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# Trace element distribution among rock-forming minerals in Black Hills migmatites, South Dakota: A case for solid-state equilibrium

**PETER I. NABELEK**

Department of Geological Sciences, University of Missouri-Columbia, Columbia, Missouri 65211, U.S.A.

## ABSTRACT

Proterozoic migmatites in the Black Hills, South Dakota, were examined to determine if partitioning of trace elements hosted by rock-forming minerals between melanosomes and leucosomes preserves residue-melt equilibrium that was presumably established during partial melting of pelitic lithologies. Granitic leucosomes in the Black Hills, as is often the case elsewhere, have positive Eu anomalies, are highly enriched in Sr and Ba, and are depleted in Rb and Cs relative to granites derived by partial melting of metapelites. Distributions of these trace elements between melanosomes and leucosomes cannot be simulated using mineral-melt distribution coefficients. A metamorphic reaction-progress method is used to demonstrate that the distributions approach mineral-mineral equilibrium rather than mineral-melt equilibrium. Application of published diffusion data for the relevant elements in feldspars shows that solid-state equilibrium is unlikely to have been established during subsolidus cooling. Instead, it is suggested that partial melts maintained chemical equilibrium with melanosomes during crystallization that lead to the migmatites.