Visualization of the incremental magma growth related to porphyry copper deposits obtained with numerical modeling

(https://doi.org/10.5880/fidgeo.2022-031)

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1. Licence

2. Citation

When using the data please cite:

Korges, Maximilian; Weis, Philipp; Andersen, Christine (2022): Visualization of the incremental magma growth related to porphyry copper deposits obtained with numerical modeling. GFZ Data Services. https://doi.org/10.5880/fidgeo.2022.031

The data are supplementary material to:

Korges, M.; Weis, P.; & Andersen, C. (2020): The role of incremental magma chamber growth on ore formation in porphyry copper deposits – Earth and Planetary Science Letter, 552. https://doi.org/10.1016/j.epsl.2020.116584

3. Data Description

Porphyry copper deposits provide most of the world's, half its molybdenum reserves and are resources for Zn, Pb, Au, and Ag. The porphyry mineralization is inferred to form on time scales between 50 and 100kyrs whereby the mineralization forming magma chamber is generally built up by multiple intrusive events. The overall source magmatic system can be active for several millions of years. We used the Complex System Modeling Platform (CSMP++) to simultaneously model sill injection, heat transfer, the release of metal-bearing magmatic fluids, the multi-phase flow of saline hydrothermal fluids, and dynamic permeability variations with a continuum porous medium approach. Our modeling studies the volumetric injection rate and its impact on the growth of the magma chamber and the Cu-ore shell but also investigates the influence of hydrothermal convection and fluid release. The setup of each modeling run is changed slightly, either by changing the influx rate, changing the geometry of the magma chamber, or changing the location of fluid release. CSMP was modified to produce vtk and vtu files every 100 years which were read into the Paraview 4.3.1 software to perform the post-processing (including the calculation of the copper enrichment factor and the pore fluid factor). Paraview was then used to produce the displayed videos.

4. File Description

The presented videos are avi files that can be displayed by a wide range of video players. The naming of the files corresponds to certain modeling setups which are described in more detail in the following table.

The magma chamber files show the copper enrichment factor in yellow (values from the other to the inner line: 100, 1000, 4000) which is a rough estimate of the copper content, e.g. a copper enrichment factor of 1000 can correspond to up to 2.5 wt% of Cu. The black line corresponds to the pore fluid factor of 0.7 (fluid pressure divided by lithostatic pressure) which is the assumed transition from lithostatic to hydrostatic pressure.

The fluid plume files show a close-up of the region above the magma chamber. The colored parameter is the magmatic water ratio (0 corresponds to pure meteoric water, 1 to pure magmatic water). The black line is again the pore fluid factor (0.7) but is only of interest within the fluid plume. The red lines correspond to the temperature whereby the 100°C line is the outer line and each following line increases the temperature in 100°C steps.

File name	**Sill rate (One sill every)**	**Injection rate (in x10^{-3} km^3/y)**	**Geometry**
C_inc_2500	2500 yrs	7.6	Centered injection location, incremental setup
C_inc_5000	5000 yrs	3.8	Centered injection location, incremental setup
C_inc_15000	15000 yrs	1.3	Centered injection location, incremental setup
C_inc_30000	30000 yrs	0.6	Centered injection location, incremental setup
C_singleChamber	No sill	Single intrusion	Centered injection location, one big magma chamber
Complete_inc_10000	10000 yrs	1.9	Injection over entire length of magma chamber, incremental setup
OneSided_inc_10000	10000 yrs	1.9	Injection at on side of the magma chamber, incremental setup
C_inc_2500_fluidplume	2500 yrs	7.6	Centered injection location, incremental setup
C_inc_5000_fluidplume	5000 yrs	3.8	Centered injection location, incremental setup
C_inc_30000_fluidplume	30000 yrs	0.6	Centered injection location, incremental setup