SN.410.7.2024

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Doc réf. : Ineris - 228198 - 2829364 –

Jannes L. KINSCHER
Nancy. Mines Nancy - Campus ARTEM
92 rue du Sergent Blandan
BP 14234. F-54042 NANCY Cedex
Tel: +33 7 69 33 90 96
Mail: Jannes-L.Kinscher@ineris.fr

Institute of Geophysics of the Polish Academy of Science
Assoc. Prof.
Rafal Junosza-Szaniawski
Deputy Research Director
ul. Księcia Janusza 64
01-452 Warszawa, Poland
tel.: +48 22 6915-950
e-mail: office@igf.edu.pl

Nancy, April 11th 2025

Object: Review on PhD thesis by Izabela Nowaczyńska at the Institute of Geophysics of the Polish Academy of Science

The submitted PhD thesis entitled "Identification of Characteristic Features of Seismic Processes as a Tool for Differentiating Tectonic Phenomena from Human-Induced Events" by Izabela Nowaczyńska addresses current scientific investigations on the understanding of induced and triggered seismicity in the context of human made (water) reservoirs. The thesis works contributes to the scientific discussion about the cause and forecast of particularly large events M> 6 potentially caused in these environments which pose significant concerns in terms of seismic risk.

In this context the PhD candidate propose an original approach to highlight differences in the nature of seismic triggering applied for two different reservoir sites in Vietnam based on data sets provided by the EPOS anthropogenic hazard platform EPISODES. The PhD candidate demonstrates the capacity to appropriate, combine and developed advanced scientific methods and models and to adequately discuss the results in the context of the state of the art of current research. The approach combines a total of four methods allowing to characterize the stress state of the involved seismic faults and to evaluate the potential impact from the reservoir. At first, the stress field is constrained by inverting seismic focal mechanisms. Based on these estimates two quantities, namely the slip and dilatation tendency are calculated which allow to characterize the criticality and degree of opening (eventually related to higher pore pressures) of the involved faults. Finally, coulomb stress change modelling is applied to highlight critically stressed areas most likely affected by the hydromechanic impact of the reservoir itself. The approach is applied by assuming different water level stands of the reservoir. The results highlight significant differences in the constitution of the activated seismogenic faults likely related to the varying impact of the reservoirs which makes it a potentially powerful tool to distinguish between cases either reservoir induced and/or tectonically driven seismic activities. Considering the relevance of these results and the originality of the approach, the thesis work is thus worth to be published in an internationally high ranked peer reviewed journal.

My major questions and comments on the presented work are as follows:

1) Seismicity at the Lai Chau reservoir has been characterized widely tectonically driven. Nonetheless, as shown by Figure 10 the seismic rate seem to have been doubled since the reservoir filling. How can this behavior ("contradiction") be explained?

2) I wonder whether any changes in the stress field inversion results could be observed when considering source mechanism of events in the direct vicinity of the reservoir and when considering rather distant events. This way one may potentially image the local perturbation of the (tectonic) stress field by the reservoir.

3) Similarly, is there eventually any change in the dilatancy and slip tendency for the observed faults as a function of their distance to the reservoir?

4) The distinction between triggered and induced seismicity is commonly discussed by the "degree" of spatial and temporal correlation to the anthropogenic driving force. Would a more simple consideration on the spatial (distance to reservoir) and temporal (correlation to level changes) distribution have provided similar results/conclusions compared to the applied approach?

5) In terms of forecast would it be useful to calculate the slip and dilatation tendency on the (geologically) mapped faults (in the reservoir surrounding) in order to image zones of high criticality?

Secondly, I suggest a **major** revision of the manuscript in terms of readability, form, structuration and documentation of methods and results, discussion.
Main suggestions in this context are as follows (further comments can be found in the joined annotated pdf):

- Add numeration of the chapters and improve referencing to figures and chapters
- Reduce excessive repetitions (particular in the result section); this may be achieved by adding a more strict structure clearly separating between review, data, methods, results and discussion sections;
- Add a single chapter presenting the thesis motivation, objectives and strategy;
- "I" phrasing might be added to allow for easier distinction between contribution from the thesis work and previous works;
- A better embedding between text and figures is required; essential figures are missing illustrating the methods and the applied workflow (as an example: No Mohr Circle is shown, no schematic illustration of governing mechanisms causing induced seismicity in reservoirs); particularly it would be helpful to better illustrate/highlight somehow in which sense the combined approaches are dependent and complementary to each other;
- Parametrization and calculation FracTend and Coumomb 3 models and results should be better documented; results of different scenarios might be combined within single figures to allow for easier comparison.

Given the scientific value of the realized work, I recommend the acceptance of this PhD thesis for public defense under the condition of a preceding revision of the manuscript.

Nancy, April 11th 2025
Dr. Jannes L. Kinscher
Ineris, France