

Tectonics

INTRODUCTION TO A SPECIAL SECTION

10.1029/2021TC006939

Key Points:

- New data and recent analysis of structural geology of the Mediterranean regions
- Introduction to “Geodynamics, Crustal and Lithospheric Tectonics, and active deformation in the Mediterranean Regions”
- A tribute to Prof. Renato Funicello

Correspondence to:

M. Meghraoui,
m.meghraoui@unistra.fr

Citation:

Meghraoui, M., Jolivet, L., Wortel, R., & Conticelli, S. (2021). Introduction to the special section in “Geodynamics, Crustal and Lithospheric Tectonics, and active deformation in the Mediterranean Regions” (A tribute to Prof. Renato Funicello). *Tectonics*, 40, e2021TC006939. <https://doi.org/10.1029/2021TC006939>

Introduction to the Special Section in “Geodynamics, Crustal and Lithospheric Tectonics, and Active Deformation in the Mediterranean Regions” (A Tribute to Prof. Renato Funicello)

Mustapha Meghraoui¹ , Laurent Jolivet² , Rinus Wortel³, and Sandro Conticelli⁴ 

¹Institut Terre et Environnement de Strasbourg (ITES - UMR 7063), Strasbourg, France, ²UPMC, France, Paris, France, ³Utrecht University, Utrecht, The Netherlands, ⁴Università degli Studi di Firenze, Firenze, Italy

The geology, the geophysics, and other components of the solid earth system have much to contribute to our understanding of the Mediterranean region, from the Tethys paleo-environment to the present-day plate tectonic boundary. Launching a special collection with new and revised research contributions on the Tethyan belt (Mediterranean to Middle East), addressing subduction and mantle convection, volcanism, and fluid circulation, structural geology and active tectonics, dynamic topography, and geomorphology is a challenge. Attempting to embrace all these topics may seem ambitious, but this effort embodies the spirit of Renato Funicello, the Mediterranean and Italian geologist who crossed the sea beforehand and spread the seeds of modern tectonics and geodynamics. This special section is dedicated to him.

This collection encompasses a broad spectrum of topics including regional and structural geology, deep-seated metamorphism and core complexes, active deformation, and tectonics, using diverse approaches, such as high-resolution topographic and GPS data, paleomagnetic and magnetic measurements, seismic tomography, isotopic dating, and analog/numerical modeling in either strike-slip extensional and contractional tectonic systems.

The contributions in this collection come from all over the Mediterranean region: from northern Africa to southern Europe, and from the regions of Anatolia in the east to the Atlas of Morocco in the west. The section includes the segmentation of the Aegean geodynamics and core complexes and proceeds with magmatic models (Brun & Sokoutis, 2018; Rabillard et al., 2018). The geodynamics of the eastern Tethyan belt is investigated through the Arabia-Eurasia collision from the Persian Mountains to the Central Taurides in Turkey (Darin et al., 2018; McPhee et al., 2018; Sadeghi-Bagherabadi et al., 2018). Modeling opposite subduction polarity follows the paleotracess of plate tectonics with the Adria microplate and the origin of the Apenninic arc (Király et al., 2018; Peral et al., 2018), along with the early Triassic volcanism in the Southern Alps (Bianchini et al., 2018), and continental mantle obduction (Gueydan et al., 2019) as a framework of the western Tethyan belt.

In the western Mediterranean, present-day geodynamics are addressed through GPS surveying and results from the western Alps (Rabin et al., 2018; Walpersdorf et al., 2018). The aeromagnetic investigation of the central Apennines shows the characteristics of the seismogenic zones (Minelli et al., 2018), followed by the contribution of Cucci et al. (2018) on the destructive M7.1 1915 Marsica earthquake near Rome.

The neotectonic structures and evolution of the central Mediterranean are addressed through studies of the burial-exhumation cycles by ⁴⁰Ar/³⁹Ar dating (Porkoláb et al., 2019), Plio-Pleistocene contraction versus extension (Storti et al., 2018), the three-dimensional structural architecture of Neogene low-angle normal faults (Molli et al., 2018), and the late Miocene-early Pliocene evolution from K-Ar dating and transpressive-collision in the Apennines and Calabrian Arc (Filice & Seeber, 2019; Viola et al., 2018). Late Miocene extension (Booth-Rea et al., 2018) and active faulting with related stress distribution (Soumaya et al., 2018) document the oblique convergence along the North African Atlas system.

The issue of volcanism and tectonics is addressed by contributions dealing with fluids and volcanic gases from active volcanoes of Central Italy (i.e., Alban Hills, Carapezza et al., 2019) and the Aegean Volcanic Arc (i.e., at Santorini, Tarchini et al., 2019). The relationships between genesis of magmas and tectonic setting of the Anatolia block are the topic of original papers dealing with crustal extension and the chemistry of

melt inclusions in alkaline rocks from Turkey (Asti et al., 2019; Nikogosian et al., 2018). Bianchini and coauthors discuss the tectonic setting and the genesis of some Triassic dyke swarm cropping out on the Alpine chain. A model that links the eruption rate at Etna volcano with the geodynamics is presented by Barreca et al. (2018).

As an addition and important input, the analysis of paleomagnetic data documents faulting processes and block rotations from the Moroccan and Algerian Atlas (Derder et al., 2019; Torres-López et al., 2018), through Sicily (Speranza et al., 2018), to the central Taurides (Koç et al., 2018).

Acknowledgments

The authors are indebted to Claudio Faccenna, John Geissman, and Taylor Schildgen for their support of the publication of the special collection. The authors are also thankful to Francesca Funiello for her assistance in improving a previous version of the introduction to the special collection.

References

- Asti, R., Faccenna, C., Rossetti, F., Malusà, M. G., Gliozzi, E., Faranda, C., et al. (2019). The Gediz supradetachment system (SW Turkey): Magmatism, tectonics, and sedimentation during crustal extension. *Tectonics*, 38, 1414–1440. <https://doi.org/10.1029/2018TC005181>
- Barreca, G., Branca, S., & Monaco, C. (2018). Three-dimensional modeling of Mount Etna volcano: Volume assessment, trend of eruption rates, and geodynamic significance. *Tectonics*, 37, 842–857. <https://doi.org/10.1002/2017TC004851>
- Bianchini, G., Natali, C., Shibata, T., & Yoshikawa, M. (2018). Basic dykes crosscutting the crystalline basement of Valsugana (Italy): New evidence of early Triassic volcanism in the Southern Alps. *Tectonics*, 37, 2080–2093. <https://doi.org/10.1029/2017TC004950>
- Booth-Rea, G., Gaidi, S., Melki, F., Marzougui, W., Azabón, J. M., Zargouni, F., et al. (2018). Late Miocene extensional collapse of northern Tunisia. *Tectonics*, 37, 1626–1647. <https://doi.org/10.1029/2017TC004846>
- Brun, J.-P., & Sokoutis, D. (2018). Core complex segmentation in North Aegean, a dynamic view. *Tectonics*, 37, 1797–1830. <https://doi.org/10.1029/2017TC004939>
- Carapezza, M. L., Barberi, F., Ranaldi, M., Tarchini, L., & Pagliuca, N. M. (2019). Faulting and gas discharge in the Rome area (Central Italy) and associated hazards. *Tectonics*, 38, 941–959. <https://doi.org/10.1029/2018TC005247>
- Cucci, L., Currenti, G., Palano, M., & Tertulliani, A. (2018). The dewatering of the Fucino Lake did not promote the M7.1 1915 Fucino earthquake: Insights from numerical simulations. *Tectonics*, 37, 2633–2646. <https://doi.org/10.1029/2017TC004940>
- Darin, M. H., Umhoefer, P. J., & Thomson, S. N. (2018). Rapid late Eocene exhumation of the Sivas basin (Central Anatolia) driven by initial Arabia-Eurasia collision. *Tectonics*, 37, 3805–3833. <https://doi.org/10.1029/2017TC004954>
- Derder, M. E. M., Djellit, H., Henry, B., Maouche, S., Amenna, M., Bestandji, R., et al. (2019). Strong neotectonic block rotations, related to the Africa-Eurasia convergence in northern Algeria: Paleomagnetic evidence from the Mitidja basin. *Tectonics*, 38, 4249–4266. <https://doi.org/10.1029/2018TC005394>
- Filice, F., & Seeber, L. (2019). The culmination of an oblique time-transgressive arc continent collision: The Pollino Massif between Calabria and the Southern Apennines, Italy. *Tectonics*, 38, 3261–3280. <https://doi.org/10.1029/2017TC004932>
- Gueydan, F., Mazzotti, S., Tiberi, C., Cavin, R., & Villaseñor, A. (2019). Western Mediterranean subcontinental mantle emplacement by continental margin obduction. *Tectonics*, 38, 2142–2157. <https://doi.org/10.1029/2018TC005058>
- Király, Á., Faccenna, C., & Funiello, F. (2018). Subduction zones interaction around the Adria microplate and the origin of the Apenninic arc. *Tectonics*, 37, 3941–3953. <https://doi.org/10.1029/2018TC005211>
- Koç, A., van Hinsbergen, D. J. J., & Langereis, C. G. (2018). Rotations of normal fault blocks quantify extension in the Central Tauride intramontane basins, SW Turkey. *Tectonics*, 37, 2307–2327. <https://doi.org/10.1029/2018TC005112>
- McPhee, P. J., van Hinsbergen, D. J. J., Maffione, M., & Altiner, D. (2018). Palinspastic reconstruction versus cross-section balancing: How complete is the central Taurides fold-thrust belt (Turkey)? *Tectonics*, 37, 4285–4310. <https://doi.org/10.1029/2018TC005152>
- Minelli, L., Speranza, F., Nicolosi, I., D'Ajello Caracciolo, F., Carluccio, R., Chiappini, S., et al. (2018). Aeromagnetic investigation of the central Apennine Seismogenic Zone (Italy): From basins to faults. *Tectonics*, 37, 1435–1453. <https://doi.org/10.1002/2017TC004953>
- Molli, G., Carlini, M., Vescovi, P., Artoni, A., Balsamo, F., Camurri, F., et al. (2018). Neogene 3-D structural architecture of the north-west Apennines: The role of the low-angle normal faults and basement thrusts. *Tectonics*, 37, 2165–2196. <https://doi.org/10.1029/2018TC005057>
- Nikogosian, I. K., Bracco Gartner, A. J. J., van Bergen, M. J., Mason, P. R. D., & van Hinsbergen, D. J. J. (2018). Mantle sources of recent Anatolian intraplate magmatism: A regional plume or local tectonic origin? *Tectonics*, 37, 4535–4566. <https://doi.org/10.1029/2018TC005219>
- Peral, M., Király, Á., Zlotnik, S., Funiello, F., Fernández, M., Faccenna, C., & Vergés, J. (2018). Opposite subduction polarity in adjacent plate segments. *Tectonics*, 37, 3285–3302. <https://doi.org/10.1029/2017TC004896>
- Porkoláb, K., Willingshofer, E., Sokoutis, D., Creton, I., Kostopoulos, D., & Wijbrans, J. (2019). Cretaceous-Paleogene tectonics of the Pelagonian zone: Inferences from Skopelos island (Greece). *Tectonics*, 38, 1946–1973. <https://doi.org/10.1029/2018TC005331>
- Rabillard, A., Jolivet, L., Arbaret, L., Bessière, E., Laurent, V., Menant, A., et al. (2018). Synextensional granitoids and detachment systems within Cycladic metamorphic core complexes (Aegean Sea, Greece): Toward a regional tectonomagmatic model. *Tectonics*, 37, 2328–2362. <https://doi.org/10.1029/2017TC004697>
- Rabin, M., Sue, C., Walpersdorf, A., Sakic, P., Albaric, J., & Fores, B. (2018). Present-day deformations of the Jura arc inferred by GPS surveying and earthquake focal mechanisms. *Tectonics*, 37, 3782–3804. <https://doi.org/10.1029/2018TC005047>
- Sadeghi-Bagherabadi, A., Margheriti, L., Aoudia, A., & Sobouti, F. (2018). Seismic anisotropy and its geodynamic implications in Iran, the easternmost part of the Tethyan Belt. *Tectonics*, 37, 4377–4395. <https://doi.org/10.1029/2018TC005209>
- Soumaya, A., Ben Ayed, N., Rajabi, M., Meghraoui, M., Delvaux, D., Kadri, A., et al. (2018). Active faulting geometry and stress pattern near complex strike-slip systems along the Maghreb region: Constraints on active convergence in the western Mediterranean. *Tectonics*, 37, 3148–3173. <https://doi.org/10.1029/2018TC004983>
- Speranza, F., Hernandez-Moreno, C., Avellone, G., Gasparo Morticelli, M., Agate, M., Sulli, A., & Di Stefano, E. (2018). Understanding paleomagnetic rotations in Sicily: Thrust versus strike-slip tectonics. *Tectonics*, 37, 1138–1158. <https://doi.org/10.1002/2017TC004815>
- Storti, F., Balsamo, F., Mozafari, M., Koopman, A., Swennen, R., & Taberner, C. (2018). Syn-contractual overprinting between extension and shortening along the Montagna dei Fiori fault during Plio-Pleistocene antiformal stacking at the central Apennines thrust wedge toe. *Tectonics*, 37, 3690–3720. <https://doi.org/10.1029/2018TC005072>
- Tarchini, L., Carapezza, M. L., Ranaldi, M., Sortino, F., Gattuso, A., & Acocella, V. (2019). Fluid geochemistry contribution to the interpretation of the 2011–2012 unrest of Santorini, Greece, in the frame of the dynamics of the Aegean Volcanic Arc. *Tectonics*, 38, 1033–1049. <https://doi.org/10.1029/2018TC005377>

- Torres-López, S., Casas, A. M., Villalain, J. J., Moussaid, B., Ruiz Martínez, V. C., & El-Ouardi, H. (2018). Evolution of the ridges of Midelt-Er-rachidia section in the high Atlas revealed by paleomagnetic data. *Tectonics*, *37*, 3018–3040. <https://doi.org/10.1029/2017TC004936>
- Viola, G., Torgersen, E., Mazzarini, F., Musumeci, G., van der Lelij, R., Schönerberger, J., & Garofalo, P. S. (2018). New constraints on the evolution of the inner Northern Apennines by K-Ar dating of Late Miocene-Early Pliocene compression on the Island of Elba, Italy. *Tectonics*, *37*, 3229–3243. <https://doi.org/10.1029/2018TC005182>
- Walpersdorf, A., Pinget, L., Vernant, P., Sue, C., & Deprez, A., & the RENAG Team. (2018). Does long-term GPS in the Western Alps finally confirm earthquake mechanisms? *Tectonics*, *37*, 3721–3737. <https://doi.org/10.1029/2018TC005054>