

## **Thermoelastic properties of zircon: Implications for geothermobarometry**

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### **ABSTRACT**

A thermal-pressure equation of state has been determined for zircon ( $\text{ZrSiO}_4$ ) that characterizes its thermoelastic behavior at metamorphic conditions. New pressure-volume ( $P$ - $V$ ) data from a “Mud Tank” zircon have been collected from 1 bar to 8.47(1) GPa using X-ray diffraction, and elastic moduli were measured from room temperature up to 1172 K by resonance ultrasound spectroscopy. These data were fitted simultaneously with temperature-volume ( $T$ - $V$ ) data from the literature in EosFit7c using a new scaling technique. The parameters of a third-order Birch-Murnaghan EoS with a Mie-Grüneisen-Debye model for thermal pressure have compressional EoS parameters  $K_{0T} = 224.5(1.2)$  GPa,  $K'_{0T} = 4.90(31)$  with a fixed initial molar volume  $V_0 = 39.26 \text{ cm}^3/\text{mol}$  and thermal parameters  $\gamma_0 = 0.868(15)$ ,  $q = 2.37(80)$ , and  $\Theta_D = 848(38)$  K. EoS parameters that describe the variation of unit-cell parameters with pressure and temperature were determined using an isothermal-type EoS. This new EoS confirms that zircons are stiffer than garnets and exhibit a much lower thermal expansion. This results in steep isomekes between zircon and garnets, which makes zircon trapped as inclusions in garnets at metamorphic conditions a good piezothermometer.

**Keywords:** Zircon, equation of state, piezobarometry, EosFit