NSCG Newsletter

Title: Temperature Monitoring within a Hazardous Environment

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Source: Purewal, V. (1999). Temperature Monitoring within a Hazardous Environment. *NSCG Newsletter*, *Issue 10, The Ten Agents of Deterioration, 5. Temperature & 6. Relative Humidity*, 14 - 15.

URL: http://www.natsca.org/article/1135

Mineral Species, Herbarium Specimens and other Natural History Items with Sufficiently High Vapour Pressures to Cause Volatilisation

Since mercury and sulphur have relatively high vapour pressures, they will give off vapour even at normal room temperature. The rate of volatilisation will also increase with temperature. Native mercury and mercury containing mineral species (for example cinnabar) and also native sulphur should be stored in such a way as to reduce the rate of volatilisation and contain the emitted gasses.

Mercury and mercury containing mineral species should be stored in well-sealed containers (such as screw top glass jars or Stewart plastic boxes) and opened only in a well ventilated area. Not only will mercury vapour form amalgams with other native metals such as gold and silver, it is also a serious health risk. Mercury used in the production of felt was the cause of madness in hatters (refer to Alice in Wonderland), mercuric chloride solution routinely used to "poison" herbarium sheets until the early 1980s may well have a similar effect on botanists. Vicky Purewal's award winning research looked into contaminants including mercury on herbarium specimens. Mercury compounds were also used as a preservative in the preparation of vertebrate skins and mounts (Found & Helwig, 1995).

A test paper for detecting mercury vapour was developed for the pollutant monitoring project carried out on three Canadian mineral collections (Andrew, Waller and Tetreault 1993 and in press). The results of the monitoring clearly demonstrated the presence of mercury vapour in cabinets containing native mercury and mercury mineral species. More worryingly, wooden cabinets that had once held mercury-containing specimens were also continuing to emit mercury vapour.

Storage in well-sealed containers would also be sensible for native sulphur. Traditionally, mineral collections are stored in a systematic order, in small collections this results in all native species being stored together. Gaseous sulphur compounds will react with native silver causing sulphidation, a form of black tarnish.

KA

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Investigative work into the detection of pesticide residues present on herbarium specimens, identified four main chemicals. These were residues of mercuric chloride, arsenic trioxide, barium fluorosilicate and naphthalene. Frequently all four of these pesticide residues were present on the same specimen. The toxicity of these chemicals is extremely high and health surveillance of staff in contact with arsenic and mercury is strongly advised.

The results of this work disclosed extremely high concentrations of arsenic, barium and mercury and staff in contact with the collections were tested for contamination. The results later on in the year revealed that key staff working on lower plants as well as the vascular material were developing slightly elevated readings for arsenic and mercury.

The collections should only be handled whilst wearing blue nitrile gloves, not vinyl and no work should be carried out unless the area is known to be well ventilated. A fume cupboard should be used if there is no alternative. Facemasks would benefit workers as dust particles will carry contaminants and these are easily dispersed and inhaled whilst handling specimens.

The air quality should be monitored for levels of mercury and arsenic. Naphthalene is generally an easy chemical to detect due to its strong aromatic smell. The NMGW herbarium air quality was well below the recommended Health and Safety Executive levels. The herbarium is not air-conditioned but is monitored for temperature and relative humidity fluctuations. A rise in the temperature of the herbarium will contribute to a rise in the vapour pressure of the chemicals present on the collections, therefore increasing the volume of contaminants within the air. Although Mercury is a metal it has a vapour pressure due to its being a liquid. It has a relatively low vapour pressure, but an extremely small amount of this vapour within the air will very quickly exceed the Occupational Exposure Levels (OELs) due to its hazardous nature. For example, OELs and Minimum Exposure Levels (MEL) for mercury are 0.025mg m^3 volume of mercury in m^3 of air (Croners, 1998). Naphthalene, mercuric chloride, arsenic trioxide and barium fluorosilicate levels may quickly exceed the HSE regulations even at low temperatures as very small levels in air are regarded as highly hazardous.

Monitoring the herbarium temperature is imperative and increasing ventilation after a period of warmer conditions is advisable.

Reference:

Croners (1998) Chemical Hazards *in* Kellard, B. *Substances Hazardous to Health.* Kingston upon Thames, Surrey, Croner Publications Ltd pp3/A-3/868.

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Note from Ed:
Though the 'Ten Agents...' series is primarily concerned with museum collections and not the people working on/with them, it was decided to include this last piece as it relates to comments by KA. Vicky hopes to publish a more detailed and comprehensive report of her work later in the year (see page 4 of main newsletter).

Incorrect Temperature as a Risk - how significant is it?

Incorrect temperature levels may pose any of the three types of risks to collections depending on the frequency of occurrence and severity of the risk (Waller, 1994, 1995). It is easy to consider and estimate the magnitude of a type 1, rare and catastrophic, incorrect temperature risk if one considers, for example, the fate of an ice core collection exposed to >°C for several days. Similarly, the type 2, sporadic and severe, occurrences of thermal shock causing fracturing of well crystallised mineral specimens, or partial melting of wax models or casts in a collection, are relatively simple to appraise. Incorrect temperature-type 3 (T-3) is another matter. Within the T 3 generic risk are considered the mild and gradual consequences of storage at a temperature level somewhat higher or lower than ideal.

What makes this risk difficult to incorporate in risk analysis is the fact that storage at a non-optimal temperature is seldom considered and calculated as a direct risk causing damage. Rather, it tends to be either complicit with another agent in causing damage, or simply contributes to the susceptibility of specimens to damage caused by another agent. As an example of complicity, consider how the susceptibility of a collection to insect pest damage might change depending on whether the collection is stored at 10°C or 30°C. As an example of incorrect temperatures contributing to susceptibility to damage by another agent of deterioration, consider the embrittlement, and eventual physical failure, of lignin rich, acidic herbarium sheets. The degradation, leading to eventual failure, of these sheets would proceed at a greatly reduced rate at 0°C as opposed to 25°C.

The interplay of temperature with other agents of deterioration might, at first, give the impression that the effect of modest changes in collection storage temperatures cannot be considered in a risk assessment context. Recently, however, an issue arose at the Canadian Museum of Nature that required exactly that consideration. The recently completed Natural Heritage Building was designed and built to provide a state of the art