

Multi-depth spatiotemporal evolution of the Sora seismic sequence (MW4.8, central Apennines)

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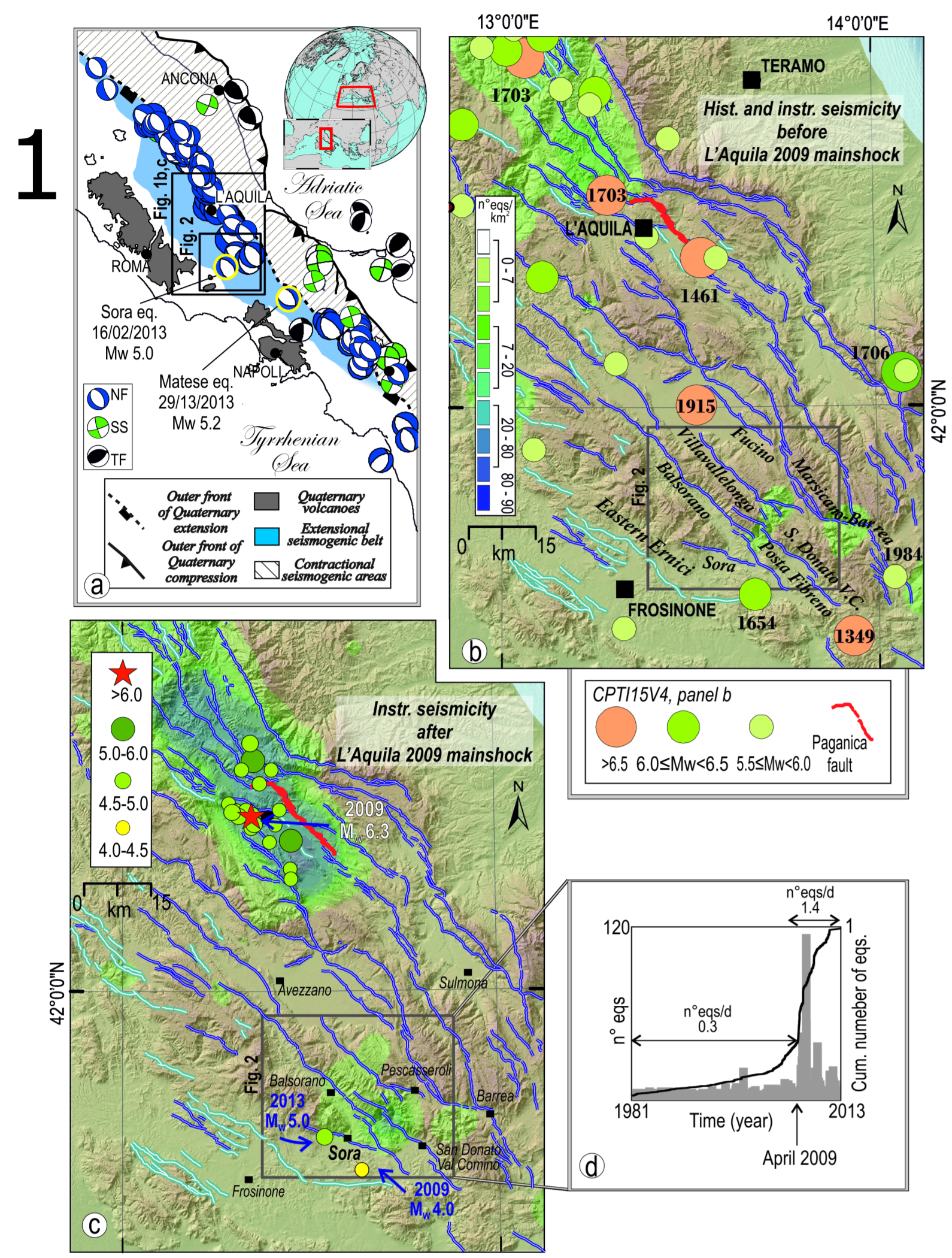
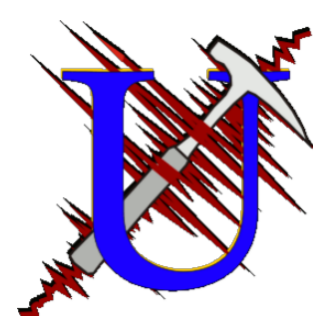


Figure 1 - Instrumental and historical seismicity in the southern-central Italy tectonic framework (a) Extensional and contractional domains in southern-central Italy and major focal mechanisms (MW > 4.5) (b) The density contour of the instrumental seismicity distribution (0 ≤ M ≤ 5.8) from 1981 to March 2009 and main seismic historical and instrumental events (MW ≥ 5.5) occurred in the study area before the L'Aquila seismic sequence (colored symbols as in the legend). (c) Density contour of seismicity distribution (0 ≤ M ≤ 6.3) and main seismic events that occurred in the study area after the L'Aquila seismic sequence (from 2009 to 2020). (d) Histogram summarizing the frequency of instrumental seismicity before and after the L'Aquila seismic sequence in the study area

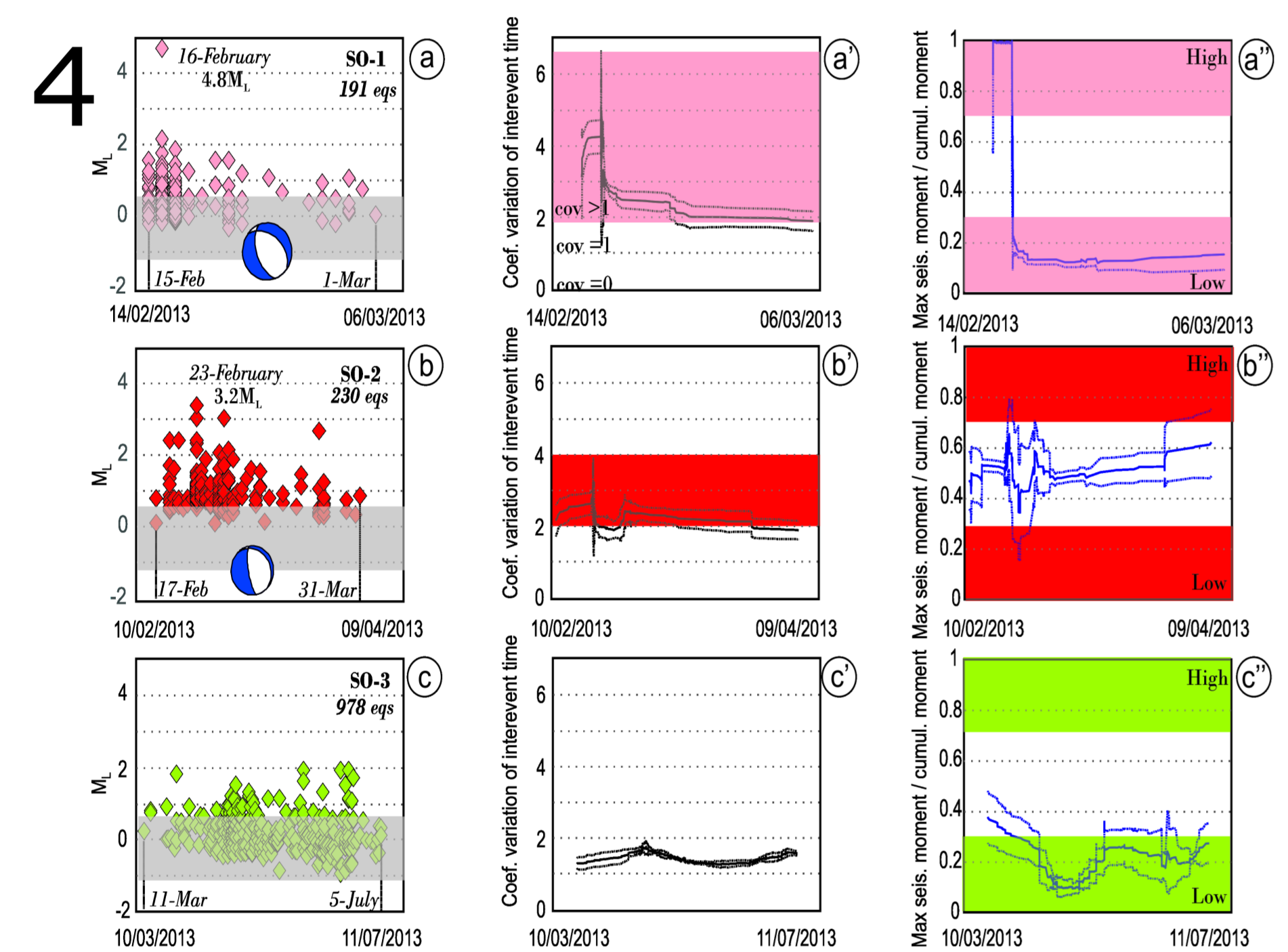


Figure 4 - General characteristics of SO-1-SO-3 clusters. (a-c) Magnitude vs time distribution. (a'-c') The grey bands represent the completeness magnitude threshold (Mc = 0 in Fig. 3). Coefficient variation of interevent times (COV). The colored bands indicate the degree of COV variation (thin band = low variation, thick band = high variation). (a''-c'') Maximum seismic moment, cumulative seismic moment ratio (MMR). Similar to COV, the colored bands highlight low (MMR < 0.25) and high (MMR > 0.75) MMR values.

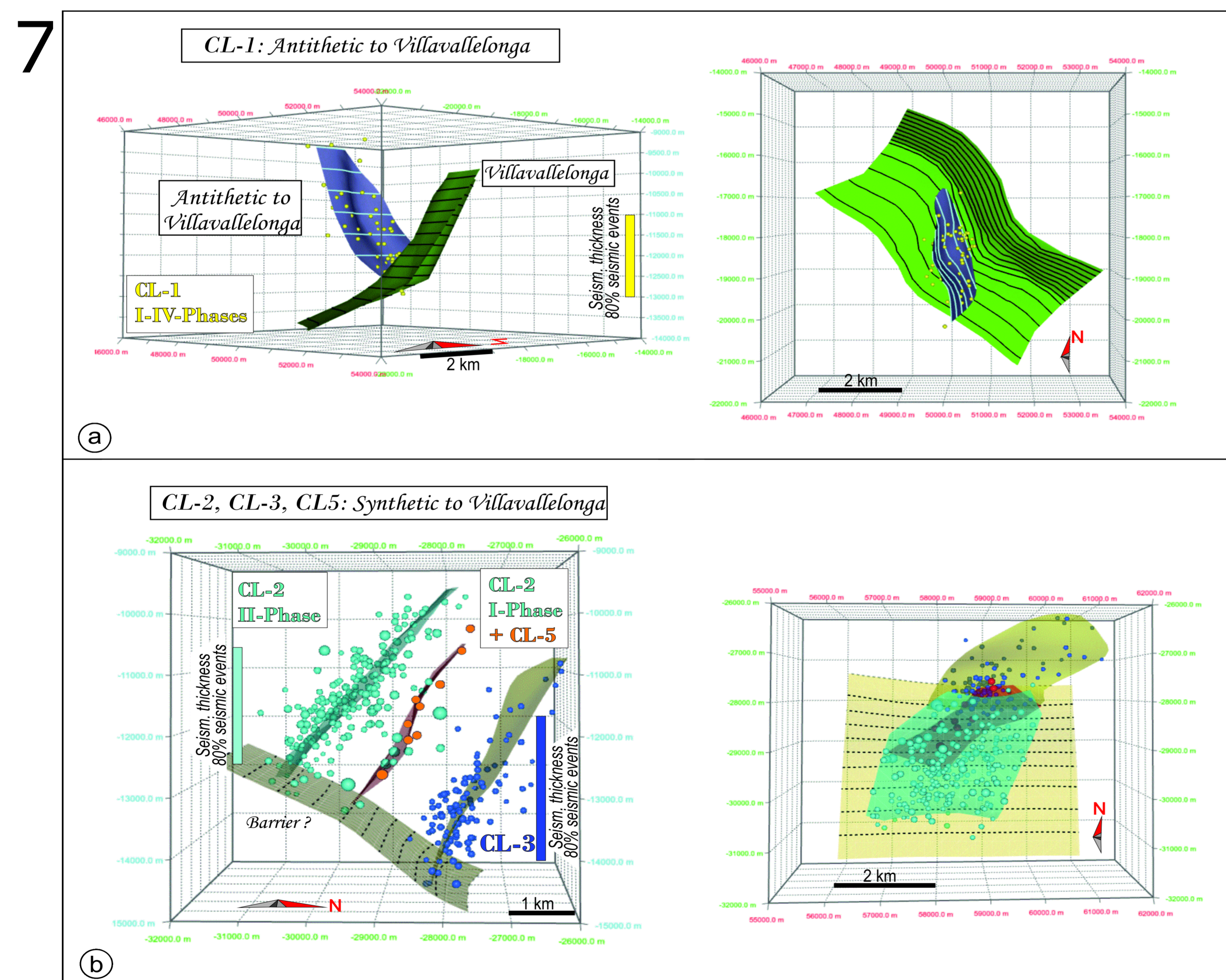


Figure 7 - Section and map views of the reconstructed 3D models. Fault surfaces were built with the MOVE Suite software v. 2023 (Petroleum Experts Ltd) (a) 3D models and depth contour lines representing Villavallelonga and its antithetic faults, illuminated by CL-1, along with concurrent background seismicity (see Fig. 9d). (b) 3D models and depth contour lines depicting synthetic structures to the Villavallelonga-Pescasseroli alignment.

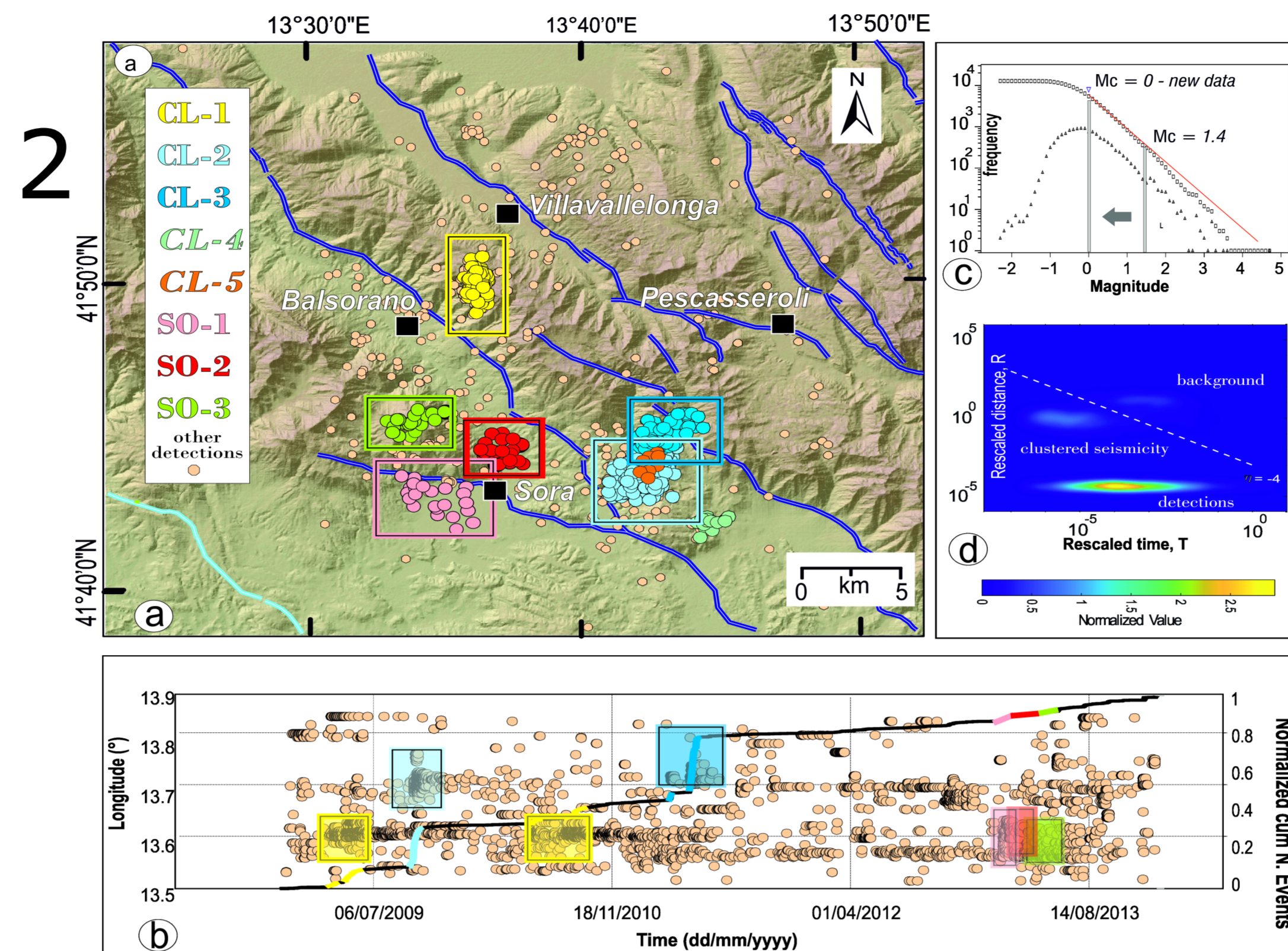


Figure 2 - Main characteristics of the enhanced catalog. (a) Map showing the new catalog obtained using template matching technique and the spatial distribution of the main clusters CL-1-CL-3 and SO-1-SO-3 and minor clusters CL-4, CL-5 (b) Temporal evolution of the analyzed seismicity for longitude. The colored rectangles indicate the clusters CL-1-CL-3 and SO-1-SO-3. (c) Gutenberg-Richter slope evaluated with the new catalog. The grey bars mark the completeness magnitude (Mc) of the old and new datasets. (d) Distribution of the nearest-neighbor distance for the analyzed seismic events computed with code. The plot displays the joint distribution of the re-scaled time and space components (T, R). Spatial and temporal occurrence of the analyzed seismic events.

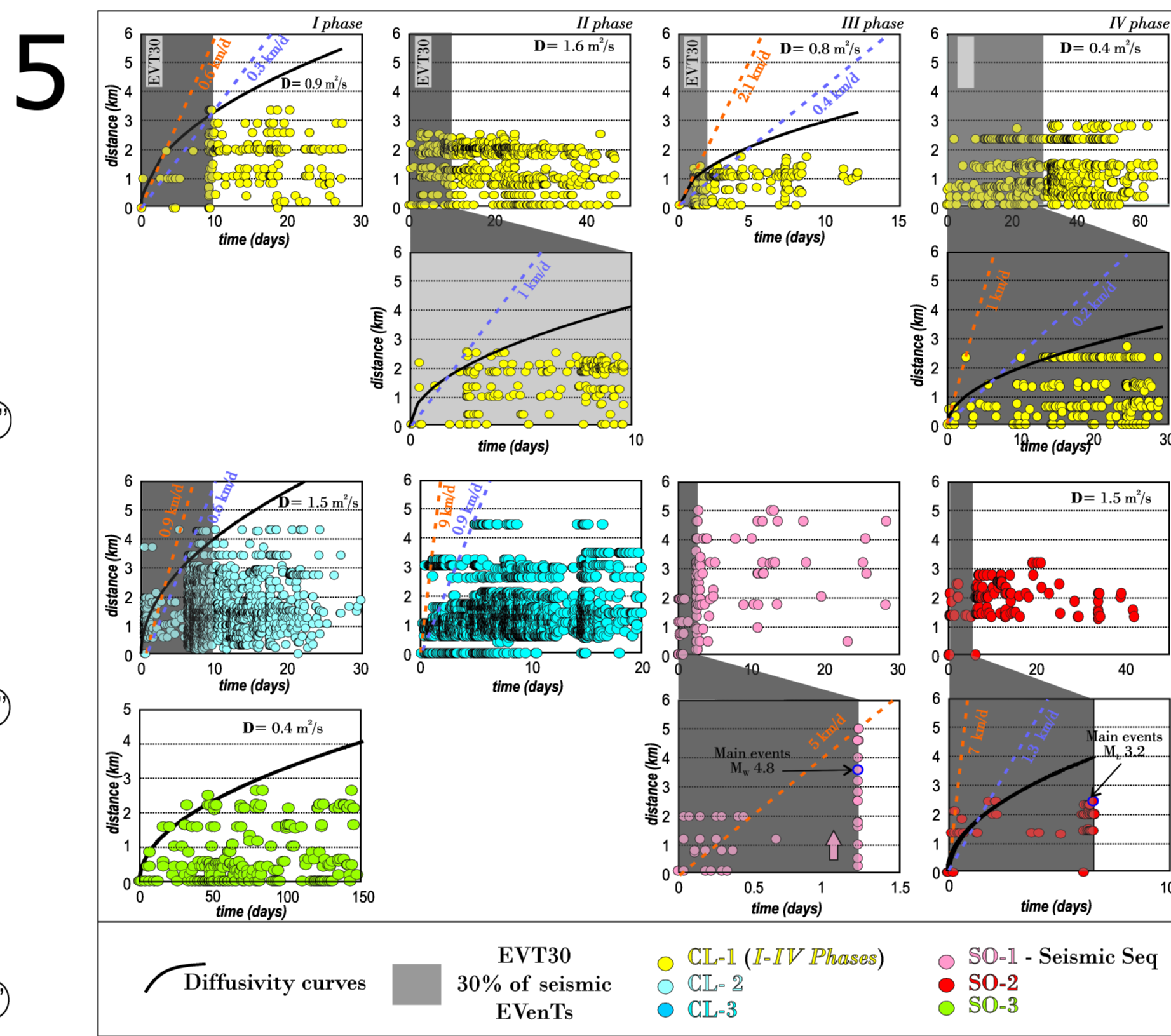


Figure 5 - Time evolution of the 2010-2013 CL-1-CL-3, SO-1-SO-3. Time evolution versus the temporal distance of seismicity from the first event of the cluster considered as the reference point. The grey bands represent the first 30% of seismic events relative to the overall duration. The dotted lines indicate the constant rate or velocity migration expressed in km/d. The black curves represent the interpolation of the data selected as the 90th percentile in each considered bin within 30% of the overall duration of the single cluster, assuming the homogeneous 3D diffusion model

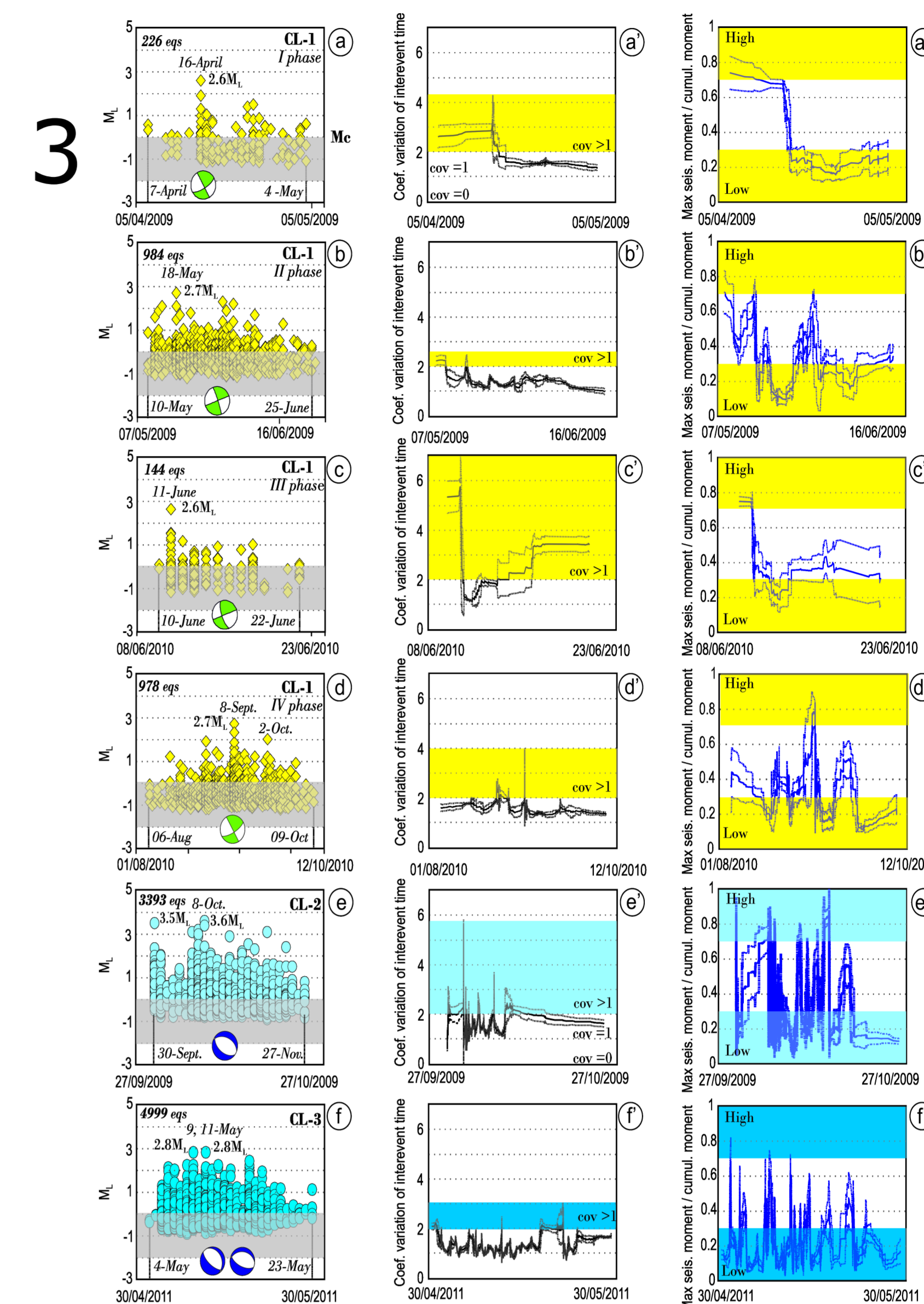


Figure 3 - General characteristics of CL-1-CL-3 clusters. (a-f) Magnitude vs time distribution. The grey bands represent the completeness magnitude threshold (Mc = 0 in Fig. 3). (a'-f') Coefficient variation of interevent times (COV). The colored bands indicate the degree of COV variation (thin band = low variation, thick band = high variation). (a''-f'') Maximum seismic moment, cumulative seismic moment ratio (MMR). Similar to COV, the colored bands highlight low (MMR < 0.25) and high (MMR > 0.75) MMR values.

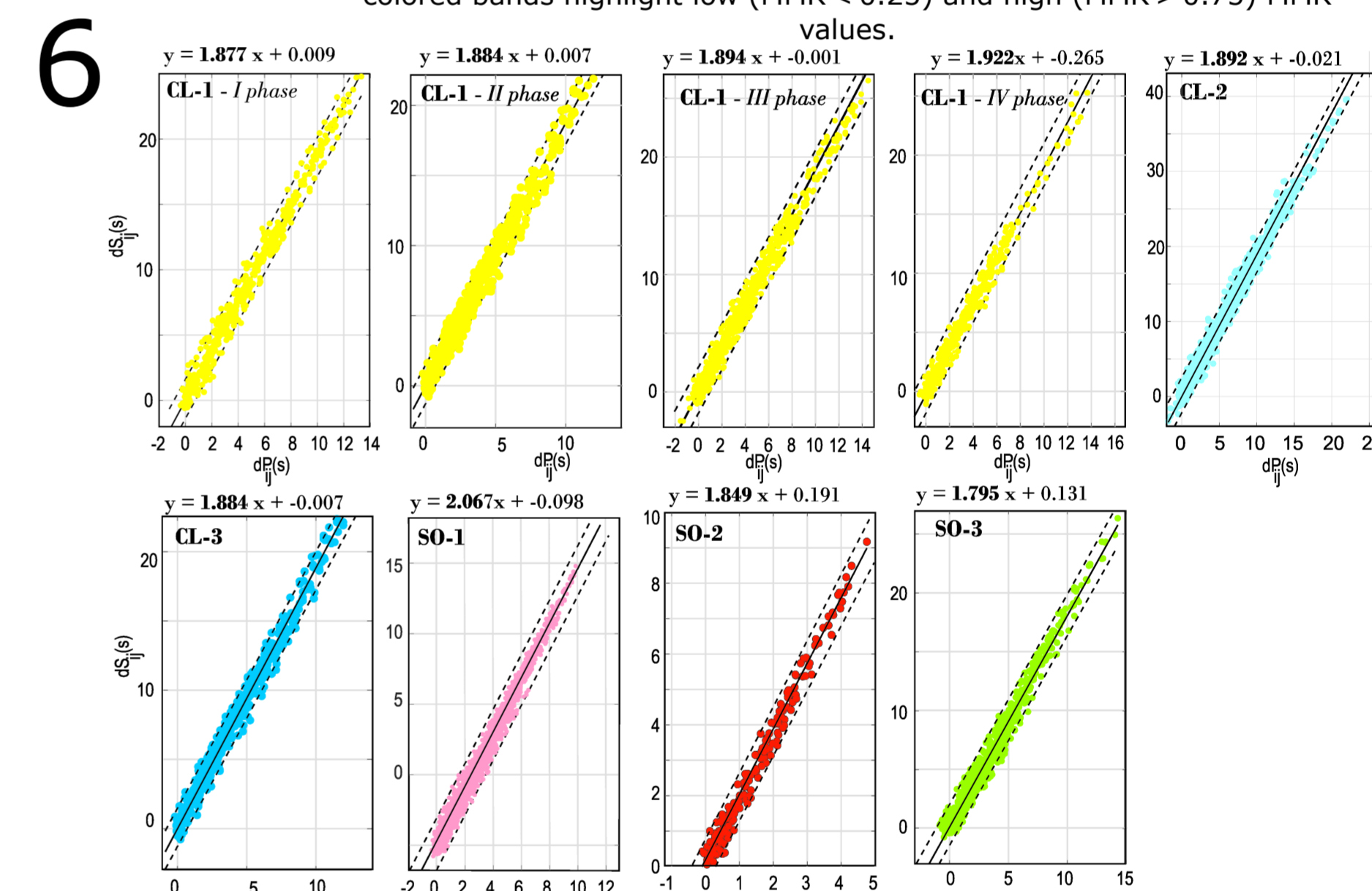


Figure 6 - Modified Wadati diagram plots computed using P- and S-arrival times of the Italian Seismic Bulletin. Black dashed lines represent the standard deviation of the orthogonal regression.

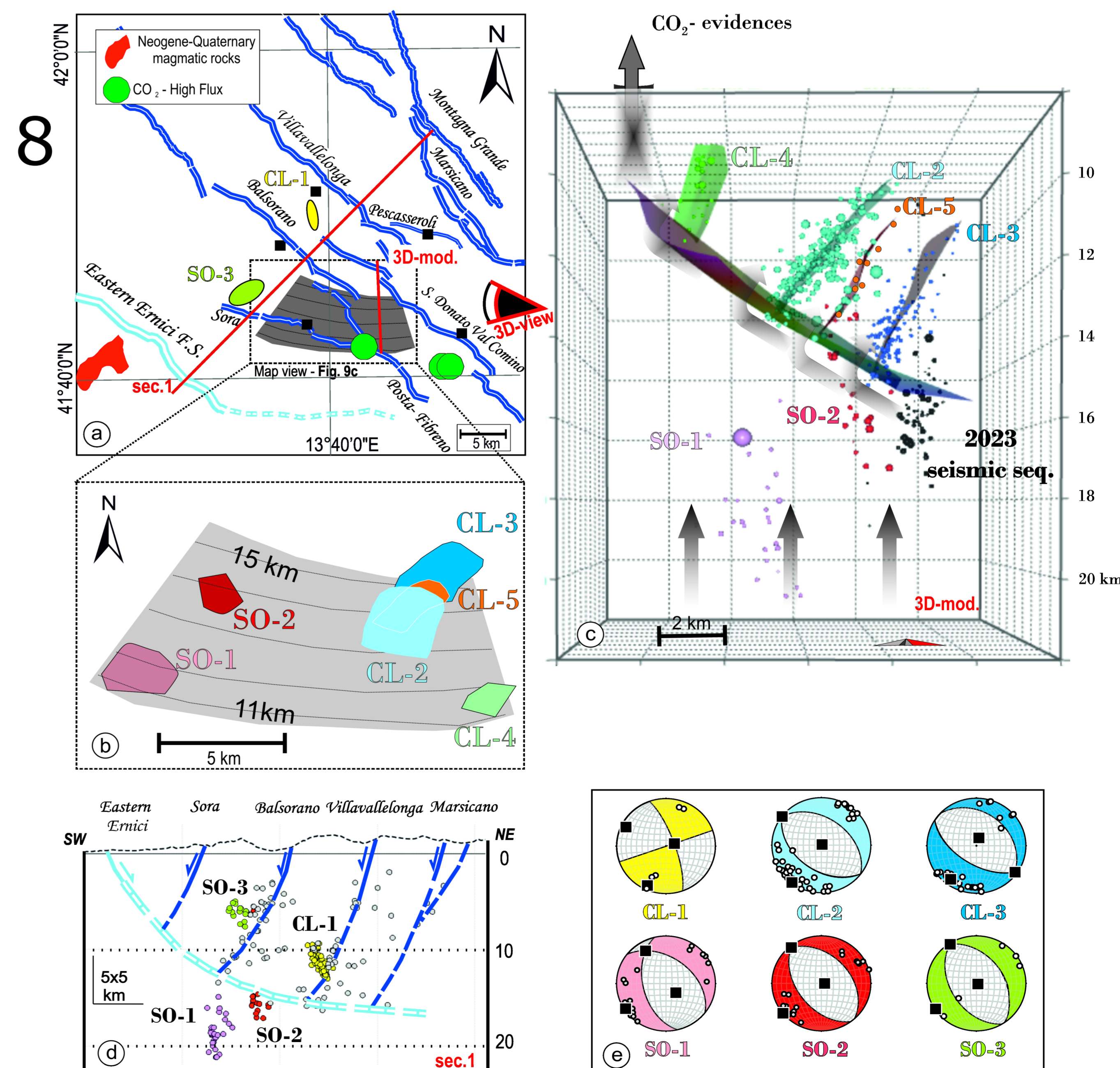


Figure 8 - Picture of the main results, fault surfaces and cross-section with the MOVE Suite software v. 2023, Petroleum Experts Ltd). (a) Active fault systems, CO2 measurements evidence of magmatic rocks, and CL-1 and SO-3. The grey area represents the WNW-ESE deformation band reconstructed using CL-2 to CL-5 clusters, and the red and grey symbol on the right represents the point of view of the 3D fault models. The red lines represent the traces of the section in panel (d) and the view of the 3D model (panel c). (b) Zoom of the WNW-ESE deformation band explicitly indicating the depth contour lines of the 3D reconstruction and the distribution of analyzed clusters. (c) The 3D models showing the seismicity at the hanging wall and footwall of the basal detachment. (d) SW-NE section view of the seismicity from 2009 to 2013. (e) Average focal mechanisms related to CL-1-CL-3 and SO-1-SO-3, computed considering Frepoli et al. data. Small circles plotted on the stereonets represent the T-axes of the single focal mechanisms, while black squares are the P, B, and T axes of the average ones.