



Fig. S2b X-X pair distances in the ABX_3 pPv phase. Seven different neighboring X-X distances are shown with the same colors used in Fig. S2a. In $MgGeO_3$ pPv, both X2-X2_h1 (dark blue) and X2-X2_h2 (red) distances are the closest at 85-109 GPa, while X1-X2_oh (yellow) is also as close as these pairs at ~80 GPa. The common feature among $MgSiO_3$, $MgGeO_3$, and $NaMgF_3$ pPv phases is that X2-X2_h2 (red) is one of the closest pairs, while the closest X-X pair in $CaIrO_3$ is X2-X2_o (green). High-temperature Rietveld data are eliminated for clarity.