



Extreme weather event recorded in fine-grained cryogenic cave carbonates from a permafrost cave in northeast Greenland by $^{230}\text{Th}/\text{U}$ and ^{14}C dating methods

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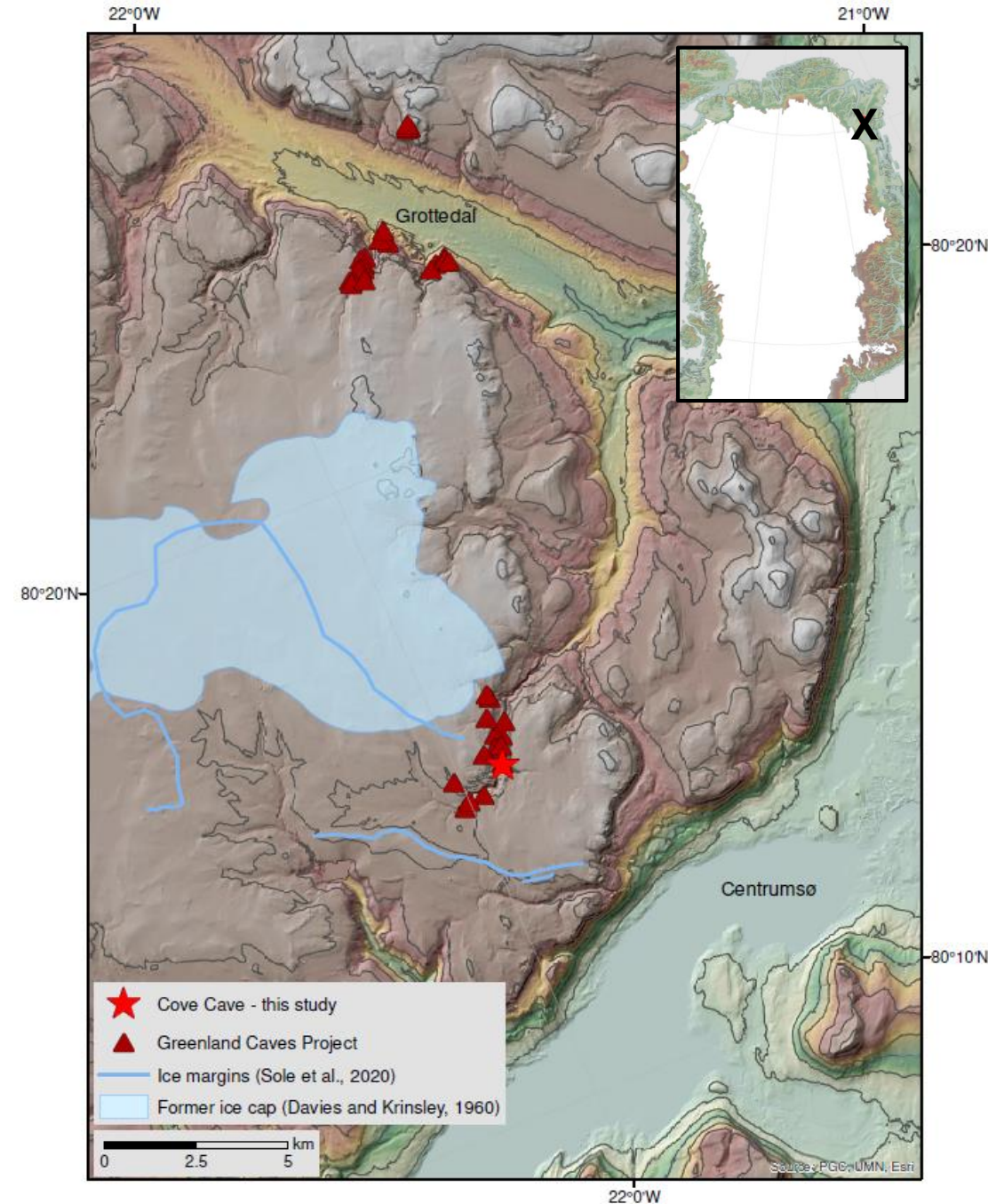


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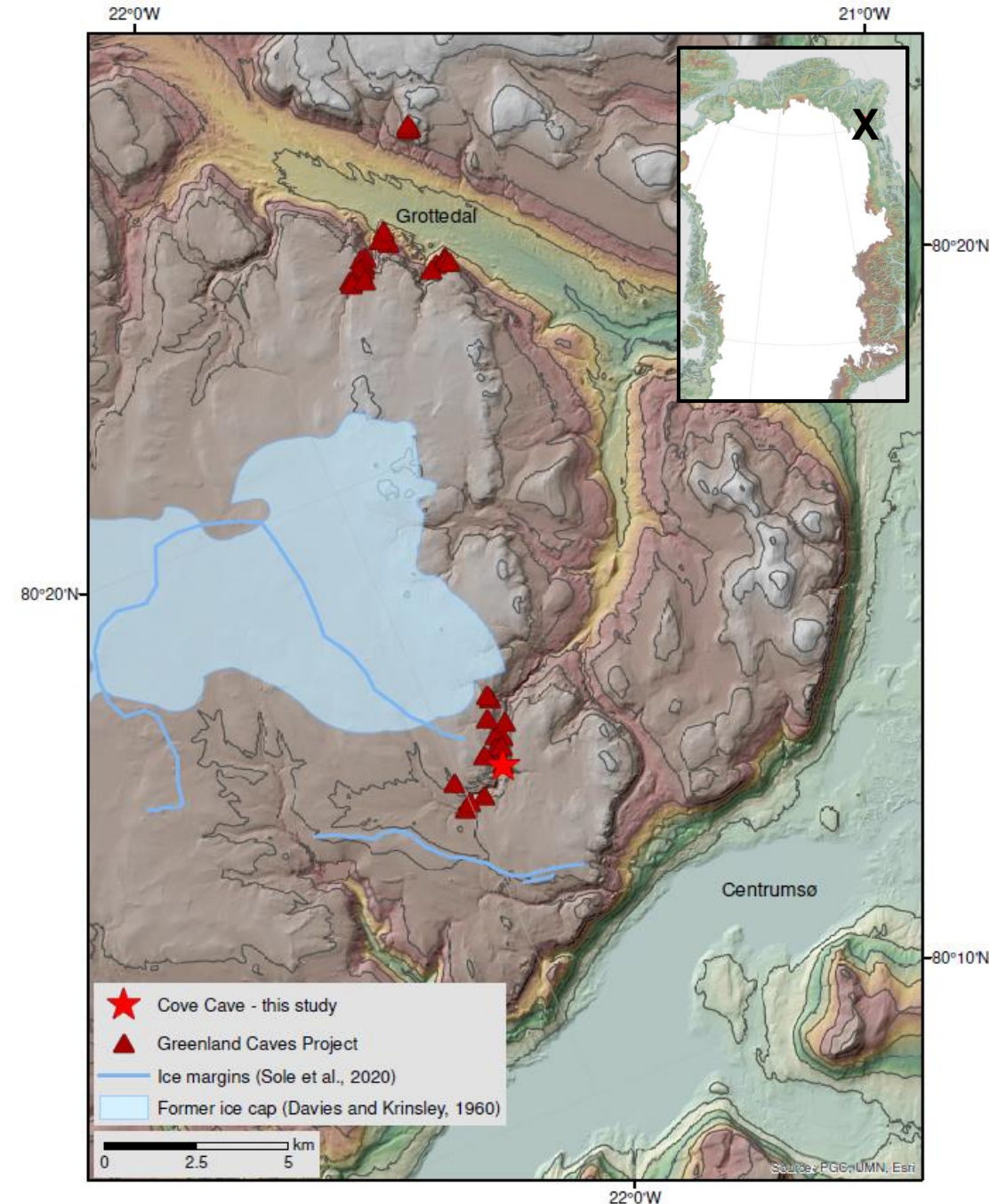
Aims

1. Investigate CCC_{fine} from the high Arctic
(morphology, mineralogy, stable isotopes – not part of this talk)



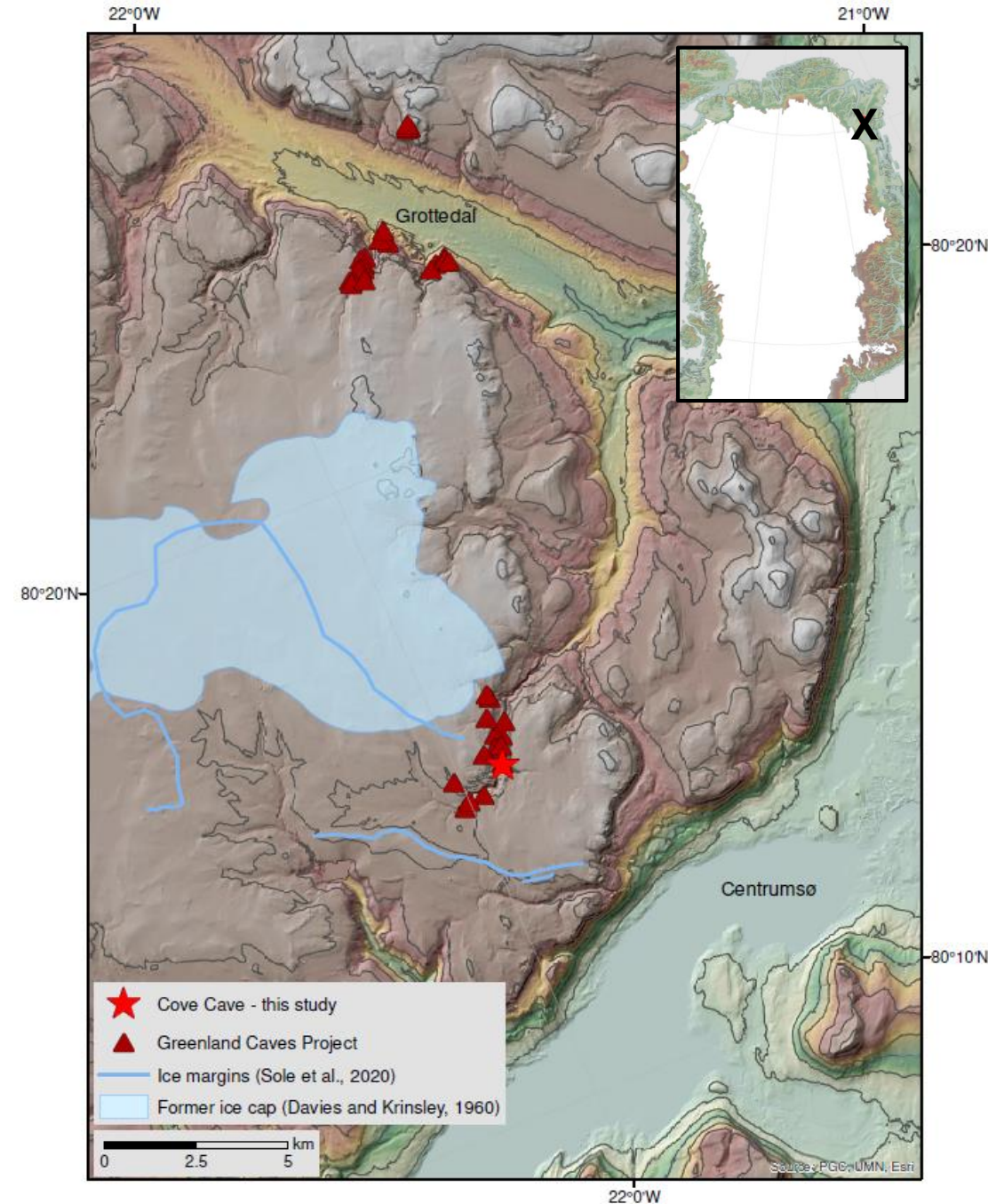
Aims

1. Investigate CCC_{fine} from the high Arctic (morphology, mineralogy, stable isotopes)
2. Precisely date CCC_{fine} with $^{230}\text{Th}/\text{U}$ and ^{14}C methods
 - Previously, $^{230}\text{Th}/\text{U}$ dating has suffered from poor age precision due to high detrital Th contamination in CCC_{fine} (Spötl and Cheng, 2014)
 - Also, large uncertainties in ^{14}C dating associated with estimating the initial radiocarbon activity and the dead carbon fraction (DCF; Lauriol and Clark, 1993)



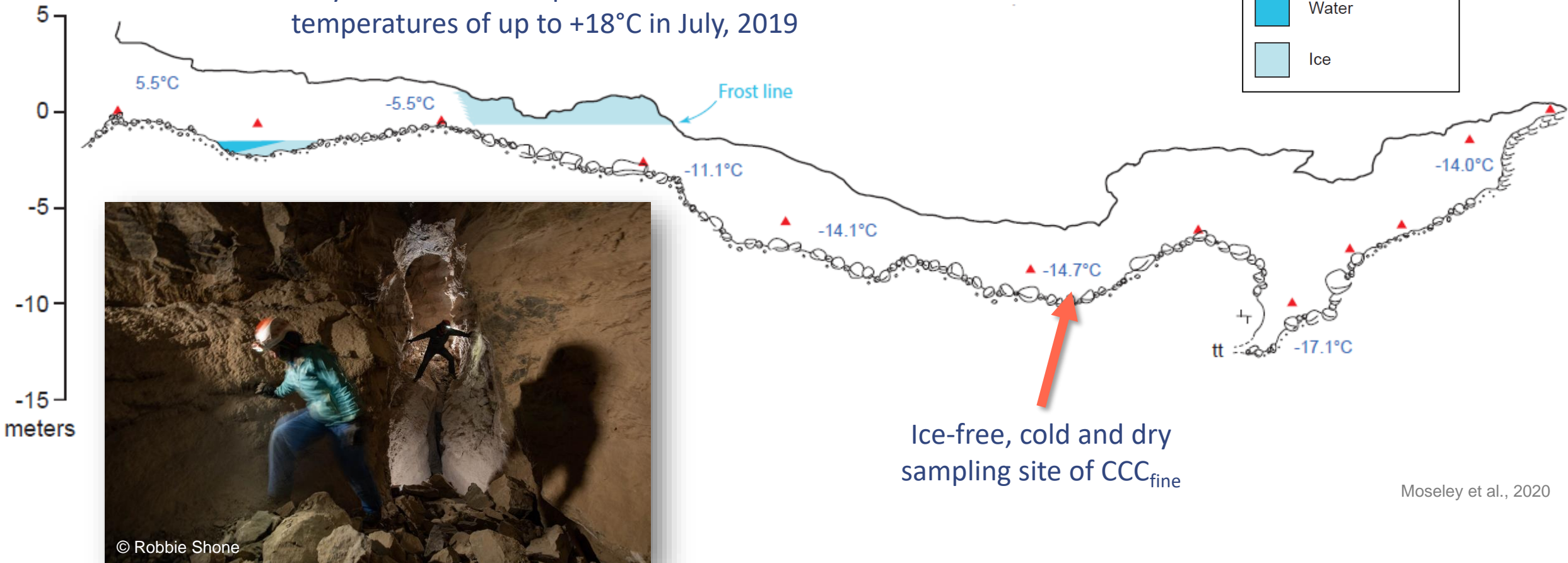
Aims

1. Investigate CCC_{fine} from the high Arctic (morphology, mineralogy, stable isotopes)
2. Precisely date CCC_{fine} with $^{230}\text{Th}/\text{U}$ and ^{14}C methods
3. Identify trigger for CCC_{fine} formation
 - was this trigger linked to palaeo-climate or -weather events?



Eqik Qaarusussuaq/Cove Cave

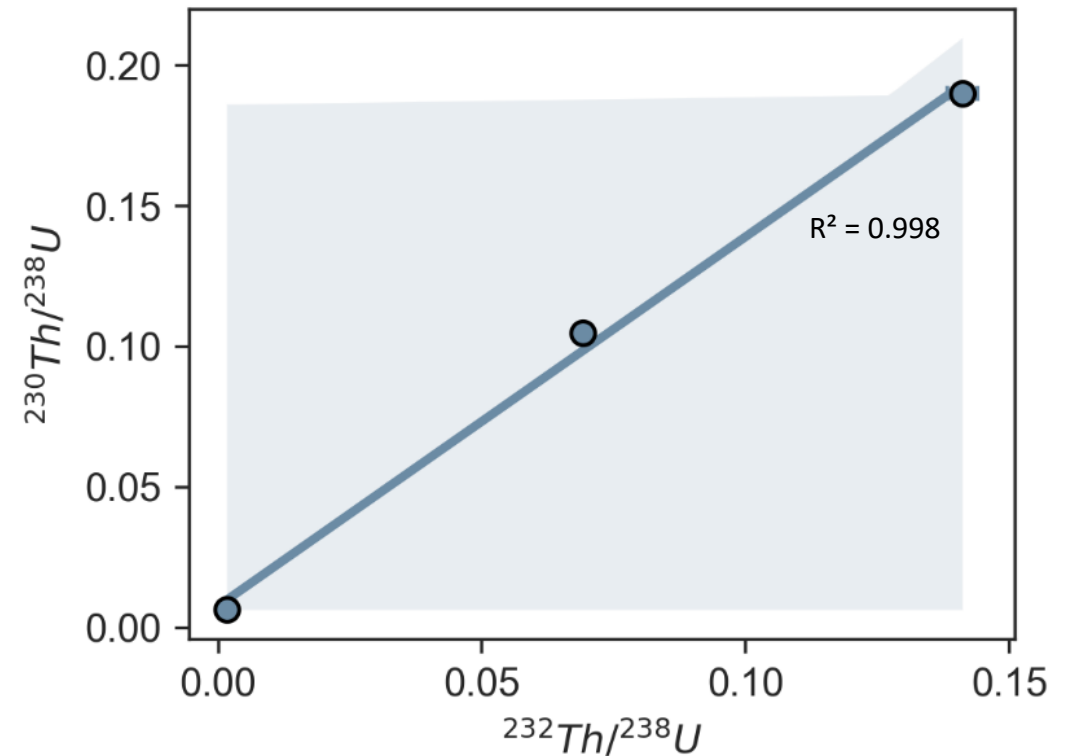
- cave situated in continuous permafrost
- no ventilation at sampling site in summer
- very low cave air temperatures contrast with outside air temperatures of up to +18°C in July, 2019



Moseley et al., 2020

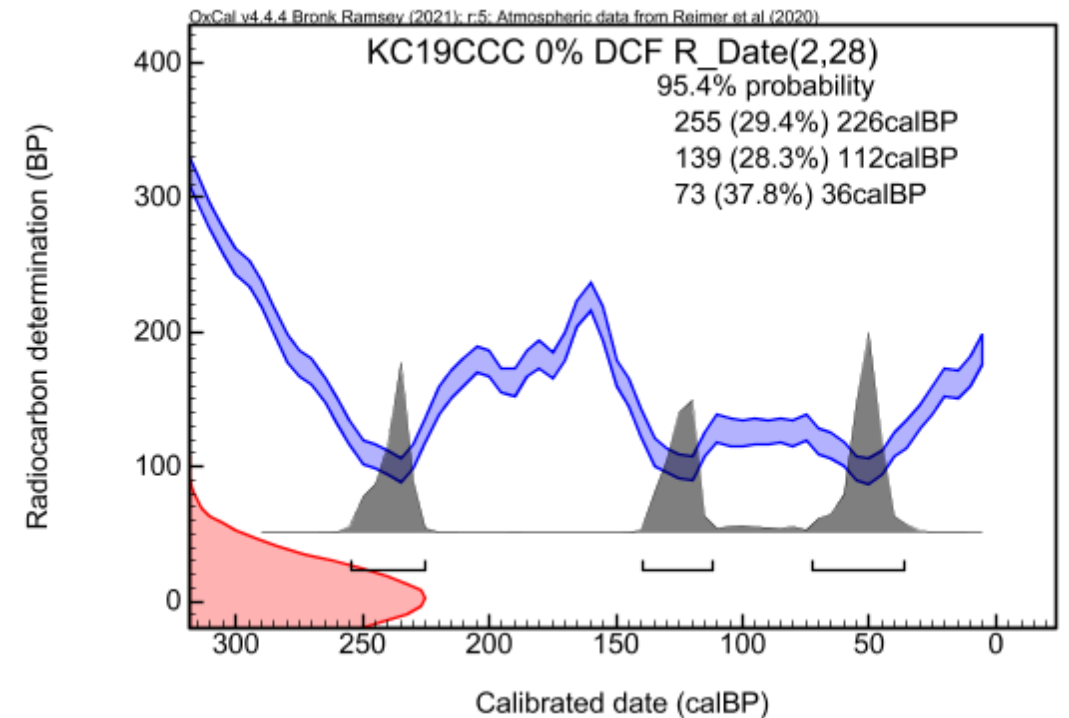
Dating approach - $^{230}\text{Th}/\text{U}$ dating

- isochron construction to mitigate effects of detrital Thorium
- maximum-likelihood isochron
- yields a $^{230}\text{Th}/^{232}\text{Th}$ initial activity, which can be used to correct individual ages
- also gives an isochron age of 65 ± 20 a BP



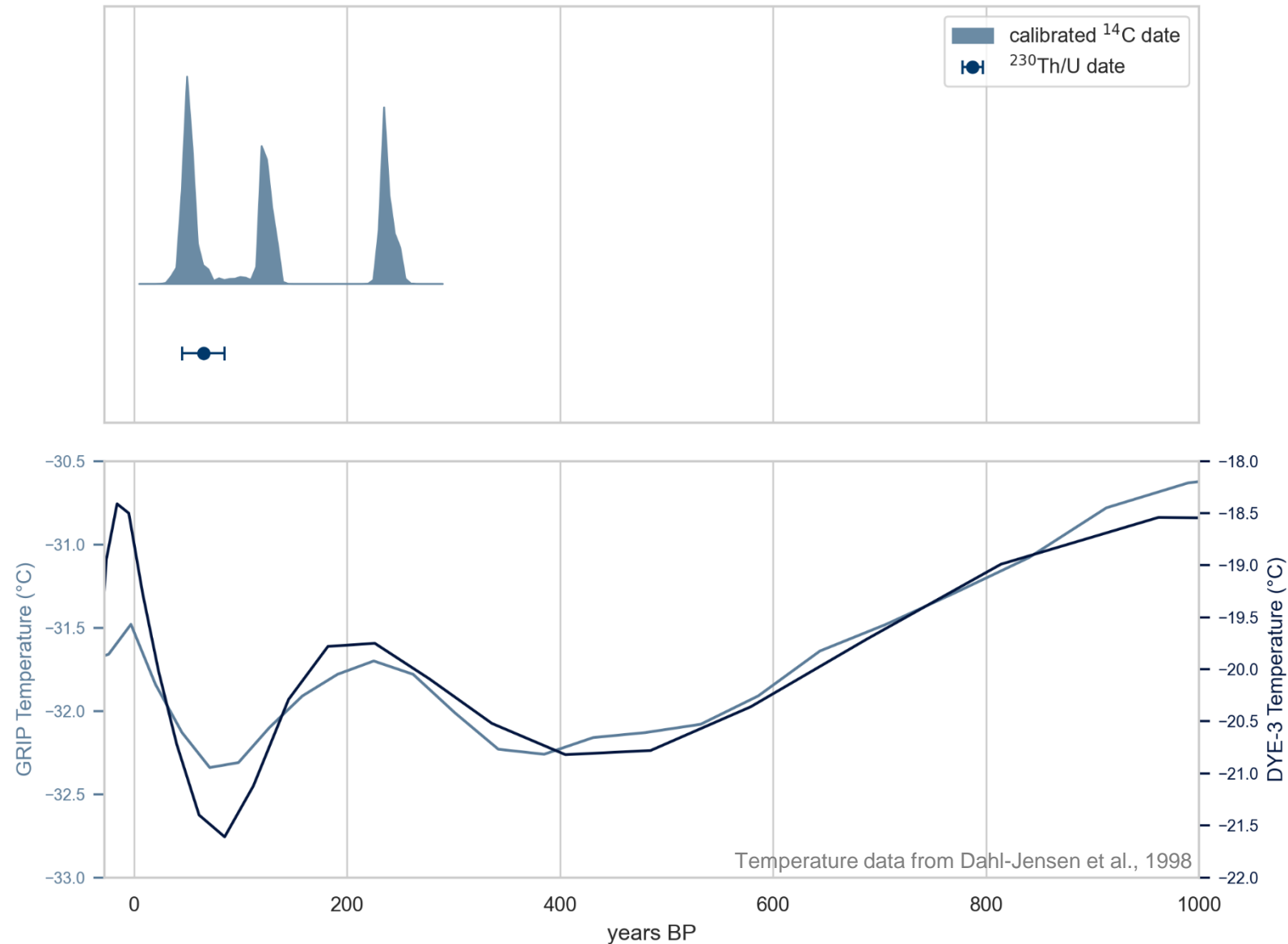
Dating approach – ^{14}C dating

- use of $^{230}\text{Th}/\text{U}$ isochron age to calculate dead carbon fraction (DCF) of the individual samples
- calculation of radiocarbon age for 0% DCF by linear approximation
- calibration of the resulting age with IntCal20 (Reimer et al., 2020)
- the three peaks are the result of plateau of calibration curve – here, the two older peaks are regarded as artefacts of the calibration curve



Results

- CCC_{fine} formation in cold period of Little Ice Age
- high $\delta^{234}\text{U}_{\text{initial}}$ suggests previously unflushed system → indicates presence of permafrost and/or arid climate
- Question: How did water enter the cave under such circumstances?

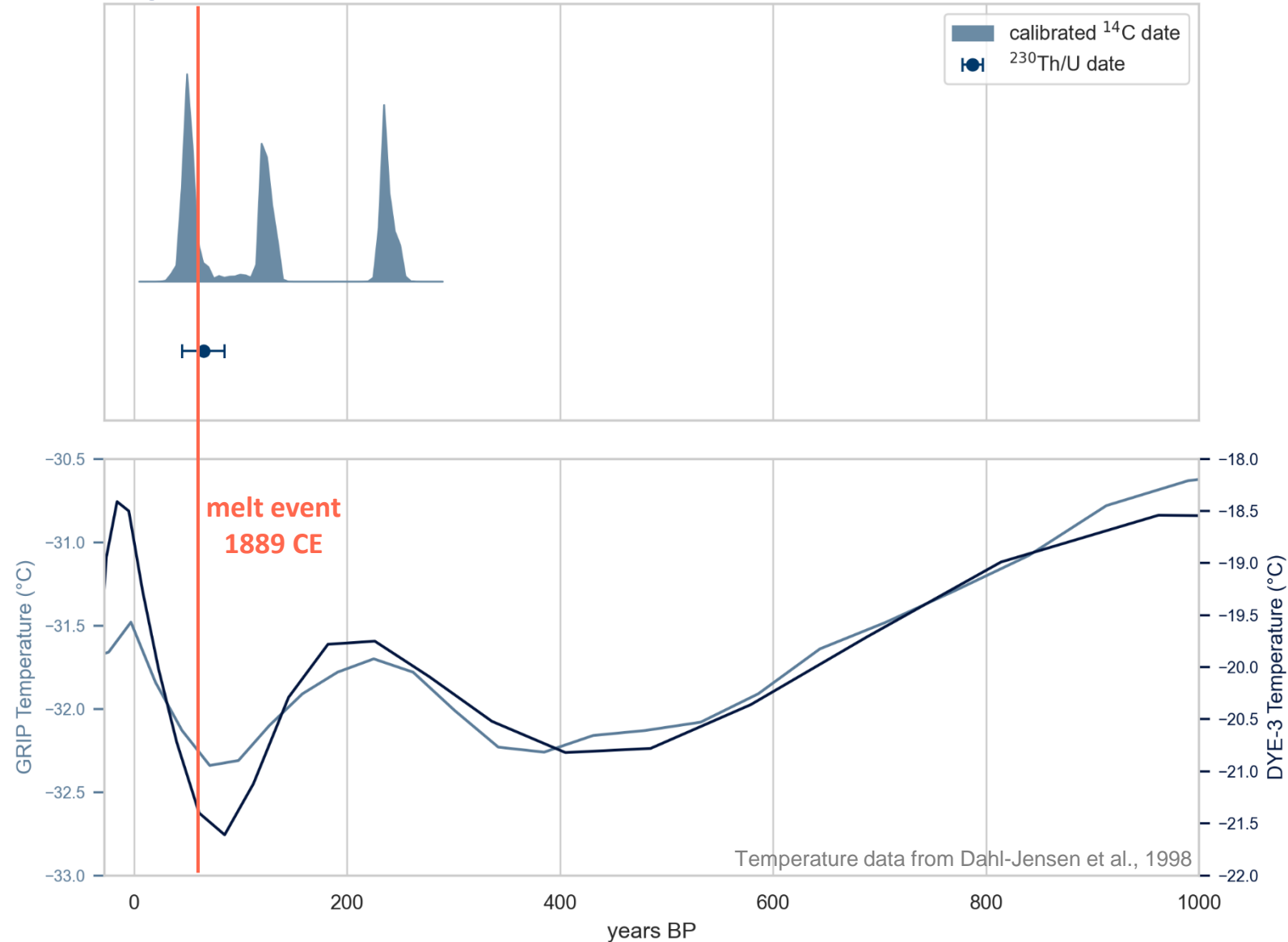


Trigger for CCC_{fine} formation

- CCC_{fine} formation synchronous with well recognised **Summer melt episode of 1889 CE** (e.g., Neff et al., 2014; Keegan et al., 2014)

➤ possible explanation for CCC_{fine} formation

- triggering melt of (local) ice caps
- releasing substantial amounts of meltwater
- infiltration through permafrost into Cove Cave
- rapid formation of CCC_{fine}
- no CCC_{fine} formation during similar episode in 2012 CE, because local ice caps had already melted



Conclusions and Outlook

- precise dating of CCC_{fine} is possible using $^{230}\text{Th}/\text{U}$ and/or ^{14}C methods
 - useful for dating e.g. cave ice without organics present
- CCC_{fine} formation in Cove Cave was triggered by an extreme weather event – synchronous with summer melt episode of 1889 CE – this could have been trigger
 - While CCC_{fine} cannot be used for palaeoclimate reconstructions, they might be utilised to reconstruct short-term (palaeo-) weather events in other caves



Thank you for your attention

**Don't hesitate to contact me:
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References

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