URANIUM & DOSIMETRY IN AQUATIC ORGANISMS: WHICH ISOTOPES & PROGENY TO CONSIDER?

Freelon S1, Simon O1, Cagnat X2, Gurriaran R2, Beaugelin-Seiller K3, Giblin R1.
1IRSN/PRP-ENV/SERIS/L2BT - 13115 Saint Paul Lez Durance 2/IRSN/PRP-ENV/SERIS/L2BT - 13115 Saint Paul Lez Durance
Contact: sandrine.freelon@irsn.fr

CONTENTS

Activity in water (Bq/L)

- Long term and low [U]
- Short term and high [U]

[Image 42x67 to 103x111]

I. Measured by ICP-MS and gamma spectrometry
II. Calculated from transfer factors (Tf) and Nuclides 2000 software

Activity of each element accumulated in organism (Bq/kg): U isotopes & progeny

Activity of progeny coming from parent accumulated (orange bars), calculated via Nuclides 2000.

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REFERENCES:

- Nuclides 2000
- Activity element (Bq/kg)
- Transfer factors (Tf)
- Accumulation Factors (AF)
- Transfer Factor (Tf)
- Activity of progeny
- Dose Conv. Coef. (DCC)
- Activity of each element accumulated in organism (Bq/kg): U isotopes & progeny
- Activity of each element accumulated in organism (Bq/kg): U isotopes & progeny
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EXPERIMENTAL RESULTS

LONG TERM – LOW [U]: “CHRONICAL SITUATION”

- Activity of 238U, 234mTh and 234mPa after calculations and measurement
- HP and Gills, calculated via Nuclides 2000:
- HP (measured by ICP-MS and γ-spectrometry)
- Gills (measured by ICP-MS and γ-spectrometry)

SHORT TERM–HIGH [U]: “INCIDENTAL SITUATION”

- Activity of 238U, 234mTh and 234mPa after calculations and measurement
- HP and Gills, calculated via Nuclides 2000:
- HP (measured by ICP-MS and γ-spectrometry)
- Gills (measured by ICP-MS and γ-spectrometry)

PARAMETERS FOR DOSE CALCULATION TO HP

- Different potential contributors (water, carapace, HP...) for dose rate calculation to HP
- HP modelling for EDEN calculations of:
- DCC HP
- DCC Internal medium
- DCC Carapace
- DCC Water
- Use of radiation weighted DCC (A; 10; B; 3; C: 1)

DCC (HP -> HP) are much higher than DCC of other contributors (Water, carapace, Internal Medium)

- For all the exposures, uranium isotopes are the major contributors to the dose rate (95 to 99%)
- In all cases, dose rate to HP is huge due to the accumulation of RNs in HP itself. According to the theoretical contribution of 234mPa to the total dose rate, the refinement of its AF in different organs is necessary.
- Experimental dose rate levels increase with the exposure duration from 0.5 up to 4.7 µGy/h but always remains < environment protection threshold of 10.
- It’s important to notice that in case of “Incidental situation”, if calculated dose rates are highly over-estimated but not acute environment protection.

CONCLUSION

- In these experiments, target organs of 234mTh and 234mPa were found to be the same for 238U (other organs<LD), i.e. HP and Gills. However bioinetics were not studied.
- Low detection limit of Modane facilities enables the calculation of 234mTh and 234mPa Accumulation Factor (AF) with 2 exposure conditions, in HP and Gills.
- Assessment of different contributions of RNs to the global radioactivity needs to take DCC into account and not only compares activities of RNs.
- Transfer factors (Tf), calculated at the equilibrium, for the whole body are not convenient to use for all exposure conditions and notably for exposure with alpha emitters for which the maximum dose rate is due to the accumulation of RNs in the organ considered. Accumulation factors (AF) calculated for each organ are more representative. To study the effect/dose rate relationship AF should even be calculated for different organs such as mitochondria or nucleus.
- Calculations validated for low level of exposure are not so easily extrapolated to high level of exposure in case of, for instance, incidental pollution: the determination of Accumulation Factors in the maximum of exposure conditions and for the maximum of organs is necessary.