

This work investigates mineralogy of micro-inclusions in the EGRIP ice core with multiple methods, including Continuous Flow Analysis, optical microscopy and micro Raman spectroscopy.

As far as I know, this is one of the most detailed studies on the microstructural distribution of impurities in polar ice.

Because impurities are not only important climate proxies but also considered to be factors controlling various physical properties of polar ice such as ice deformation, results of the work will be interesting for many potential readers.

However, in the present state, it is not clear whether the main findings of this study (the diversity in mineralogy) is correct or not, due to the critical lack of information (results and discussion of Raman spectra).

Figure 3:

Raman shifts of the three spectra shown in the figure are considerably (about  $5\text{ cm}^{-1}$ ) larger than those reported in previous studies: for example, the position of the main peak for feldspar is  $508\text{ cm}^{-1}$  (e.g. Sakurai and others, 2011), that for gypsum is  $1008\text{ cm}^{-1}$  (e.g. Ohno and others, 2005; Sakurai and others, 2011), that for quartz is  $465\text{ cm}^{-1}$  (Sakurai and others, 2011). Although a small difference in Raman shift (a few  $\text{cm}^{-1}$ ) between reports may be caused by differences in apparatus and/or calibration method, this discrepancy is too large. Information about how the apparatus was calibrated and the accuracy of Raman shift (spectral resolution) must be shown in the paper.

Figure 3:

My understanding is that one of the highlights of this work is to investigate the variety of minerals, including previously unreported species. However, Raman spectra being the key in analyzing the chemical forms of micro-inclusions are shown only for the three minerals in the paper. To verify the statements about the diversity in mineralogy, spectral information about the other minerals are needed.

Lines 205-206: "Sulphates can be difficult to distinguish due to tiny differences in Raman spectra, but most sulphates were identified (Fig. 4B)."

Indeed, it is difficult to distinguish some sulphates, especially between Mg-sulphate and Na-sulphates due to tiny (about  $1\text{cm}^{-1}$ ) differences in the position of the main peaks (Ohno and others, 2005). Therefore, many earlier works (e.g. Ohno and others, 2006; Sakurai and others, 2011) hesitated to distinguish the two sulphates, and reported

peaks around 989-990  $\text{cm}^{-1}$  as Mg-sulphates and /or Na-sulphates. I want to know how the authors told Mg-sulphates from Na-sulphates using the “compact” spectrometer (the spectra must be shown). As a rule, focal Length of a compact spectrometer is short, resulting in low spectral resolution.

Lines 207-208:” Spectra with a strong peak at 1050  $\text{cm}^{-1}$  probably indicate K-nitrates while a strong peak around 1070  $\text{cm}^{-1}$  might indicate Na-nitrates (Ohno et al., 2005).” The direct comparison with the spectra by Ohno and others (2005) is not inappropriate. As mentioned above, for some reason, Raman spectra in the present work are shifted by approximately 5  $\text{cm}^{-1}$  compared with those of the previous study.

Figure 4:

It is difficult to distinguish some minerals because of similar colors. In addition to different colors, the use of different patterns will be helpful to differentiate mineral species.

Line 233:”below a depth of”

Above?

Lines 304-305:” We identified most sulphates as gypsum or Na-sulphates, which agrees with e.g., Ohno et al. (2005); Eichler et al. (2019) (Fig. 4B).”

The statement of this sentence inconsistent with the Fig. 4B. The figure shows that Na-sulphates (yellow) is a minor species.

Line 479: “26 different spectra were identified”

All 26 spectra should be shown in the paper. Also, Raman peak assignment by comparing those with reference spectra must be done. First, the spectral information is essential to validate the identifications. Second, if the identifications are correct, the spectral information will be very valuable for potential readers.