

## Comment on se-2021-152

Anonymous Referee #2

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Referee comment on "Progressive veining during peridotite carbonation: insights from listvenites in Hole BT1B, Samail ophiolite (Oman)" by Manuel D. Menzel et al., Solid Earth Discuss., <https://doi.org/10.5194/se-2021-152-RC2>, 2022

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### General comments:

In this manuscript carbonate-veined serpentinites and listvenites from the Samail ophiolite (Oman) are described using detailed mineralogical and petrographic observations, dominantly microscopy, CL imaging and SEM. Numerous generations of serpentine-, carbonate-, and quartz-veining are described in a lot of detail resolving the evolution of the carbonation sequence and discussing the mechanisms of carbonation by mineral replacement. This manuscript is very well written and well structured. It contains a very detailed results section presenting the petrographic observations of a large range of samples from the Oman drill core. Despite the large data set, the text can be followed well and distinctions between different groups of vein formation are clearly highlighted. Hence, the data is overall clearly presented and of high quality. There are a few suggestions concerning the mineralogy and the drivers for mineral carbonation that should be considered before acceptance of this manuscript:

- Were the different carbonate minerals only determined using the SEM? Or did you use any other techniques such as Raman spectroscopy or XRD? You mention that magnesite and dolomite were detected, but previous studies have also described the abundance of aragonite and calcite vein generations (see e.g., Ternieten et al., 2021, JGR). I would suggest determining the mineralogy of some of these veins e.g., by Raman spectroscopy for confirmation. Furthermore, I suggest to add a short summary in what way these vein generations differ or are similar to those described in e.g., Ternieten et al. (2021) (or other studies on the carbonates from the Oman ophiolite), which were done on similar drill core samples from the Oman drilling project.
- Furthermore, is there any change in mineralogy within these carbonate veins from early to later formation (i.e., vein generation)? And can you provide any information in what way the fluid conditions would have favoured the formation of magnesite over dolomite and vice-versa? Generally, how did factors (as those for example mentioned at the beginning of section 5.2) control the precipitation of magnesite versus dolomite versus potentially calcite or aragonite that occur in some of these drill cores?
- Finally, it would also be useful to state how the mineral replacement from peridotite to

a magnesite-quartz rock proceeds. You mention in the discussion that carbonation proceeds via mineral dissolution. What would drive mineral dissolution and replacement in these veins (see e.g., in lines 474/475)? Can you infer the conditions that would have driven mineral replacement rather than simple filling of fractures? It would be good to further expand on these points.

Specific comments:

Line 15: It would be better to specify throughout the text if you are talking about magnesite and/or dolomite veins.

Line 19-20: Same as above, it would be better to specify what carbonate minerals make up the veins, since dolomite is also a carbonate mineral.

Line 33: add the meaning of the abbreviation of IPCC.

Line 72: You can already add here a reference to Fig. 1

Line 202: To me these magnesite veins look rather random than following the serpentine mesh texture. It might be better to use a thin section image here rather than a BSE image where the mesh texture is not visible.

Line 255: "Sq1" □ It would be useful to label these types of veins in Fig. 5a.

Line 257: Was the resolution of the EDS maps high enough to reveal nanometer-sized mineral inclusions? What is shown in the figures is all only resolvable to the micrometer scale.

Line 278: Is there any theory why the magnesites follow the mesh rims, but the center of the serpentinite-mesh texture was replaced by quartz?

Line 313: What is the evidence that these are silica nano-inclusions? Is this only based on

elevated Si contents in the EDX maps? Or did you detect them as individual mineral phases using the FE-SEM? Fig. 7f only shows an overview BSE image, but does not allow the identification of nanoscale mineral phases.

Line 369: might be simpler to just call this "microcrystalline quartz" rather than chalcedony.

Line 386: it would be good to label the panels in Fig. 10 with a,b,c etc. and then refer to them when discussing the different stage of rock formation below.

Line 392: Is there a reference for the serpentinization temperature?

line 400: "ellipsoidal/spheroidal grains" □ Are these single grains or mineral aggregates? Typically, single carbonate grains are not ellipsoidal when they precipitate.

Line 401: specify in which panel this is seen: Fig. 10b?

Line 426: It would be useful to have the sequence of reactions that take place during serpentinite replacement written out somewhere, such as:



Line 427: "steps (4) – (8)" □ Do you mean here the steps described above? If yes, it would be useful to use roman numbers here.

Line 436: This should be Schwarzenbach et al., 2016 (please also adjust the reference list)

Line 449: Did you find any evidence for nano-porosity in these samples when studying them with the SEM?

Line 507: Did you determine if the serpentine veins, that are partly replaced by carbonates, are either chrysotile or lizardite, e.g., using Raman spectroscopy?

Fig 2 (line 855): In what way are these carbonate veins pseudomorphic? Pseudomorphic after which mineral phase? Please specify.

Line 863: "partial replacement by magnesite and crosscut by zoned carbonate veins"  are the carbonate veins not also magnesite? Or are there any other carbonate mineral present in these veins?

Fig. 4 (line 873): Which elements were measured in this thin section and are shown in the composite-color EDS maps?

Fig. 4g: What is shown by the yellow arrow? Please add this to the figure caption.

Fig. 5 (line 930): Please label the carbonate and quartz in Fig. 5d and e. What does "ViP xpol" mean?