

Low–pressure subsolidus and suprasolidus phase equilibria in the MnNCKFMASH system: Constraints on conditions of regional metamorphism in western Maine, northern Appalachians

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ABSTRACT

The peak of regional metamorphism in western Maine was reached at ca. 404 Ma during the waning stage of Devonian Acadian deformation. Regional metamorphic mineral assemblages in metapelitic rocks range from greenschist to upper amphibolite facies. Subsolidus rocks are characterized by the association andalusite + staurolite; at the highest grades, anatectic migmatites are developed. Results of thermodynamic modeling in the MnNCKFMASH system are consistent with field data and imply a metamorphic field gradient that extends from 3.5–4.0 kbar at lower grades (500–520 °C) to > 4.5 kbar at suprasolidus temperatures that exceeded 700 °C. Regional isotherms that are inferred to have been shallowly inclined at lower grades are closely spaced around synmetamorphic granites and at the migmatite front, consistent with advection-controlled intracrustal redistribution of heat within the regionally extensive thermal high. Peak pressures vary both along and across the strike of the Central Maine belt, which is interpreted to record differential thickening during syntectonic metamorphism. Contact metamorphism associated with the Mooselookmeguntic igneous complex occurred ca. 35 million years after the regional metamorphic peak, and records higher pressure conditions than the regional event. We suggest that the final increment of late-Acadian thickening accounts for the pressure increase, consistent with regional cooling prior to the emplacement of the Mooselookmeguntic igneous complex. Pluton emplacement at deeper levels ca. 35 million years after the peak of Acadian metamorphism reflects lowering of the brittle-viscous transition zone, a level at which ascending magma is trapped, consequent on regional cooling and a steeper geotherm. An overall counter-clockwise *P-T-t* evolution is implied in the Central Maine belt, consistent with that proposed for Acadian metamorphism in western New Hampshire.