Model of the equation of state for the rock-forming mineral forsterite as a mixture of quartz and periclase at high pressures

Seredkin N N[1,2,@] and Khishchenko K V[1,2,3]

[1] Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia
[2] Federal Research Center of Problems of Chemical Physics and Medicinal Chemistry of the Russian Academy of Sciences, Academician Semenov Avenue 1, Chernogolovka, Moscow Region 142432, Russia
[3] Moscow Institute of Physics and Technology, Institutskiy Pereulok 9, Dolgoprudny, Moscow Region 141701, Russia

[@] nikser12@yandex.ru

Forsterite (Mg_2SiO_4) is one of the components of the lithosphere of the Earth; it is also found in the interior of terrestrial planets, in meteorites and comets.

This paper presents a model of the equation of state for forsterite as a mixture of two components: silica (SiO_2) and periclase (MgO). The model is based on the equations of state of the mixture components, which are presented as a system of two sums, $E(V,T)$ and $P(V,T)$ (E is the specific internal energy, P is the pressure, V is the specific volume, T is the temperature).

Knowing the equations of state of the mixture components, we can obtain the equation of state of the mixture in the following form:

$$V_{1N}(P,T) = \sum_{i=1}^{N} \alpha_i V_i(P,T), \quad E_{1N}(P,T) = \sum_{i=1}^{N} \alpha_i E_i(P,T), \quad (1)$$

where index $1N$ corresponds to values for the mixture, index i—for the i-th component; α_i is the mass fraction of the i-th component; N is the number of components.

The results of calculations of the shock adiabats of the components (silica and periclase) and the mixture (forsterite) based on equation of state (1), are consistent with data from shock-wave experiments in a wide range of pressures and temperatures.