

**Equations S5. GMA mass balance equations for unlabeled pools.**

$$\begin{aligned}
dU_1/dt &= u_{12,1} - u_{1,2} \\
dU_2/dt &= (u_{1,2} + u_{3,2} + u_{4,2}) - (u_{2,3}^a + u_{2,4} + u_{2,5})^* \\
dU_3/dt &= (u_{2,3}^c + u_{8,3} + u_{18,3} + u_{19,3}) - (u_{3,2} + u_{3,7} + u_{3,8}^a) \\
dU_4/dt &= u_{2,4} - (u_{4,2} + u_{4,17}) \\
dU_5/dt &= (u_{2,5} + u_{6,5} + u_{7,5}) - (u_{5,6} + u_{5,7}^a) \\
dU_6/dt &= u_{5,6} - (u_{6,5} + u_{6,17}) \\
dU_7/dt &= (u_{3,7} + u_{5,7}^c + u_{8,7} + u_{18,7} + u_{19,7}) - (u_{7,5} + u_{7,8}^a + u_{7,43}) \\
dU_8/dt &= (u_{3,8}^c + u_{7,8} + u_{20,8}) - (u_{8,3} + u_{8,7} + u_{8,18} + u_{8,20}) \\
dU_9/dt &= u_{11,9} - (u_{9,10} + u_{9,15}) \\
dU_{10}/dt &= u_{9,10} - u_{10,56} \\
dU_{11}/dt &= u_{12,11} - (u_{11,9} + u_{11,14}) \\
dU_{12}/dt &= (u_{4,17} + u_{6,17} + u_{24,12} + u_{33,30} + u_{34,31} + u_{35,32} + u_{40,39} + u_{158,12}) \\
&\quad - (u_{12,1} + u_{12,11} + u_{12,23}^a + u_{12,148} + u_{30,33} + u_{31,34} + u_{32,35}) \\
dU_{13}/dt &= u_{37,13} - (u_{12,1} + u_{9,10} + u_{13,32}) \\
dU_{14}/dt &= (u_{3,8}^b + u_{7,8}^b + u_{11,14} + u_{18,19}) - (u_{14,142} + u_{14,145}) \\
dU_{15}/dt &= u_{9,15} - (u_{3,8}^b + u_{7,8}^b + u_{15,44} + u_{18,19}^b) \\
dU_{16}/dt &= u_{47,16} - u_{9,15} \\
dU_{17}/dt &= (u_{4,17} + u_{6,17}) - u_{14,145} \\
dU_{18}/dt &= (u_{8,18} + u_{21,18}) - (u_{18,3} + u_{18,7} + u_{18,19}^a + u_{18,21}) \\
dU_{19}/dt &= (u_{18,19}^c + u_{22,19}) - (u_{19,3} + u_{18,7} + u_{19,22}) \\
dU_{20}/dt &= u_{8,20} - u_{20,8} \\
dU_{21}/dt &= u_{18,21} - u_{21,18} \\
dU_{22}/dt &= u_{19,22} - u_{22,19} \\
dU_{23}/dt &= u_{12,23}^c - (u_{2,3}^b + u_{5,7}^b) \\
dU_{24}/dt &= u_{25,24} - (u_{12,23}^b + u_{24,12}^a) \\
dU_{25}/dt &= u_{62,25} - (u_{24,12}^b + u_{25,24}) \\
dU_{26}/dt &= u_{25,26} - u_{26,27} \\
dU_{27}/dt &= u_{26,27} - u_{27,28} \\
dU_{28}/dt &= u_{27,28} - (u_{28,29} + u_{28,179}) \\
dU_{29}/dt &= u_{28,29} - u_{29,30} \\
dU_{30}/dt &= (u_{29,30} + u_{33,30}) - (u_{30,31} + u_{30,33}) \\
dU_{31}/dt &= (u_{30,31} + u_{34,31}) - (u_{31,32} + u_{31,34}) \\
dU_{32}/dt &= (u_{31,32} + u_{35,32} + u_{37,32} + u_{39,32}) - (u_{32,35} + u_{32,37} + u_{32,41} + u_{32,186})
\end{aligned}$$

$$\begin{aligned}
dU_{33}/dt &= u_{30,33} - u_{33,30} \\
dU_{34}/dt &= u_{31,34} - u_{34,31} \\
dU_{35}/dt &= (u_{32,35} + u_{40,35}) - (u_{35,32} + u_{35,40}) \\
dU_{36}/dt &= (u_{37,36} + u_{39,36}) - (u_{36,37}^a + u_{36,37}^b + u_{36,37}^c + u_{36,39}) \\
dU_{37}/dt &= (u_{32,37} + u_{36,37}^a + u_{36,37}^b + u_{36,37}^c) - (u_{37,32} + u_{37,36}) \\
dU_{38}/dt &= (u_{124,38} + u_{125,38}) - u_{38,25} \\
dU_{39}/dt &= (u_{42,39} + u_{36,39} + u_{40,39}) - (u_{39,32} + u_{39,36}) \\
dU_{40}/dt &= u_{35,40} - (u_{40,35} + u_{40,39})
\end{aligned}$$

(\*) A superscript indicates deviations from the total pools.