

PRESIDENTIAL ADDRESS

Patterns of mineral occurrence in metamorphic rocks

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ABSTRACT

Patterns in the occurrence of minerals in metamorphic rocks suggest additional opportunities for investigating chemical and physical processes during metamorphism. Three such patterns are reviewed. First, trace minerals in metamorphic rocks commonly occur with regular distributions indicating their participation in prograde reactions that can be mapped as isograds. Examples include the distribution of allanite and monazite in pelitic rocks and of zircon and baddeleyite in siliceous dolomites. Recognition of these isograds points to the potential for developing a chronology of specific chemical reactions during metamorphism and for defining the *P-T* conditions of those reactions. Second, the mineralogical products of retrograde metamorphism in many cases occur in distinctive associations that are consistent with partial mineral-fluid equilibrium. Examples include the distribution of retrograde calcite, quartz, and tremolite in siliceous limestones and of retrograde tremolite, dolomite, brucite, and serpentine in siliceous dolomites from contact aureoles. Among other things, application of partial equilibrium to retrograde metamorphic rocks leads to constraints on the amount and direction of fluid flow in contact aureoles as they cool. Third, pseudomorphs are typically absent from prograde metamorphic rocks but are common in retrograde metamorphic rocks. The distribution may be explained by the effect of “force of crystallization.” The pattern of occurrence of pseudomorphs thus suggests novel phenomena during metamorphism that develop from an interplay between chemical and mechanical processes.