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High-pressure behavior of kyanite: Decomposition of kyanite into stishovite and corundum

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ABSTRACT

The pressure stability of kyanite was experimentally reversed with the use of a multi-anvil apparatus. Kyanite was found to decompose into its oxides stishovite and corundum between 14 ± 0.5 GPa (at 1000 °C) and 17.5 ± 1.0 GPa (at 2000 °C).

Reliable thermodynamic calculations can be performed to temperatures of approximately 1500 °C. Up to this temperature, the location of the equilibrium kyanite = corundum + stishovite, determined in this study, constrains the equilibrium coesite = stishovite. A set of thermodynamic data was calculated by linear programming from the kyanite breakdown reaction and the coesite = stishovite equilibrium. Feasible values for the fitted thermodynamic properties are −28.5 to −26.3 MPa/K for the temperature derivative of the bulk modulus $[(dK/dT)_P]$ of kyanite, −815254 to −813635 J/mol for $G^0_{(1298)}$ of stishovite, and 24.6 to 26.3 J/mol · K for $S^0_{(1298)}$ of stishovite.

The experimental results indicate (1) that in peraluminous eclogites of basaltic or sedimentary origin, stishovite may coexist stably with corundum at a depth greater than 420–450 km and (2) that in an inhomogeneous Al-enriched mantle, corundum could be a minor constituent in the lower mantle.