

SPINELS RENAISSANCE: THE PAST, PRESENT, AND FUTURE OF THOSE UBIQUITOUS MINERALS AND MATERIALS

Pressure-volume equation of state for chromite and magnesiochromite: A single-crystal X-ray diffraction investigation†

FABRIZIO NESTOLA^{1,*}, BENEDETTA PERIOTTO¹, GIOVANNI B. ANDREOZZI², ENRICO BRUSCHINI² AND FERDINANDO BOSI²

¹Dipartimento di Geoscienze, Università di Padova, Via Gradenigo 6, I-35131, Padova, Italy

²Dipartimento di Scienze della Terra, Sapienza Università di Roma, Piazzale Aldo Moro 5, I-00185, Roma, Italy

ABSTRACT

The pressure-volume equation of state for the two spinel end-member compositions chromite FeCr_2O_4 and magnesiochromite MgCr_2O_4 was determined for flux-grown synthetic single crystals at room temperature up to 8.2 and 9.2 GPa, respectively, by single-crystal X-ray diffraction using a diamond-anvil cell. The pressure-volume data show that the linear volume compressibility (here used only for purpose of comparison), calculated as $\beta_V = |[(\Delta V/V_0)/\Delta P]|$, is 0.00468 and 0.00470 GPa^{-1} , for chromite and magnesiochromite, respectively, with a negligible difference below 0.5%. The experimental data were fitted to a third-order Birch-Murnaghan equation of state (BM3) allowing a simultaneous refining of the following coefficients: $V_0 = 588.47(4) \text{ \AA}^3$, $K_{T0} = 184.8(1.7) \text{ GPa}$, and $K' = 6.1(5)$ for chromite and $V_0 = 579.30(4) \text{ \AA}^3$, $K_{T0} = 182.5(1.4) \text{ GPa}$, and $K' = 5.8(4)$ for magnesiochromite.

The difference in K_{T0} is reduced to <1.5% going from Fe to Mg end-member composition, whereas the first pressure derivative seems not to be affected by the chemical variability. The limited difference in the equation of state coefficients recorded for FeCr_2O_4 and MgCr_2O_4 allowed us to fit the pressure-volume data of both to a single BM3 equation, resulting in a $K_{T0} = 184.4(2.2) \text{ GPa}$ and $K' = 5.7(6)$.

Keywords: Magnesiochromite, chromite, high-pressure, diamond, equation of state

* E-mail: fabrizio.nestola@unipd.it

† Special collection papers can be found on GSW at <http://ammin.geoscienceworld.org/site/misc/specialissuelist.xhtml>.