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Appendix

The thermal properties of olivine may be found in a large number of the original literature. Table 8 lists those literature data on thermal expansion α_v and specific heat C_p used in the present work. The α_v values were obtained from Skinner (1966) and Singh & Simmons (1971). The C_p data were based on work of Robie & Waldbaum (1968) and JANAF Thermochemical Data tables (Dow Chemical Company (1960)). Incorporating the elasticity data with these thermal data, Gruneisen's parameters γ_G and δ_s have been evaluated as a function of temperature; results on two temperatures (one at ambient temperature and the other at the Debye temperature) for three chosen olivine compositions are entered in Table 8. The γ_G and δ_s values evaluated at the Debye temperature θ_D represent constant values at high temperature. Values of the Debye temperature of olivine, as listed in the last row of Table 2, were calculated from the present elastic constant data at 296° K in the usual way. The critical thermal gradients for density and *P* and *S* wave velocities of 100 Fo, 50 Fo, and 100 Fa olivines are presented in Table 8. In geophysics, the critical thermal gradient for density evaluated at the Debye temperature is of more interest than that evaluated at the ambient temperature.

Table 8

Thermal properties, Grüneisen's parameters, and critical thermal gradients of olivine

Olivine property	Unit	T, °K	Olivine composition, mole % 100 Fo	50 Fo	100 Fa
ρ_0	g cm^{-3}	296	3·217	3·800	4·393
		θ_D†	3·162	3·760	4·364
α_v	10^{-5}/°K	296	2·54	2·45	2·40
		θ_D	3·86	3·20	2·88
C_p	cal/mole−°K	296	28·2	(30·0)‡	31·8
		θ_D	39·2	(39·1)	39·0
$\frac{d \ln K_s}{dT}$	10^{-4}/°K	296	−1·02	−1·07	−1·13
		θ_D	−1·44	−1·39	−1·31
γ_G	None	296	1·21	1·10	1·02
		θ_D	1·26	1·08	0·98
δ_s	None	296	4·0	4·4	4·7
		θ_D	3·7	4·3	4·5
$(\partial T/\partial p)_{v_p}$	°K/kb	296	24	24	23
$(\partial T/\partial p)_{v_s}$	°K/kb	296	12	8	2
$(\partial T/\partial p)_\rho$	°K/kb	296	31	33	35
		θ_D	22	27	30

† The Debye temperature values used here are tabulated in Table 2. They are respectively 754°K for 100 Fo, 633°K for 50 Fo, and 523°K for 100 Fa, and these values were calculated from the present elastic constants data in the usual way.

‡ These values are calculated from the Debye temperature of this material.