HLWYM HEmails

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Sent: Thursday, April 13, 2006 11:11 AM
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Subject: Np calculations for TAD Meeting
Attachments: Calculations of Np Release at Solubility Limit.doc

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Attached is a discussion of my neptunium solubility release calculations. My results are in Ci/y; I did not translate these to fractional rates, because I don't have the necessary numbers in front of me.

Sorry about the poor quality of the DOE figures - this is how they look in the AMR.

Colloidal Pu is on the way.

David

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Subject: Np calculations for TAD Meeting
Sent Date: 4/13/2006 11:11:04 AM
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Calculations of Np Release at Solubility Limit
David Pickett, 4/13/06

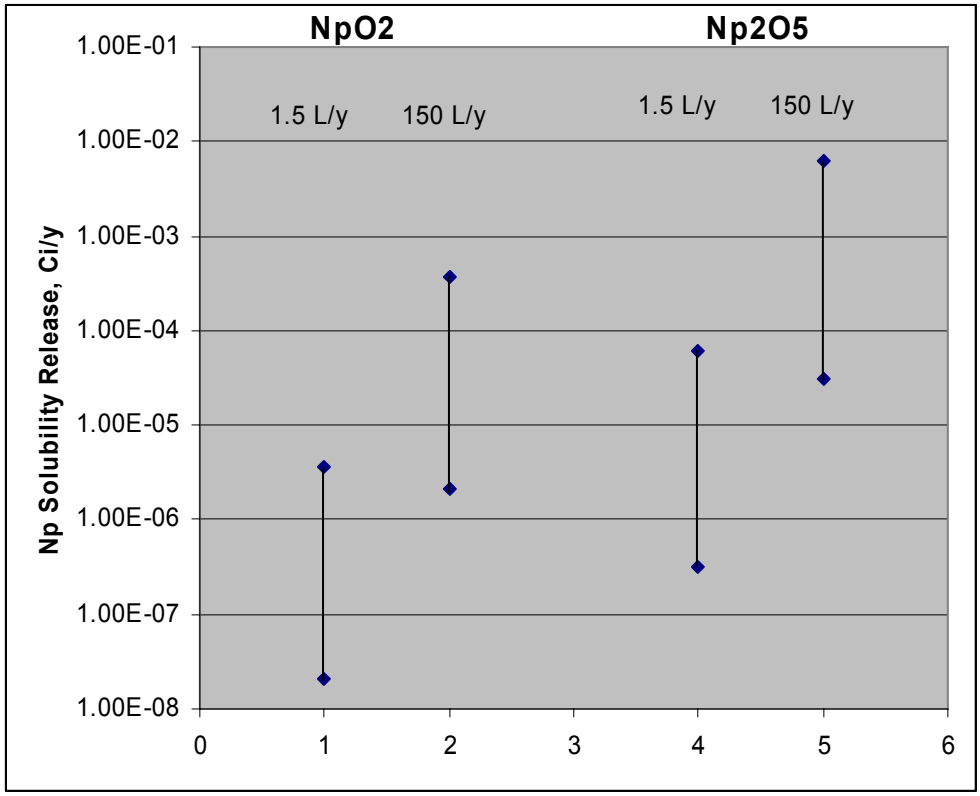
Assumptions
pH = 5.5 to 8
Log f(CO2) = -2 to -3

Solubility Model: Presently, the DOE NpO2 model appears reasonable. All else being equal, the Np2O5 model yields concentrations a factor of 15 higher. We have not reached a final conclusion on the appropriateness of the DOE NpO2 model, but we will adopt it for these calculations.

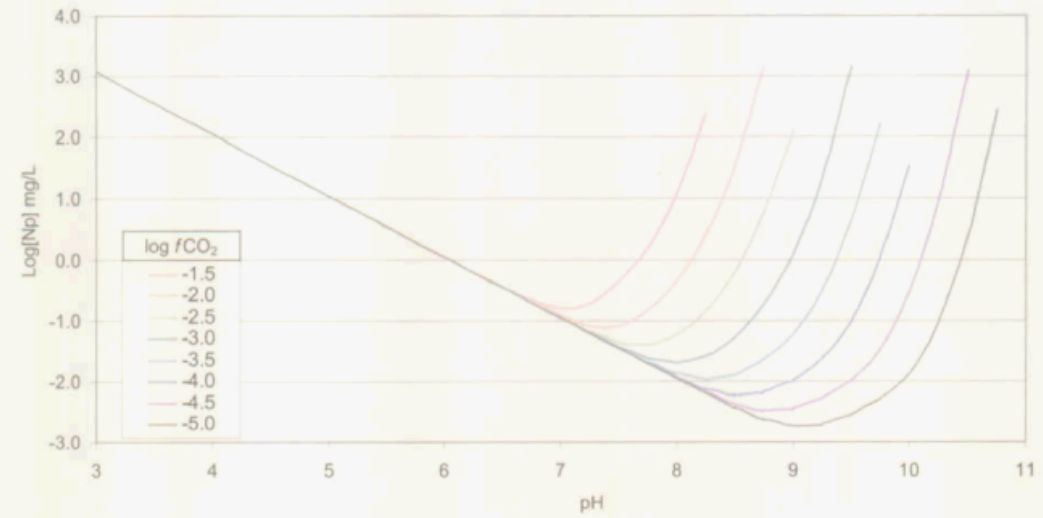
At 1.5 L/y, the range of Np solubilities gives release rates of 2.1e-08 to 3.6e-06 Ci/y.
At 150 L/y, the range of Np solubilities gives release rates of 2.1e-06 to 3.7e-04 Ci/y.

The high values represent the low pH range, while the low values represent the high pH range. I have made no attempt, yet, to construct probability distributions. If Log f(CO2) minimum is -2.5 rather than -3.0, minimum values may be up to a factor of two higher.

Note that higher water fluxes would tend to yield higher pH, because the water would tend toward ambient values (e.g., Figure 6-40 of "In-Package Chemistry Abstraction," ANL-EBS-MD-000037, Rev 03). This implies that at 150 L/y, Np solubility may tend to the lower part of the range. This adds some confidence that, at least for these release rate calculations, it is OK to use NpO2 rather than Np2O5. See plot below. This should be reconsidered if we conclude that 150 L/y is not credible.

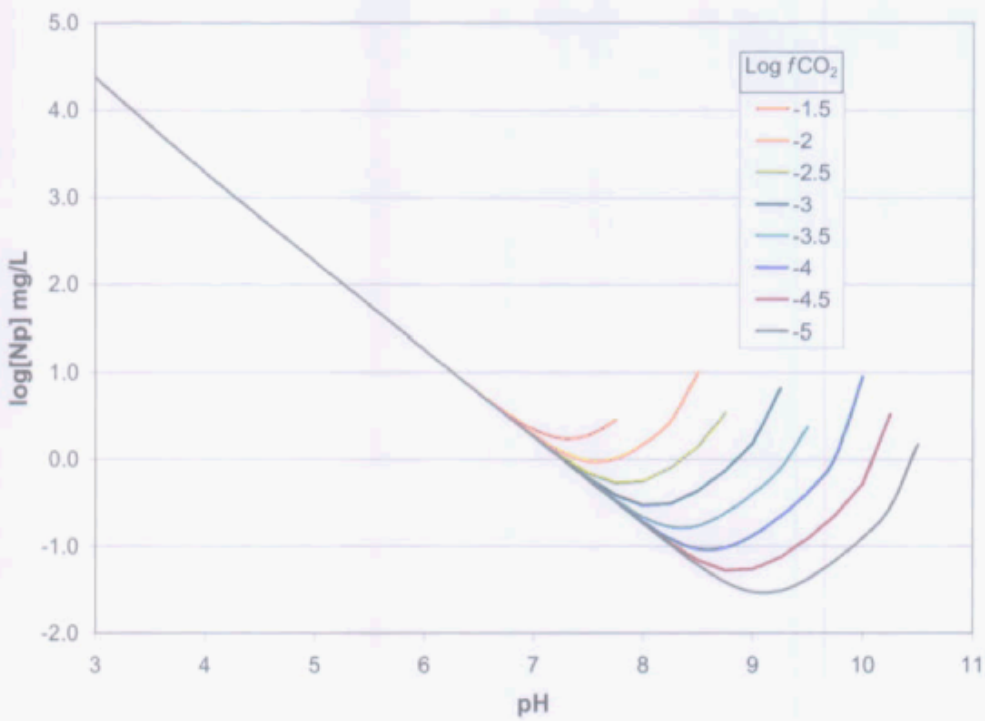


Figures from "Dissolved Concentration Limits of Radioactive Elements," ANL-WIS-MD-0000 10 REV 03



Source: *NpO2 Solubilityfo2reg.xls* (Appendix I).

Figure 6.6-4. NpO_2 Solubility Modeled as a Function of pH and log fCO_2



Source: *Np base case-Ehadjusted.xls* (Appendix I).

Figure 6.6-1. Np_2O_5 Solubility Modeled as a Function of pH and log fCO_2