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High-pressure crystal chemistry of four natural REE(As,P)O_4 minerals from Mt. Cervandone, Italy

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REE orthoarsenates and orthophosphates are common accessory minerals characterized by the general chemical formula $REEXO_4$, where REE represents one of the lanthanides (La-Lu series), Y, Sc, Ca or Th, whereas X stands for As, P or Si. In the framework of a long-term project on the high-*T*/high-*P* crystal-chemistry and phase-stability of REE-bearing minerals, the high-pressure behavior of chernovite-(Y) (nominally $YAsO_4$), xenotime-(Y) (nominally YPO_4) gasparite-(Ce) (nominally $CeAsO_4$) and monazite-(Ce) (nominally $CePO_4$), has been studied. Chernovite-(Y) and xenotime-(Y) show a HREE- (Gd-Lu series) and Y-enrichment, and the same tetragonal symmetry (space group $I4_1/amd$), whereas gasparite-(Ce) and monazite-(Ce) share the same LREE (La-Eu) enrichment and monoclinic cell (space group $P2_1/n$). All these minerals occur at Mt. Cervandone (Western Alps, Italy), a renowned Alpine REE-bearing mineral deposit. The crystal chemistry of the four minerals has been studied via EPM-WDS analysis. Excluding gasparite-(Ce), which formation is bound to the replacement of the mineral synchisite-(Ce) ($CaCe(CO_3)_2F$), a sensible enrichment in Gd and Ho is observed. Moreover, the majority of the chernovite-(Y) show a variable amount of ThO_2, up to 13 wt%, and phosphorous as substitute for arsenic in almost every proportion. In the case of the monoclinic series between monazite-(Ce) and gaparite-(Ce), no solid solution has been observed. Experiments at high-pressure were performed by in situ synchrotron X-ray diffraction using a diamond anvil cell. The high-pressure behavior of single crystals of xenotime-(Y), gasparite-(Ce) and monazite-(Ce) has been studied up to ~20 GPa, whereas that of chernovite-(Y) has been studied by powder diffraction up to 8.20(5) GPa. A II-order Birch-Murnaghan equation of state was fitted to the *V*-*P* data, within the phase stability field of the minerals, yielding the following bulk moduli: $K_{P0,T0}$ = 125(3) GPa (β_{V0} = 0.0080(2) GPa^{-1}) for chernovite-(Y); $K_{P0,T0}$ = 145(2) GPa (β_{V0} = 0.0069(1) GPa^{-1}) for xenotime-(Y); $K_{P0,T0}$ = 106.7(9) GPa (β_{V0} = 0.0094(1) GPa^{-1}) for gasparite-(Ce), $K_{P0,T0}$ = 121(2) GPa (β_{V0} = 0.0083(1) GPa^{-1}) for monazite-(Ce). $K' = \partial K_V/\partial P$ = 4 (fixed) for all the minerals. Deformation mechanisms, at the atomic scale, were described on the basis of structure refinements.

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