Institute of Geophysics
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Seasonal stress inversion, pore pressure and shape ratio trends of RTS in Song Tranh2 reservoir, Vietnam

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All data are available on the IS-EPOS platform

IS-EPOS PLATFORM

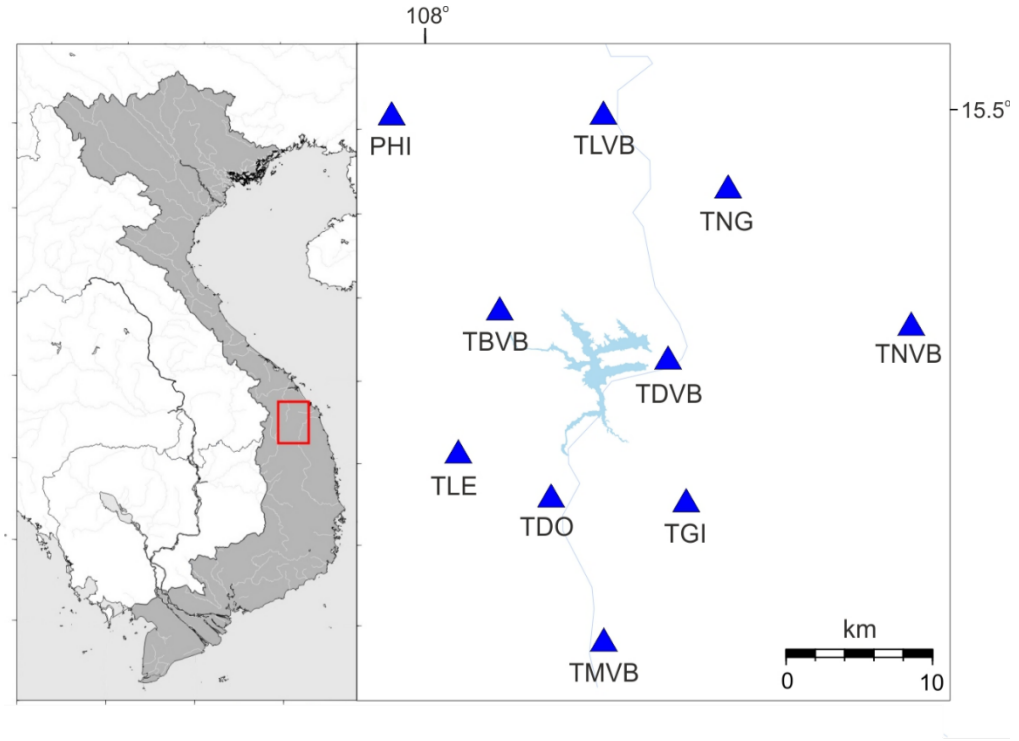
Resevoir triggered seismicity and reservoir induced seismicity

- "induced" describes seismicity resulting from an activity that causes a stress change that is comparable in magnitude to the ambient shear stress acting on a fault to cause slip;
- "triggered" is used if the stress change is only a small fraction of the ambient level.

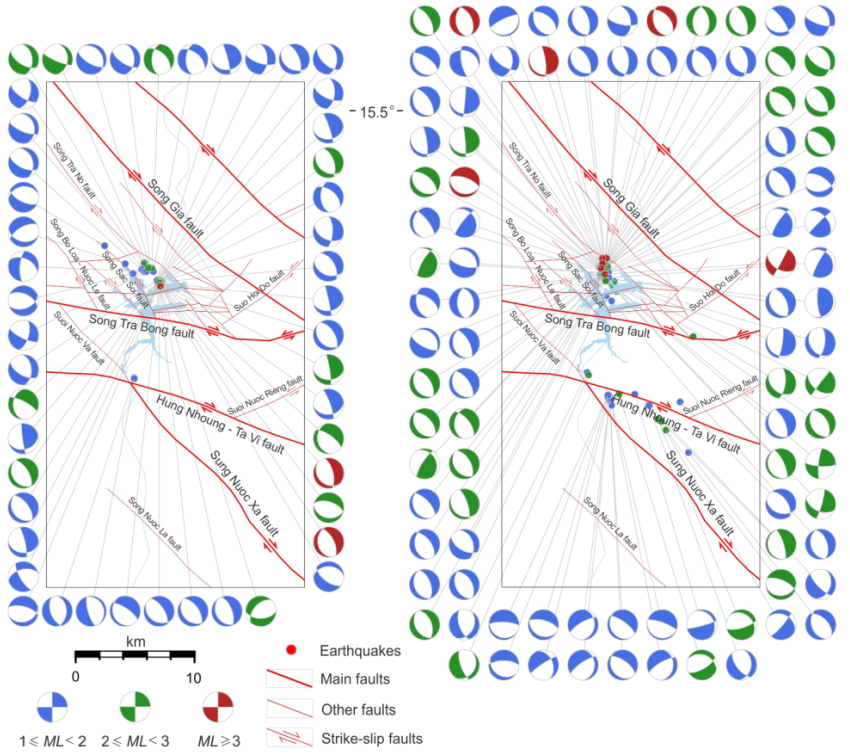
Data

- Song Tranh2 reservoir;
- 10 stations;
- 180 events of 0.7≤ML≤3.6 recorded between August 28, 2013 and October 19, 2016;
  - High water period between November and April (48 events);
  - Low water period between May and October (132 events);
  - Shallow events, usually not deeper then 8km;
  - Most of events occur in northern part of STH2 (northern cluster).

Song Tranh 2 reservoir

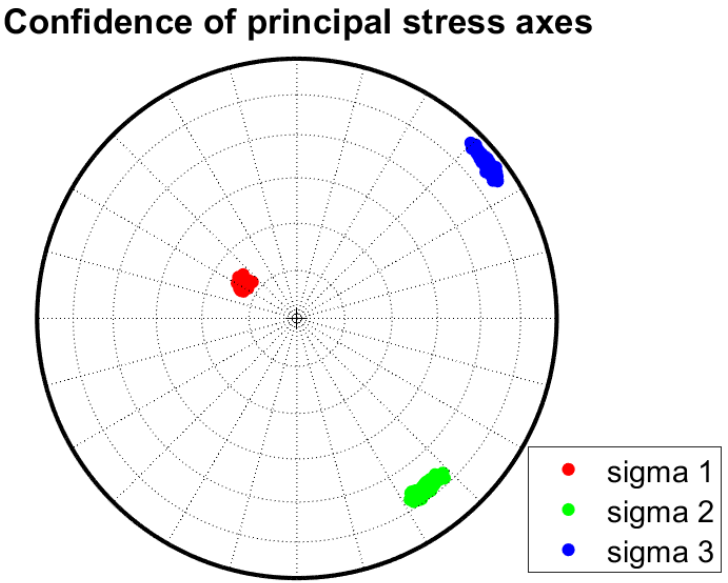


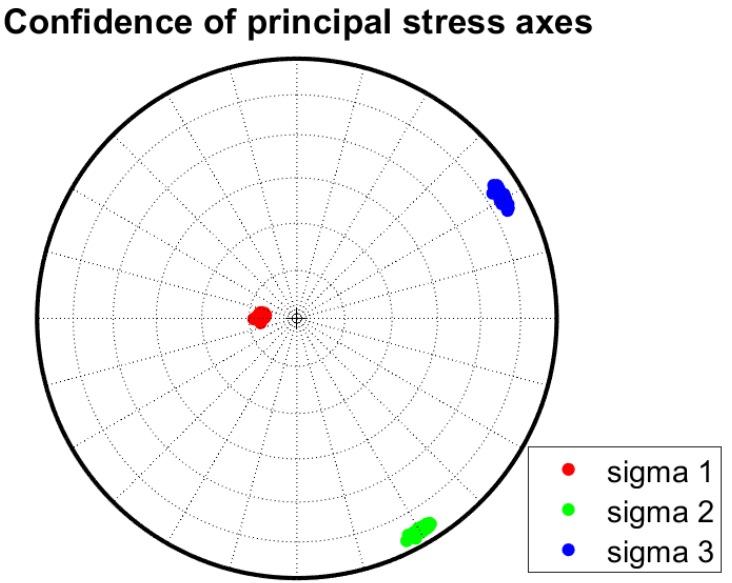
Location of STR2 and the seismic network.



Spatial distribution and focal mechanism examples obtained for the available data: high water period (left) and low water period (right).

Stress Inversion





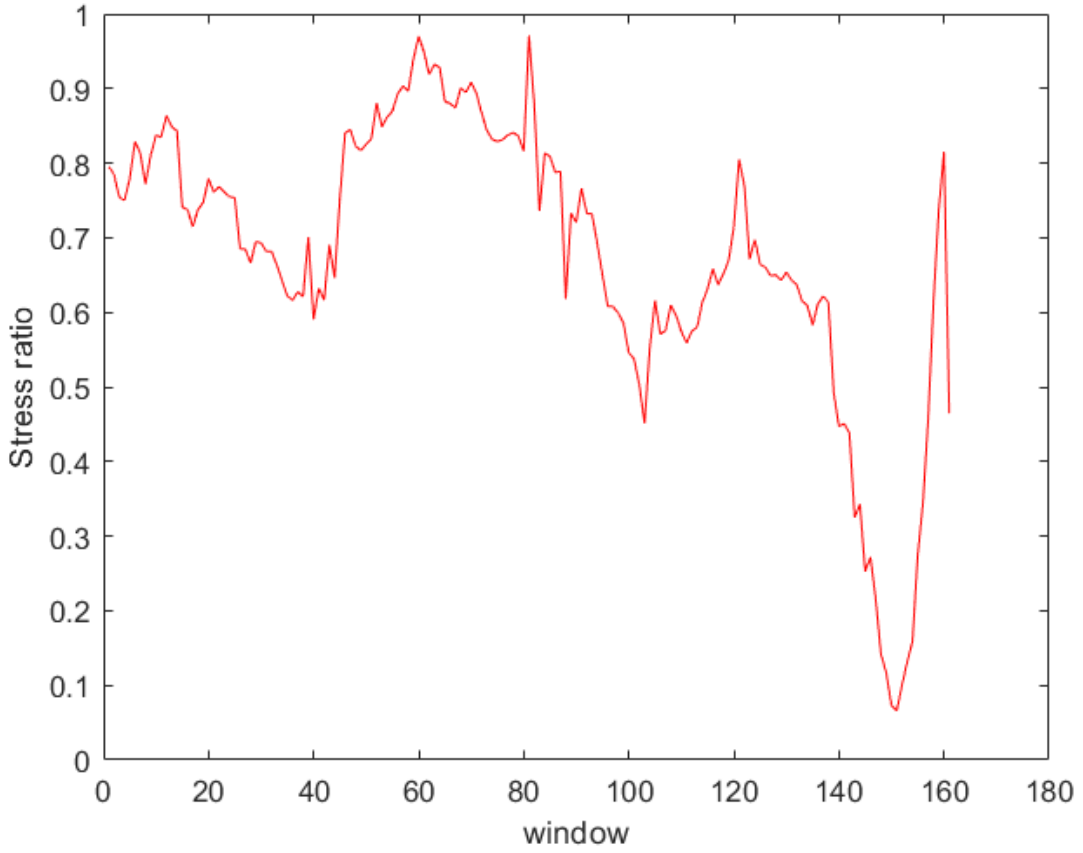
Principal stress orientation: high level period (left), low level period (right)

Shape Ratio

$$R = \frac{\sigma_1 - \sigma_2}{\sigma_1 - \sigma_3}$$

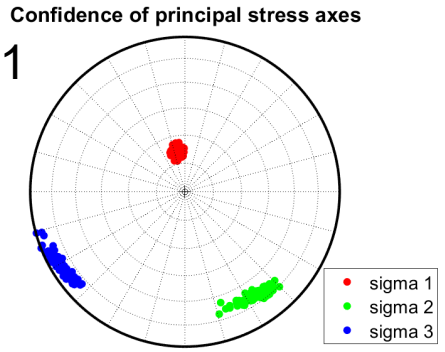
- Variations in R in relation to pore pressure, if detected, can have a physical origin but may also be spurious due to different inversion performance at different pore pressure levels.
- the catalog has been divided into windows of 20 events, shifted by 1

Results of Shape Ratio

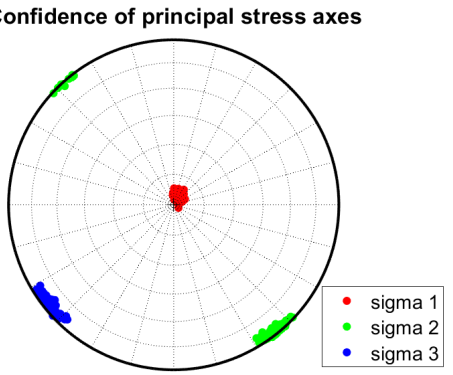


Results of Shape Ratio

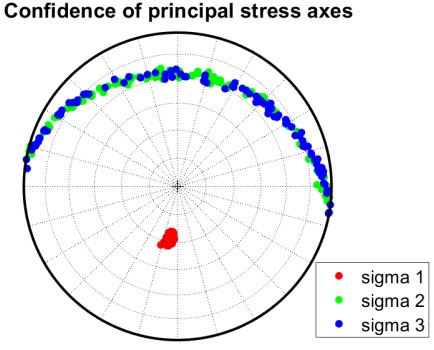
Window 11



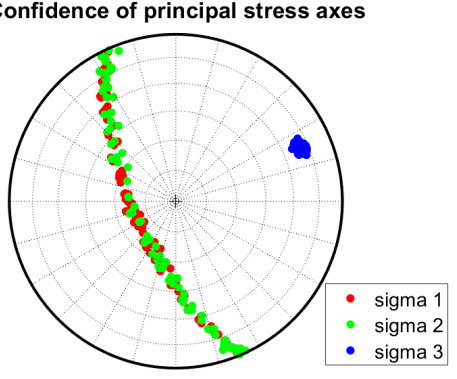
Window 55



Window 81



Window 151

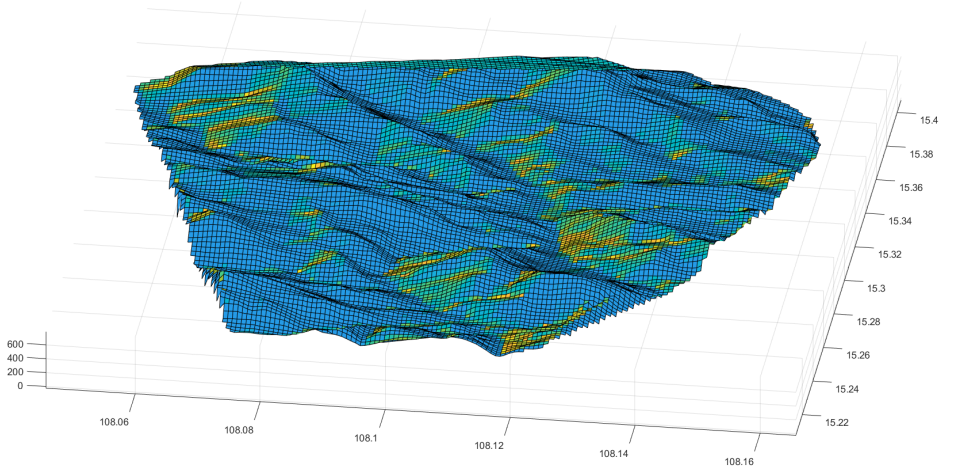


Future plans

Calculations of Coulomb Failure Criterion

Pore pressure analyssis

Calculations for Lai Chau reservoir

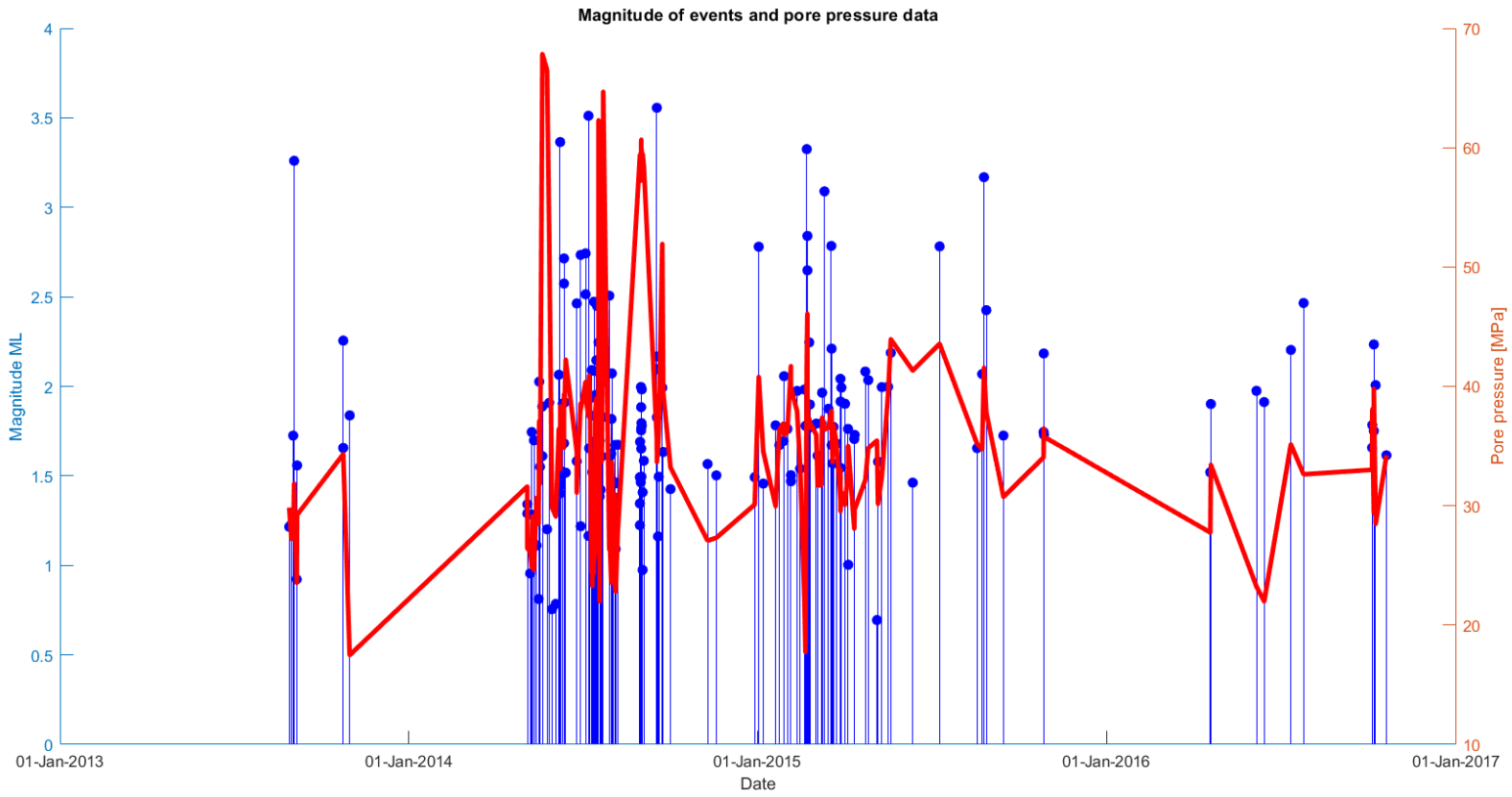


Pore pressure

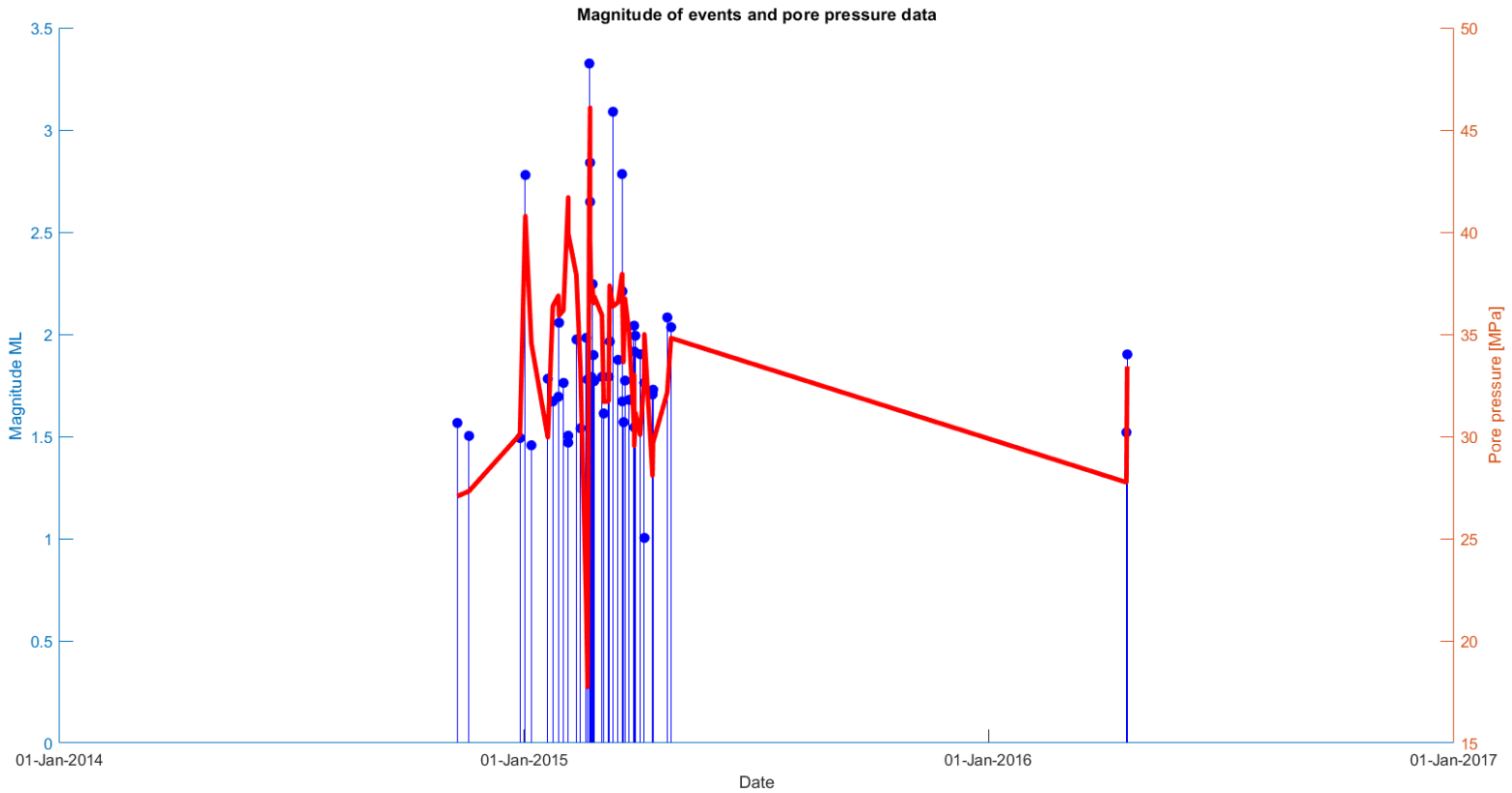
Water pore pressure reduces the normal stress within a rock while not changing the shear stress. Under any circumstances, an increase in water pore pressure means that a failure is more likely. The critical value of shearing stress may be made arbitrarily low by increasing the pore pressure.

$$Pp = \rho_w g z_w + \frac{dPp}{dz}\left(z - z_w\right)$$

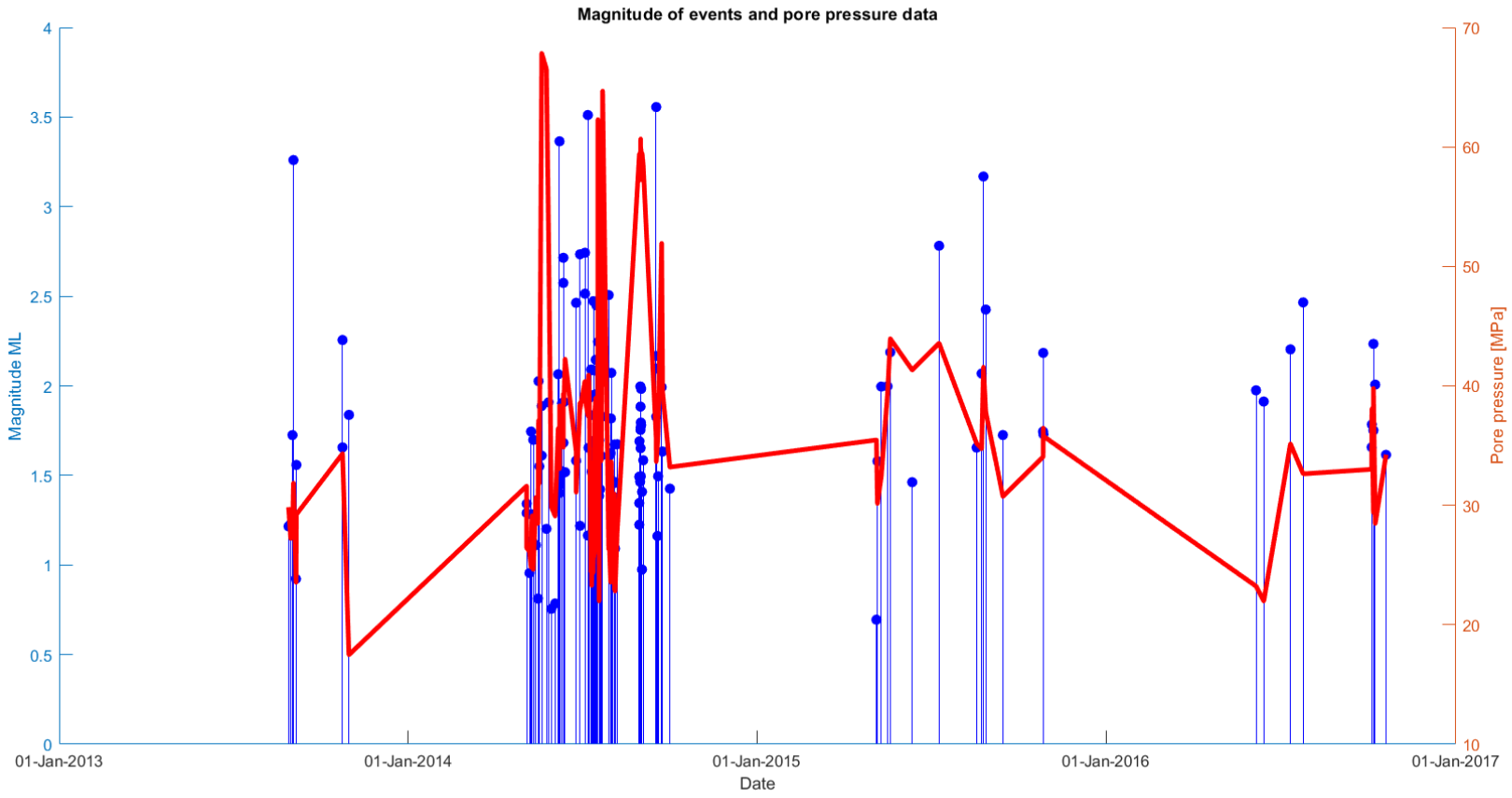
Results for whole period



Results for high water period

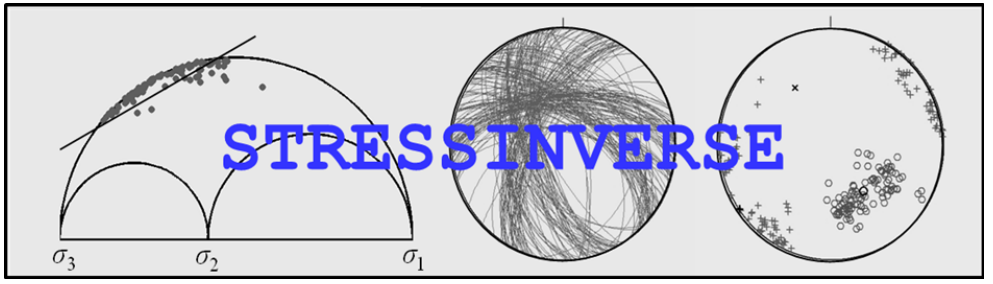


Results for low water period



Software

- IS-EPOS Platfrom (data events and water level);
- STRESSINVERSE by V. Vavryčuk;
- Matlab (sorting and selecting data).



Conclusions

- The principal stress σ1 orientation during high water levels is rotated about 30° toward the NW in comparison to the low water stress state derived from focal mechanisms.
- The Shape Ratio results showed instability for the extreme values of R and rotation of the principal stress (small numer of events in the window may also play a role)
- Significant variations of shape ratio are result of focal mechanism variability indicated by high and low water level stress orientations results
- The more variable nodal plane orientations the lower shape ratio
- Pore pressure data sugest that there can be some corelation between magnitude and pore pressure (especially visable for high water period)

References

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