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Stress orientation–dependent reactions during metamorphism

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Grain-scale pressure variations have been recognized as an important driver for the formation of distinct mineral assemblages during high- and ultrahigh-pressure metamorphism. However, the effects of differential stress acting during hydration of granulite remain underexplored. Here, we present textural evidence for the orientation dependence of two distinct amphibolite-facies plagioclase grain boundary replacement assemblages that formed in response to differential stress during the early stage of lower-crustal hydration. The two assemblages, A1 (zoisite, kyanite, and quartz) and A2 (plagioclase and K-feldspar), are indicative of contemporaneous formation at local equilibrium conditions at ∼700 °C and 1.1 GPa and 0.9 GPa, respectively. Mineral replacement was accompanied by minor redistribution of chemical components by the alteration fluid in response to the heterogeneous stress field and local equilibria. Thus, our observations provide new insight into the driving forces for pressure solution and indicate that differential stress and fluid-induced mass transfer may define the evolution of metamorphic assemblages.