RESPONSE TO COMMENTS OF REFEREE #1 (Scott Johnson)

Referee's first comment: *How might the paleopiezometry estimates have been affected by grain growth at relatively high temperature (the abundance of triple-junctions speaks to at least some grain-boundary area-driven coarsening)?*
Author's response: We acknowledge that grain boundary area reduction may have modified grain size, and potentially influenced paleopiezometry results. To address the question of how much has the microstructure been modified by grain boundary area reduction, we quantified the type of plagioclase triple junctions in the three granulite xenoliths, which we used to estimate stress. We found that stable (~120°) triple junctions between plagioclase grains range from 6% to 21%, resulting in a partial foam microstructure (cf. Kidder et al., 2016, J. Struct. Geol.) We interpret this observation to suggest that plagioclase grains have only partly been affected by grain-boundary energy driven grain-growth. The two granulites with the highest number of stable triple junctions of plagioclase grains (15% and 21%) record lower differential stresses (12 and 14 MPa, respectively), compared to the xenolith with the lower number of stable triple junctions. It seems that the microstructure of these two xenoliths has been affected in some extent by grain growth, which could be associated with deformation during decreasing stress conditions.
Change in manuscript: We added new quantitative description of the type of plagioclase triple junctions and discussed the influence of grain boundary area reduction on piezometric estimates.

Referee's second comment: *How well do existing flow laws really reflect the deformation mechanisms dominating polymineralic rocks deformed in Earth time frames?*
Author's response and change in manuscript: We used the Dimanov and Dresen (2005) and Wilks and Carter (1990) flow laws, which describe plagioclase rheology in two-phase mixtures and polymineralic rocks, respectively. The Dimanov and Dresen (2005) flow law describes the rheology of plagioclase in synthetically produced plagioclase and clinopyroxene aggregates. The Wilks and Carter (1990) flow law describes the rheology of plagioclase in the Pikwitonei granulite, which is primarily composed of plagioclase and hornblende. To understand how well the Dimanov and Dresen (2005) flow law reflects the deformation mechanisms in our naturally deformed rocks, we compared the microstructural observations from the San Quintin xenoliths against the predictions of the flow law regarding the prevalent deformation mechanism. There is an agreement between the flow law and the microstructures that diffusion creep contributes significantly to the deformation of the granulites. We note, however, that the Dimanov and Dresen (2005) flow law may underestimate the contribution of dislocation creep in the studied granulite xenoliths.

Referee's third comment: *What are the errors on the quantitative estimates presented in this paper? Errors on temperature estimates feed back exponentially on rheology and viscosity estimates.*
Author's response and change in manuscript: In Table 1, we report the error associated with the estimation of the equilibration temperature using the two-pyroxene geothermometers. Moreover, in the last figure of the manuscript, we present how the error associated with the uncertainties in the estimation of the equilibration temperature propagate to the strain rate and viscosity estimates (horizontal error bars).

Referee's comment: *I think Fig. S6 might be good in the published paper if there is room. The near-random, random-pair orientation distributions are important 1st-order evidence for processes other than dislocation creep (in particular grain boundary sliding), despite the evidence in the finer-grained fraction for subgrain rotation recrystallization. In addition, the M- Index would be a superb way to quantify the fabric strength in this particular instance as it would really go well with the random-pair misorientation data.*
Author's response and change in manuscript: Following referee's suggestion, we included Fig. S6 to the paper. Moreover, we calculated the M-index for all the phases and added this information in the revised manuscript.

Referee's comment: *The paleopiezometers give differential stress. How did you go from differential stress to shear stress in Section 5.3 and Fig. 11? Maybe I misunderstand?*
Author's response and change in manuscript: Assuming strike-slip deformation, shear stress is half of the differential stress. We included this information in the revised manuscript.