

I CONVEGNO ISTITUTO DI SCIENZE POLARI

THEORETICAL AND EXPERIMENTAL ANALYSIS FOR CLEANING ICE CORES FROM ESTISOL™ 140 DRILL LIQUID

Francesco Enrichi¹, Dorte Dahl-Jensen²,
Jørgen Peder Steffensen² and Carlo Barbante¹

¹ ISP-CNR Institute of Polar Sciences, National Research Council, Mestre-Venezia, Italy

² Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark



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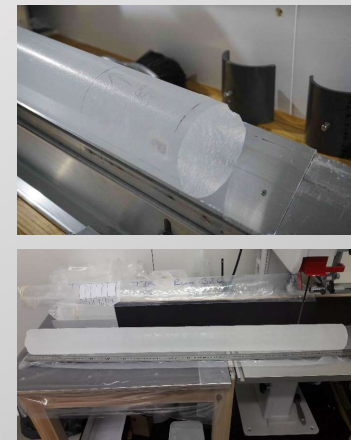
Beyond EPICA Oldest Ice Core – EU project

Aim: reconstructing the climate history of the past 1.5 Million years

How: by drilling and analyzing about 2700 m of ice core in East Antarctica (2021-2025)



*Estisol*TM 140 drill liquid has to be removed from the ice cores



Beyond EPICA Oldest Ice Core – EU project

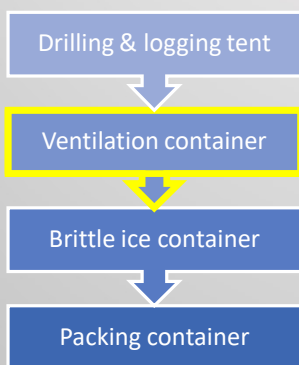
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Deliverable No 4.1: Refine the protocol for proper ice processing, transportation and cutting plan (20 dec. 2019)



inlet/outlet of cold air of 40 m³/h for 7 days at – 50°C



- drying efficiency for different temperatures
- avoiding ice sublimation losses

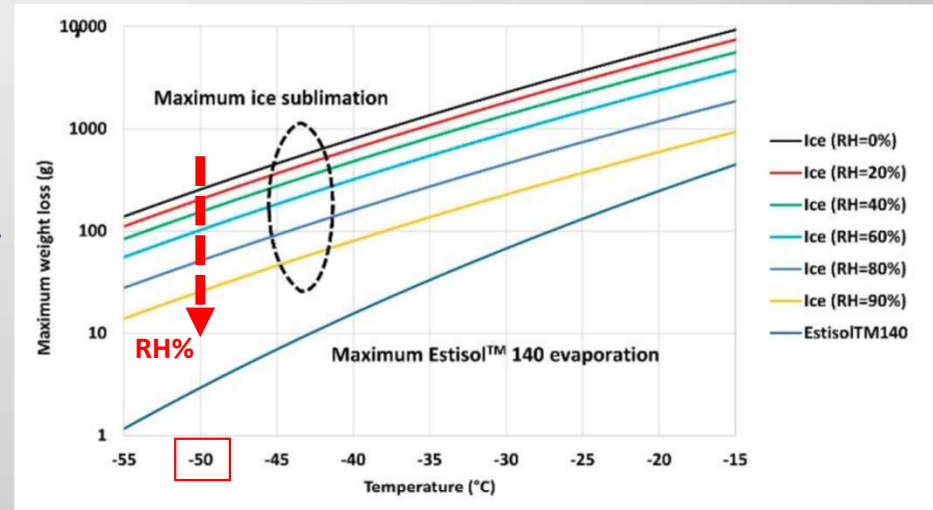
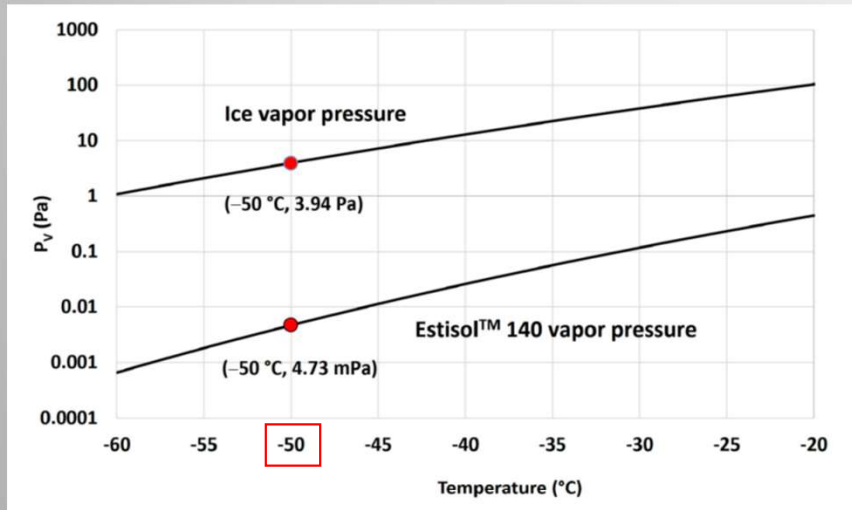


F. Enrichi et al., Appl. Sci. 2021, vol. 11, p. 3830

Theoretical analysis

$$P_{ice} = \exp(9.550426 - 5723.265/T + 3.53068 \ln(T) - 0.00728332T) \quad (T > 110 \text{ K})^{[1]}$$

$$\ln P_{Est140} = A - \frac{B}{C+T} \quad (P \text{ in bar}, T \text{ in } ^\circ\text{C}) \quad \text{with } A = 9.95390; \quad B = 3932.58; \quad C = 196,630^{[2]}$$



Theoretical analysis

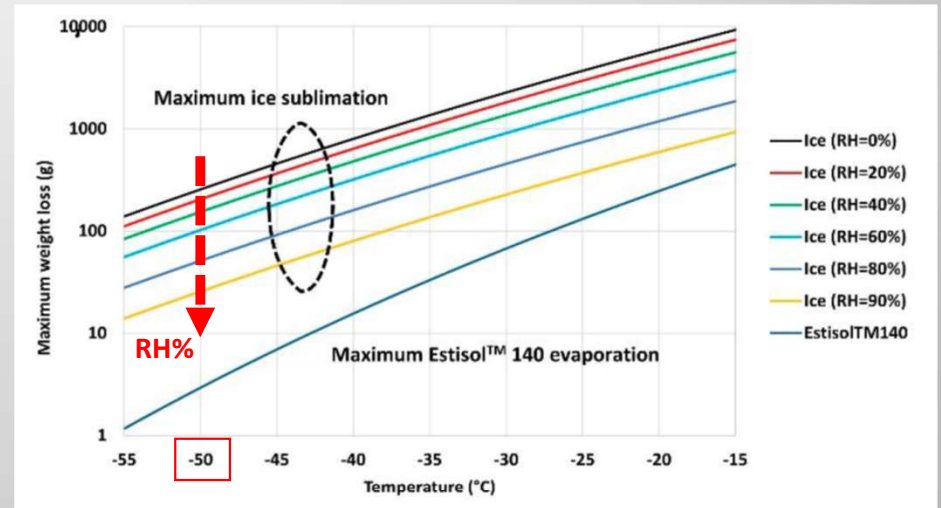
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$$M_{ice} \cong (1 - RH\%) \cdot 260 \text{ g}$$

Negligible in any condition, absent for saturated air






$$M_{Est140} \cong 3 \text{ g} \quad \text{Negligible}$$



Experimental testing

(provided by Dorte Dahl-Jensen and Jørgen Peder Steffensen , May 2020)

Tests are done on 4 inch full ice cores, 55 cm long
(depth 400m from NEEM North Greenland Eemian Ice Drilling S4 shallow ice core)

Temperature	Ventilated+core trough	Enclosed+core trough	Enclosed+no core trough
-50 deg C			
-30 deg C			
-18 deg C			

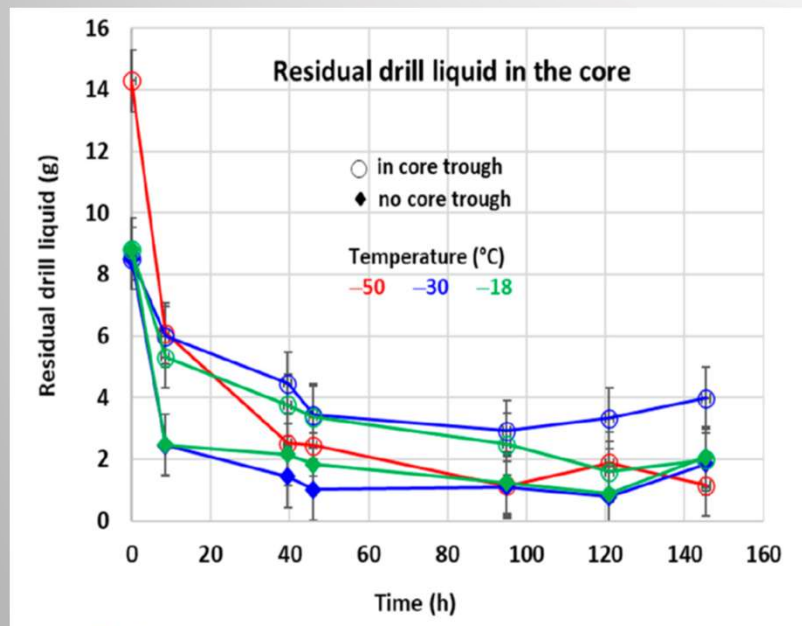
Procedure

- ice cores are weighed as dry cores
- the cores are soaked in Estisol 140 and wiped with paper towels
- the ice cores are weighed again
- the residual liquid is assumed as the difference in weight

Experimental testing

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Observations

- no significant differences with temperature (the first point is possibly due to higher fluid viscosity)
- no significant differences with or without ventilation
- significant dripping of the fluid was observed, favoured in non-contact conditions
- most of the removable fluid is gone after 45 h

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Conclusions

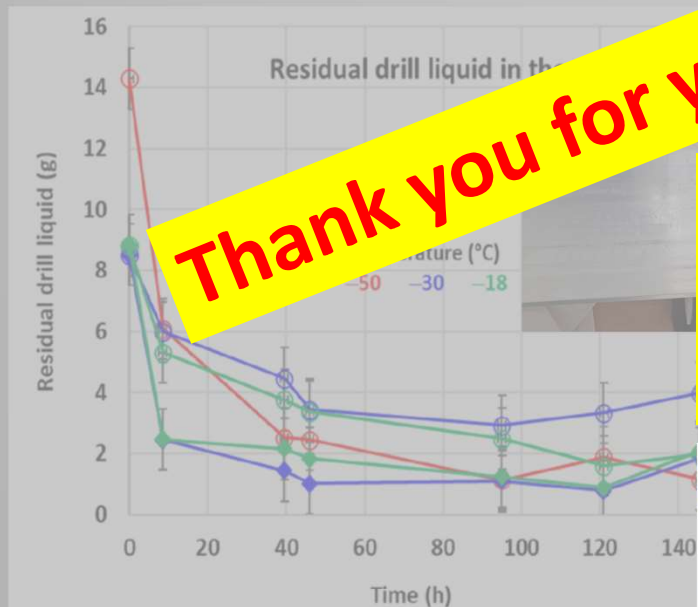
- fluid evaporation and ice sublimation are not significant
- fluid dripping from the cores is the main drying process

The ventilation chamber was abandoned

Experimental testing

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Thank you for your attention!

Contacts:

Francesco Enrichi

ISP-CNR Venezia

francesco.enrichi@cnr.it



Article

Theoretical and Experimental Analysis for Cleaning Ice Cores from Estisol™ 140 Drill Liquid

Francesco Enrichi ^{1,2,*}, Dorthe Dahl-Jensen ^{3,4}, Jørgen Peder Steffensen ³ and Carlo Barbante ^{1,5,*}

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