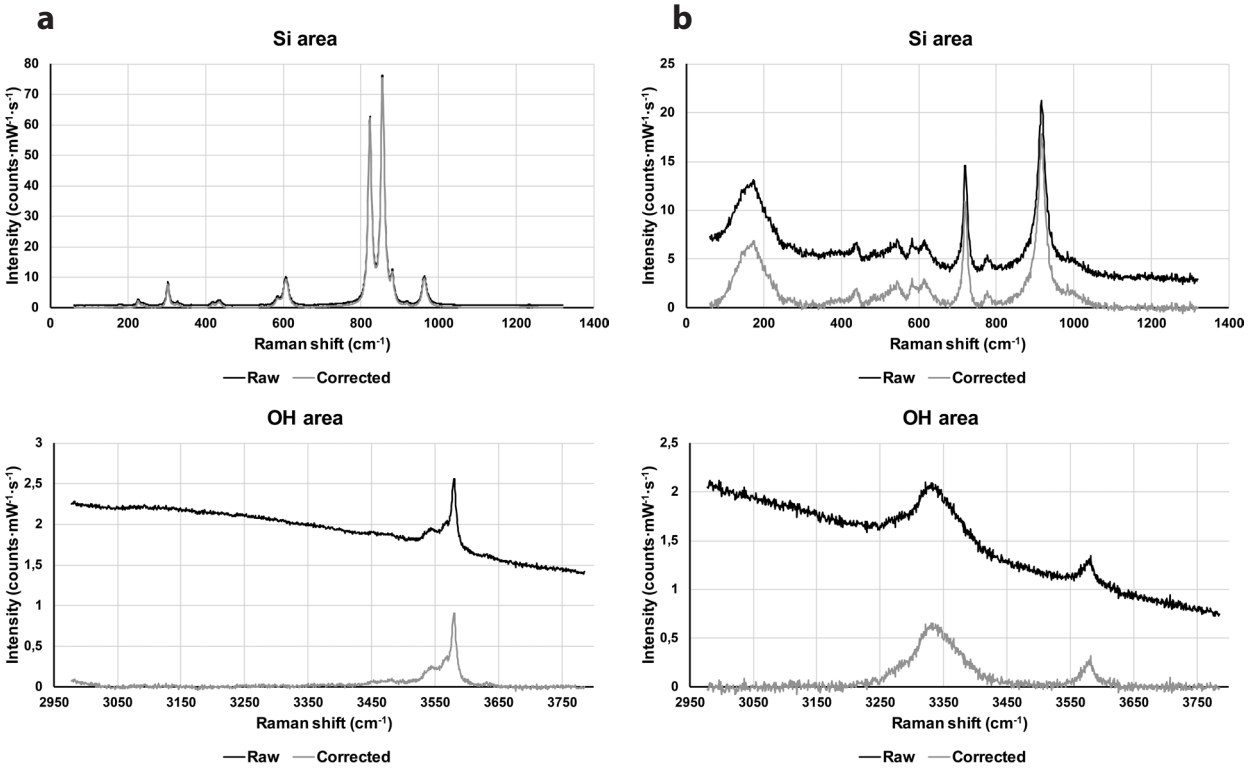
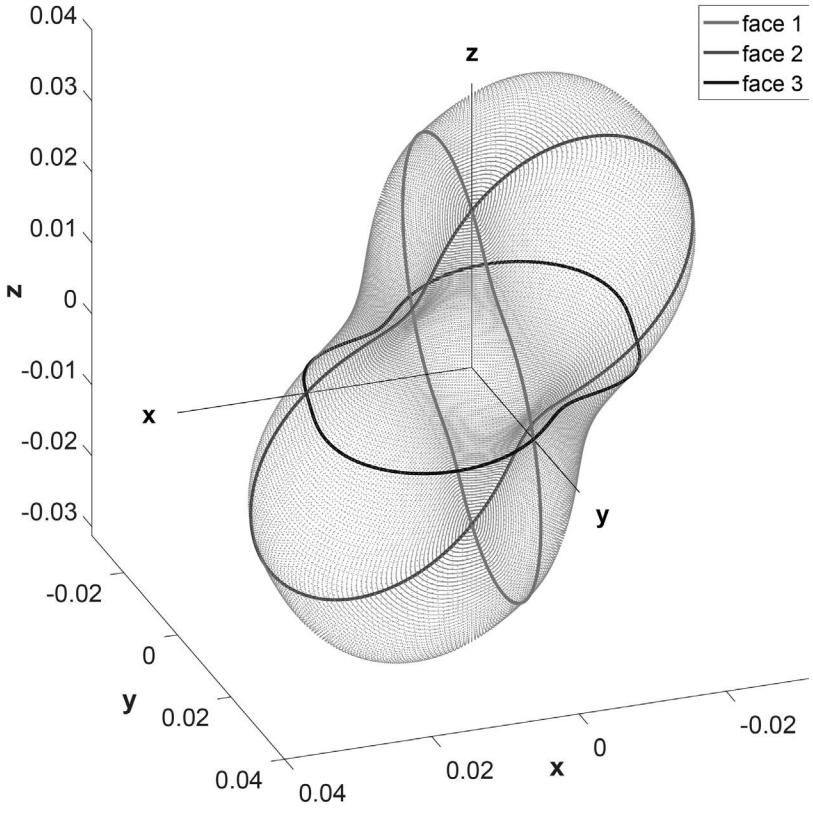
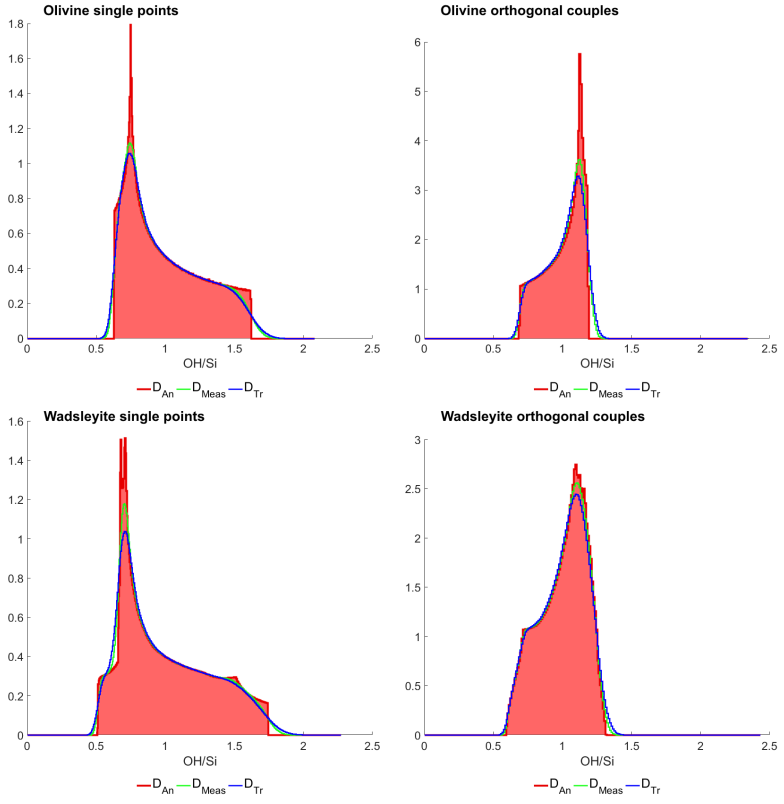


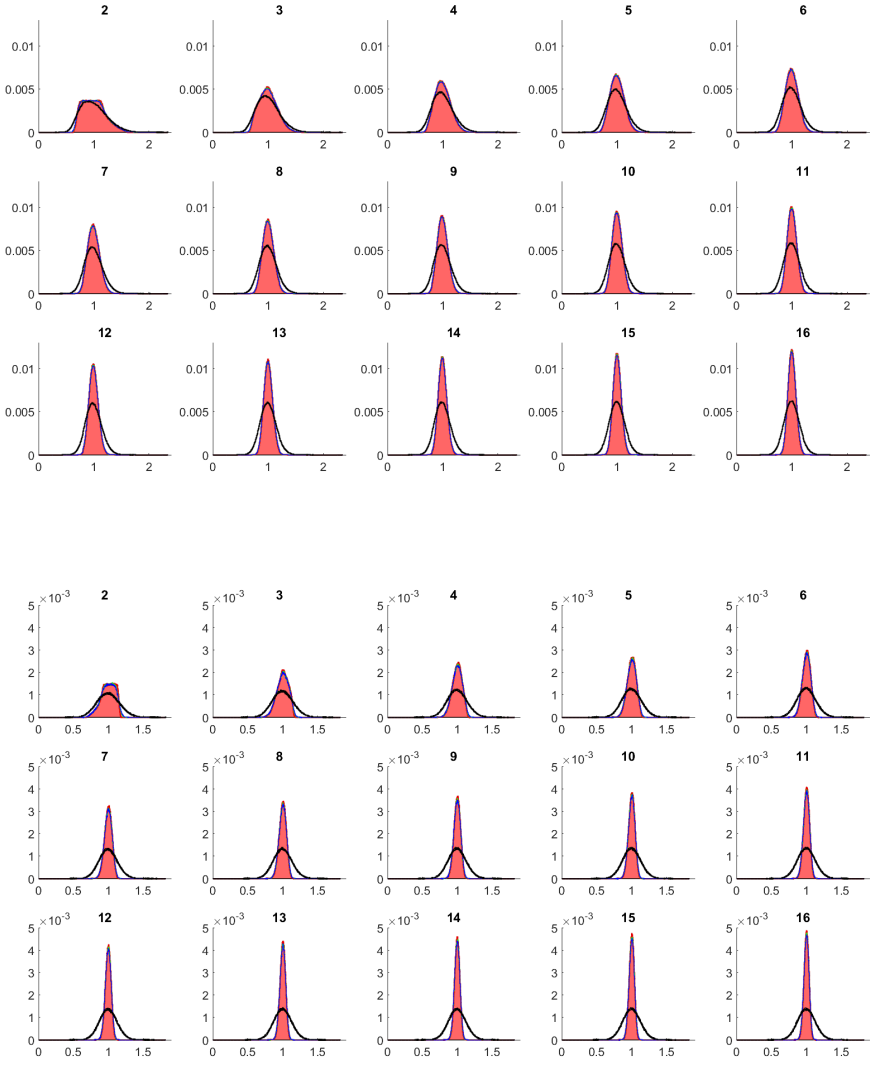
Supplementary Figure OM1: Comparison between raw spectra (black) and corrected spectra (gray) for olivine (**a**) and wadsleyite (**b**), for Si (top) and OH area (bottom), following the anchor points described in Figure 2.



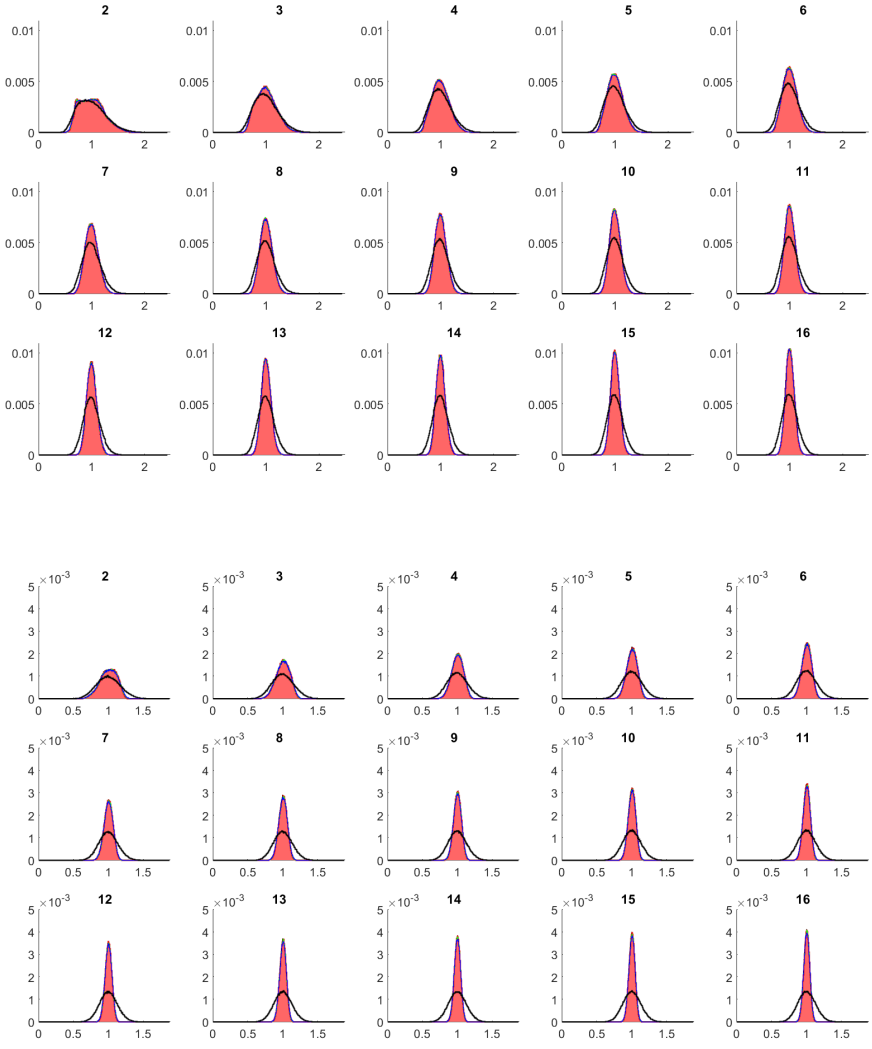
Supplementary Figure OM2: Equivalent to Figure 4, but for wadsleyite. Three-dimensional plot of OH/Si values of wadsleyite (as fitted in Fig. 3) as a function of orientation. As the orientation has been lost in the polishing process, faces are named arbitrarily. Gray points (which due to their density may be displayed as light gray lines here) are the extrapolations of the solid lines (derived from Fig. 3) for any given orientation (see Eq. 5).



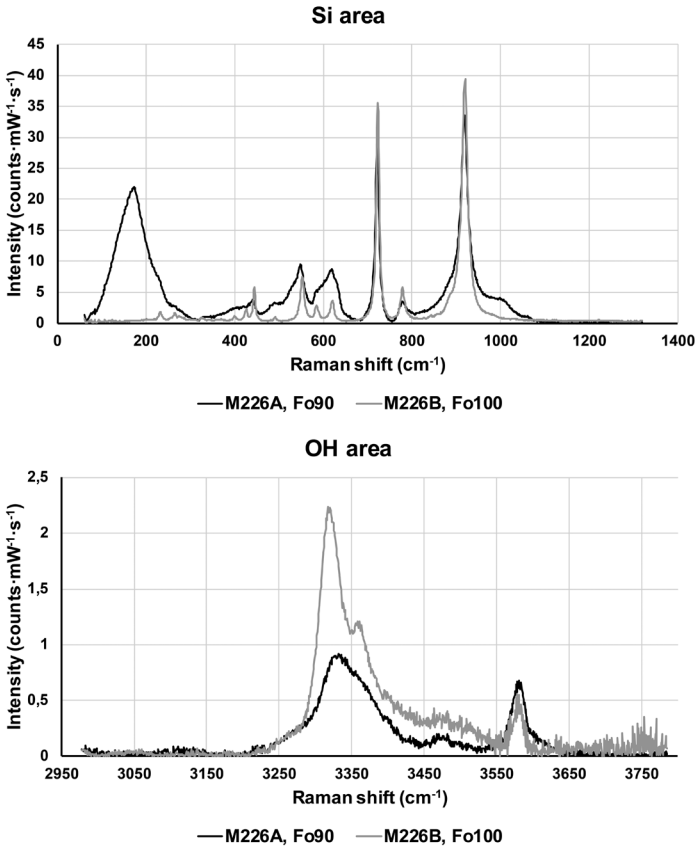
Supplementary Figure OM3: Histograms of OH/Si values normalized to the average (one). The red area depicts the distribution accounting for anisotropy only (no error). The green line depicts the OH/Si distribution after adding measurement error, and the blue one, accounting for data treatment error. Note that the orthogonal couples method highly reduces the dispersion and the orientation of the asymmetry.



Supplementary Figure OM4: Histograms of OH/Si values distribution of simulated measurement sessions consisting of 2 to 16 measurement points, all normalized to the average (one). The red area depicts the distribution accounting for anisotropy only (no error). The green line depicts the OH/Si distribution after adding measurement error, the blue one, accounting for data treatment error, and the black one adds the power-drift correction error. Parts **a** and **b** are for olivine, **c** and **d** for wadsleyite. Parts **a** and **c** are for the case of single points measurements; **b** and **d** are for orthogonal couples. Note that the originally highly asymmetric distribution (see Fig. 3), still present for a small number of points, tends to quickly disappear, leading to symmetric Gaussian-shaped distributions, as expected from central limit theorem.



SUPPLEMENTARY FIGURE OM4:—*CONTINUED*



Supplementary Figure OM5: Average spectrum of the Si (top) and OH area (bottom) of two samples of iron-bearing wadsleyite (M226A) and iron-free wadsleyite (M226B), with comparable water content (4209 and 4000 ppm, respectively). Note the absence of the broad band at 171 cm^{-1} in the Si area of iron-free wadsleyite, and the sharper peaks.