Supplementary Information

Investigation of the high-temperature redox chemistry of Sr$_2$Fe$_{1.5}$Mo$_{0.5}$O$_{6-\delta}$ via \textit{in situ} neutron diffraction

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**Figure S1** Powder neutron diffraction profiles for Sr$_2$Fe$_{1.5}$Mo$_{0.5}$O$_{6-\delta}$ in O$_2$ in the temperature range 500-850°C.
**Figure S2** Observed (black crosses), calculated (red line), and difference (blue line) powder neutron diffraction profile for Sr$_2$Fe$_{1.5}$Mo$_{0.5}$O$_6$ in O$_2$ at 850°C, refined in the cubic space group *Pm*-3*m*. The vertical markers correspond to the allowed Bragg reflections.
Figure S3  Observed (black crosses), calculated (red line), and difference (blue line) powder neutron diffraction profile for Sr$_2$Fe$_{1.5}$Mo$_{0.5}$O$_{6.8}$ at 25°C after having been cooled in O$_2$, refined in the tetragonal space group $I4/mcm$. The vertical markers correspond to the allowed Bragg reflections.