

Contact metamorphism of a Cretaceous accretionary prism by the 14 Ma Okueyama granite, a single post-kinematic pluton in Central Kyushu, Japan: SVD analysis of metamorphic reactions and thermal release

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ABSTRACT

Petrologic analysis is used to determine the intensity and extent of the thermal effects of a post-kinematic granite on its surrounding rocks to understand the thermal evolution of an accretionary prism in Central Kyushu, Japan. The relatively young (14 Ma) Okueyama granite represents a single magma chamber, which solidified as a zoned pluton, and is therefore suitable for the study of the thermal effects by a single heat source. The Lower Shimanto Group country rock, an accretionary prism of Cretaceous age, has undergone contact metamorphism, to form an orthopyroxene zone, cordierite zone, and biotite zone in order of decreasing metamorphic grade. Singular value decomposition (SVD) analysis of composition matrices of relevant mineral assemblages results in the following isograd reactions

$0.475\text{Bt}^{\text{Crd}} = 0.538\text{Opx} + 0.179\text{Bt}^{\text{Opx}} + 0.665\text{Kfs} + 0.075\text{Crd} + 0.067\text{Ilm}$, for the orthopyroxene isograd, and

$0.612\text{Bt}^{\text{Bt}} + 0.218\text{Ms}^{\text{Bt}} + 0.063\text{Ilm} = 0.292\text{Kfs}^{\text{Crd}} + 0.686\text{Bt}^{\text{Crd}} + 0.137\text{Crd}^{\text{Crd}}$, for the cordierite isograd.

Peak metamorphic temperatures for each zone were determined using ternary feldspar and garnet-biotite thermometers, yielding a peak thermal gradient of 0.071 °C/m. This thermal gradient yields isograd temperature conditions of 740 °C for the orthopyroxene isograd and 550 °C for the cordierite isograd, respectively.

Keywords: Thermal effect, accretionary prism, granite, contact metamorphism, SVD analysis