Seismogenic fault system of the Mw 6.4 November 2019 Albania earthquake: new insights into the structural architecture and active tectonic setting of the outer Albanides

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Abstract

A seismic sequence that affected the Durrës region in late 2019 to early 2020 sheds new light on the structural architecture and active tectonic setting of the northern outer Albanides. Stress inversion analysis using focal mechanisms confirms that the area is dominated by ENE-trending horizontal maximum compression. The seismogenic sources consist mainly of ENE-dipping thrust faults roughly parallel to the coastline. The hypocentre distribution indicates that most of the earthquakes, including the M_w 6.4 main shock, nucleated within the basement, with only some of the shallow aftershocks tending to cluster around the deeper portion of previously identified seismogenic structures within the sedimentary cover. Our results, unravelling for the first time the fundamental role of deeply rooted, crustal ramp-dominated thrusting in seismogenesis, imply a profound reconsideration of the seismotectonic setting of the region in terms of a correct assessment of seismic hazard in this densely populated area of Albania.

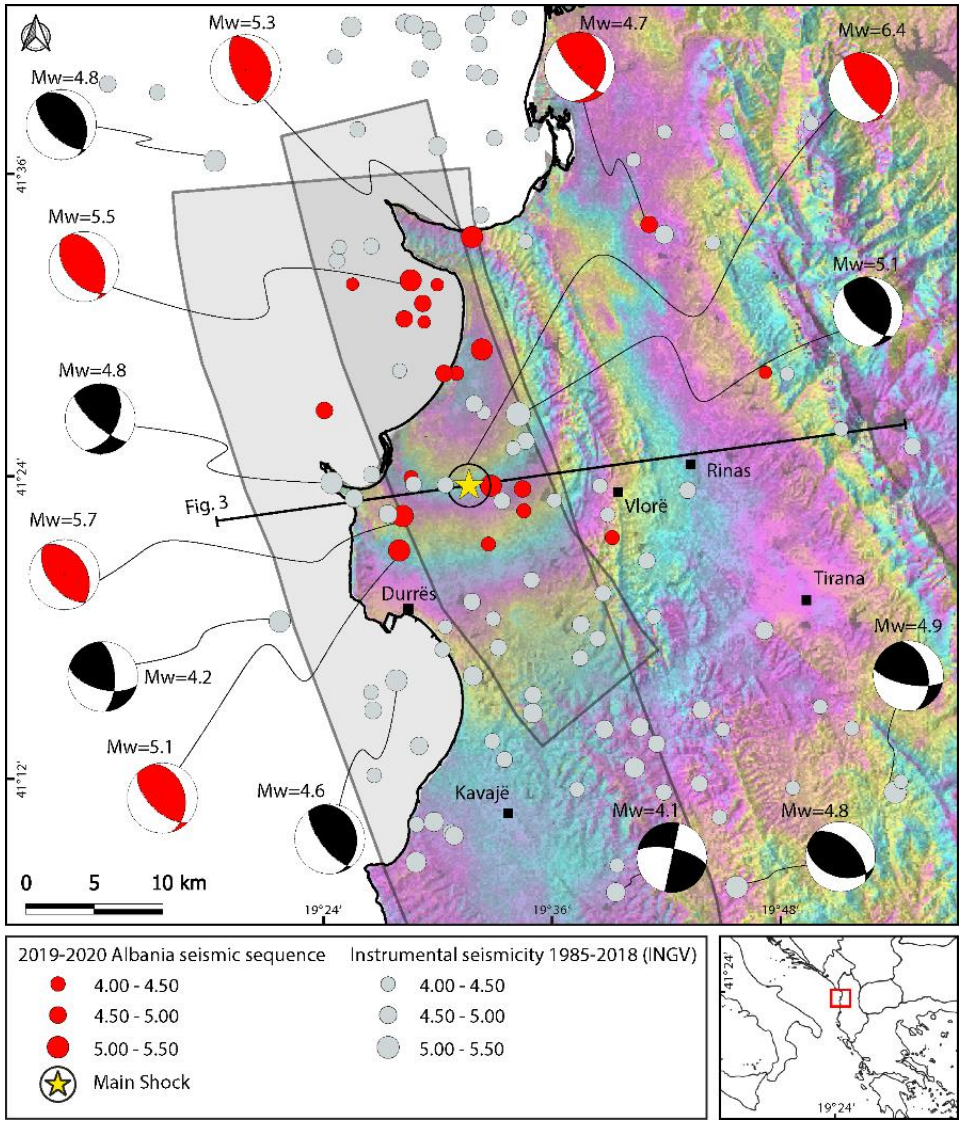


Fig. 1. Map showing epicentre location and focal mechanisms for the 2019-2020 seismic sequence (in red) and previous seismic events recorded by INGV since 1985 (in grey). The epicentres are plotted using the location from the ISIDe database (http://terremoti.ingv.it/iside), while magnitude (MW) and focal mechanism data are from the RCMT catalogue (Pondrelli 2002; http://rcmt2.bo.ingv.it/). Light grey polygons represent the 'composite seismogenic sources' according to the Database of Individual Seismogenic Sources (Basili et al., 2008; DISS Working Group, 2018). The co-seismic interferogram from Sentinel 1 (26-11-2019, 00:00 UTC to 08-12-2019, 00:00 UTC; http://sarviews-hazards.alaska.edu/; last access: 18-02-2020) is shown as an overlay draped onto the digital elevation model (https://www.eea.europa.eu/).

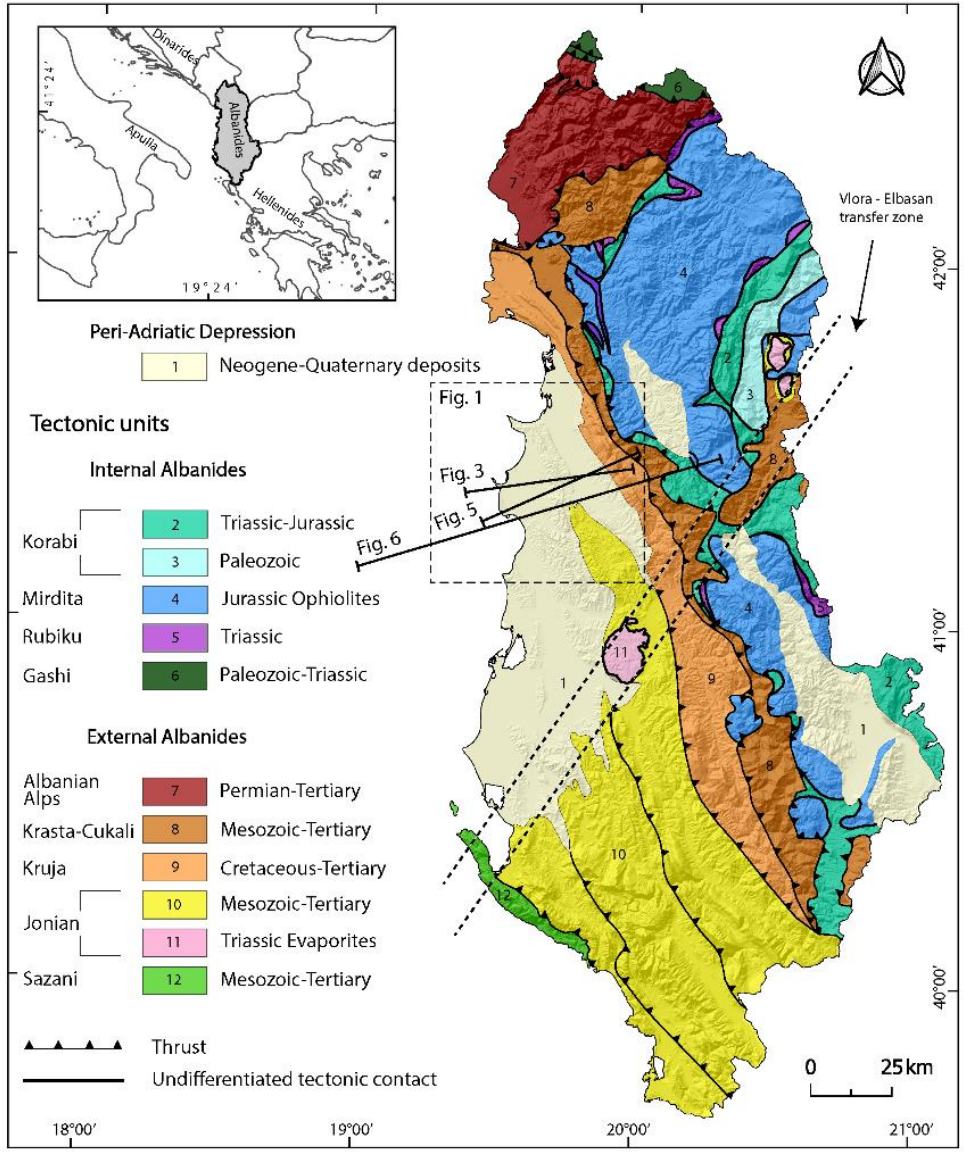


Fig. 2. Tectonic sketch map of Albania (after Roure *et al*. 2004 and Muceku *et al.* 2008, modified and draped onto the digital elevation model; https://www.eea.europa.eu/), showing the location of the map of Fig.1, and of cross-sections (Figs. 3 and 6) and seismic line (Fig. 5).

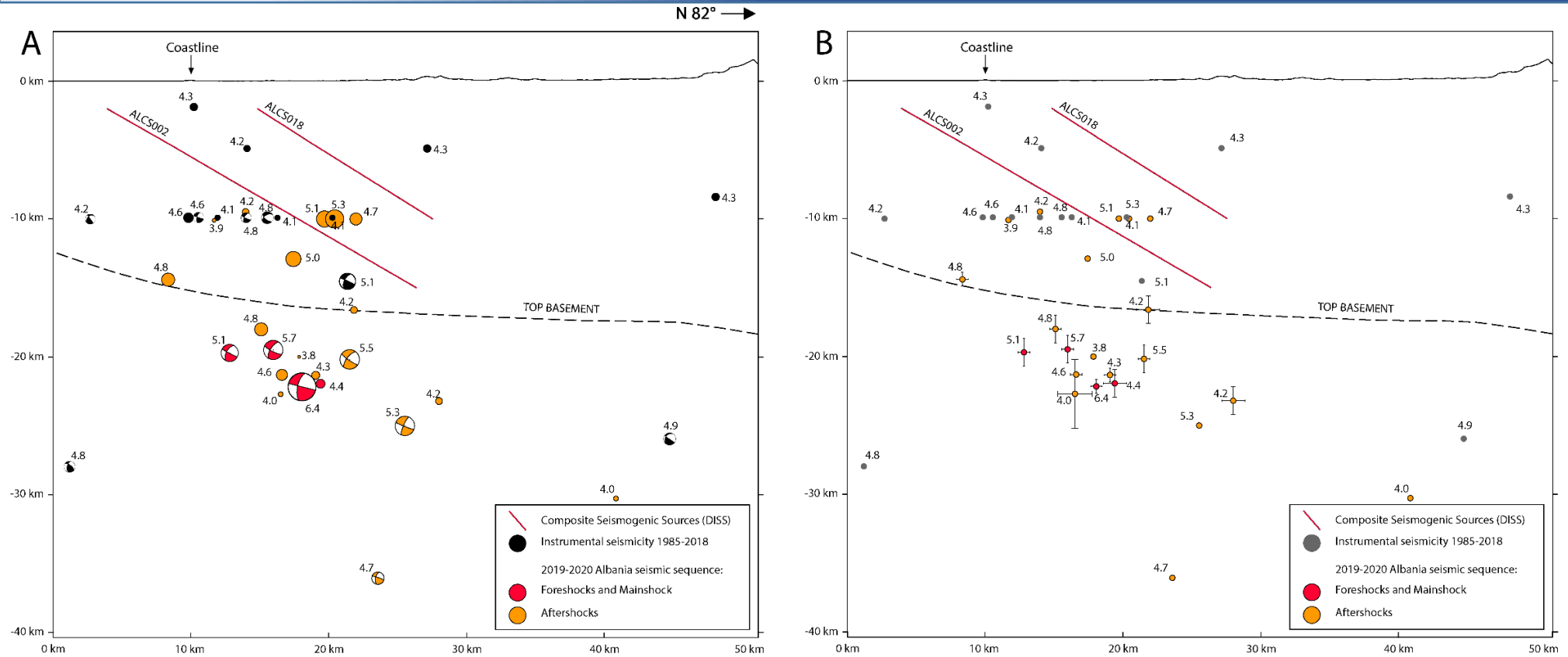
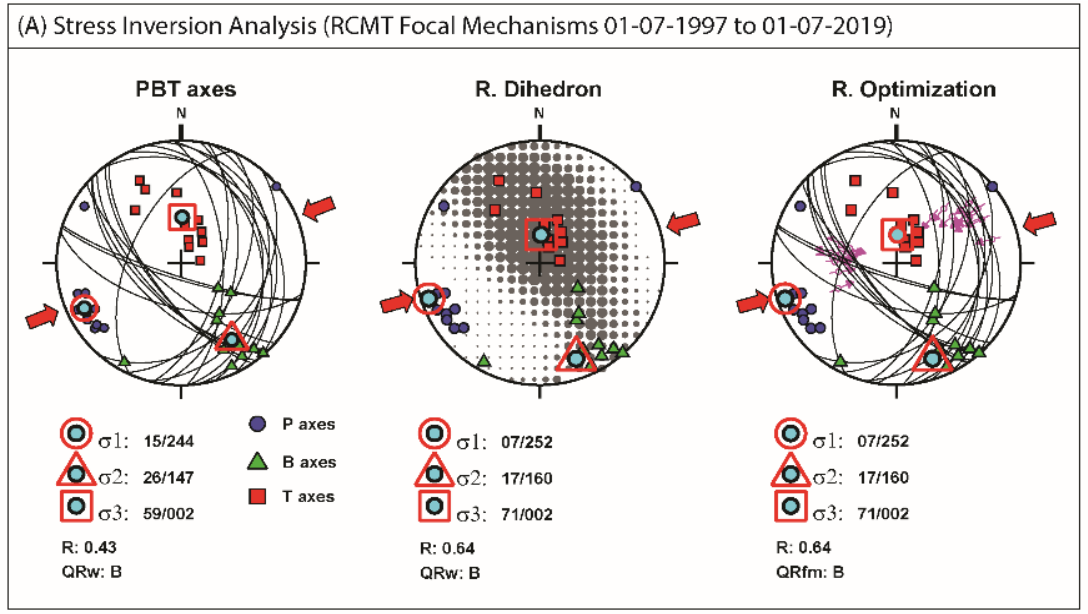


Fig. 3. (A) WSW-ENE vertical section showing hypocentral distribution for the seismic events recorded by ISIDe (http://terremoti.ingv.it/iside) since 1985. The 2019-2020 seismic events (red and orange) are separated from the historical seismicity (black). Hypocentres and focal mechanisms are projected onto a plane normal to the thrust faults identified as 'composite seismogenic structures' by the DISS (Basili *et al.* 2008; DISS Working Group 2018). Some earthquake clustering at a 10 km depth represents an artefact due to the conventionally assigned depth to not well-constrained events in the seismic catalogue. The seismogenic structures are displayed using the parameters defined in the latter catalogue (ALCS002: minimum depth = 2 km, maximum depth = 15 km, fault plane dipping 32° to the ENE; ALSC018: minimum depth = 2 km, maximum depth = 10 km, fault plane dipping 37° to the ENE). Basement geometry after Roure *et al.* (2004). (B) Hypocentral distribution for the 2019-2020 seismic events for which both vertical and horizontal uncertainties are provided in the ISIDe (http://terremoti.ingv.it/iside) catalogue (error bars are shown in the same section of diagram A).



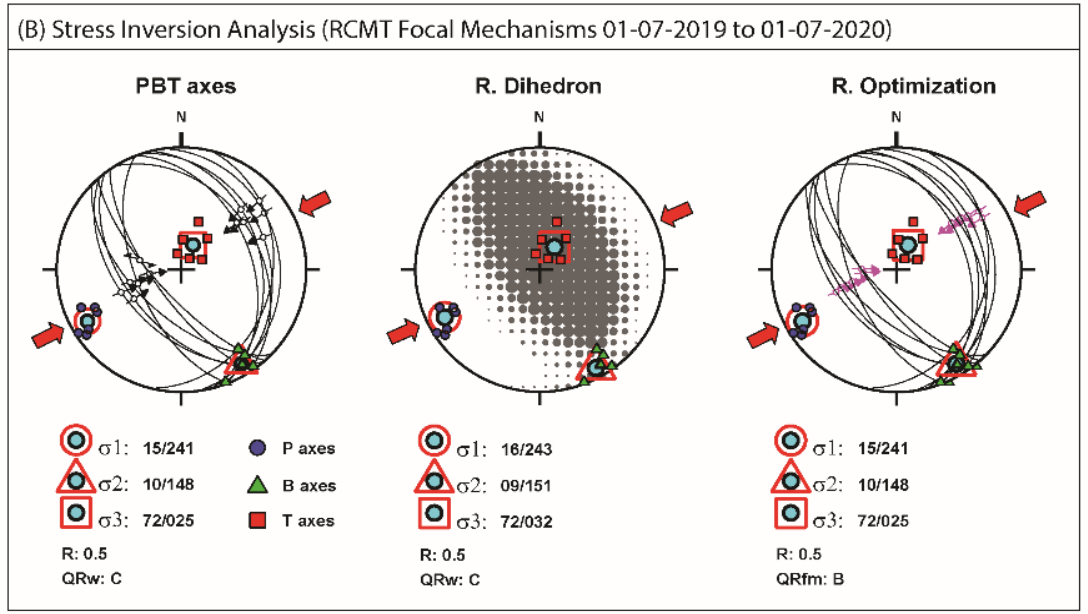


Fig. 4. Stress field analysis results performed by WinTensor™ (Delvaux and Sperner 2003) using the three different methods explained in the text, applied onto the seismological dataset availabe from the European-Mediterranean RCMT Catalogue lsolutions (http://rcmt2.bo.ingv.it/). (a) Analysis based on 1997 to June 2019 seismicity. (b) Analysis based on the focal mechanisms of the 2019-2020 seismic sequence. The obtained principal stress axes are shown.

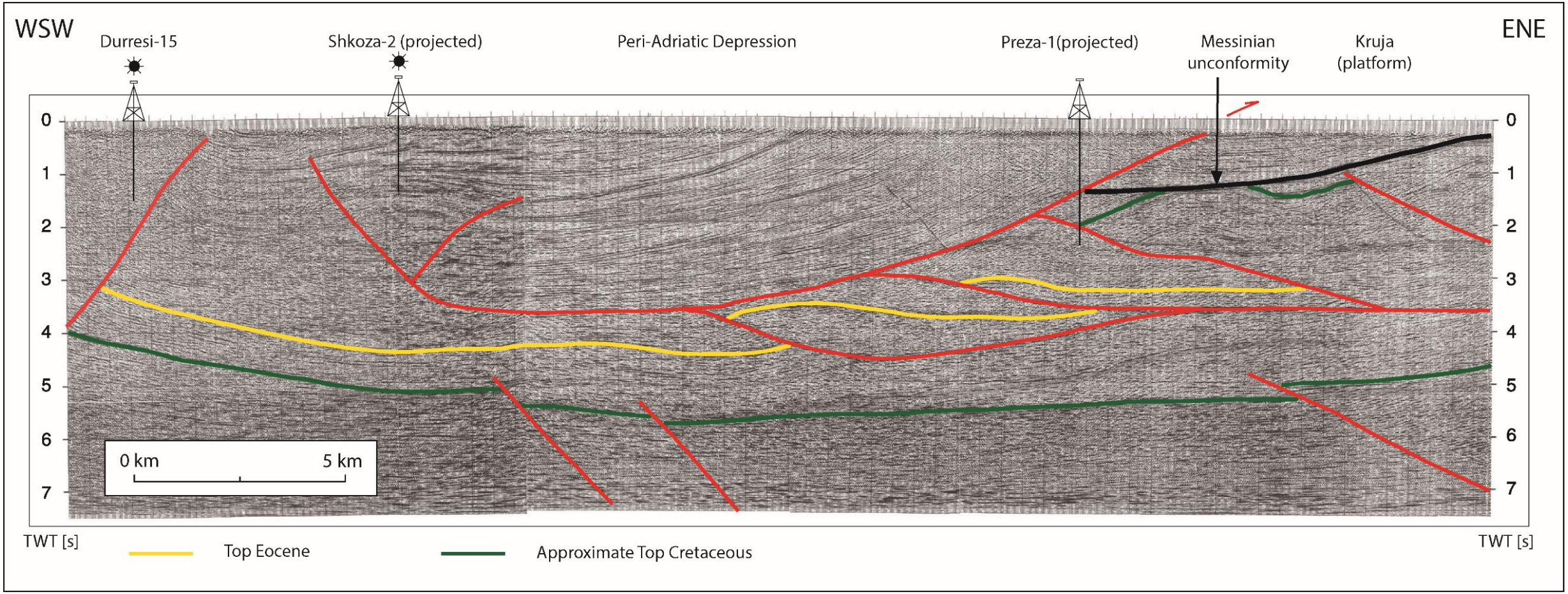


Fig. 5. Interpreted seismic (time) section across the outer Albanides (after Roure *et al*. 2004, modified; located in Fig. 2).

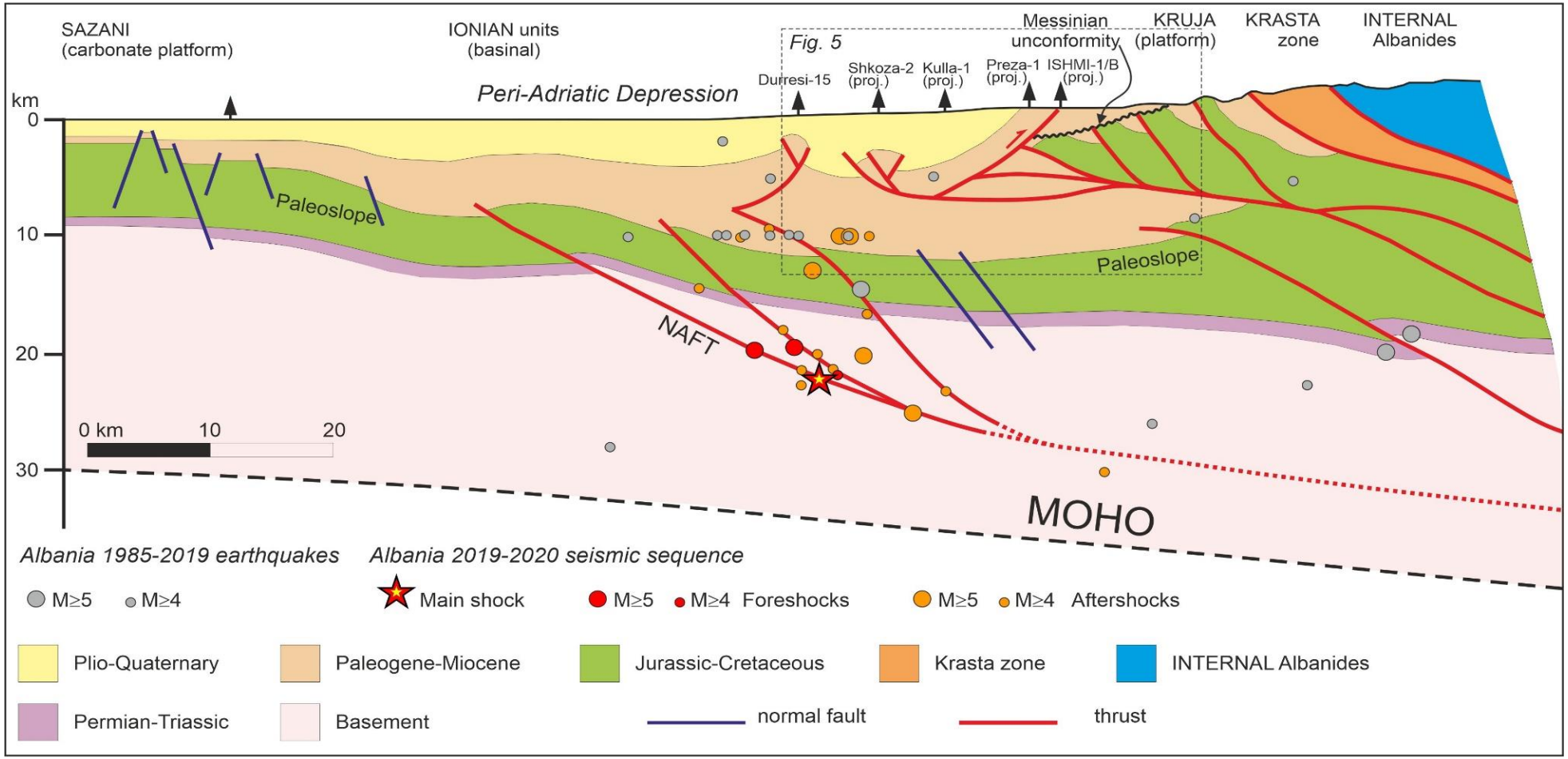


Fig. 6. WSW-ENE regional geological section across the northern outer Albanides (sedimentary cover structure based on Roure *et al*. 2004, and Frasheri *et al*. 2009, modified) showing earthquake hypocentres (red dots are the events of the 2019-2020 seismic sequence; grey dots represent previous seismic events recorded since 1985 by ISIDe: http://terremoti.ingv.it/iside; earthquake clustering at a 10 km depth is due to an artefact, refer to Fig. 3) and approximate extent of the portion covered by the seismic line of Fig. 5. No internal stratigraphy is shown for the Internal Albanides and Krasta units, which are not relevant for this study.

Thanks for your attention

How to **cite** the work:

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