

Early Earth Plate Tectonics; A Universal or Craton Specific Feature? Implication from Poisson's Ratio Calculation of the Primary Melts

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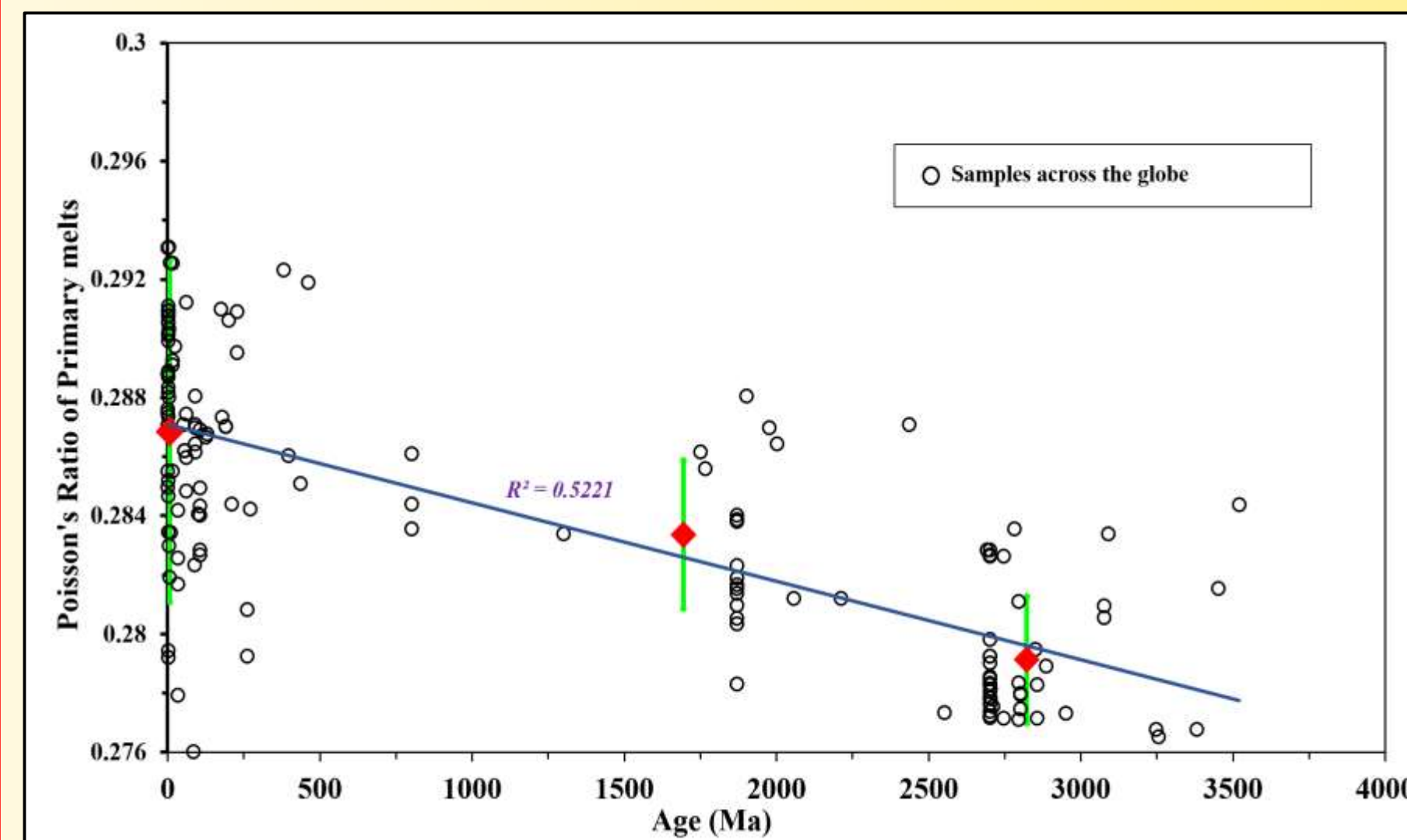
Materials and Methodology

1. Primary melt compositions and mantle potential temperatures (Tp) for mafic dikes, basalts across the globe ranging from Archean to present were calculated using PRIMELT3 of Herzberg and Asimow, (2015) considering a constant redox condition at the source ($\text{Fe}_{+2}/\text{Fe}_{\text{Total}}=0.9$). The final results of these calculations were checked geochemically and statistically to meet the program requirements.

2. Volume normative mineral% were calculated for these calculated primary melts.

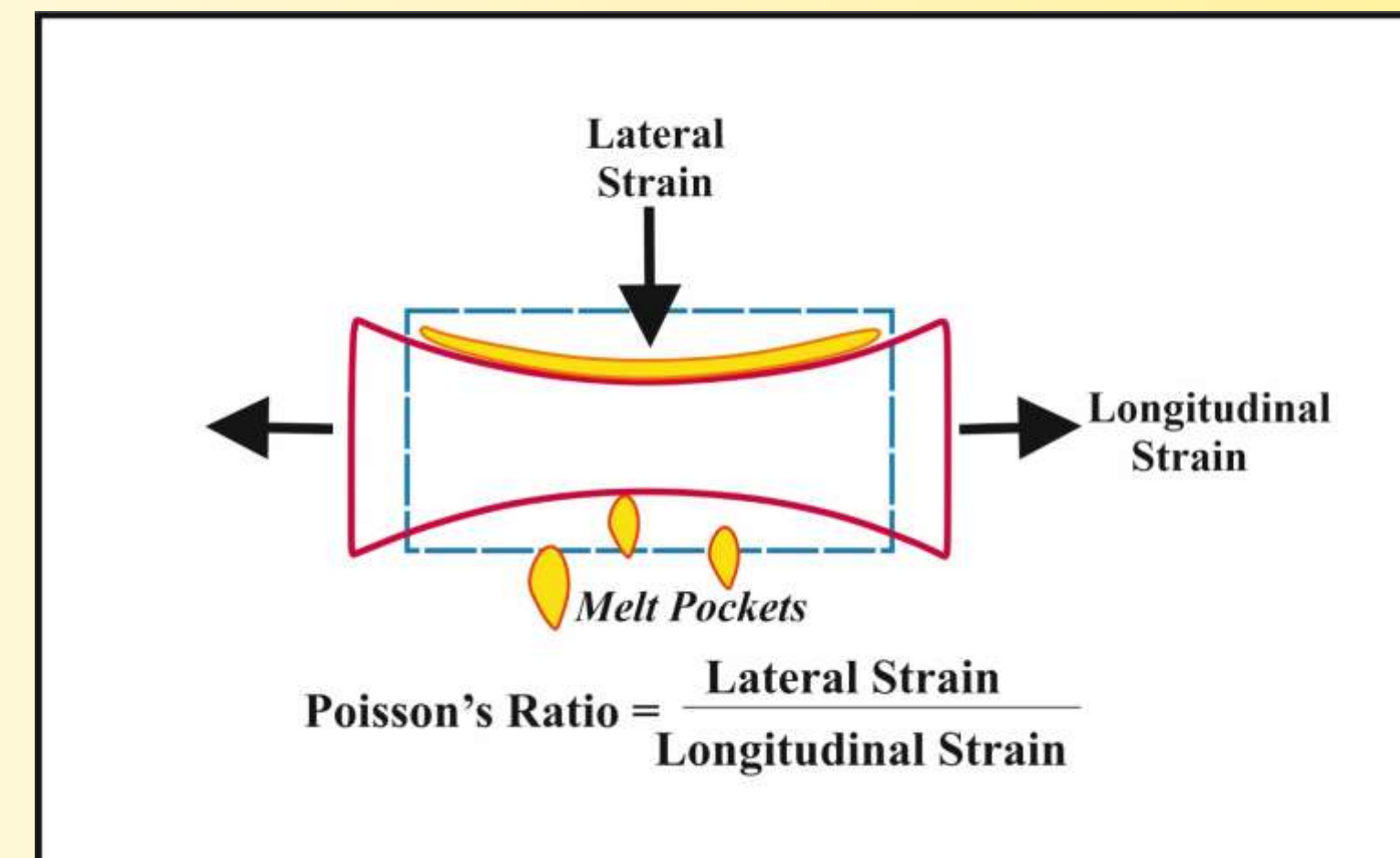
3. Physical properties of the primary melts were calculated using the volume normative mineral% utilizing the program by Abers&Hacker, (2016).

4. A comparison between Poisson's ratio of the primary melts with their ages is shown in the following figure.



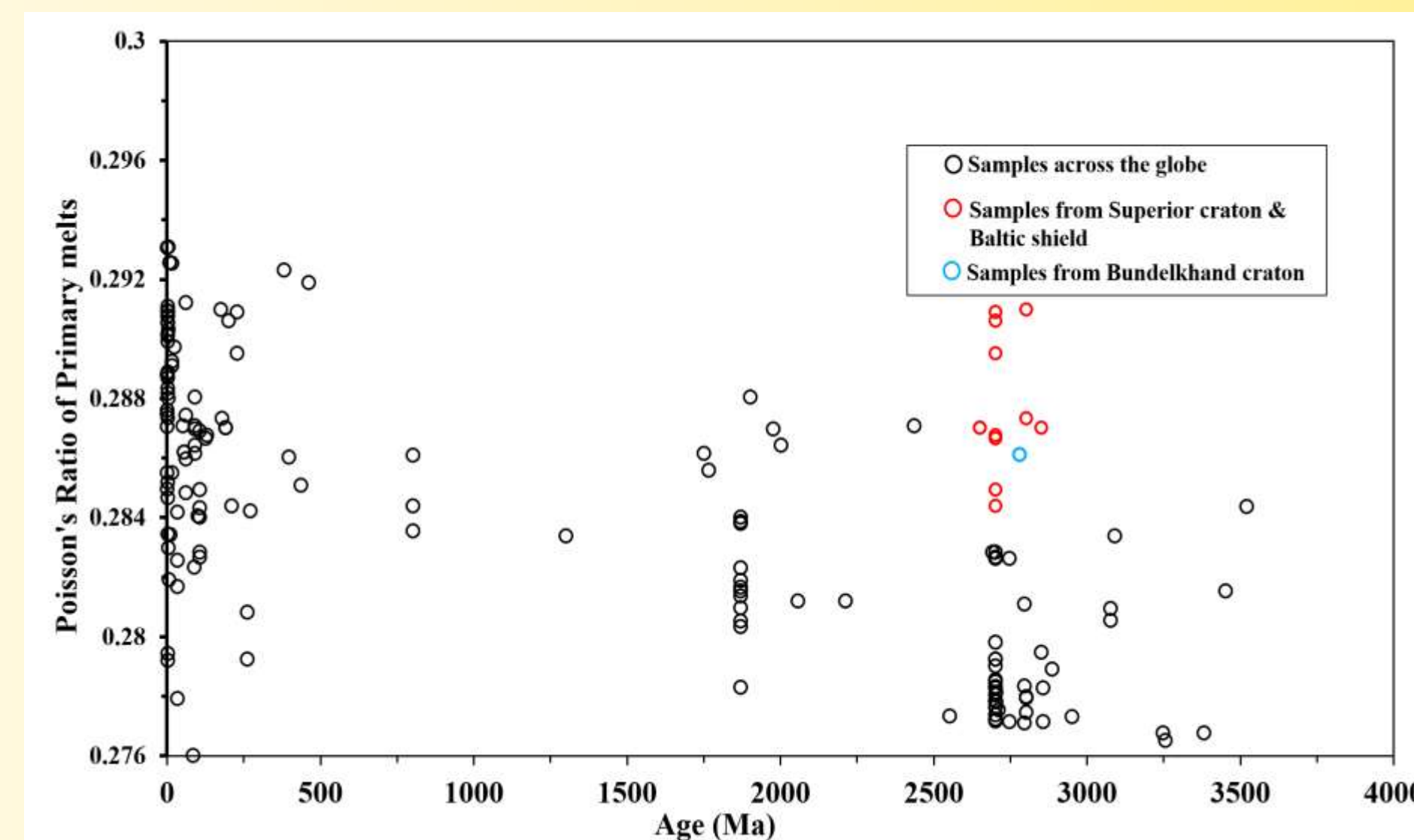
Rigid plate motion during Archean

1. Following is a figure illustrating Poisson's ratio



2. The Archean was characterized by high Tp values (>1500 degrees celsius) and low Poisson's ratio value. The minimum drop in Tp value was calculated to be 200 degrees celsius since the last 2.5 Ga.

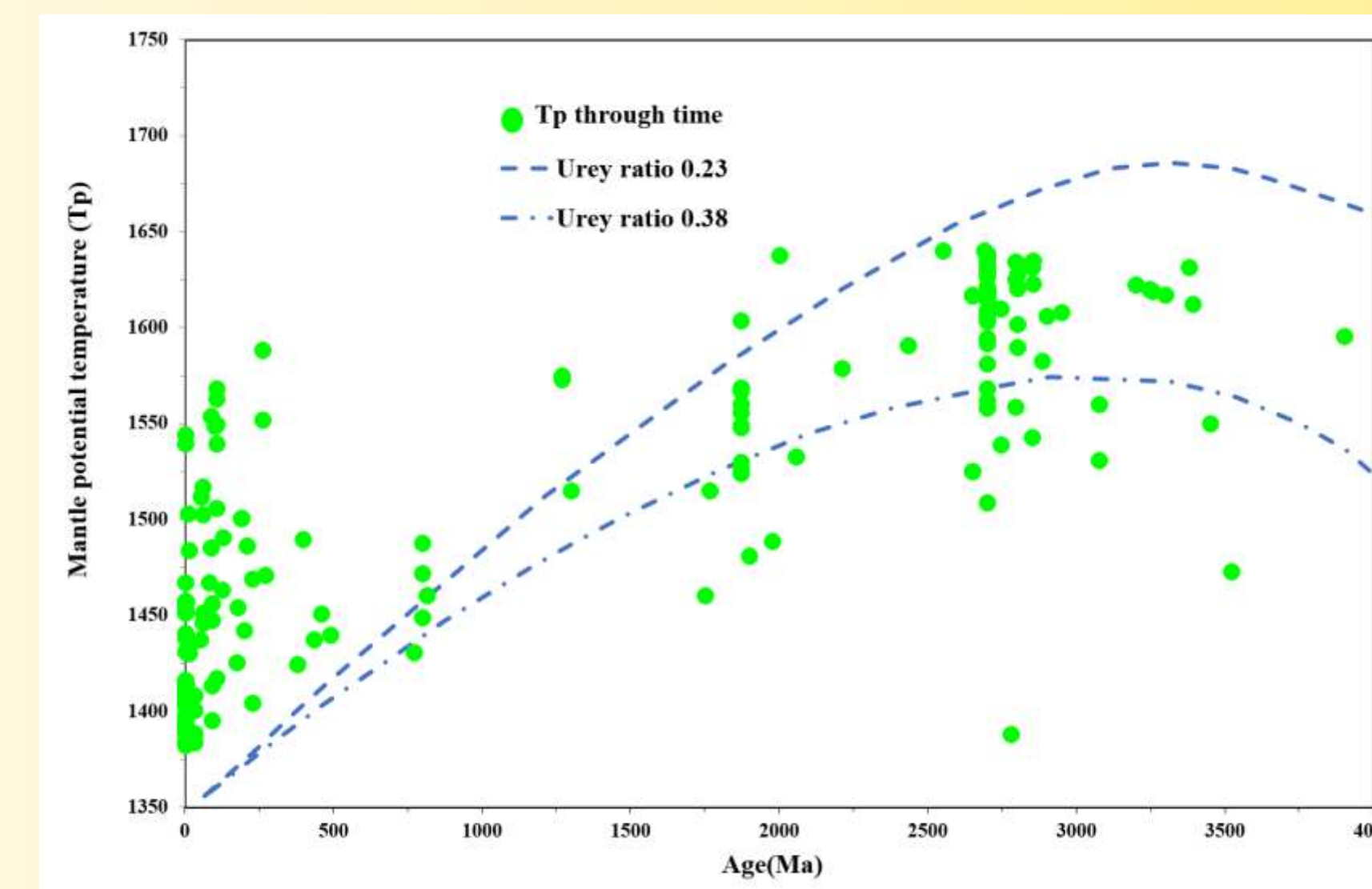
3. However, Archean samples from Superior craton and Baltic shield show high Poisson's ratio and high Tp values (1530-1638 degrees celsius).



High Tp and Mantle Overturn?

1. Sample from Bundelkhand Craton however shows low Tp and higher Poisson's ratio value during Archean.

2. Bédard, (2020, 2013); Stern, (2008) suggested intermittent mantle overturn periods during the Archean and showed the birth of subduction dominated plate motion at least during paleo-proterozoic.



3. The multiple peaks in Tp (data from this study and from Ganne and Feng, (2016))values around the globe, however, indicate a similar scenario for many of the cratons

Summary

•Archean was characterized by high Tp and low Poisson's ratio value for primary melts.

•Unlikely some cratons around the globe show a present-day-like Poisson's ratio value during Archean.

•Nevertheless, their high Tp is unlikely to represent a rigid present-day type tectonic activity.

•However, low Tp producing samples with a high Poisson's ratio during Archean seems to be a possible crustal composition that could have manifested subduction-related tectonic activity.

References

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