Solid Earth Discussions

Solid Earth Discuss., referee comment RC1
https://doi.org/10.5194/se-2021-115-RC1, 2021

Comment on se-2021-115

Anonymous Referee #1

Referee comment on "Thermal equation of state of the main minerals of eclogite: Constraining the density evolution of eclogite during the delamination process in Tibet" by Zhilin Ye et al., Solid Earth Discuss., https://doi.org/10.5194/se-2021-115-RC1, 2021

Review of Delamination in Tibet: deriving constraints from the density of eclogite by Ye et al.

General comments
This paper established new equations of state for constituent minerals of eclogite and discuss the density of these minerals and eclogite in the mantle depth with implications for possible role of eclogite density in delamination of lower crusts and lithospheric mantle.

High-pressure and temperature experiments seem to have been done nicely in externally heated diamond cell to 700 K. However the experimental temperatures are low compared to the Debye temperatures of the minerals and its applicability to mantle temperatures needs some attention. The choice of the starting material needs clarification. Some of the wordings are not very clear to me, for example, eclogitization of lithospheric mantle does not make sense to me. Some equations are incorrect and wrongly used. I don't think the title represents what the authors studied here, as they did not discuss the mechanism of delamination in Tibet as a function of the density of eclogite; what they did is construction of EoS of the minerals. Therefore, I'm afraid that the current version is not at the publishable level.

Specific comments
1. The title does not represent what is done in this paper. The authors established EoS of minerals, calculated the density of eclogite and peridotite, and compared them. The only discussion they made regarding delamination processes is the percentage of eclogitizaiton when the rock density reaches the value for isostatic balance. I do not understand how this puts constraints on the delamination processes.
2. Why did they use natural samples as the starting material? As the authors said themselves (L300-302), natural samples may not represent what they were in the mantle due to retrograde metamorphism.
3. The thermal EoS was formulated using the high-T Birch-Murnaghan formulation. This is an empirical formulation to describe the high-T behaviour and an extrapolation to the

mantle temperature needs attention. Why did not the authors use a thermal pressure model such as using the Mie-Gruneisen relation? The authors should check the high-T behaviour of their EoS by calculating the thermal expansivity at high pressure; it should be increasing with temperature (which will be levelling off above the Debye T). To my eye, omphacite and epidote EoS seem to violate this rule at about 20 GPa, namely the thermal expansivity decreases with T.

4. Density is an intensive property and the simple average scheme cannot be applied to obtain the rock density.

5. Equations 1 and 4 are wrong. Not sure if these are typos, or the authors calculated those properties using these equations. If they did, all the calculations were incorrectly done.

6. Equation 2 is not needed here as the authors dropped off the higher terms.

7. I do not understand what it means by eclogitization of lithospheric mantle. Does this mean mantle peridotite is getting eclogite?