

## Cumulate and residual wallrock major element calculation tool for Magma Chamber Simulator output

This Excel worksheet tool can be used to calculate the major element composition of the cumulate (each step and bulk) and residual wallrock, because these are not standard output in MCS. The calculator does this by calculating what is added to the cumulate pile each step (i.e. what is being lost from the M melt) and what is being removed from the residual wallrock each step (i.e. decrement of WR melt added to M from bulk residual WR each step).

The central equation behind the incremental cumulate calculations is:

$$X_{ic} = (X_p - \left( X_c \left( 1 - \frac{m_s}{m_l + m_s + m_f} \right) \right)) / \left( \frac{m_s}{m_l + m_s + m_f} \right)$$

where

$X_{ic}$  = oxide composition of incremental cumulate in the current step

$X_p$  = oxide composition of M liquid (melt) + fluid in the previous step

$X_c$  = oxide composition of M liquid (melt) + fluid in the current step

$m_s$  = mass of incremental solids in the current step

$m_l$  = mass of M liquid (melt) in the current step

$m_f$  = mass of M cumulative fluid in the current step

The central equation behind the residual WR calculations is:

$$X_r = X_p - X_l \left( \frac{m_l}{m_l + m_r} \right)$$

where

$X_r$  = composition of WR residual in the current step

$X_p$  = composition of bulk WR in the previous step

$X_l$  = composition of WR liquid in the current step

$m_l$  = mass of WR liquid added to M in the current step

$m_r$  = mass of residual WR in the current step

This is then further refined to also calculate out melt (below percolation threshold) and fluid from the residual WR and output solid WR residual composition.

All calculations are normalized to 100 wt.% for output. See the worksheet for more info.