

Introduction and geological setting

Nappe stacking and subsequent extension in the Aegean region related to the final closure of the Neotethys ocean has been a subject of intensive researchs in regions like Rhodopia and the Cyclades (e.g. Brun and Sokoutis, 2007; Jolivet and Brun, 2010, Brun et al. 2016). This contrasts with the region of the Northern Sporades, which have not yet been thoroughly studied in the light of subduction-exhumation processes. We present a study on the latest Cretaceous -Paleogene tectonic evolution of the Northern Sporades islands (Greece) using multi-scale structural analysis and white mica Ar/Ar dating. We show new geological maps, cross sections, and kinematic datasets from the islands of Skiathos and Skopelos. Structural observations are supplemented by the Ar/Ar dating of mylonitic sericite foliations.





Figure 1. Geological map of the Hellenides and its surroundings. NAF=North Anatolian Fault, NAT=North Aegean Trough. Modified after Burg et al. (2012).



Thrusting and extensional exhumation in an Accretionary Wedge: The Paleogene evolution of the **Northern Sporades (Greece)**

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Figure 2. a: Geological map of Skopelos, modified after Matarangas (1992). b: Tectonostratigraphic column of Skopelos, modified after Matarangas (1992). c: Cross section through Skopelos showing the major structures of the island.

> Figure 3. SW-NE cross section of NE-Skiathos. The formations of the island are stacked on top of each other by top-S to SW thrusts. The thrusts produce thin slices of rocks explaining the substantial observed repetition of the formations. Thrusting was largely accomodated by the formation of carbonate mylonite zones (Figure 5) that were acting as weak decoupling layers under greenschist facies metamorphic conditions. The contact between the low-grade metamorphic cover units and the medium-grade Paleozoic is a top-E to NE normal-sense shear zone formed during the exhumation of the units, and explains the difference in metamorphic grade.

The cross sections have the same color scale as Figure 2.

Figure 4. NW-SE cross section of Skopelos showing the somewhat larger scale nappe structure that characterizes the Northern Sporades. Skopelos also exhibits top-NE, normal sense shear zones that run parallel to sub-parallel with the main foliation. In between the shear zones distributed top-NE shearing developed that can be found in many outcrops on Skopelos.

Key outcrops: From top-SW thrusting to top-NE exhumation



Ar/Ar dating of sericite fabrics - timing of deformation





Deformation induced the crystallization of a main foliation that is largely defined by fine grained sericite. Formation of sericitic fabrics took place under greenschist facies conditions at ~400 °C. Consequently, Ar-loss in these sericites was related to deformation-induced crystallization, and not thermal diffusion. Our Ar/Ar sericite ages thus provide direct time constraints for the deformation-event.

Geodynamic implications and Conclusions



References and Acknowledgments

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Brun, J.-P., Faccenna, C., Gueydan, F., Sokoutis, D., Philippon, M., Kydonakis, K., and Gorini, C., 2016, The two-stage Aegean extension, from localized to distributed, a result of slab rollback acceleration 1: Canadian journal of earth sciences, v. 53, no. 11, p. 1142-1157. Brun, J.-P. & D. Sokoutis 2007, Kinematics of the southern Rhodope core complex (North Greece). International Journal of Earth Sciences, 96(6), 1079-

Burg, J.-P. 2012, Rhodope: From Mesozoic convergence to Cenozoic extension, Journal of the Virtual Explorer, 42, 1. Jolivet, L. & J.-P. Brun (2010), Cenozoic geodynamic evolution of the Aegean. International Journal of Earth Sciences, 99(1), 109-138. Matarangas, D., 1992, Geological investigation of Skopelos island, North Sporades, Greece, Forschungszentrum Jülich, Zentralbibliothek. Vidakis, M., 1995. Skiathos island - geological map of Greece. Vol. 1:50.000IGME.



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Figure 8. Top-NNE normal-sense shear zone on Skiathos separating the Albian-Cenomania marbles at the bottom and the lates Cretaceous-Paleogene Flysch or top. The marbles are mylonitic below the contact with strong stretching lineations The Flysch is deformed first by ductile, top-NNE shearing which is gradually replaced by top-NNW semibrittle and brittle normal faulting. Semi-brittle shearing is accompanied by tight, asymmetric olding.

igure 9. Ductile top-NE shearing is localized along a pre-existing thrust contact on Skopelos The shear zone is 9 15m thick, and is cut by semi-brittle and brittle top-NE to top-NW normal faults.

Sample ID	Age [Ma]	±1σ error [Ma]	
2.2	74.75	0.39	
3.3	55.06	0.21	
7.1	62.22	0.45	
7.2	64.09	0.5	
12.3	53.22	0.34	
1. Table of Ar/Ar sericte age results.			

Thrace basin • Tectonic burial by top-SW thrusting initiated in the latest Cretaceous – Early Paleocene, and resulted in the stacking of the outcropping geological units of

Table

- All the formations were buried to greenschist facies conditions, where shortening was largely accommodated by the formation of reverse-sense shear
- Tectonic burial resulted in the formation of a fine-grained sericite foliation which yields Ar/Ar ages between 74 and 53 Ma.
- .Top-SW thrusting was followed by top-NE shearing related to the initiation of slab roll-back triggering the extensional exhumation of the formations. Top-NE shear zones localized at pre-existing stratigraphical and tectonic contacts, and are subparallel with the main foliation.
- Ductile top-NE shearing was gradually replaced by normal faulting which was driven by both NE-SW and NW-SE extensional directions. Normal faults are characteristic features of the whole Northern Sporades and are linked to the formation and evolution of the North Aegean Trough.

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