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Updates to the RESRAD-OFFSITE Version 4.0 and Revisions to the RESRAD QA program — How it Meets the DOE O 414.1D QA Requirements and RAMP and the DOE-NRC MOU and What It Means to DOE Users

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ERAD Webinar

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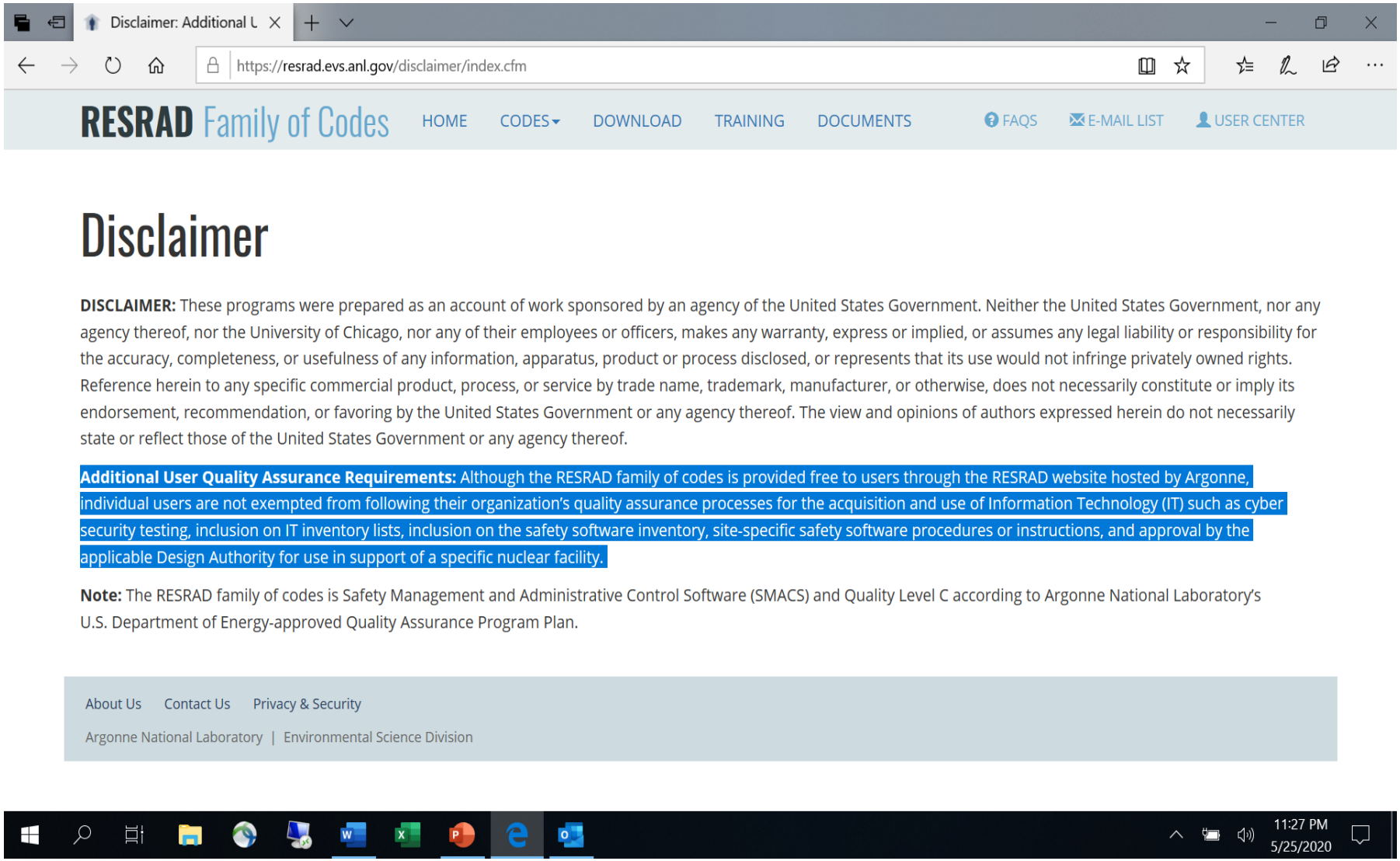
Updates to RESRAD-OFFSITE Version 4.0

- Updated default parameter values and distributions (NUREG/CR-7267, Default Parameter Values and Distribution in RESRAD-ONSITE, RESRAD-OFFSITE, and RESRAD-BUILD codes)
- Upgraded solubility- and diffusion-limited source release models, delayed release and waste in containers, etc.
- Upgraded surface water model to have realistic dose results for the surface water pathways
- Conducted quality assurance testing and released RESRAD-OFFSITE Version 4.0 and User's Manual and User's Guide (NUREG/CR-7268, Vol. 1 and Vol. 2)
- Participated in RAMP user meetings

Updates to RESRAD QA Program

- Updated RESRAD Program Software Quality Assurance Plan (SQAP) and RESRAD Program Software Configuration Management Plan (SCMP)
- Upgraded RESRAD QA Processes and Procedures, including related forms, databases, documentation, etc.
- Reviewed against DOE Order 414.1D and ASME Nuclear Quality Assurance-1 (NQA-1) Standard 2008/2009
- RESRAD family of codes is Safety Management and Administrative Control Software (SMACS) and Quality Level C Safety Software
- Independent Audit/Assessment (on-going)
- Additional User QA requirements posted on RESRAD Website

RESRAD Disclaimer on RESRAD Website



Revision of the RESRAD-QA Program and How It Meets DOE O 414.1D QA Requirements

- RESRAD has maintained a QA program throughout development
  - Software requirements and use documentation
  - Change Process Control
  - Version Control
  - Software Testing including verification and validation exercises
  - User Support & Training

- RESRAD-OFFSITE re-categorized as safety software
  - Required to meet NQA-1 requirements
  - Increased need for documentation (of documentation of documentation)
  - Increased documentation and traceability of testing, design, and requirements
  - Increased document control (Documented approvals, discussions)
  - Documentation of flow from DOE to Argonne to Division to Program QA Process (added more administrative support and layers)

DOE Order 414.1D Chg 1

CURRENT

DOE O 414.1D Chg 1 (Admin Chg), Quality Assurance

Functional areas: Administrative Change, Quality Assurance and Oversight

The Order defines roles and responsibilities for providing quality assurance for DOE products and services.Admin Chg 1, dated 5-8-13, supersedes DOE O 414.1D.

o414.1dAdmChg1.pdf -- PDF Document, 83 KB

Writer:	Christian Palay
Subjects:	Administration Management and Operations
ID:	DOE O 414.1D Chg 1 (Admin Chg)
Type:	Order
OPI:	AU - Office of Environment, Health, Safety and Security
Status:	Current
Approved Date:	Apr 25, 2011
Last Update:	May 08, 2013
CRD:	Yes
Invoking Directive:	Yes

RELATED | HISTORY | EXEMPTIONS | STANDARDS

Related to:

DOE G 414.1-2B Chg 2 (Admin Chg), Quality Assurance Program Guide

DOE O 414.1D Chg 1 (Admin Chg), Quality Assurance - Change Chart

Some History of Revising QA for Central Registry Safety Software

- DOE Safety Software Toolbox Group (Fall 2017)
- Argonne Review (2018)
- DOE AU Group Meeting (2019)
- Consultant
- Argonne Safety Software Manager Assistance
- Revised SQAP and Software QA documents for RESRAD-OFFSITE 4.0 Release (March 2020)
- Independent Assessment (Argonne): Ongoing
- Central Registry Review: TBD 2020

Criteria

- Management
  - Program
  - Personnel
  - Quality Improvement
  - Documents and Records
- Performance
  - Work Processes
  - Design
  - Procurement
  - Inspection and Acceptance Testing
- Assessment
  - Management Assessment
  - Independent Assessment

Management

1. Program:
   a. Organizational structure integrated with other higher level organizations
   b. Processes documented. Implementation documented.
2. Personnel Training and Qualifications:
   a. Qualifications documented. Selection process for wide variety of tasks.
   b. Continuous Training: Continuous Plan, Document and Procedure training
3. Quality Improvement:
   a. Quality problems detected and prevented.
   b. Correct items that do not meet requirements.
   c. Identify the causes of problems.
   d. Identify improvement opportunities.
4. Documents and Records
   a. Develop Document and Records system.
   b. Implement system.

Performance

5. Work Processes
    a. Perform work consistent with technical standards, administrative controls, and other hazard controls adopted to meet regulatory or contract requirements using approved instructions, procedures, or other appropriate means.
    b. Identify and control items to ensure proper use.
    c. Maintain items to prevent damage, loss, or deterioration.
    d. Calibrate and maintain equipment used for process monitoring or data collection.
6. Design
    5. Professionally Design items
    6. Develop requirements
    7. Design interfaces.
    8. Verify or validate design
    9. Control design and implementation
7. Procurement
    5. Procure quality items
    6. Select quality suppliers
    7. Monitor quality of items and suppliers
8. Inspection and Acceptance Testing
    5. Test for acceptance
    6. Maintain testing tools

Assessment

9. Management Assessment
    a. Managers continue to improve their processes
10. Independent Assessment
    a. Conduct independent assessments
    b. Ensure actual independence
    c. Ensure assessors are qualified

Major Updates and Demo of RESRAD-OFFSITE Version 4.0

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Major updates in RESRAD-OFFSITE 4.0

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Major updates

- Primary contamination and release
  - Conceptualization of primary contamination
  - Transfer mechanisms
  - Change over time

- Surface water body
  - Modes of contamination
  - Water balance
  - Sediment balance
  - Radionuclide balance

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Surface Water Body Model in RESRAD-OFFSITE

Rapid Overview

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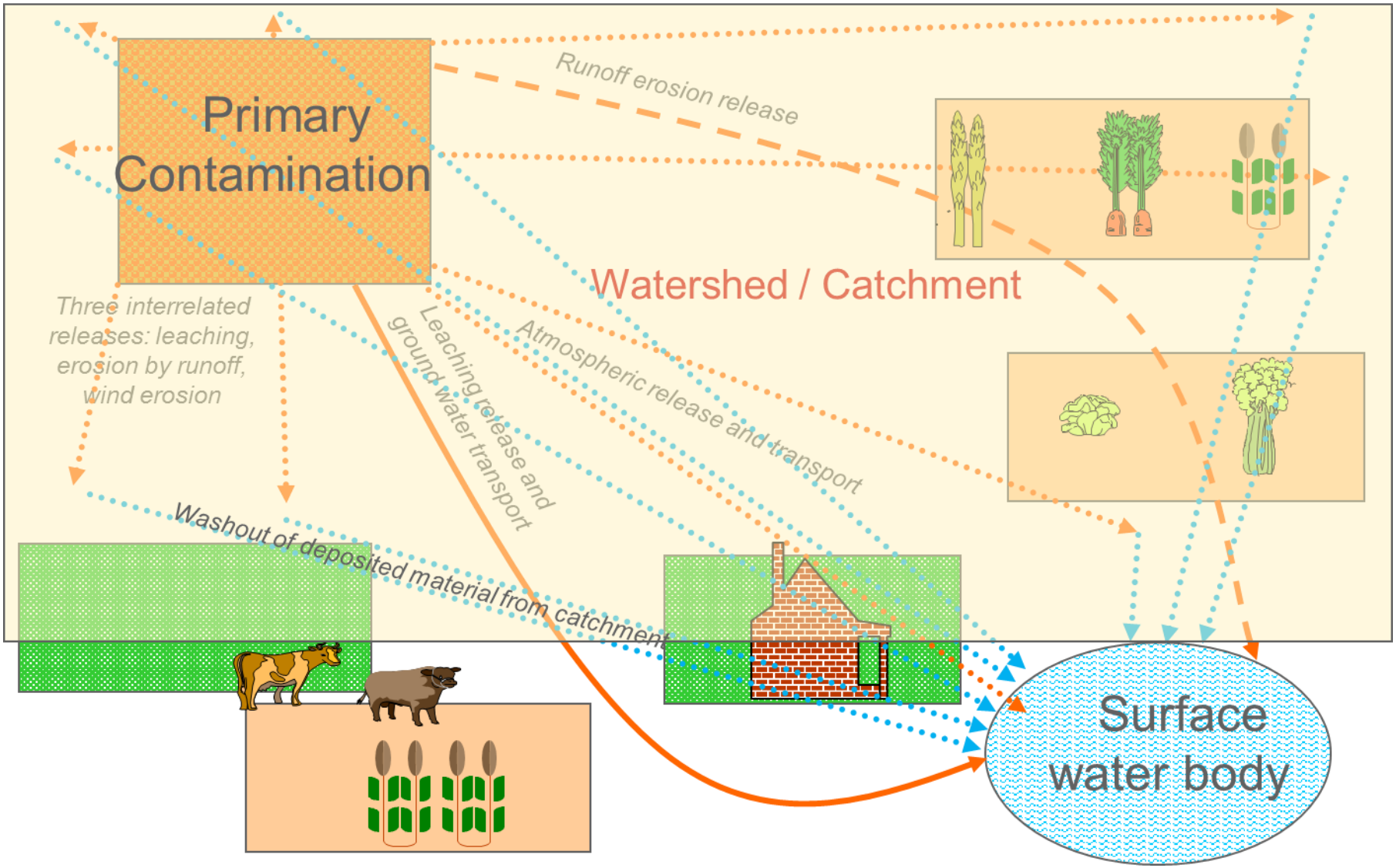
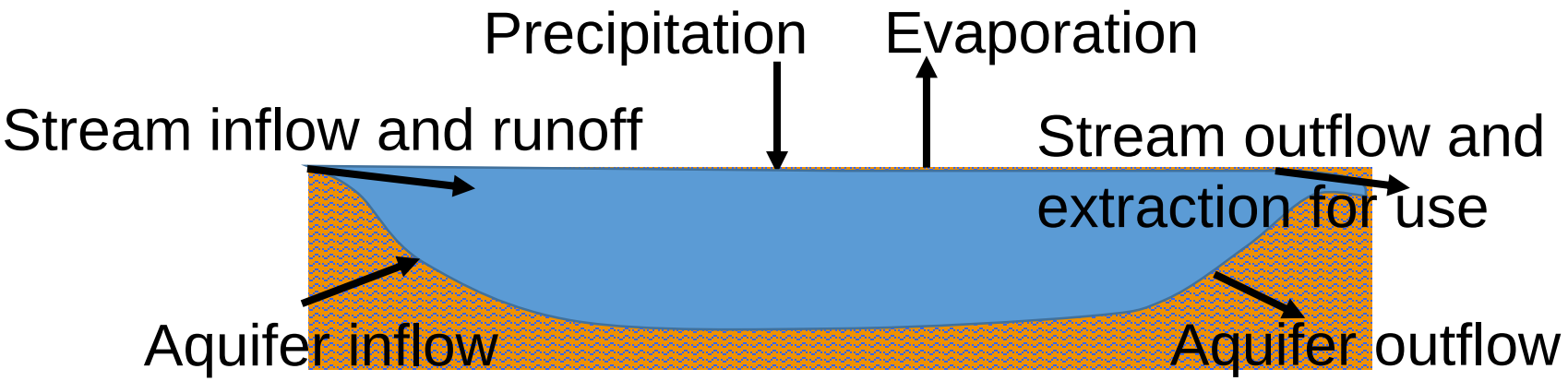
Transport to Surface Water Body



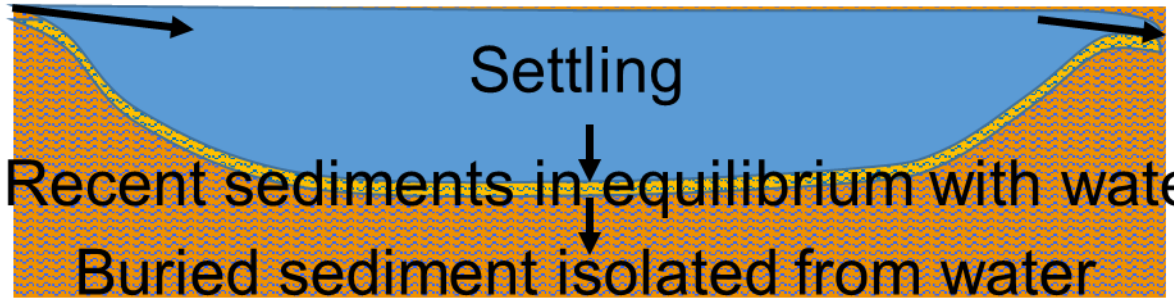
Water Balance



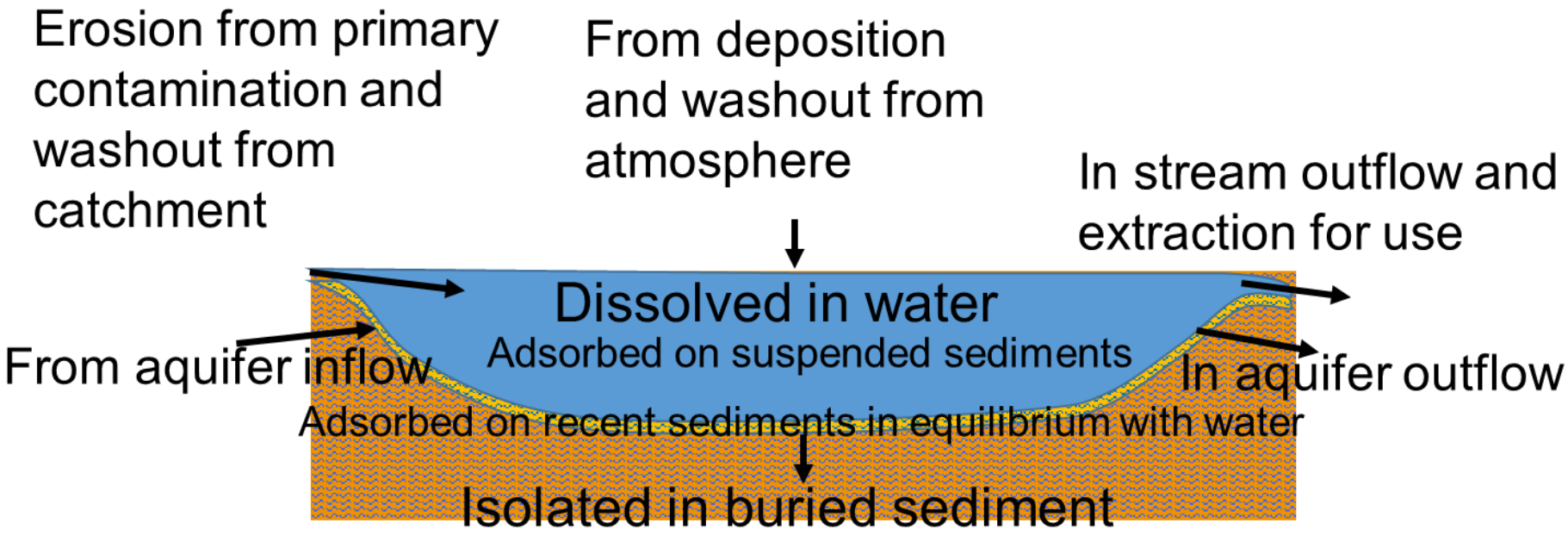
Sediment/particulate Balance

Erosion from catchment

In stream outflow and extraction for use



Nuclide Balance



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Models for Transfer to Infiltration and Release in RESRAD-OFFSITE

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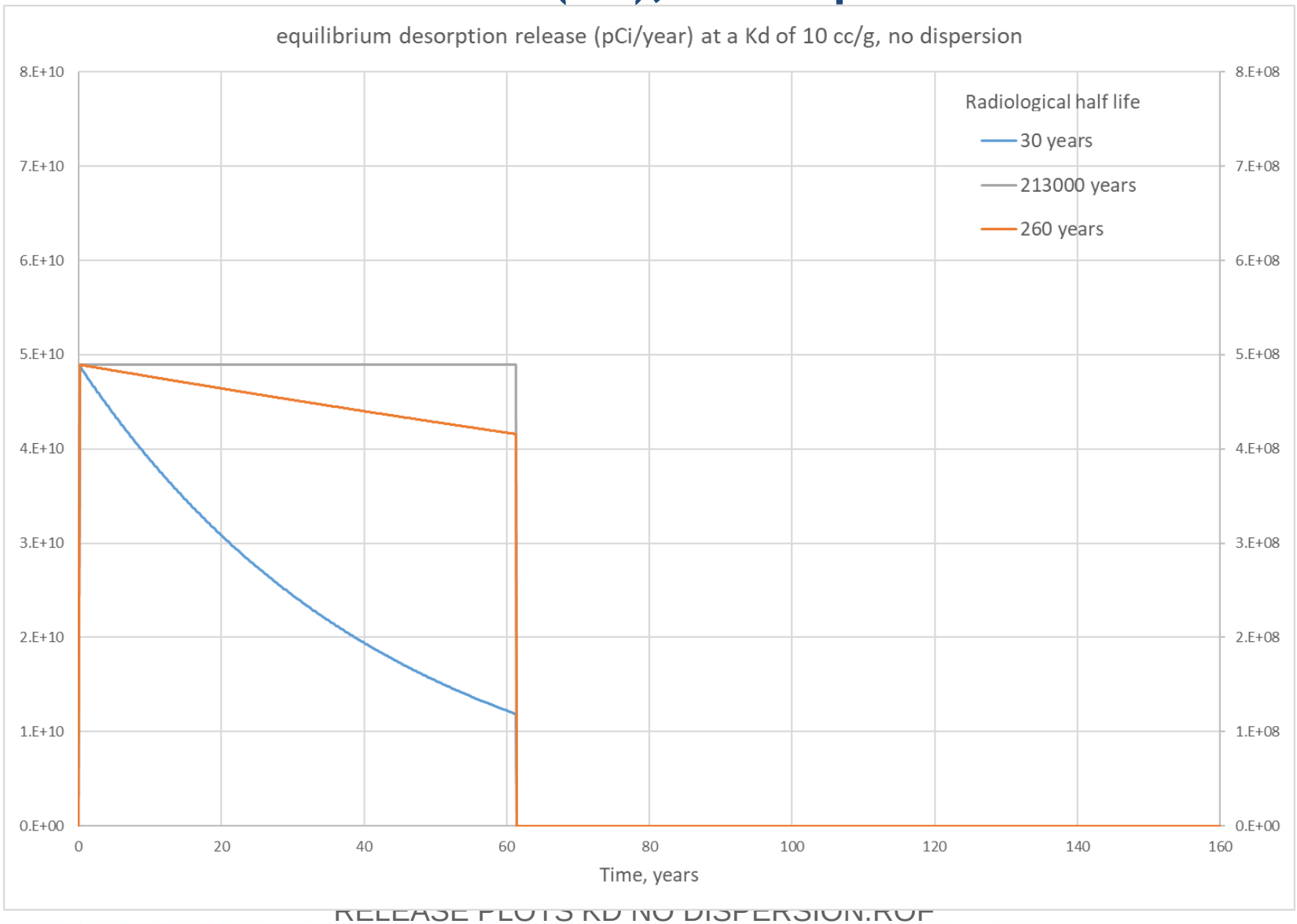
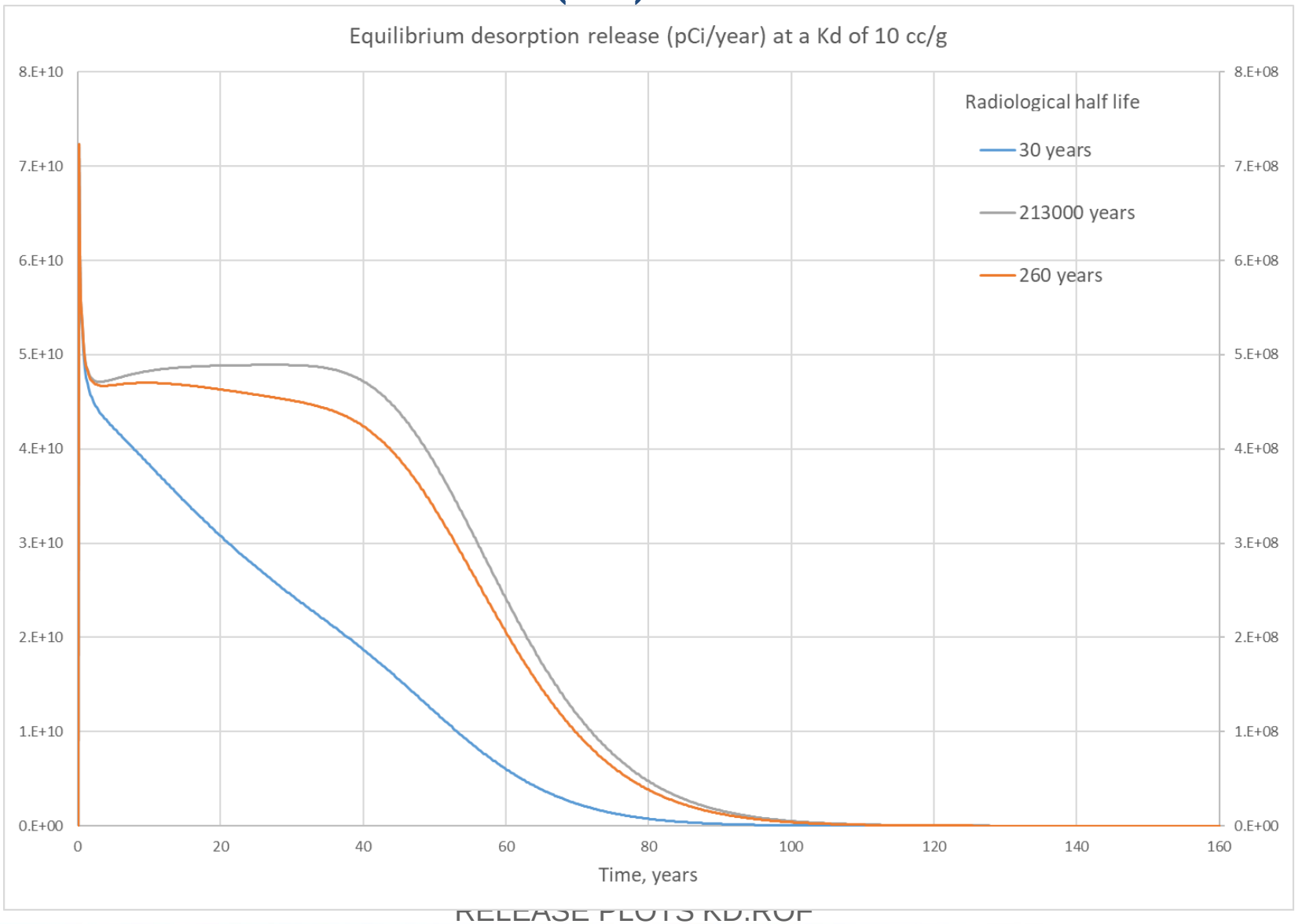
Equilibrium Desorption Release at a Specified Distribution Coefficient (Kd), no Dispersion

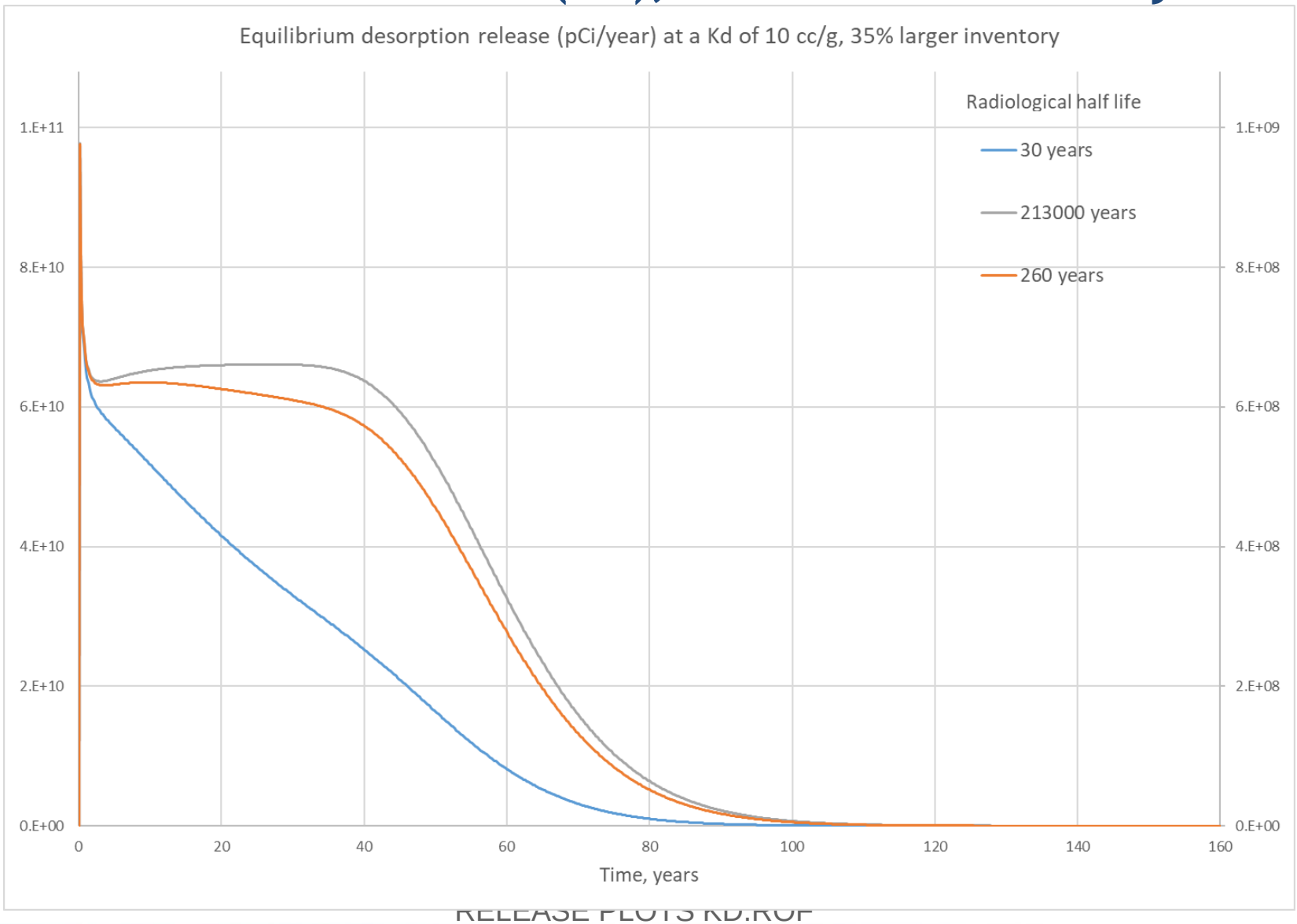


RELEASE PLOTS KD NO DISPERSION.ROF

Equilibrium Desorption Release at a Specified Distribution Coefficient (Kd)



Equilibrium Desorption Release at a Specified Distribution Coefficient (Kd), 35% more inventory

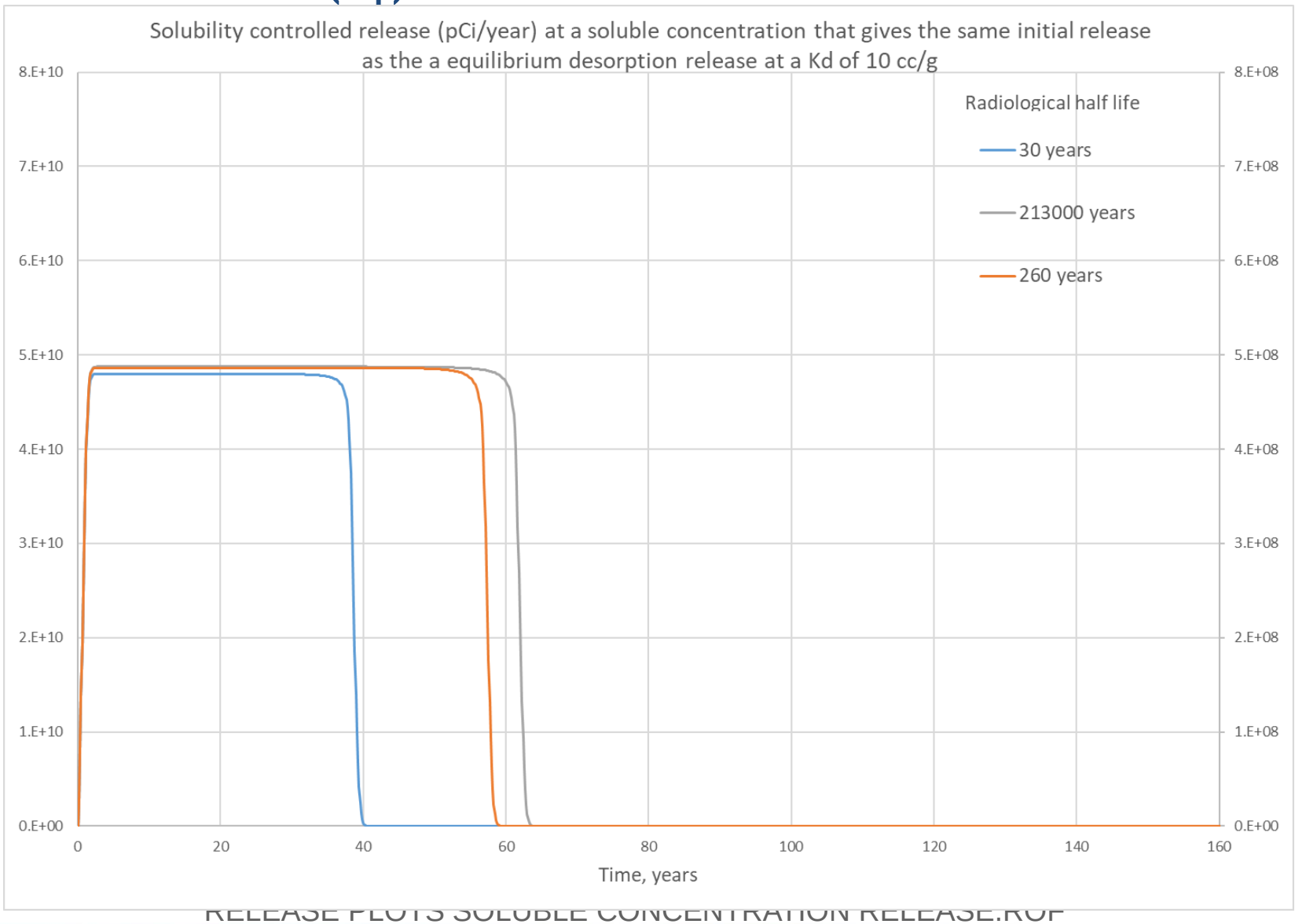


RELEASE PLOTS KD.ROF

Observation on Equilibrium Desorption Release Plots

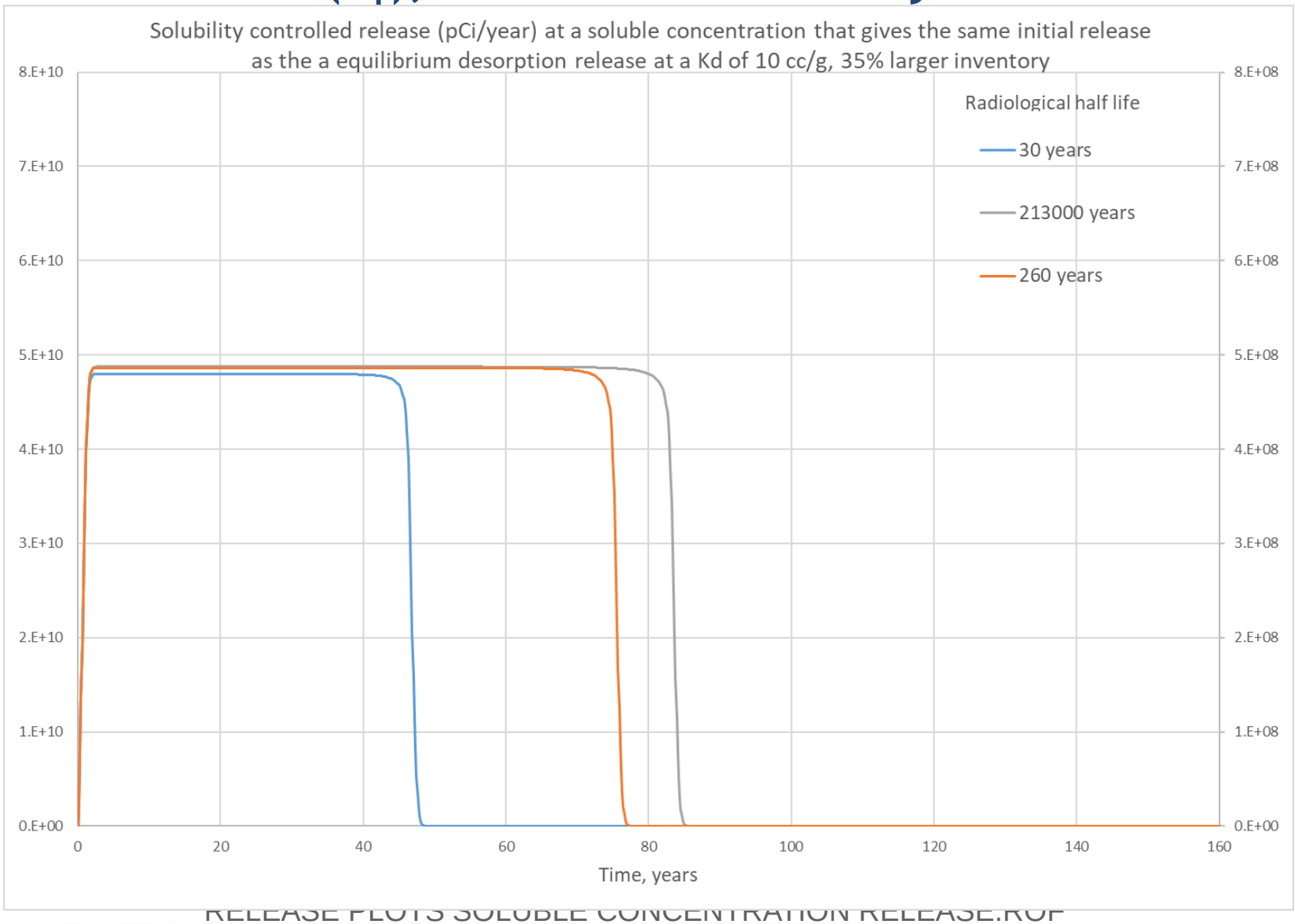
- Release rate is proportional to inventory
- Release duration is independent of inventory
- Initial high release
  - Does not imply that the concentration increased above the equilibrium value
  - A combination of
    - a nearly steady advective component
    - an initially high dispersive component
      - because of the sharp (infinite) concentration gradient at the leading edge
- The dispersive flux quickly smooths out the concentration profile at the leading edge,
  - The release dips below the purely advective release and then recovers as the leading edge moves out

Equilibrium Solubility Release at a Specified Soluble Concentration (c_T)



RELEASE PLOTS SOLUBLE CONCENTRATION RELEASE.ROF

Equilibrium Solubility Release at a Specified Soluble Concentration (c_T), 35% more inventory

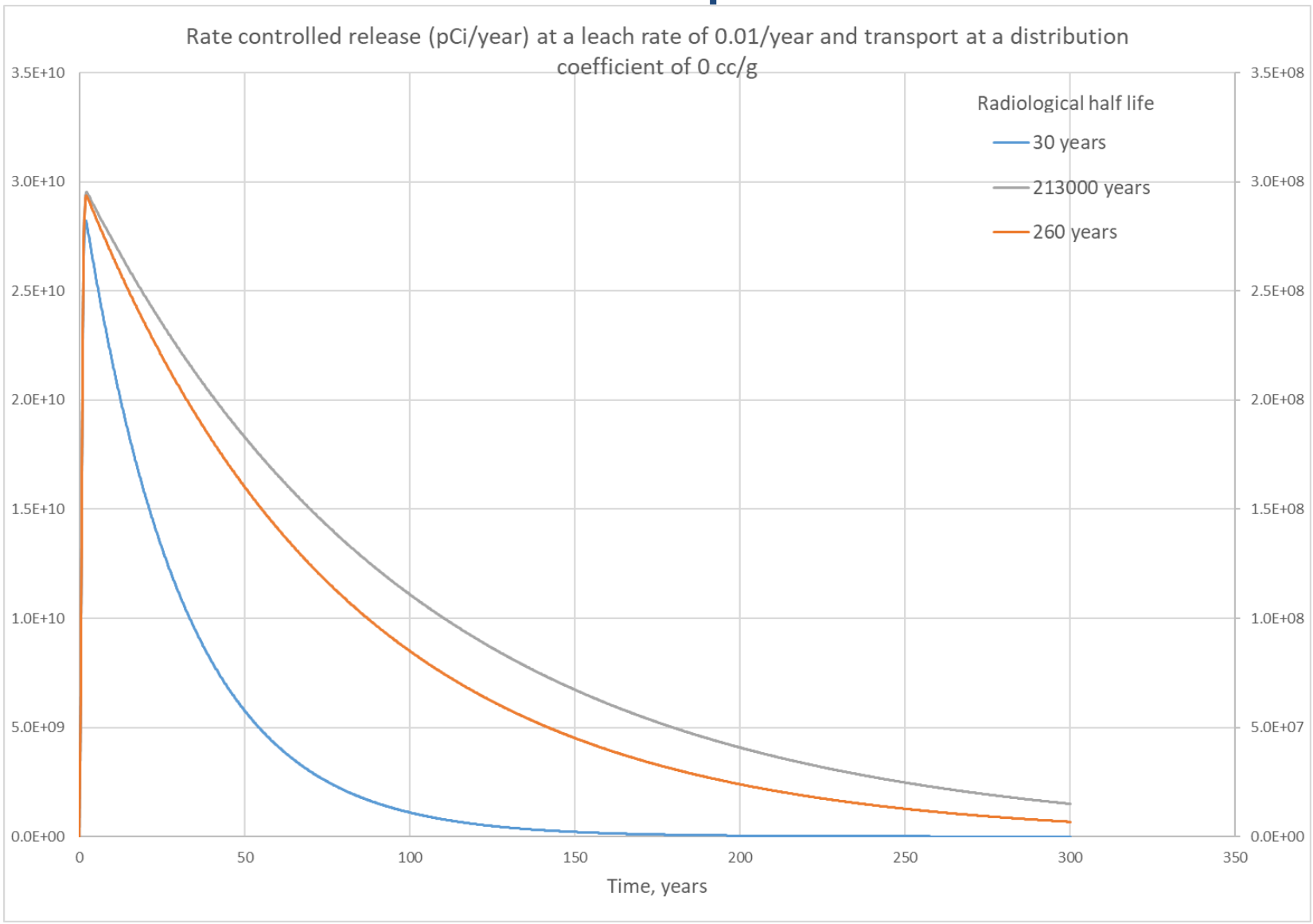


RELEASE PLOTS SOLUBLE CONCENTRATION RELEASE.ROF

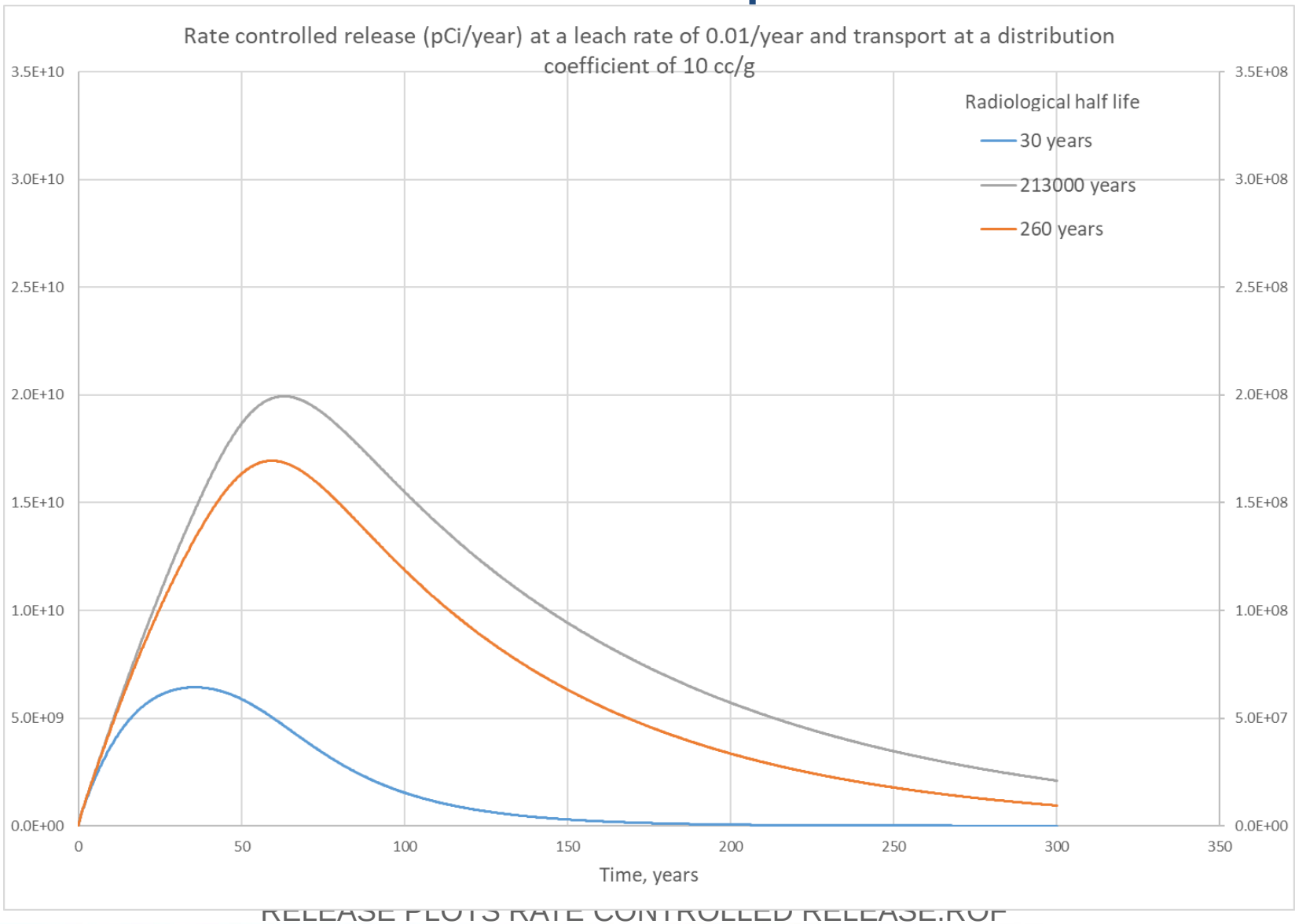
Observation on Equilibrium Solubility Release Plots

- Release rate depends on the specified soluble concentration
  - Independent of the total inventory for a single isotope of an element
  - Depends on the relative inventories if multiple isotopes of an element are present
- The release duration depends on the inventory
- The rounding at the end of the release is due to the numerical scheme used to compute the release
  - It is not due to dispersion

First Order Rate Controlled Release at a Specified Leach Rate - no reactive transport

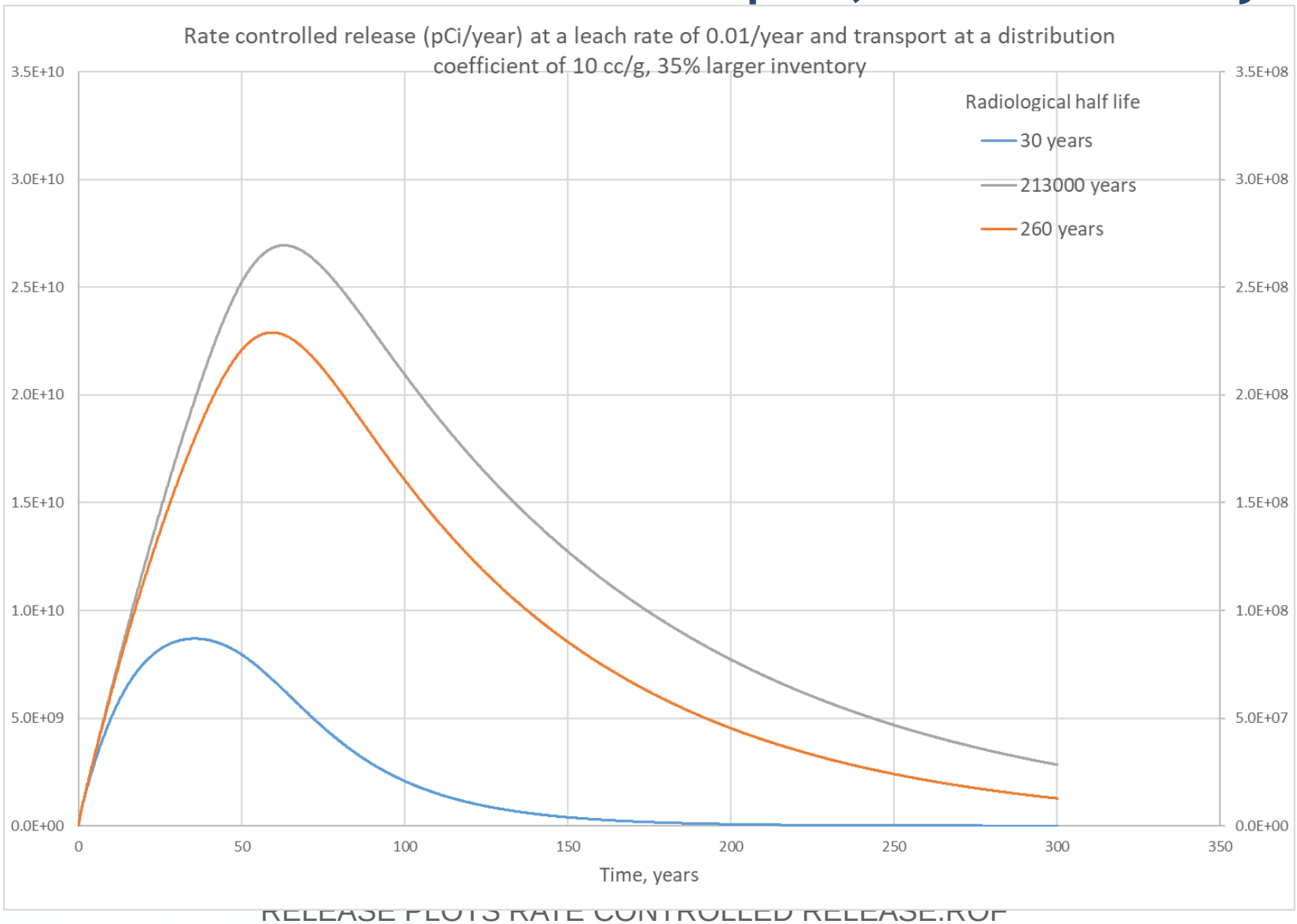


First Order Rate Controlled Release at a Specified Leach Rate - with reactive transport



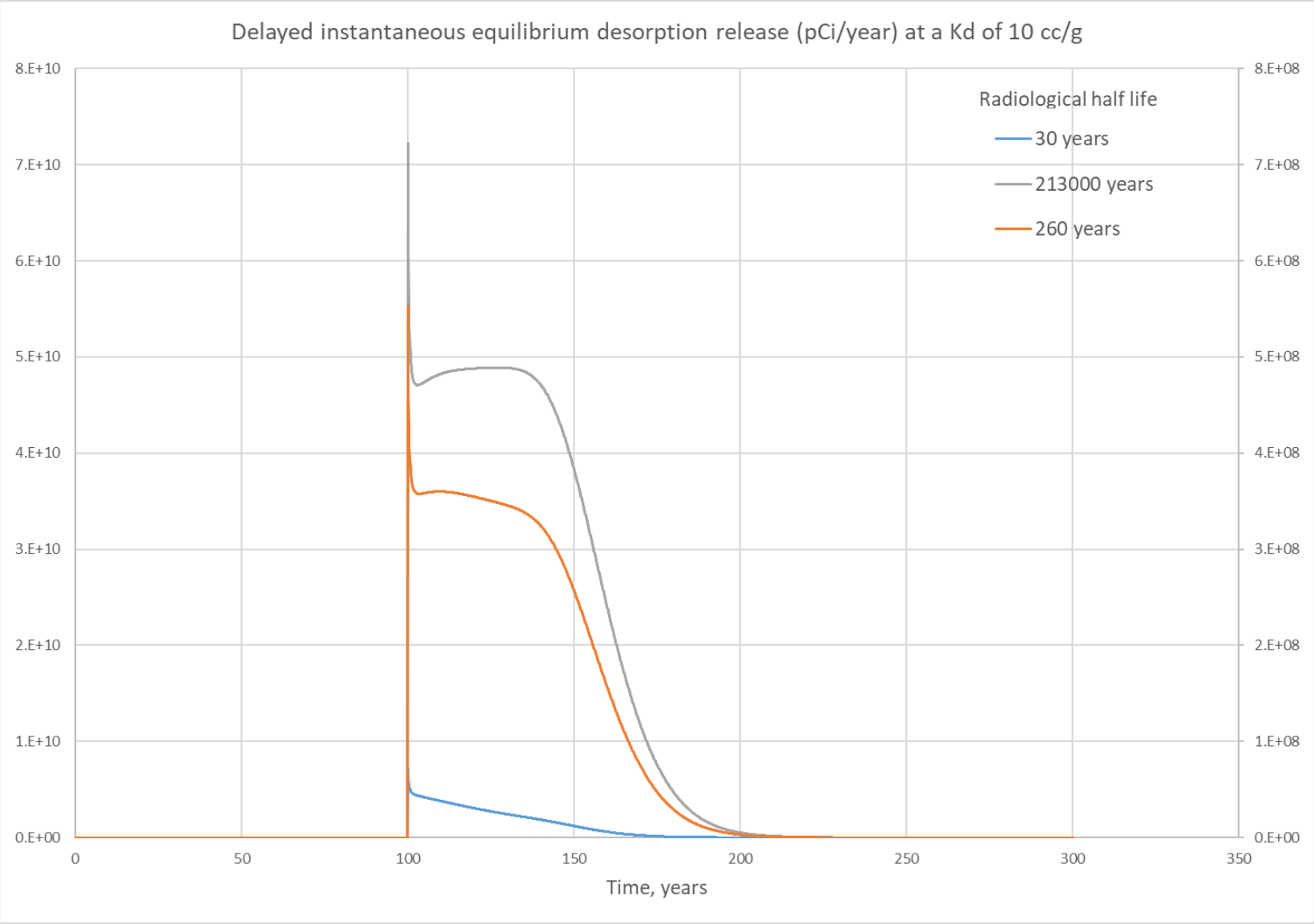
RELEASE PLOTS RATE CONTROLLED RELEASE.ROF

First Order Rate Controlled Release at a Specified Leach Rate - with reactive transport, 135% inventory



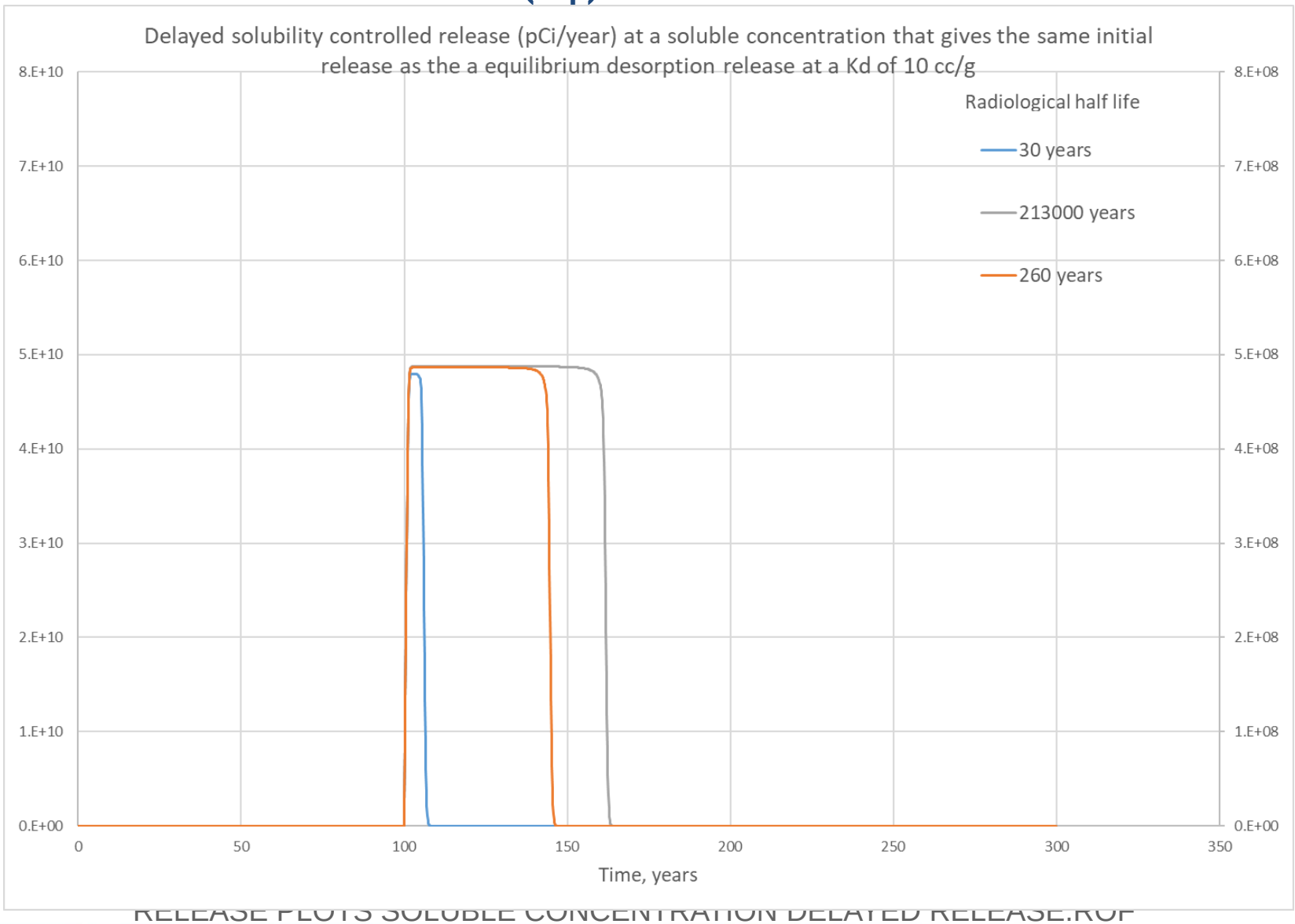
RELEASE PLOTS RATE CONTROLLED RELEASE.ROF

Delayed Equilibrium Desorption Release at a Specified Distribution Coefficient (Kd)



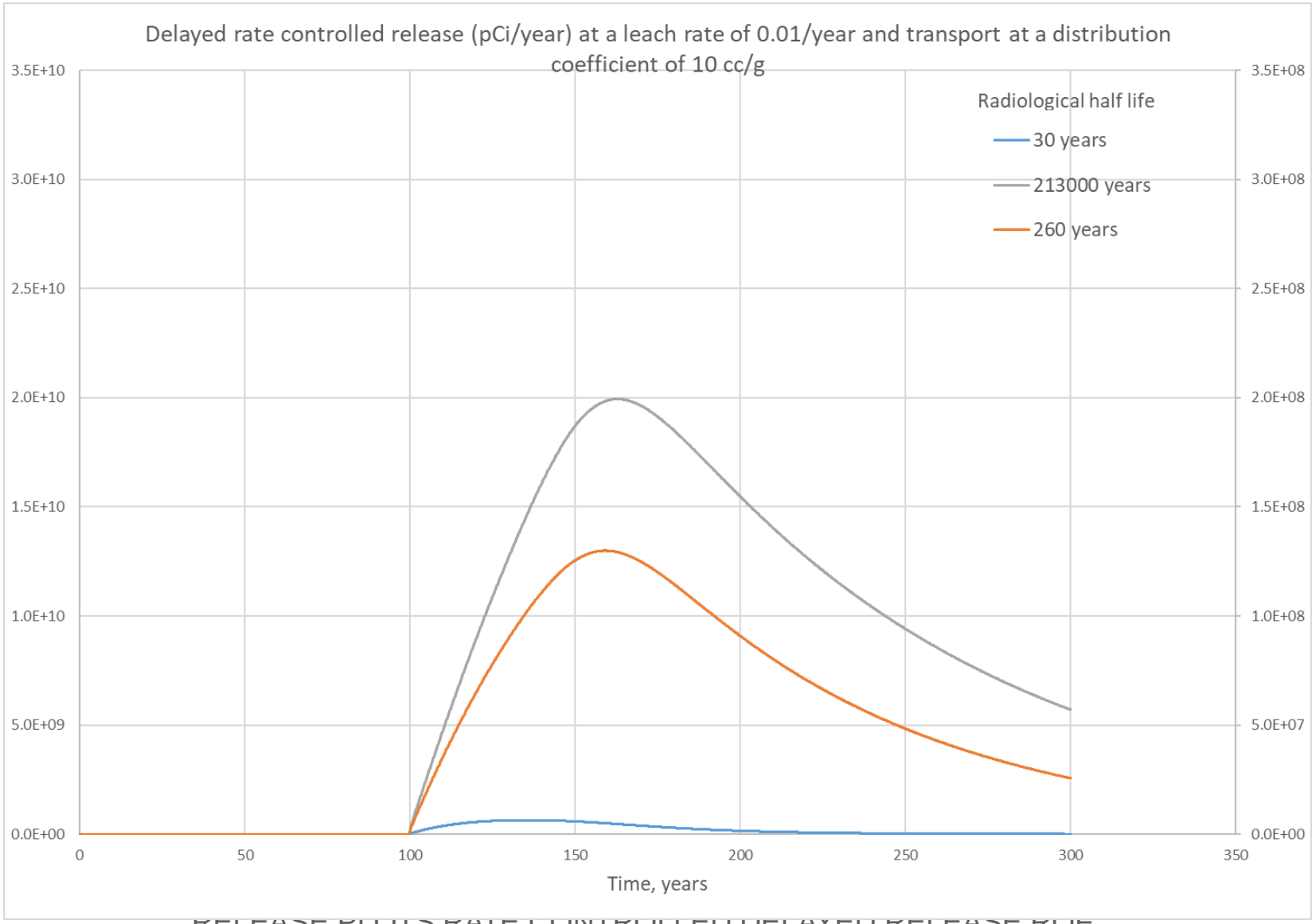
RELEASE PLOTS KD DELAYED RELEASE.ROF

Delayed Equilibrium Solubility Release at a Specified Soluble Concentration (c_T)



RELEASE PLOTS SOLUBLE CONCENTRATION DELAYED RELEASE.ROP

Delayed First Order Rate Controlled Release at a Specified Leach Rate

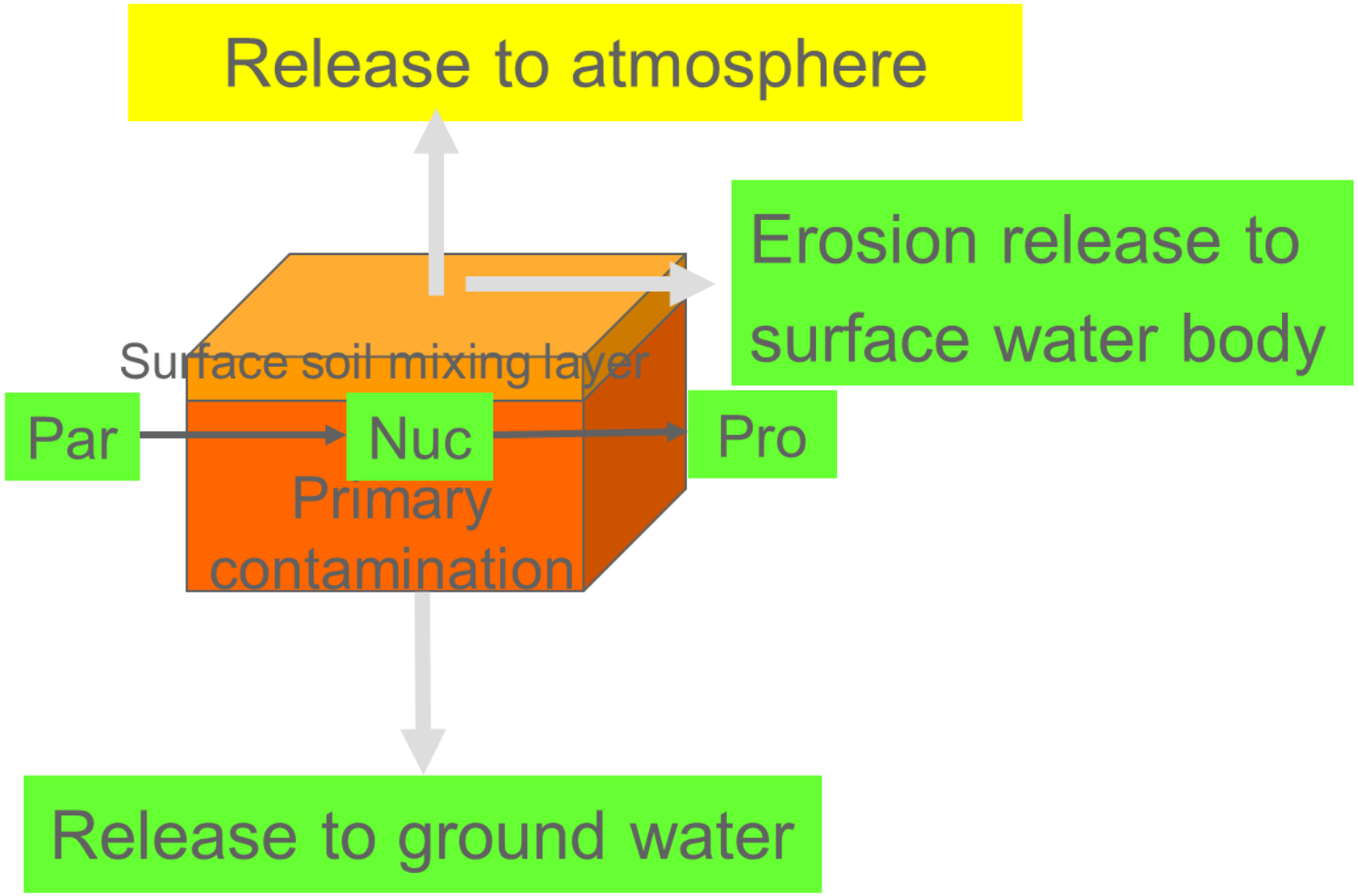


RELEASE PLOTS RATE CONTROLLED DELAYED RELEASE.ROF

Conceptualization of Release of Progeny

- The progeny derived from an initially present radionuclide can have a different release mechanism from that of the initially present parent
  - Except if a parent is release by equilibrium desorption, the progeny produced by the releaseable part of the parent will also be modeled as being released by equilibrium desorption
- Each radionuclide will be released according to the release mechanism chosen for it regardless of whether it is a parent or a progeny

Radionuclide Balance of the Releases from and the Remaining Inventory in the Primary Contamination



Source balance considering radioactive transformations, leaching and erosion

Questions/Discussion