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On geological interpretations of crystal size distributions: Constant vs. proportionate growth

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ABSTRACT

Geological interpretations of crystal size distributions (CSDs) depend on understanding the crystal growth laws that generated the distributions. Most descriptions of crystal growth, including a population-balance modeling equation that is widely used in petrology, assume that crystal growth rates at any particular time are identical for all crystals, and, therefore, independent of crystal size. This type of growth under constant conditions can be modeled by *adding* a constant length to the diameter of each crystal for each time step. This growth equation is unlikely to be correct for most mineral systems because it neither generates nor maintains the shapes of lognormal CSDs, which are among the most common types of CSDs observed in rocks. In an alternative approach, size-dependent (proportionate) growth is modeled approximately by *multiplying* the size of each crystal by a factor, an operation that maintains CSD shape and variance, and which is in accord with calcite growth experiments. The latter growth law can be obtained during supply controlled growth using a modified version of the Law of Proportionate Effect (LPE), an equation that simulates the reaction path followed by a CSD shape as mean size increases.