15th International Congress of the Geological Society of Greece
Athens, 22-24 May, 2019 | Harokopio University of Athens, Greece
Bulletin of the Geological Society of Greece, Sp. Pub. 7 Ext. Abs. GSG2019-172

Mid-Miocene Strike Slip in Continental Greece

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The Aegean system and Continental Greece are marked by back-arc extension that is commonly viewed as occurring in two stages: 1/ classical back-arc extension with N150 normal faults (e.g parallel to the trench) during miocene 2/ followed by mainly N50 dextral strike-slip (North Anatolian fault-NAF) with E-W normal faults (Gulf of Evvia and Corinth) since 5 Ma marking the impact of the NAF in the tectonic system (Armijo et *al*., 1999; Hubert-Ferrari et *al*., 2002). However, some published structural data in the Cyclades show that N50 dextral strike-slip were already active during mid-Miocene time (e.g. during granite intrusion between 15 and 10 Ma; Kokkalas and Aydin, 2013), questioning this classical view of the Aegean extension. In this study, we wish to constrain the potential activity of dextral strike slip faulting during Mid-Miocene in Continental Greece.

Geological Setting

Central Greece is characterized by the stacking of two units, from bottom to top: 1/ the Cycladic Unit made of HP rocks so-called the Cycladic Blueschist Unit (C.B.U) and 2/ the Pelagonian unit made of metasediment covered by Trias-Jurassic marble and limestone (Fig. 1). The boundary between these two terranes is characterized by the N50 Pelagonian fault (Xypolias et *al*., 2003). In order to constrain the potential mid-Miocene activity of N50 dextral faults and achieve our objective, we focus on Evvia, Attic and, Continental Greece, to understand the tectonic context of the deposition of two mid-Miocene basins 1/ in the south of Evvia and Attic which border the N50 Pelagonian fault and 2/ in the north of Evvia far from N50 structures. We complete field data with Apatite Fission track currently non-existent in the area.

Geological Data

The Northern Miocene basin shows N150 normal faults and late E-W normal faults. The major N150 faults are systematically associated with larger amount of sedimentation indicating syn-kinematical filling of the basin. This suggests N150 faulting during mid Miocene. Field arguments do not allow us to know the chronology of the appearance and activities of the E-W faults. However, they have the same orientations and characteristics as the normal faults bordering the Gulf of Corinth as well as the faults mapped by (Royden and Papanikolaou, 2011). These faults are therefore supposed to have been active since the Pliocene and are younger than the N150 faults.

The Southern Miocene basin is located near the roughly N50 Pelagonia fault between the Cycladic Blueschist Unit and the Pelagonian unit. The entire Mid-Miocene basin is located on Pelagonian rocks. It is bounded to the south by the Pelagonian fault and does not extend beyond it. This particular geometry shows an overlap of this basin by the fault that delimits it and indicates that it predates the functioning of the fault. However, the bedding in the basin are sub-horizontal, even close the fault, suggesting a deposition after the fault activity. Faults and folds analysis demonstrates the existence of a major dextral slip kinematic associated with this N50 fault. All these data allow us to argue for a dextral strike slip activity of the Pelagonian fault during mid Miocene time.

Apatite Fission Track Data

Times Samples for the apatite fission track (AFT) method were collected along a cross line perpendicular to the Pelagonian fault and along the N150 and N-E faults. This sampling logic aims to better constrain the large-scale deformation associated with the formation of the Miocene basin and to indirectly date the activity of the Pelagonian fault by comparing the Cycladic and Pelagonian AFT ages (AFT data in the Cyclades from Hejl et *al*., 2008, 2003; Ring et *al*., 2007). The study of AFT averages reveals a first tectonic event during the Oligocene to early Miocene (Fig. 1). This one stands out on the majority of the rocks imposing an event impacting the whole of Continental Greece important. Two sample (G11-G16) show younger mean age with a last stage of exhumation in the middle Miocene. These two samples are located on the hanging-wall of the N150 fault, allowing a dating of the activity of these faults at mid-Miocene time, an interpretation that is consistent with the findings from the basin analysis. These new data in Continental Greece highlight a major change in age distribution between the C.B.U. rocks exhumed during the Mio-Pliocene and the Oligo-Miocene Pelagonian rocks. This difference is attributed to a recent exhumation event affecting only the Cyclades at the end of the Miocene. From these results, we can hypothetise that the N50 Pelagonian fault was active since the mid-Miocene, as a major strike slip fault that potentially accommodate strain partitioning during back arc extension.

Discussion

This study provides new field and dating data allowing a better understanding of the evolution of Continental Greece since the Oligocene. It could be describe in three steps:

- A generalized extension over the entire Aegean domain in the Eo-Oligocene period, creating a first episode of slow exhumation of deep rocks followed by the formation of metamorphic Core Complex.
- A change in back-arc extension at mid Miocene time, implying the coeval activity of N50 dextral strike slip and N150

normal faults.

- A second change in back arc dynamics at 5Ma with the interplay between NAF and back arc extension and the formation of the Corinth and Evvia rifts system with E-W normal faults.

The origin of such strain partitioning during mid-Miocene time between N150 extensional fault and N50 dextral strike slip is most probably the interplay between the extension related to the retreat of the slab and the onset at around 15 Ma of westward extrusion of Anatolia.

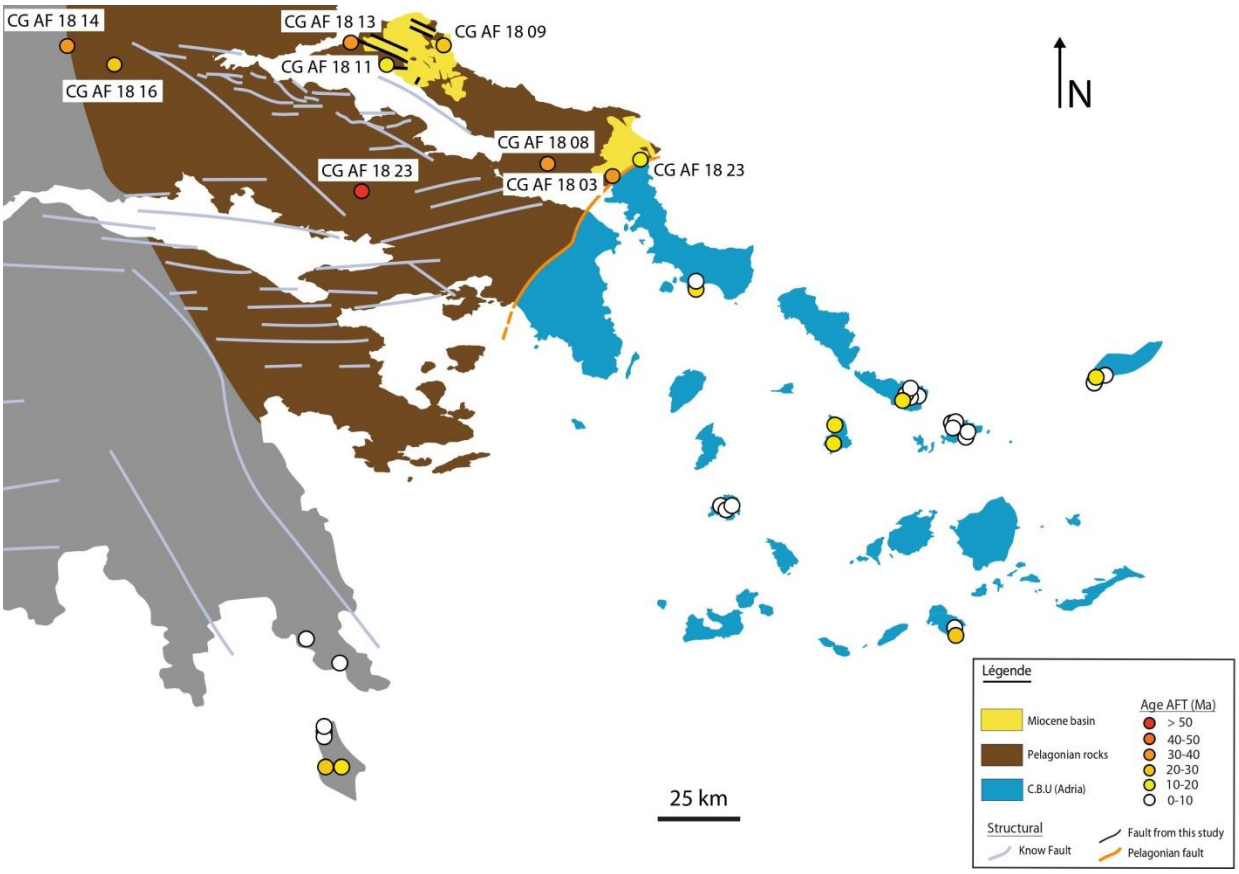

Figure 1. Geological Map of Greece with new structural (black line) and AFT data (circle in Continental Greece)

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