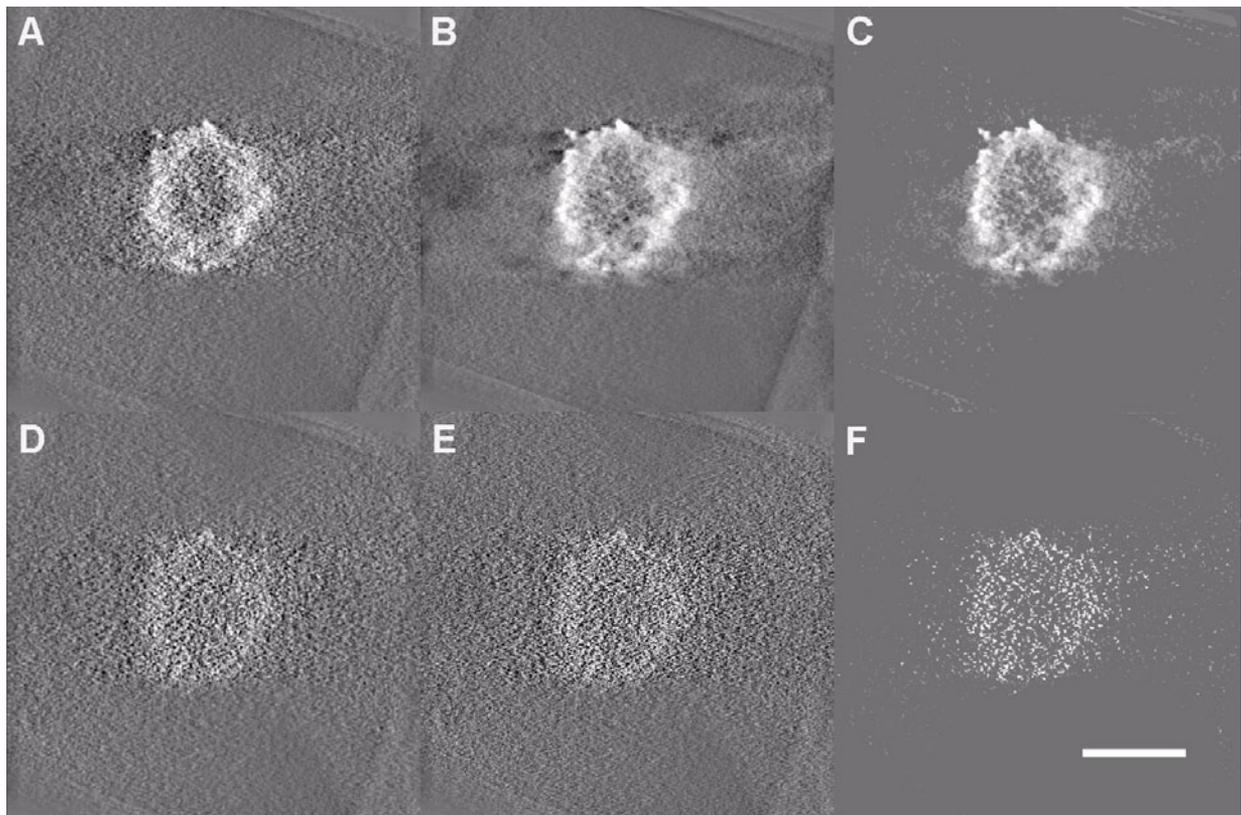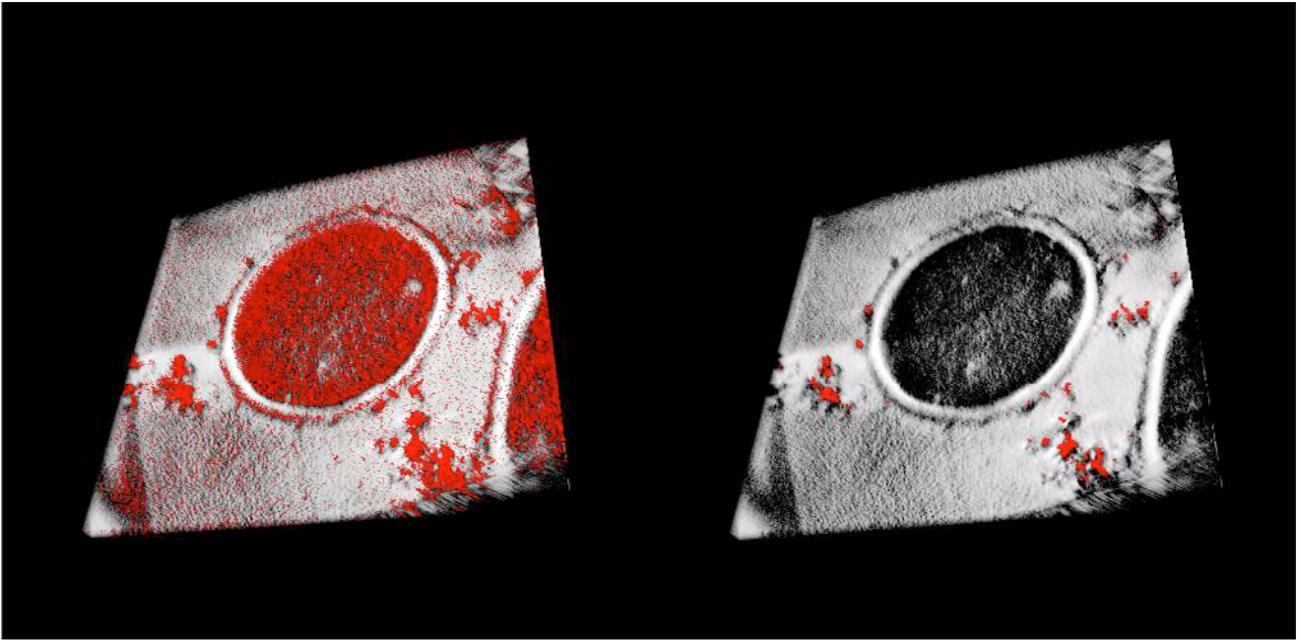**Supplementary Video 1.** Iron 3D maps of *F. pedrosoi*. **A:** Without MVA or BgART. **B:** After MVA and image reconstitution using eigenvectors 1 and 6 obtained by principal component analysis (PCA). **C:** After applying the procedure described in (**B**) followed by BgART. Scale bar = 200 nm.

Supplementary Video 2. Titanium and oxygen 3D maps of a TiO_2 particle. Top panels correspond to the Ti-3D maps before the use of MVA (**A**), after MVA removing the last eigenvector (**B**) and after combining MVA and BgART (**C**). Bottom panels show the oxygen 3D maps as previously before the use of MVA (**E**), after MVA removing the last eigenvector (**F**) and after combining MVA and BgART (**G**). In these reconstructions, the tilt-series images acquired at 406, 436, and 481 eV for Ti and 504, 514, and 547 eV for O were aligned using a C (295 eV) tilt series as reference. In all cases a 20 eV window has been used. Scale bar = 500 nm.

Supplementary Video 3. 3D rendering of threshold-segmented iron 3D maps from *F. pedrosoi* corresponding to Figure 5. Left stream shows Z-loss volume (in gray levels) superposed with iron 3D maps (in red) before the use of MVA while the right stream corresponds to segmentation after combining MVA and BgART. Both renderings have been done using the same threshold value (128) in an 8-bit dynamics.