshore Lefkada, towards its northwestern coast. According to static stress transfer studies (e.g. Papadimitriou, 2002; Papadimitriou, et al., 2006) this earthquake may trigger another strong event in the area, so the short-term seismic hazard may have increased. Our study will examine if it is possible to make a probabilistic forecast for middle and long-term seismic hazard based only on the recurrence interval distributions of strong earthquakes. The efficiency of the probabilistic forecast can be improved if additional evidence can be obtained, from which, whether an active fault zone is in its seismically active period or in a quiet period can be identified.
The earthquakes are divided into four (4) groups. From north to south the groups are (a) events associated with the Northern Lefkada Segment (NLS), (b) events associated with the Southern Lefkada Segment (SLS), (c) events associated with the Northern Kefallinia Segment (NKS) and (d) events associated with the Southern Kefallinia Segment (SKS). All events are reported in Table 1 and Table 2, respectively. Black arrows indicate plate motion

1 DATA

We selected two faults of the Kefallinia fault zone in the Ionian Sea (Fig. 1). The Fault Lefkada in the north, which further includes the Northern Lefkada Segment (NLS) and the Southern Lefkada Segment (SLS) and the Fault Kefallinia in the south, which includes the Northern Kefallinia Segment (NKS) and the Southern Kefallinia Segment (SKS). The segmentation was mainly done on the basis of macroseismic data by grouping the data into four regions: North & South Lefkada, North & South Kefallinia, respectively. We found no evidence for a megathrust earthquake rupturing all 120 km of the Kefallinia transform. However, it is possible that this preliminary segment configuration can be split into smaller segments but not enough data exists to support a finer segmentation structure. We analyzed the whole recurrence behaviors of these two faults. On the basis of published focal mechanisms (Louvari, et al., 1999) and the location of earthquakes we suggest that all events of our catalogue have occurred on fault planes with right-lateral strike-slip kinematics. We also assume that strong earthquakes occur on weak pre-existing faults rather than initiating new faults. The magnitude range is $M_s > 6.0$ (1636–1983) and $M_w > 5.5$ (1983–2003). Our catalogue results from a compilation of
data sources including the historical catalogue of Comninakis and Papazachos (1986), the instrumental catalogue of Makropoulos, et al. (1989), Papazachos and Papazachou (2003), the NOA catalogue (www.gein.noa.gr), the work of Papadopoulos, et al., (2003), Fokaefs and Papadopoulos (2004) and the work of Louvari, et al., (1999). The data are presented in the Tables 1 and Table 2, respectively.

The dataset is subject to the following errors: time of event, location of event and magnitude of event. First, the timing of strong events in the Ionian Sea is well constrained from many studies so our data is suitable to determine the recurrence interval. Second, all events are located offshore because the historical and instrumental descriptions do not mention surface ruptures. To determine the magnitude we used two types of measurements that describe the size of an earthquake: (a) for historical events the earthquake Intensity—a measure of the degree of earthquake shaking at a given locality based on the amount of damage and (b) for instrumental events the Magnitude—an estimate of the amount of energy released at the source of the earthquake. The drawback of intensity scales is that destruction may not be a true measure of the earthquake’s actual severity. The amount of structural damage attributable to earthquake vibrations depends on (a) intensity and duration of the vibrations, (b) nature of the material upon which the structure rests and (c) design of the structure. Another drawback for historical events is the lack of consideration of the directivity effect, i.e., fault ruptures in certain directions, along which seismic energy is more focused.

In order to group the northern (Lefkada) events into the two sets shown in Fig. 1 we also took into account the evidence provided by the latest strong earthquake, a magnitude $M_W = 6.2$ event offshore the island of Lefkada that occurred on August 14, 2003. The maximum intensity has been evaluated $I_0 =$ VIII (EMS) at Lefkas municipality (Papadopoulos, et al., 2003), while VI to VII+ intensities were evaluated at many other villages of the island. The offshore NNE-SSW oriented strike-slip right-lateral fault was activated by the main shock (Karakostas, et al., 2004). The most characteristic macroseismic effects were extensive typical ground failures like rock falls, soil liquefactions, subsidence, compaction, ground cracks and landslides. These macroseismic effects are remarkably similar to those reported from some historical Lefkada shocks (Papadopoulos, et al., 2003; Pavlides, et al., 2004) e.g. during 1704, 1914 ($M_S = 6.3$) and 1948 ($M_S = 6.5$).

**Table 1** Lefkas Offshore Seismicity since 1704

<table>
<thead>
<tr>
<th>Date</th>
<th>Intensity</th>
<th>Magnitude</th>
<th>Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1704-11-22</td>
<td>IX</td>
<td>6.3</td>
<td>NLS</td>
</tr>
<tr>
<td>1722-06-05</td>
<td>VIII</td>
<td>6.4</td>
<td>SLS</td>
</tr>
<tr>
<td>1723-02-22</td>
<td>IX</td>
<td>6.6</td>
<td>NLS</td>
</tr>
<tr>
<td>1741-06-23</td>
<td>IX</td>
<td>6.6</td>
<td>SLS</td>
</tr>
<tr>
<td>1769-10-12</td>
<td>X LN</td>
<td>6.7</td>
<td>NLS</td>
</tr>
<tr>
<td>1783-03-23</td>
<td>X LS</td>
<td>6.7</td>
<td>NLS</td>
</tr>
<tr>
<td>1783-06-07</td>
<td>VIII LN</td>
<td>6.3</td>
<td>NLS</td>
</tr>
<tr>
<td>1815</td>
<td>VIII</td>
<td>6.2</td>
<td>NLS</td>
</tr>
<tr>
<td>1820-02-21</td>
<td>IX</td>
<td>6.4</td>
<td>NLS</td>
</tr>
<tr>
<td>1825-01-19</td>
<td>X LN</td>
<td>6.5</td>
<td>NLS</td>
</tr>
<tr>
<td>1869-12-28</td>
<td>X LN</td>
<td>6.4</td>
<td>NLS</td>
</tr>
<tr>
<td>1914-11-27</td>
<td>IX</td>
<td>6.3</td>
<td>NLS</td>
</tr>
<tr>
<td>1948-04-22</td>
<td>IX LS</td>
<td>6.5</td>
<td>SLS</td>
</tr>
<tr>
<td>1948-06-30</td>
<td>IX LN</td>
<td>6.4</td>
<td>NLS</td>
</tr>
<tr>
<td>1994-02-25</td>
<td></td>
<td>5.5</td>
<td>NLS</td>
</tr>
<tr>
<td>2003-08-14</td>
<td>VIII LN</td>
<td>6.2</td>
<td>NLS</td>
</tr>
</tbody>
</table>
Table 2 Kefallinia offshore seismicity since 1636, related to the strike-slip plate boundary

<table>
<thead>
<tr>
<th>Date</th>
<th>Intensity</th>
<th>Magnitude</th>
<th>Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1636-09-30</td>
<td>X</td>
<td>7.2</td>
<td>SKS</td>
</tr>
<tr>
<td>1658-08-01</td>
<td>X</td>
<td>6.9</td>
<td>NKS</td>
</tr>
<tr>
<td>1714-08-28</td>
<td>IX</td>
<td>6.6</td>
<td>SKS</td>
</tr>
<tr>
<td>1759-06-14</td>
<td>IX</td>
<td>6.5</td>
<td>NKS</td>
</tr>
<tr>
<td>1766-07-24</td>
<td>IX</td>
<td>6.7</td>
<td>SKS</td>
</tr>
<tr>
<td>1767-07-11</td>
<td>X</td>
<td>7.2</td>
<td>NKS</td>
</tr>
<tr>
<td>1862-03-14</td>
<td>IX</td>
<td>6.7</td>
<td>NKS</td>
</tr>
<tr>
<td>1867-02-04</td>
<td>XI</td>
<td>7.3</td>
<td>NKS</td>
</tr>
<tr>
<td>1972-09-17</td>
<td></td>
<td>6.3</td>
<td>NKS</td>
</tr>
<tr>
<td>1981-06-28</td>
<td></td>
<td>6.0</td>
<td>SKS</td>
</tr>
<tr>
<td>1983-01-17</td>
<td></td>
<td>6.7</td>
<td>SKS</td>
</tr>
<tr>
<td>1987-02-27</td>
<td></td>
<td>5.7</td>
<td>NKS</td>
</tr>
<tr>
<td>1996-02-01</td>
<td></td>
<td>5.5</td>
<td>SKS</td>
</tr>
</tbody>
</table>

3 METHOD

We empirically determine the lower limit $M_{\text{min}}$ of earthquake magnitudes for every fault according to the relative intensity of seismicity. In the present study we take $M_{\text{min}} = 5.5$. Otherwise, to discern the main behaviors of strong earthquake recurrences, the foreshocks and aftershocks are not treated as independent events.

The whole earthquake recurrence behaviors of these two faults are analyzed in two different ways.

The first way does not consider the time-predictable or slip-predictable behaviors. The coefficient of variation $\sigma$ (the ratio of the standard deviation $\sum$ of recurrence time intervals to the average value $T_m$ of various cycle intervals), however, is used to measure the variability of recurrence times. For every fault, the coefficient of variation $\sigma$ of earthquake recurrence intervals is calculated:

$$\sigma = \frac{\sum T}{T_m}$$

The parameter $\sigma$ reflects the complexity of the time process. The larger $\sigma$ is, the more complicated the recurrence time process is, and the more dispersive the distribution of recurrence time intervals is. Investigations have shown that if $\sigma < 1$, the recurrence presents quasi-periodic behavior; if $\sigma > 1$, the recurrence shows clustering behavior; and if $\sigma = 1$, the recurrence behaves like completely random Poisson process (Kagan and Jackson, 1991). However, generally speaking, the case of $\sigma < 1$ doesn’t mean that the recurrence behavior of earthquakes is of a good quasi-periodicity. But only when $\sigma \ll 1$, it behaves as quasi-periodic recurrence behavior in favor of long-term prediction (Bakun and McEvilly, 1984). If $\sigma < 1$ and $\sigma$ is nearly equal to 1, the recurrence is close to random behavior.

The second way considers the time-predictable or slip-predictable behaviors of the earthquake recurrence process. For every fault, two regression functions, corresponding to these two types of behaviors respectively, are established as follows:

$$\ln T = a + bM_h$$

$$M_h = A + B \ln T$$

$T$ is the time interval between two successive events. $M_h$ and $M_\pi$ are the magnitude of the prior and latter events respectively. $a$, $b$ and $A$, $B$ are all regression coefficients.
If function (1) is satisfied, the recurrence behavior is time-predictable (Shimazaki and Nakata, 1980; Papazhacos, 1989). Assuming a constant rate of strain accumulation and constant fault strength, Shimazaki and Nakata (1980) concluded that the time interval between two successive large earthquakes is approximately proportional to the amount of coseismic displacement of the preceding earthquake and not of the following earthquake. After an earthquake with larger coseismic displacement, it will take a longer time for the next earthquake to occur. If the amount of slip during the past earthquake is known, the time of the next earthquake can be predicted.

If function (2) is satisfied, the recurrence behavior is slip- or magnitude-predictable (Shimazaki and Nakata, 1980; Wen Xueze, 1999). In this case, both the recurrence time and the amount of time elapsed since the previous shock is taken into account. These behaviors are compatible with the seismic gaps hypothesis which suggests that the probability for a future earthquake to fill up the gap is small immediately following the occurrence of a characteristic earthquake and increases with the time elapsed since the previous event. These are distinct from the time-independent behaviors (i.e., Poisson distributions) in that the latter ones use only information concerning recurrence intervals and do not take into account the amount of time elapsed since a prior event. These behaviors cannot be used to predict when an earthquake will occur, but they can be used to predict the magnitude of the earthquake that would occur at any given time. The potential fault slip at any time is proportional to the shear stress on the fault. Thus, if the time of the last earthquake is known, the magnitude of the next earthquake can be determined at any particular time.

According to whether the correlation coefficient $r$ is larger than or equal to the critical value $r_\alpha$ with a given confidence degree $\alpha$, the recurrence behaviors of time-predictable or slip-predictable can be determined. The confidence degree $\alpha$ is usually taken as 0.05.

### 4 ANALYSIS OF THE WHOLE RECURRENCE BEHAVIORS

By use of the methods described above, we analyzed these two faults in the Ionian Sea. From Table 3, we can see that the earthquake recurrence behavior of Fault Lefkada is near-random with a variation coefficient $\sigma = 0.824$ and that of Fault Kefallinia presents clustering behavior with a variation coefficient $\sigma = 1.19$. Yi Guixi, et al. (2003) found that the greater the number of segments of one fault is, the more complex the whole earthquake recurrence process of this fault is. As the variance coefficient $\sigma$ of Fault Kefallinia is larger than that of Fault Lefkada, the number of segments of Fault Kefallinia may be greater than that of Fault Lefkada.

According to the calculated correlation coefficient $r$ and the judgments of the recurrence behaviors (Table 3), for Fault Lefkada, both time-predictable and slip-predictable recurrence behaviors are not existent. For Fault Kefallinia, however, the time-predictable recurrence behavior is existent, but the slip-predictable recurrence behavior is not existent.

### Table 3 Earthquake recurrence parameters and behavior judgments

<table>
<thead>
<tr>
<th>Fault name (number of events)</th>
<th>Variance coefficients $\sigma$ and average recurrence intervals $T_m$</th>
<th>Function $\ln T = a + bM_0$, The correlation coefficient $r$ and judgment of time-predictable behavior</th>
<th>Function $M_0 = A + B\ln T$, The correlation coefficient $r$ and judgment of slip-predictable behavior</th>
<th>Recurrence behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lefkada (16)</td>
<td>$\sigma = 0.824$ $T_m = 19.92$</td>
<td>$r = 0.06$ $</td>
<td>r</td>
<td>&lt; r_\alpha = 0.514$ Not existent</td>
</tr>
<tr>
<td>Kefallinia (13)</td>
<td>$\sigma = 1.19$ $T_m = 29.94$</td>
<td>$r = 0.66$ $</td>
<td>r</td>
<td>&gt; r_\alpha = 0.576$ Existent</td>
</tr>
</tbody>
</table>
slip-predictable recurrence behavior is not existent. It means that for Fault Kefallinia, one can make earthquake prediction to a certain extent according to the magnitude of the prior strong earthquakes.

Fig. 2 shows the statistical distribution map of earthquake recurrence time intervals of these two faults. In order to erase the effect of different average earthquake recurrence time intervals of different faults, we took a normalized earthquake recurrence time interval $T/T_m$ as a statistical sample (Nishenko and Buland, 1987), which is the ratio of an exact recurrence time interval $T$ to average recurrence time interval $T_m$. In this figure, the distribution trend is that short recurrence time intervals have a high probability. In Fig. 2(b), the statistical map of Fault Kefallinia indicates a second peak at 3 times the average recurrence time interval, which suggests that the earthquake recurrence time intervals of Fault Kefallinia obviously alternate between relatively active periods and relatively quiet periods. If $\sigma > 1$, such as it is for Fault Kefallinia, the second peak in the statistical distribution map moves obviously to the right with the increase of the $\sigma$ value. It suggests that the quiet periods are longer than the active periods and the recurrence behavior shows a true clustering. Studies show that whole earthquake clustering of an active fault zone is the result of a process of different fault segments breaking successively in a relatively short period (Perkins, 1987). The process is also the rupture triggering process between segments.

![Fig. 2](image)

**Statistical distribution of earthquake recurrence time intervals**

($\sigma$ is variance coefficient and $n$ is the number of recurrence time intervals)

(a) Fault Lefkada; (b) Fault Kefallinia

For these two faults, we also calculated the normalized earthquake recurrence time intervals of relatively quiet periods ($T_q/T_m$) and relatively active periods ($T_a/T_m$). $T_q$ and $T_a$ are relatively quiet and relatively active recurrence time intervals respectively. $T_q$ and $T_a$ are average intervals respectively. Fig. 3 shows the probability density distribution of relatively active recurrence time intervals (Fig. 3a) and relative quiet recurrence time intervals (Fig. 3b) of these two faults. Several different probability density functions (PDFs) are used to fit the statistical distribution.

It is easy to see in Fig. 3 that the time interval distribution of active periods is more dispersive than that of quiet periods. Within active periods, it is proper to use the Weibull PDF with two parameters to accurately fit this distribution, while not the negative exponential PDF. The probability density function of Weibull is:

$$p(x) = \begin{cases} \alpha \lambda^\alpha x^{\alpha-1} \exp(-\lambda x^\alpha), & x \leq 0 \\ 0, & x > 0 \end{cases} (\lambda > 0, \alpha > 0)$$

We estimated the parameters $\alpha = 1.1231, \lambda = 0.9535$ with the method of moment. The Weibull (stretched exponential) PDF has often been applied to recurrence statistics (Hagiwara, 1974;
Statistical distribution of earthquake recurrence time intervals of relatively active periods (a) and relatively quiet periods (b)

Rikitake, 1976, 1982; Utsu, 1984, and was firstly introduced into the study on earthquake recurrence as early as 1974 (Hagiwara, 1974). It has proven useful in a broad variety of similar applications, particularly lifetime modeling. For using mathematical treatments of failure time can simulate the rupture time of the earth’s crust, it is successfully applied to reliability considerations of the earth’s crust with respect to earthquake occurrences. The Weibull is characterized by its steadily increasing hazard function for a range of parameter values. Rikitake (1975) analyzed crustal movements associated with an earthquake and showed that ultimate strain to rupture of the earth’s crust can be well approximated by a Weibull distribution. In recent years a numerical simulation-based study showed the Weibull can describe the simulation data substantially better than other distributions, not only the distribution of interval times, but also the failure of a group of fault segments interacting by means of elastic stress transfer (Rundle, et al., 2005).

Within quiet periods, we tried to use normal distribution ($a = 1.00, \sigma^2 = 0.0747$), logarithmic normal distribution ($a = -0.036, \sigma^2 = (0.268)^2$) and Weibull ($\alpha = 4.1171, \lambda = 0.6718$) distribution to depict the probability density distribution. It is not easy to say which function is more like the true distribution due to a lack of samples.

From the analysis above, due to the complexity of earthquake occurrence processes, it is impossible to give an exact middle- and long-term earthquake prediction and seismic hazard assessment for a whole active fault zone. However it is possible for us to estimate the probability according to the characteristic of the distribution. If additional evidences can be acquired, the efficiency of the probabilistic forecast can be improved, and whether an active fault zone is in its seismically active period or in a quiet period can be identified.

5 DISCUSSION AND CONCLUSIONS

We examined the whole strong earthquake recurrence behaviors of two fault zones along the Kefallinia Transform, Ionian Sea, Greece. The fault zones are Fault Lefkada and Fault Kefallinia. Our results can be summarized as follows.

1. For Fault Lefkada, both time-predictable and slip-predictable recurrence behaviors are not existent. For Fault Kefallinia, however, the time-predictable recurrence behavior is existent, but the slip-predictable recurrence behavior is not existent. It means that for Fault Kefallinia, one can make earthquake prediction to a certain extent according to the magnitude of prior strong earthquakes.
(2) The recurrence behavior of Fault Lefkada is near random while Fault Kefallinia shows clustering behavior possibly due to static stress transfer (Stein, et al., 1997; Papadimitriou, 2002). A physical basis for this difference may be that Fault Lefkada is at the end of the plate boundary where segmentation may not be so well developed as along Fault Kefallinia. It is possible that several smaller structures exist that help release part of the energy stored along the plate boundary (this has to be tested by future seismicity studies). A second reason may be the mechanical interaction of Fault Lefkada with thrust faults of the collisional plate boundary further north. Fault Lefkada is located at the end of this major, dextral strike-slip system where deformation is taking place northwards by crustal shortening along the Greek and Albanian coasts.

(3) The seismicity of the two faults alternates between relatively active periods and relatively quiet periods. The time intervals distribution of active periods is more dispersive than that of quiet periods, and it is proper to use the Weibull PDF with parameters $\alpha = 1.1231$, $\lambda = 0.953$ to accurately fit this distribution. However, the distribution of quiet periods can be depicted either by the normal distribution, the logarithmic normal distribution or the Weibull distribution.

ACKNOWLEDGEMENTS

This study is part of the results from the study on the earthquake recurrence behaviors of the main seismogenic fault zones in China and Greece, which belongs to a framework of Sino-Greece scientific cooperation project, the Ministry of Science of Technology of the People's Republic of China and the General Secretariat for Research and Technology of Greece. The authors thank George Stavrakakis and Spyros Pavlides for discussions. George Papathanassiou provided the historical earthquake catalogue for Table 1.

REFERENCES


Louvari, E., Kratzi, A. A., Papazachos, B. C. The cephalonia transform fault and its extension to western Lefkada.


Yi Gaixi, Wen Xueze, and Xu Xiwei. Study on integrated recurrence behaviors of strong earthquakes along entire active

About the Author

Qi Cheng, born in 1979, graduated in solid geophysics from the Earth and Space Sciences Department of the University of Science and Technology of China in 2001, and is a post doctorate in the Institute of Geology and Geophysics, Chinese Academy of Sciences. He got his doctor’s degree in the same institute in 2006. He mainly works on seismic tomography and seismic activity. Email: qicheng@mail.igcas.ac.cn