Evidence of frustration in the $S=1/2$ square-lattice antiferromagnet $Sr_2CuTe_{1-x}W_xO_6$ OTTO MUSTONEN, Aalto University, SAMI VASALA, ELISA BAGGIO-SAITOVITCH, Centro Brasileiro de Pesquisas Físicas (CBPF), HELEN WALKER, ISIS Neutron and Muon Source, MAARIT KARPPINEN, Aalto University — The $S=1/2$ Heisenberg frustrated square-lattice model, or $J_1$-$J_2$ model, describes systems with competing antiferromagnetic interactions. Magnetic order is Néel type when $J_1 \gg J_2$ and columnar when $J_2 \gg J_1$. The nature of the ground state in the highly frustrated $J_2/J_1 \approx 0.5$ region is under debate with proposals including different valence bond solids and spin liquids. We report experimental evidence of frustration in a tunable $J_1$-$J_2$ model system. Recent neutron scattering experiments by us [1] and ref. [2] have shown the Cu$^{2+}$ square-lattice double perovskites $Sr_2CuTeO_6$ and $Sr_2CuWO_6$ to be highly two-dimensional antiferromagnets with $J_2/J_1 = 0.03$ (Néel order) and $J_2/J_1 = 7.92$ (columnar order), respectively. We have synthesized the solid solution series $Sr_2CuTe_{1-x}W_xO_6$ $0 \leq x \leq 1$, and report the magnetic properties. Magnetic susceptibility $\chi(T)$ shows a broad maximum at $T_{\text{max}} = 73$ K and $83$ K in $Sr_2CuTeO_6$ and $Sr_2CuWO_6$, respectively. $T_{\text{max}}$ reaches a minimum of $\approx 50$ K in the vicinity of $x \approx 0.5$ coinciding with a maximum in $\chi_{\text{max}}$. This suggests the realization of the highly frustrated $J_1$-$J_2$ antiferromagnet near $x \approx 0.5$. [1] H. Walker et al., Phys. Rev. B 94 64411. [2] P. Babkevich et al., arXiv:1605.09714.