Role of fluid on earthquake occurrence:
Example of the 2019 Ridgecrest and the 1997-2016 Central Apennines sequences

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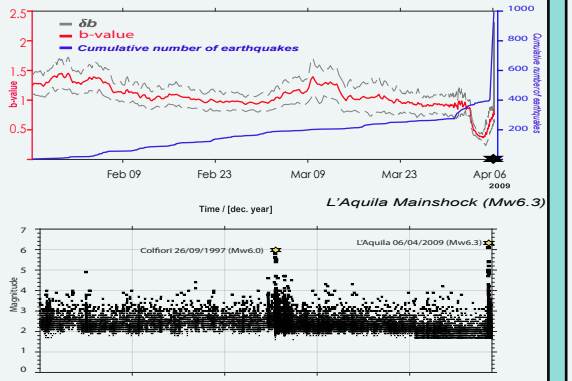
Introduction

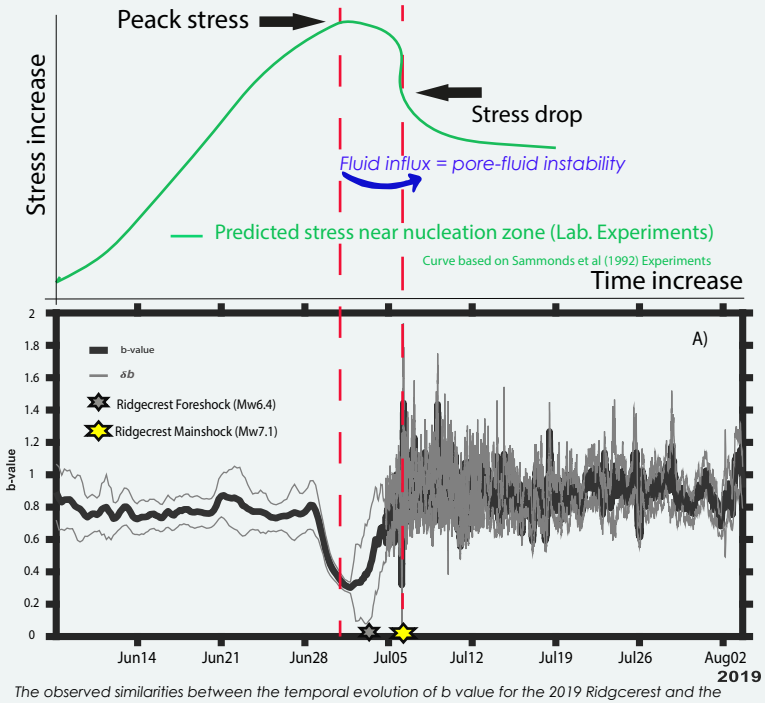
This present work tend to explore the influence of fluids migration on earthquake occurrence by analyzing the temporal evolution of seismicity for two active tectonic zones with available high quality dense seismic networks: the Central Apennine (Italy) and the Eastern California Shear Zone (ECSZ).
Two major earthquake sequences are studied in detail:
the entire 1997-2016 Central Apennine sequence and the 2019 Ridgecrest (California) sequence.
These two seismic sequences are explored in terms of seismic productivity and related fluid migration.
By analyzing the evolution of seismicity and stress distribution, I found a causative relation between the pore fluid effect and the Spatio-temporal evolution of crack growth before and during major earthquakes.
The results are also compared to the laboratory experiments for a better constrain the role of fluids on the different phases of earthquake generation.

The 1997-2009 Colfiori-L'Aquila sequences

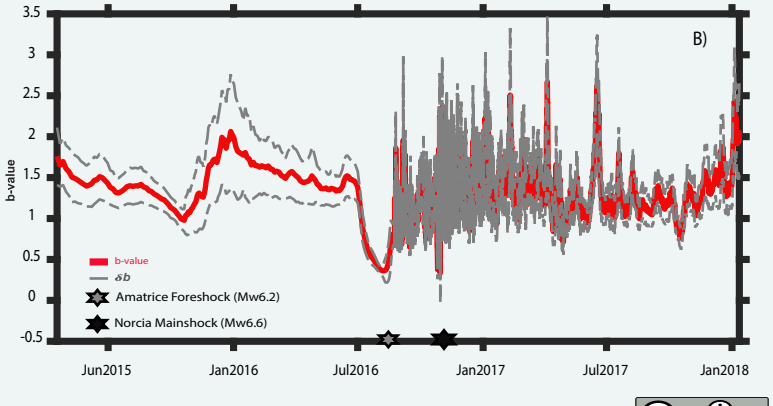


The analysis of the Time-magnitude series shows an apparent increase of small magnitude earthquakes accompanied by a decrease of the number of events with a magnitude M > 3.5 in the ~ months prior the 2009 L'Aquila mainshock. The time -magnitude variation is highly coupled with the gradual decrease in the b-value time series and interpreted here as an influx of pore fluid into a dilatant volume near the nucleation zone.

b-value times series: case of the 2019 Ridgecrest and the 2016 Amatrice-Norcia sequences



The observed similarities between the temporal evolution of b value for the 2019 Ridgcerest and the 2016 Amatrice-Norcia sequences may suggest an analog physical mechanism controlling the foreshock occurrence



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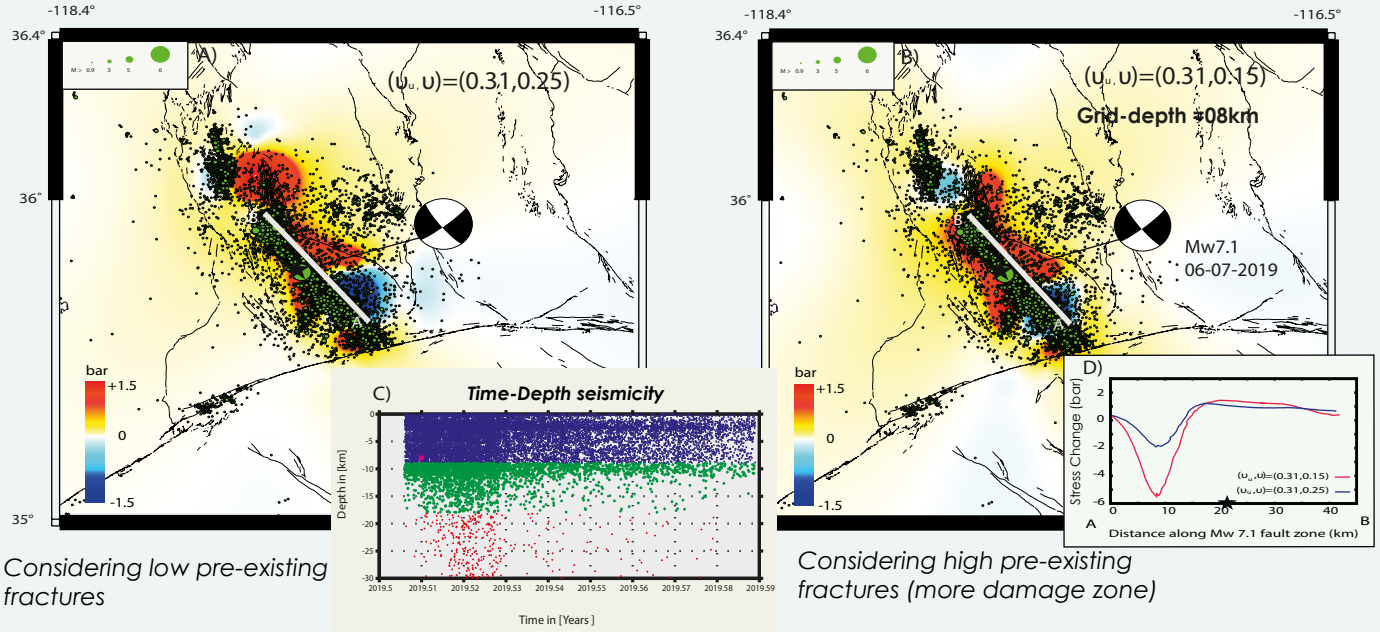
Poroelastic stress change modeling following the Mw7.1 Ridgecrest Earthquake

Cumulative stress change due to the full poroelastic relaxation of the Mw7.1 Ridgecrest earthquake.
The effect of stress redistribution is coupled to the temporal variation of the Poisson ratio from the undrained state of fluid (υu) to the fully drained state of fluid (υ)



Considering low pre-existing fractures

Considering high pre-existing fractures (more damage zone)