The rate of change of the ^{64}Zn and ^{66}Zn abundances in the gastro-intestinal reservoir (g) is described by:

$$\frac{\mathrm{d}^{66}\mathrm{Zn}_g}{\mathrm{d}t} = {}^{66}J_d - {}^{66}J_b - {}^{66}J_f \tag{1}$$

$$\frac{\mathrm{d}^{64}\mathrm{Zn}_g}{\mathrm{d}t} = {}^{64}J_d - {}^{64}J_b - {}^{64}J_f \tag{2}$$

where J_d, J_b and J_f are the fluxes of ^{64}Zn and ^{66}Zn from diet (d), toward bulk (b) and feces (f). The rate of change of the of ^{66}Zn/^{64}Zn ratio in the gastro-intestinal box equals:

$$\frac{\mathrm{d}^{66/64}\mathrm{Zn}_g}{\mathrm{d}t} = \frac{1}{{}^{64}\mathrm{Zn}_g}\left[\frac{\mathrm{d}^{66}\mathrm{Zn}_g}{\mathrm{d}t} - \frac{{}^{66}\mathrm{Zn}_g}{{}^{64}\mathrm{Zn}_g}\frac{\mathrm{d}^{64}\mathrm{Zn}_g}{\mathrm{d}t}\right] \tag{3}$$

Using Eq.1 and Eq.2, Eq.3 becomes:

$$\frac{\mathrm{d}^{66/64}\mathrm{Zn}_g}{\mathrm{d}t} = \frac{1}{{}^{64}\mathrm{Zn}_g}\left[{}^{66}J_d - {}^{66}J_b - {}^{66}J_f - \left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_g({}^{64}J_d - {}^{64}J_b - {}^{64}J_f)\right] \tag{4}$$

$$\frac{\mathrm{d}^{66/64}\mathrm{Zn}_g}{\mathrm{d}t} = \frac{1}{{}^{64}\mathrm{Zn}_g}\left\{{}^{64}J_d\left[\frac{{}^{66}J_d}{{}^{64}J_d} - \left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_g\right] - {}^{64}J_b\left[\frac{{}^{66}J_b}{{}^{64}J_b} - \left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_g\right] - {}^{64}J_f\left[\frac{{}^{66}J_f}{{}^{64}J_f} - \left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_g\right]\right\} \tag{5}$$

Replacing the ratios of fluxes by the corresponding ratios of abundances gives:

$$\frac{\mathrm{d}^{66/64}\mathrm{Zn}_g}{\mathrm{d}t} = \frac{1}{{}^{64}\mathrm{Zn}_g}\left\{{}^{64}J_d\left[\left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_d - \left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_g\right] - {}^{64}J_b\left[\left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_b - \left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_g\right] - {}^{64}J_f\left[\left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_f - \left(\frac{{}^{66}\mathrm{Zn}}{{}^{64}\mathrm{Zn}}\right)_g\right]\right\} \tag{6}$$

Assuming that there is no fractionation between the digestive tract and the feces simplifies Eq.6 into:

$$\frac{\mathrm{d}\delta^{66}\mathrm{Zn}_g}{\mathrm{d}t} = \frac{{}^{64}J_d}{{}^{64}\mathrm{Zn}_g}\left\{\left[\delta^{66}\mathrm{Zn}_d - \delta^{66}\mathrm{Zn}_g\right] - \frac{{}^{64}J_b}{{}^{64}J_d}\left[\delta^{66}\mathrm{Zn}_b - \delta^{66}\mathrm{Zn}_g\right]\right\} \tag{7}$$

The gastro-intestinal reservoir shortly goes to steady-state, so $d\delta^{66}\mathrm{Zn}_g/dt \rightarrow 0$, leading to:

$$0 = \delta^{66}\mathrm{Zn}_g - \delta^{66}\mathrm{Zn}_d + \frac{^{64}J_b}{^{64}J_d}\left[\delta^{66}\mathrm{Zn}_b - \delta^{66}\mathrm{Zn}_d + \delta^{66}\mathrm{Zn}_d - \delta^{66}\mathrm{Zn}_g\right] \tag{8}$$

Or:

$$0 = \frac{^{64}J_d - ^{64}J_b}{^{64}J_d}\left[\delta^{66}\mathrm{Zn}_g - \delta^{66}\mathrm{Zn}_d\right] + \frac{^{64}J_b}{^{64}J_d}\left[\delta^{66}\mathrm{Zn}_b - \delta^{66}\mathrm{Zn}_d\right] \tag{9}$$

Rearranging Eq.9 finally gives:

$$\frac{^{64}J_b}{^{64}J_f} = \frac{\delta^{66}\mathrm{Zn}_g - \delta^{66}\mathrm{Zn}_d}{\delta^{66}\mathrm{Zn}_d - \delta^{66}\mathrm{Zn}_b} \tag{10}$$

For a $\delta^{66}\mathrm{Zn}_d$ of 0‰, and given that $\delta^{66}\mathrm{Zn}_b = \delta^{66}\mathrm{Zn}_g + 0.25$ ‰, we obtain a $\delta^{66}\mathrm{Zn}_g$ value of -0.00026‰, and a $\delta^{66}\mathrm{Zn}_b$ steady-state value of ~ 0.25‰.