Resolving Non-conservatism in Regulatory Models for Tritium in the Environment

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Background

- Recent publications (CNSC and CNL) have shown that organically bound tritium (OBT) to tissue free water tritium (TFWT) ratios in plants are greater than expected from regulatory models
- On this basis, the CNSC (Thompson et al. 2015) concluded that parameters and models for HTO and OBT in the environment need to be revisited.

Objectives

- The objective of this project is to develop new parameters and models to resolve the non-conservatism in current regulatory OBT models.

Primary Stakeholder: CNSC

Project Status

This project consists of two components:

1. A survey of background OBT levels in vegetation and soils across Canada-wide climatic gradients

- Milestone completed September 2016

2. A controlled, replicated experiment examining OBT formation in field crops under background exposure and reactor point source conditions.

- 2017 and 2018 field work completed in collaboration with Agriculture and Agri-food Canada, Lethbridge, AB and Morden, MB; Deep River, ON (2017)
- 2019/20 work has focused on developing and implementing new analytical apparatus for low-level OBT analyses

Apparatus design

Development of apparatus for the analysis of low-level tritium samples at Chalk River:

- Isotopic exchange between atmospheric vapour and sample materials presents a major challenge to achieving high analytical accuracy and precision in low-level samples.
- Progress on sample analysis hinges on the development of a system to defensibly control the high tritium background at CNL.
- Procedures based on standard small-scale protocols for stable water isotope analyses, designed to prevent sample exposure to deuterium and 18O laboratory background.
- Planned procedures involve sample handling inside a nitrogen-purged dry-box with HTO background monitoring (batch).
- Samples are extracted from sealed tubes in closed systems, effectively excluding Chalk River atmospheric background.
- Adaptation of protocols to handle large sample masses required for OBT analysis.

- Increase sample throughput to allow for rapid analysis of >1000 agricultural samples
- Several projects will rely on developing this new capability at this point, including FST-Marine OBT

Field study design

- Comprehensive sampling and analysis
- Standardized vegetation, soil and source water (precipitation)
- Assessment of growing conditions: weather and soil parameters
- Seasonal time-series
- Vegetative and mature crop stages
- First study to examine TFWT and OBT in connection with stable isotopes (δ18O, δD), climatic factors and plant physiology
- Expecting a large comprehensive data set to yield a robust basis for model development and testing mechanistic modeling approach