Chemical Continuous Time Random Walks

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The Gillespie algorithm models chemical reactions as random walks in particle number space. The reaction lag times are exponentially distributed based on the assumption that the system is well mixed. We propose a generalization of this method and introduce non-exponential reaction lag time distributions, which may reflect the impact of incomplete mixing on the chemical reactions. From such a chemical continuous time random walk, we derive a generalized chemical Master equation. We present test cases to study the impact of non-exponential reaction times on the overall reaction behavior.

Generation of a multi-annuli corona sequence in two-pyroxene gabbro, Fiordland, New Zealand: intrusion, rapid post-magmatic cooling and transformation of gabbro to high-*P* granulite

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Arc-related gabbroic intrusives of the Pembroke Valley, New Zealand preserve an unusual and unique sequence of coronas developed between igneous Fe-Mg silicates, Fe-Ti oxides and matrix plagioclase. The igneous assemblage does not contain garnet, constraining the depth of gabbro intrusion to less than *c*. 35 km at temperatures above 1000ºC. Two distinct stages of corona crystallisation (C_1 and C_2) at lower-crustal levels have been identified. C_1 coronas involve symplectic intergrowths of Ca–amphibole-kyanite-clinopyroxene-K–feldspar-plagioclase-clinozoisite-quartz ± orthopyroxene, and formed during incipient hydration at the boundary between the two-pyroxene- and garnet granulite-facies at *c*. 25-35 km depth and temperatures of ≈ 800ºC. Both igneous and C_1 corona mineral assemblages are crosscut by a series of ramifying anorthositic veins. Adjacent and parallel to these veins, igneous and C_1 corona minerals are pseudomorphed by garnet-clinopyroxene-rutile-bearing C_2 coronas within the selvage zones to the central vein. C_2 coronas formed via dehydration and recrystallisation of igneous and C_1 mineral assemblages in the garnet granulite-facies at pressures of ≈ 1.1 GPa (*c*. 30-35 km depth) and temperatures of ≈ 750ºC. The sequence of corona annuli development at Pembroke represents the post-magmatic recrystallisation of gabbroic lithologies at constant or slightly increasing pressure and declining temperature. U-Pb isotopic ages of magmatic and recrystallised zircons indicate that the timing of intrusive and garnet granulite forming events were separated by as little as 11-17 Myr. This implies that the process of cooling (isobaric or up pressure) to produce high-pressure granulites is not just restricted to decreasing heat flow in old continental root zones, but may also occur in a transient setting during relatively rapid (11-17 Ma) isobaric cooling of young mafic under-plate in an intracontinental arc setting.

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