Rapidly fluctuating orbital occupancy above the orbital ordering transition in spin-gap compounds\footnote{FR acknowledges support from ERC through Starting Grant 2DThermS.} FRANCISCO RIVADULLA, BEATRIZ RIVAS-MURIAS, Physical Chemistry Dept. and Center for Research in Biological Chemistry and Molecular Materials, Univ. Santiago Compostela, Spain, HAIDONG ZHOU, National High Magnetic Field Laboratory, Florida State University, Tallahassee, FL 32306-4005, USA, JOSE RIVAS, Applied Physics Department, University of Santiago de Compostela, Spain — Low-dimensionality spin systems develop a spin-dimer phase within a molecular orbital that competes with long-range antiferromagnetism below $T_S$. Very often, preferential orbital occupancy and ordering are the actual driving force for dimerization, as in the orbitally-driven spin-Peierls ($\text{MgTi}_2\text{O}_4$, $\text{CuIr}_2\text{S}_4$, $\text{La}_4\text{Ru}_2\text{O}_{10}$, $\text{NaTiSi}_2\text{O}_6$, etc.). Through a microscopic analysis of the thermal conductivity in $\text{La}_4\text{Ru}_2\text{O}_{10}$, we show that the orbital occupancy fluctuates rapidly above $T_S$, resulting in an orbital-liquid state. Strong orbital-lattice coupling introduces dynamic bond-length fluctuations that scatter the phonons to produce a glass-like thermal conductivity above $T_S$. This phonon-glass to phonon-crystal transition occurs in other spin-dimer systems, like $\text{NaTiSi}_2\text{O}_6$, pointing to a general phenomenon.