

Toxic collections: increasing the understanding of organic pesticide residues in indigenous and world cultures collections in museums

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Why are objects contaminated?

To protect objects from pest damage museums have treated their collections with a variety of harmful chemicals for centuries. The residues from these chemicals are a hazard present in museum collections^{1,2}.

Health and Safety Concerns

How hazardous are these chemical residues for people working and handling the collections?

Which organic pesticides are more likely to remain on objects or on the areas surrounding objects?

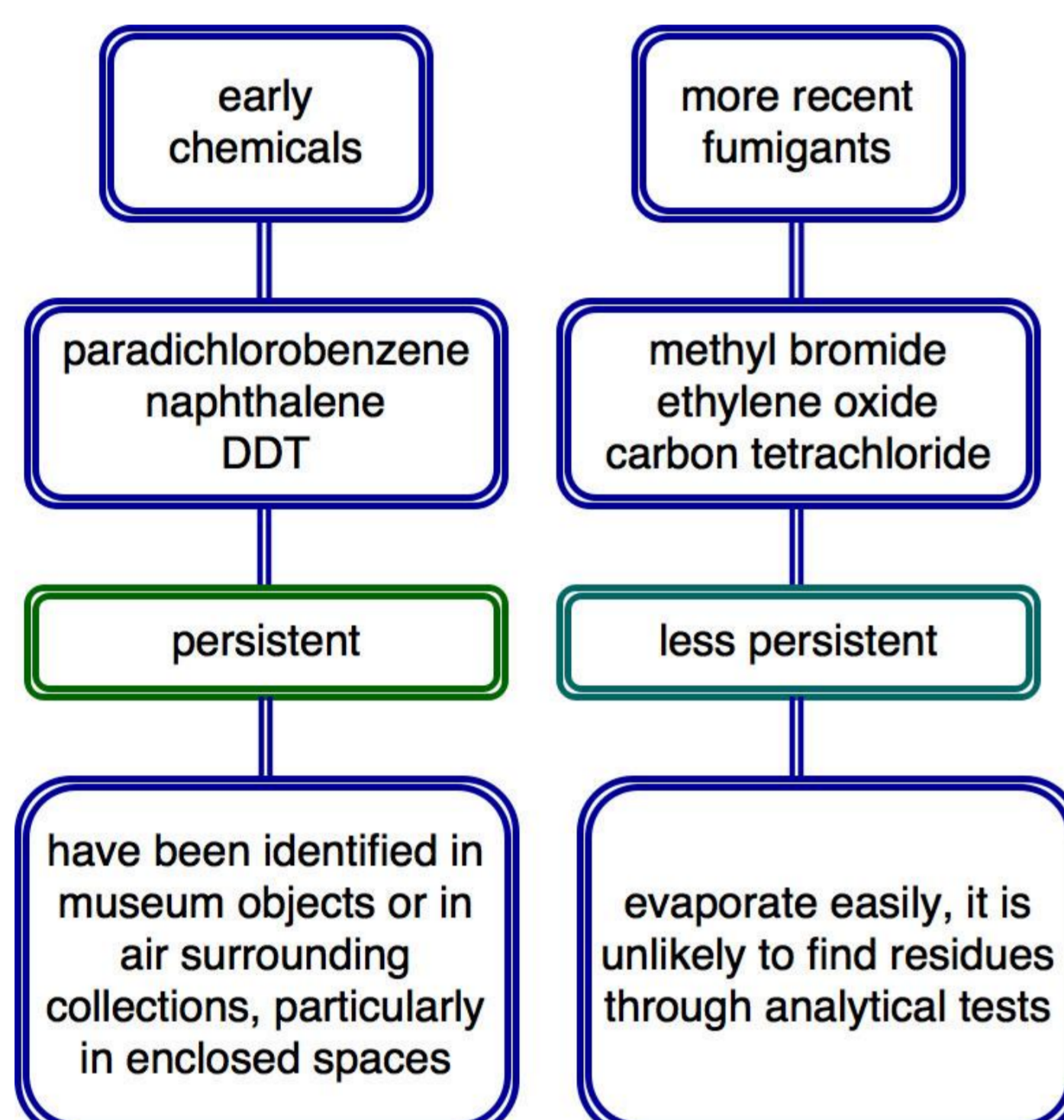


Fig 1. Object with confirmed pesticide contamination using SPME-GCMS (naphthalene, pentachlorophenol and lindane). Image ©The Trustees of the British Museum 2018

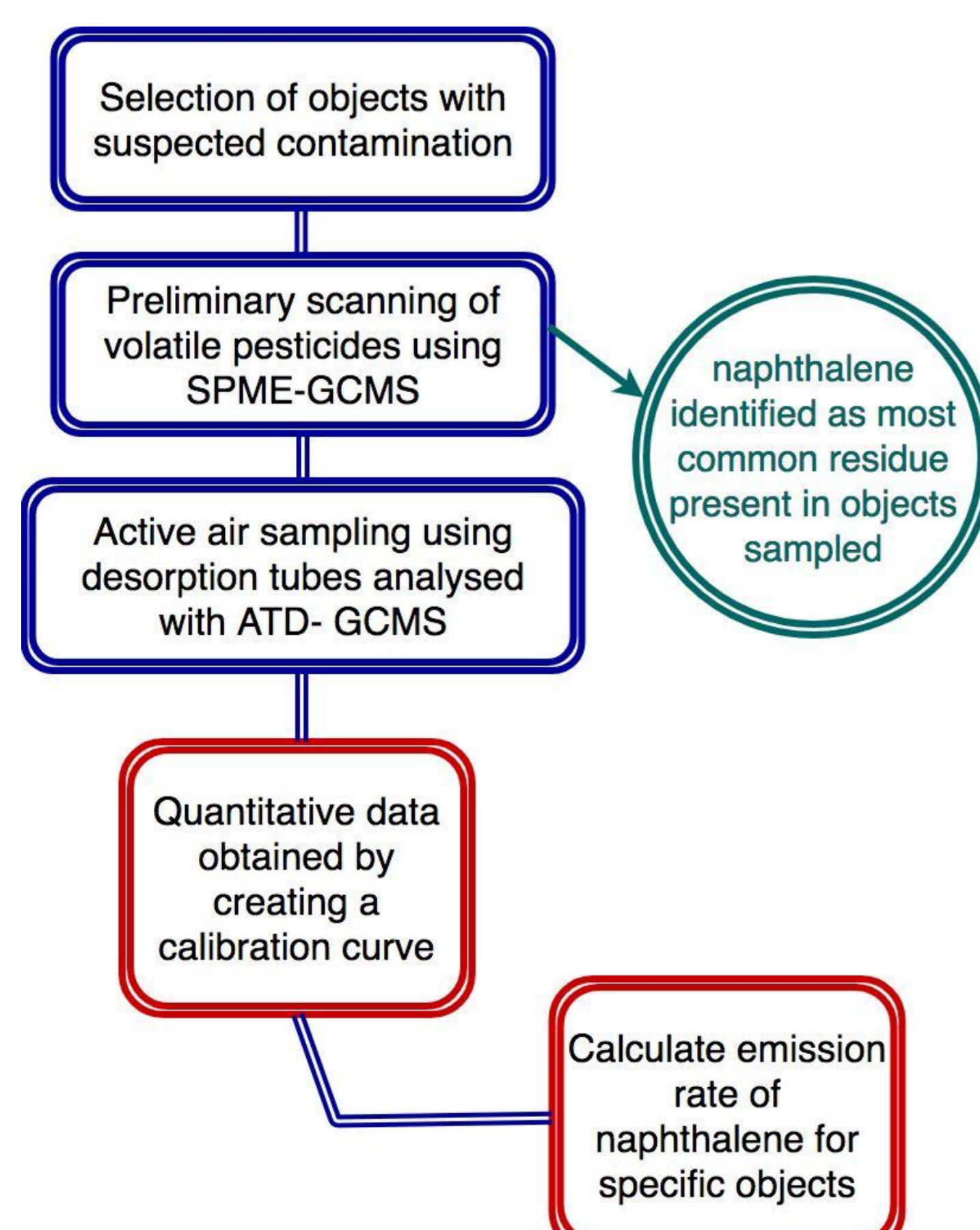


Fig 2. Handling object with suspected pesticide residues. Image ©The Trustees of the British Museum 2018

Criteria for selection of objects with suspected contamination:

- Objects flagged as having a strong chemical smell.
- Objects recorded as giving members of staff physical discomfort e.g. burning of the eyes, headaches and sore throat.
- Objects acquired by the museum before 1930, usually vulnerable to pests, which are in perfect condition.
- Objects with crystalline surface deposits suspected to be pesticide residues.

Methodology



Preliminary analytical scanning of pesticides

Solid phase micro-extraction (SPME) paired with gas chromatography paired with mass spectrometry (GCMS) was selected as a suitable method to sample the air surrounding 8 suspected contaminated objects, as it is a multiresidue, non-invasive, non-destructive technique⁵. The SPME fibres were exposed next to the selected objects and analysed with GCMS to obtain qualitative data regarding the compounds present.

The analysis identified:

- Naphthalene (most common residue identified in 5 of the 8 objects analysed)
- Lindane
- Pentachlorophenol

Active air sampling using desorption tubes and ATD paired with GCMS

In order to sample the emissions for a specific contaminated artefact the experimental design focused on creating a suitable sampling chamber for museum objects. The object was placed inside a tightly sealed aluminium chamber. The air from inside the chamber was sampled using a stainless-steel desorption tube loaded with TENAX TA™ attached to an air sampling pump (see Fig.3).

The sorbent tubes were desorbed using automated thermal desorption (ATD) and analysed using GCMS.

Quantification of naphthalene emissions

To obtain quantitative data obtained in the sorbent tubes, known amounts of naphthalene were spiked on to TENAX TA™ tubes and analysed with ATD-GCMS. This created a calibration curve.

The aim of a calibration curve is to have a wide range of amounts of naphthalene against peak areas. When an unknown amount of naphthalene (the sample) is analysed, its chromatogram SIM peak integration area is compared against the known points previously obtained.

Intended outcomes

- Establish the emission rate of naphthalene for specific objects.
- Provide information that can improve the health and safety considerations when handling these objects.

References

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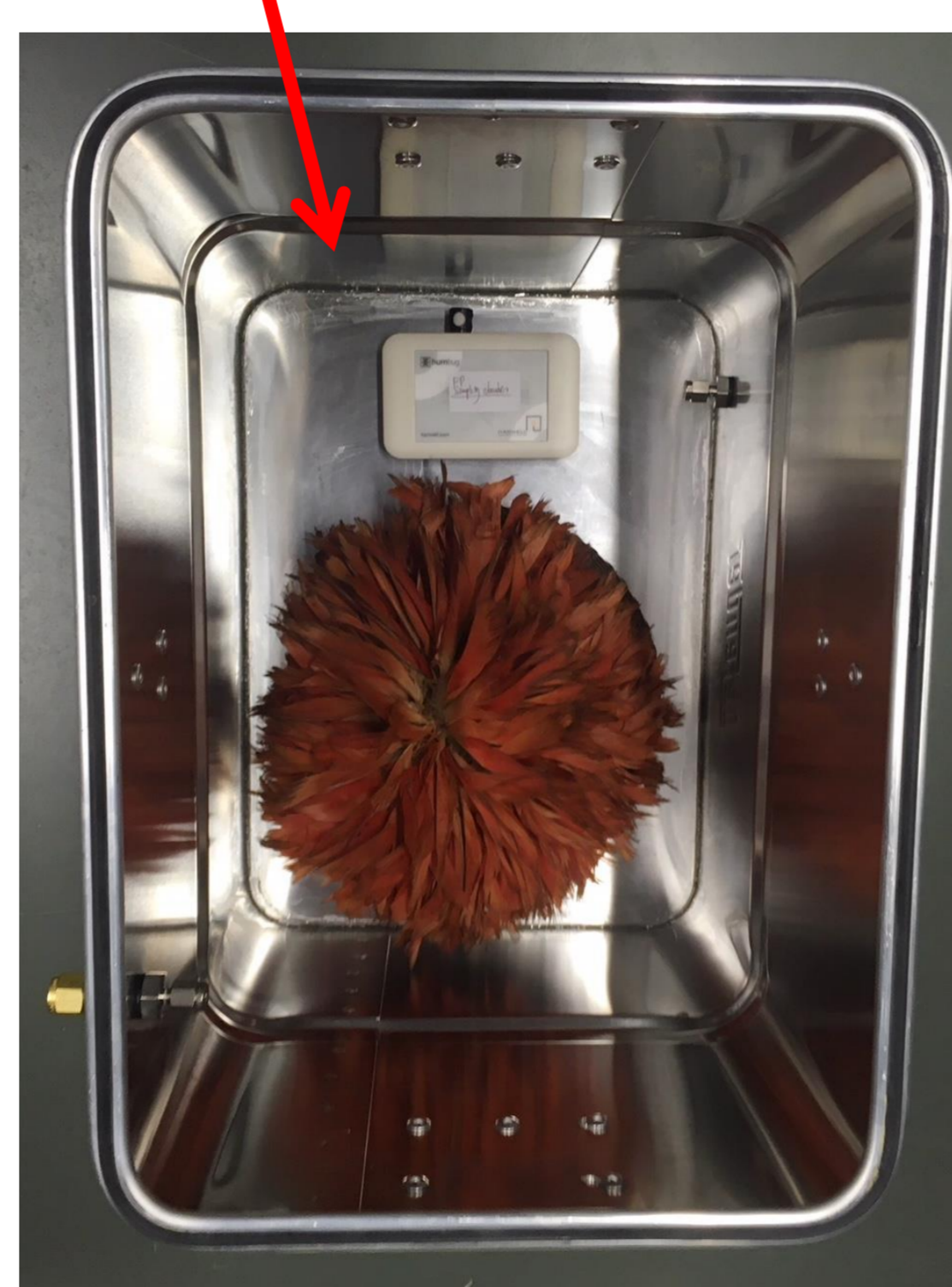
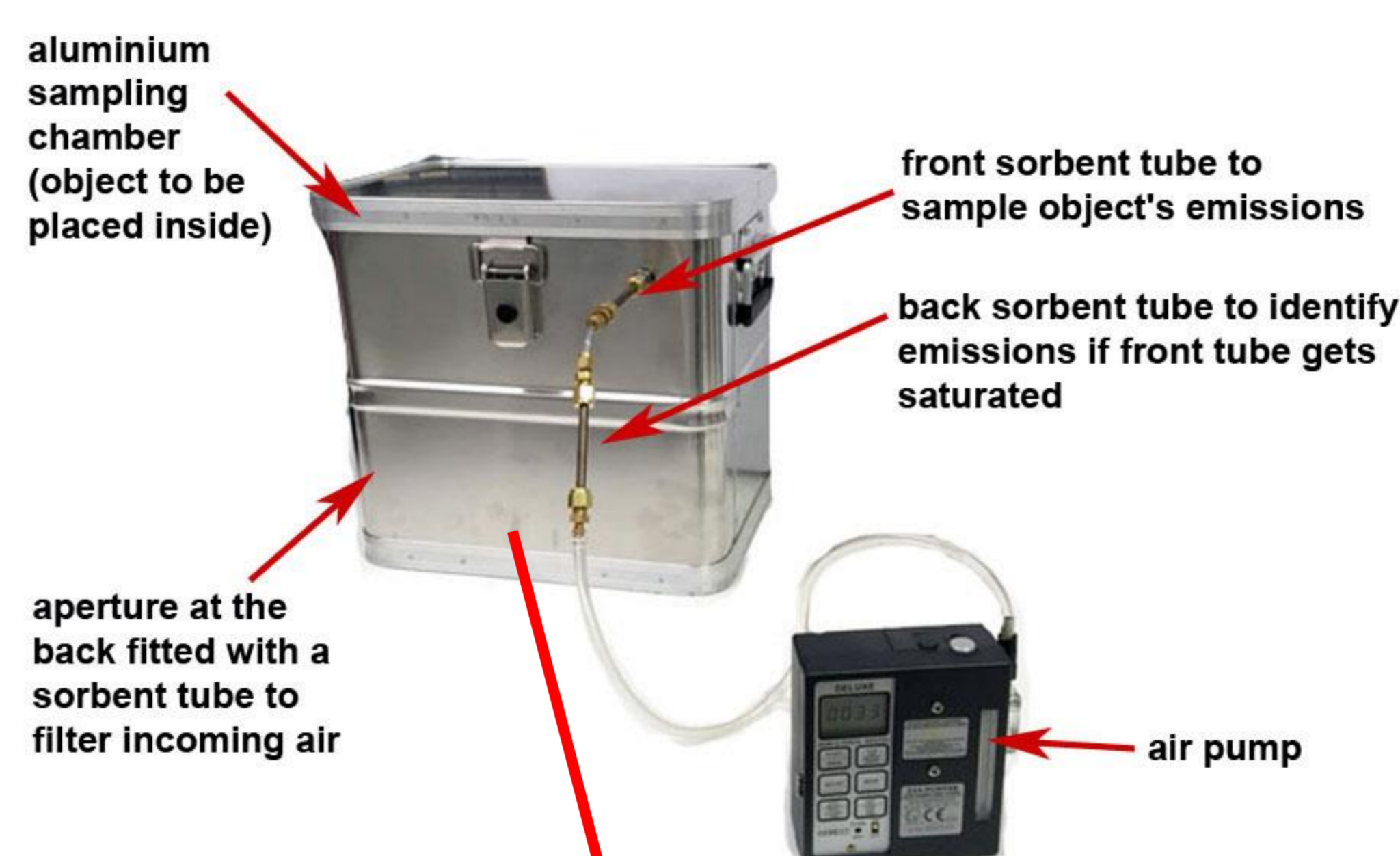


Fig 3 Diagram of experimental set-up and example of object inside sampling chamber with temperature and relative humidity logger.