

SUPPLEMENTARY MATERIAL 2

Integrating olivine diffusion chronometry with monitoring data to decipher the magma dynamics at the Fani Maoré volcano

**Karoline Brückel¹, Etienne Médard¹, Fidel Costa², Carole Berthod^{2,3}, Pauline Verdurme^{1,4},
Patrick Bachèlery¹, Lise Retailleau², Jean-Christophe Komorowski², Lucia Gurioli¹**

¹ Université Clermont Auvergne, CNRS, IRD, OPGC, Laboratoire Magmas et Volcans, F-63000 Clermont-Ferrand, France

² Institut de physique du globe de Paris, Université Paris Cité, CNRS, F-75005 Paris, France

³ Observatoire volcanologique et sismologique de la Guadeloupe, Institut de physique du globe de Paris, 97113, Gourbeyre, France

⁴ GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany

Corresponding author: Karoline Brückel (karoline.bruckel@uca.fr)

Supplementary Material 2 shows all results from diffusion modelling on the triple-zoned olivine, for which 3 EPMA profiles and 7 grayscale profiles (calibrated to Fo content) were analyzed and modelled.

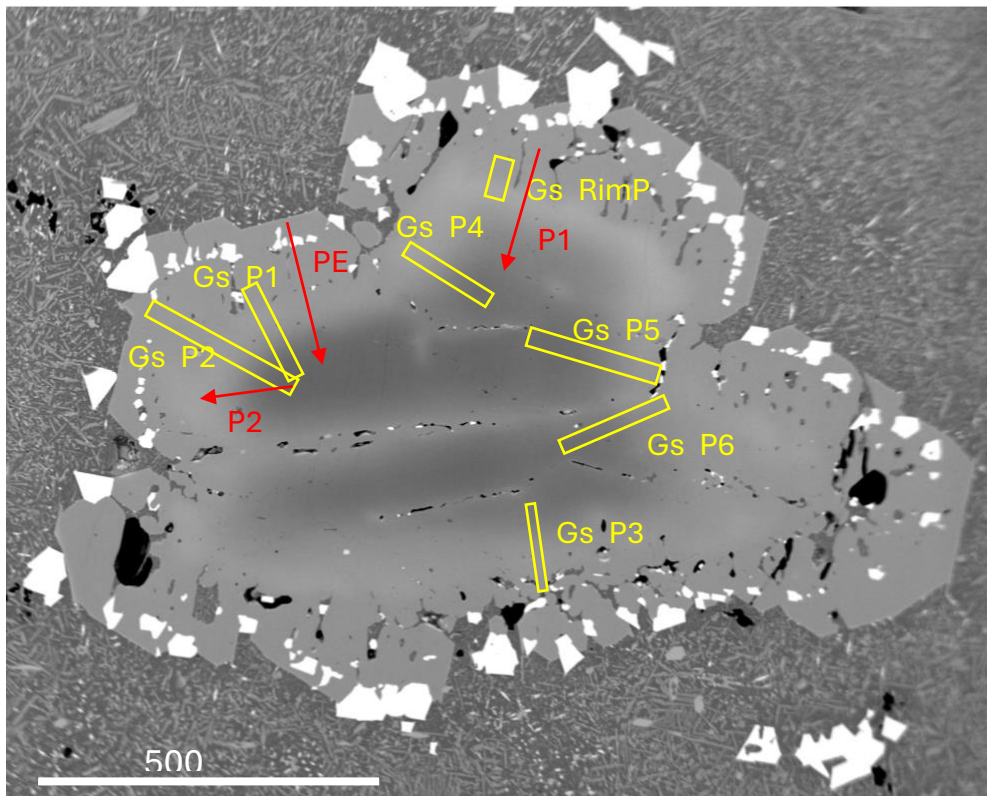


Fig. 1. Triple zoned olivine with all profile locations. Arrows in red are EPMA linescans. Yellow boxes are grayscale profiles.

Table 1. Timescales for diffusion of Fo along selected profiles in the triple zoned olivine. EPMA profiles are shown in red, calibrated grayscale profiles are shown in yellow. Timescales for diffusion at $970 \pm 20^\circ\text{C}$ along the core-mantle boundary (in years) and at $1072 \pm 20^\circ\text{C}$ along the mantle-rim boundary (in days) are provided. Uncertainty on timescales are derived from uncertainty on temperature and are 0.35%. The two profiles with asterisk were considered as unrealistic, since they were asymmetric or were taken in areas with merging diffusion fronts.

	Profile name	Time Core (years)	Time Rim (days)	Comment
EPMA	P1	34.25	41.67	
	P2	34.25		
	PE	4.46*		No smooth profile (kink in concentration)
Grayscale	Gs_RimP		20.84	
	Gs_P1	16.38	13.89	
	Gs_P2	20.84	37.04	
	Gs_P3	14.90		
	Gs_P4	22.33		
	Gs_P5	34.99		
	Gs_P6	56.58*		Two merging diffusion fronts
	Gs_P7	20.84		

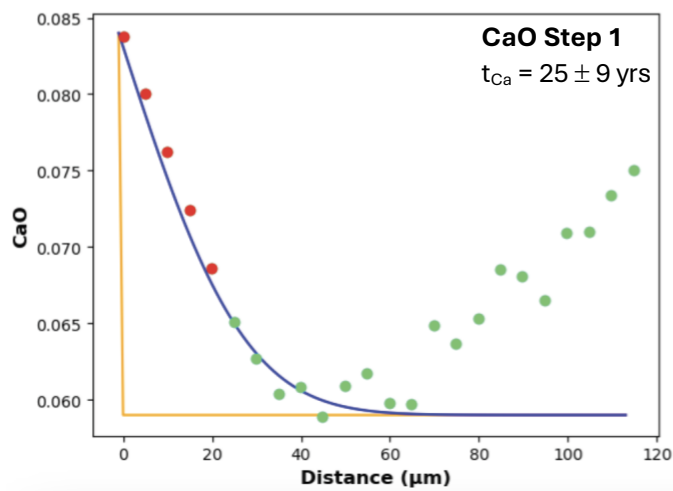
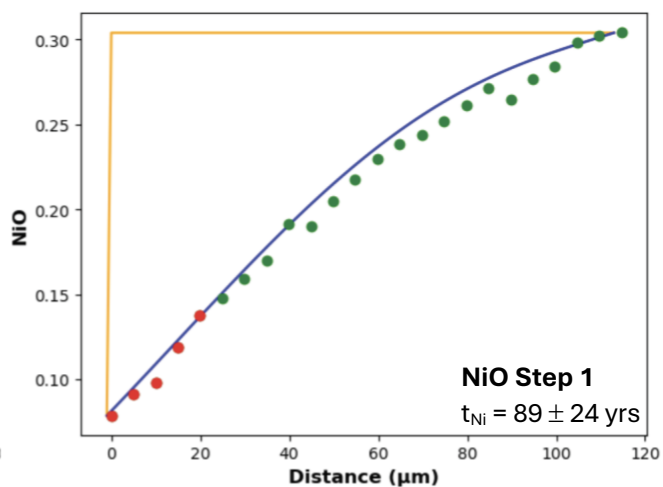
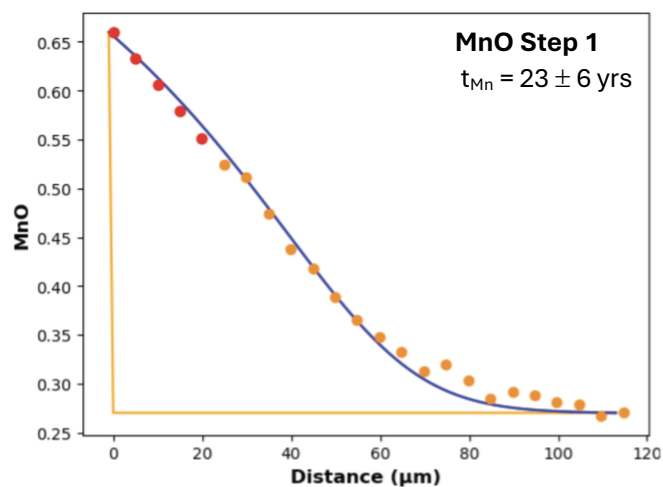
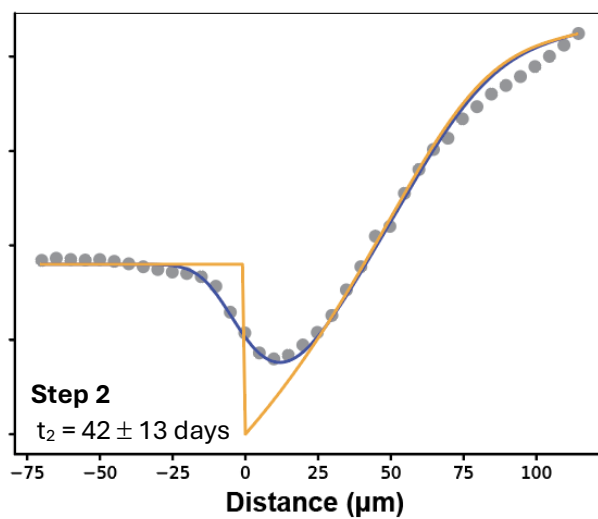
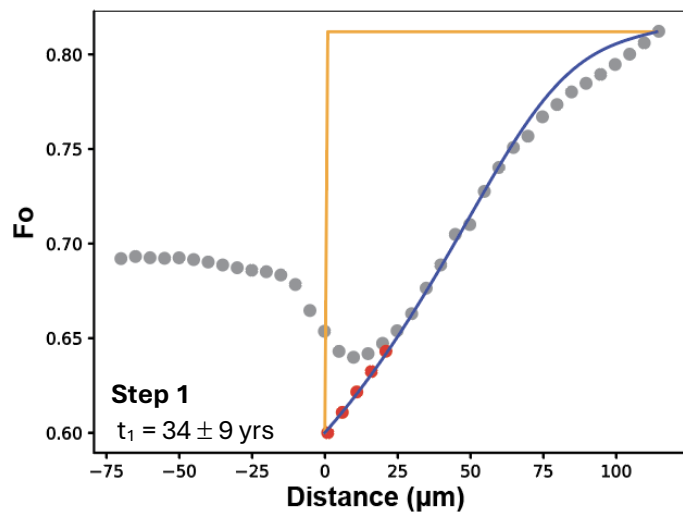
Modeling Approach

In the following, we modelled all profiles from the triple zoned olivine in two steps. Step 1 models profiles along the core-mantle boundary. For this step, diffusion at $970 \pm 20^\circ\text{C}$ was assumed to occur along the former crystal-melt interface (i.e. initial profile is a homogenous concentration with the composition of the core). Step 2 models diffusion the full profile at $1072 \pm 20^\circ\text{C}$ after the growth of a rim onto the outer edge of the mantle (i.e. initial profile is the final profile from step 1 + initial step function). Pressure was kept at 770 MPa and oxygen fugacity at the NNO buffer. Since step 2 resulted in diffusion of the final profiles from step 1, we assumed that the profile for step 1 was longer before diffusion during step 2 and therefore added hypothetical points to decrease the concentration of the inner mantle (assuming the lowest Fo concentration of the mantle in the given region). Since step 1 largely dominated the profile shape, some profiles were only taken along the core-mantle boundary and solely modelled for step 1, assuming that step 2 will not significantly change the resulting timescales. For the EPMA Profiles 1 and 2, we also modelled of Mn, Ni and Ca for step 1.

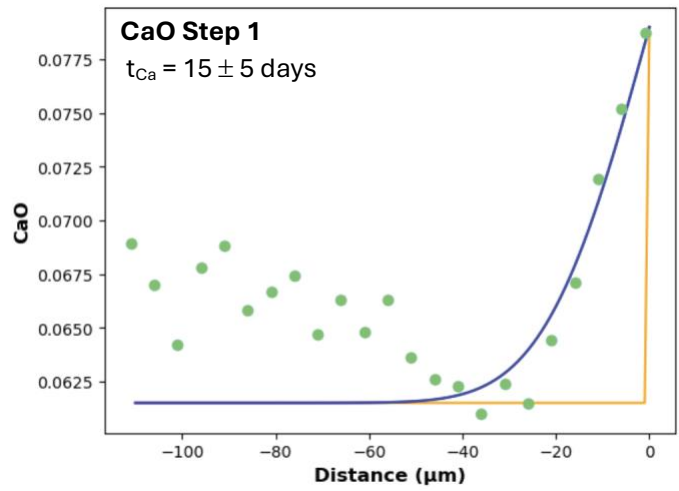
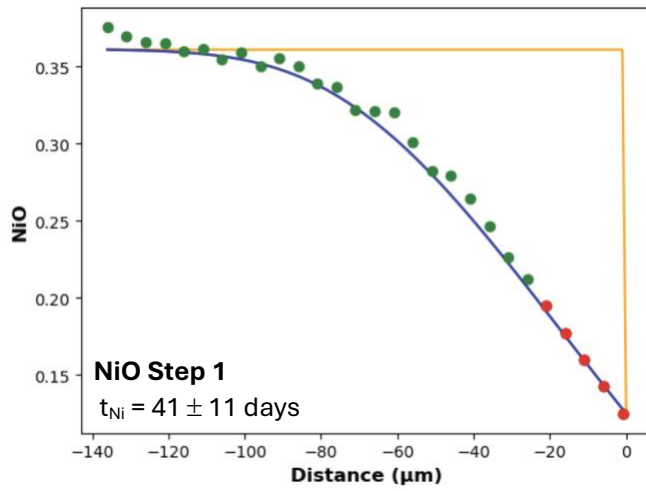
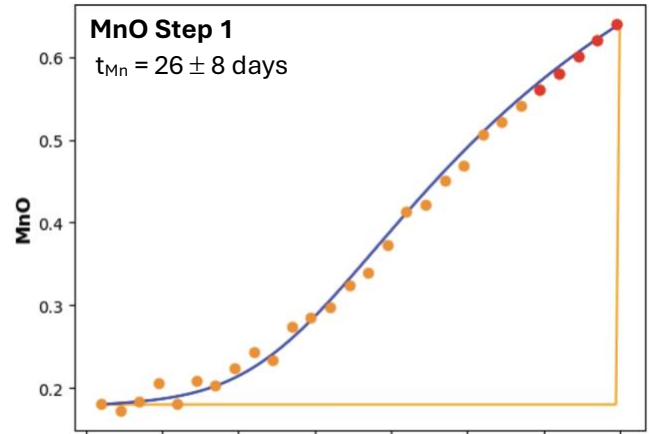
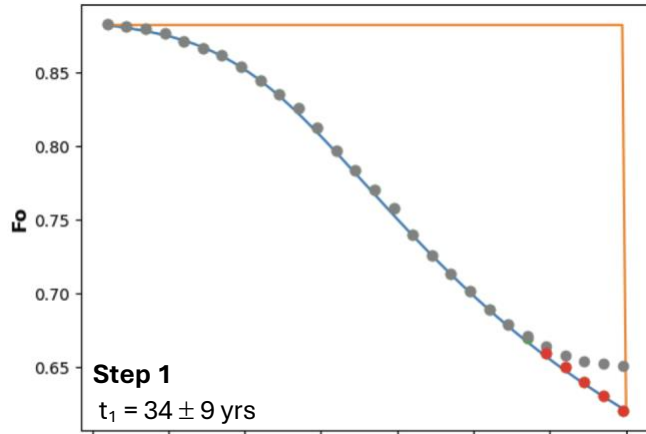
All profile fits are shown with the same consistent symbols/colors:

- Analyzed data = gray circles
- Hypothetical data = red circles
- Initial profile = orange line
- Best fit = blue line

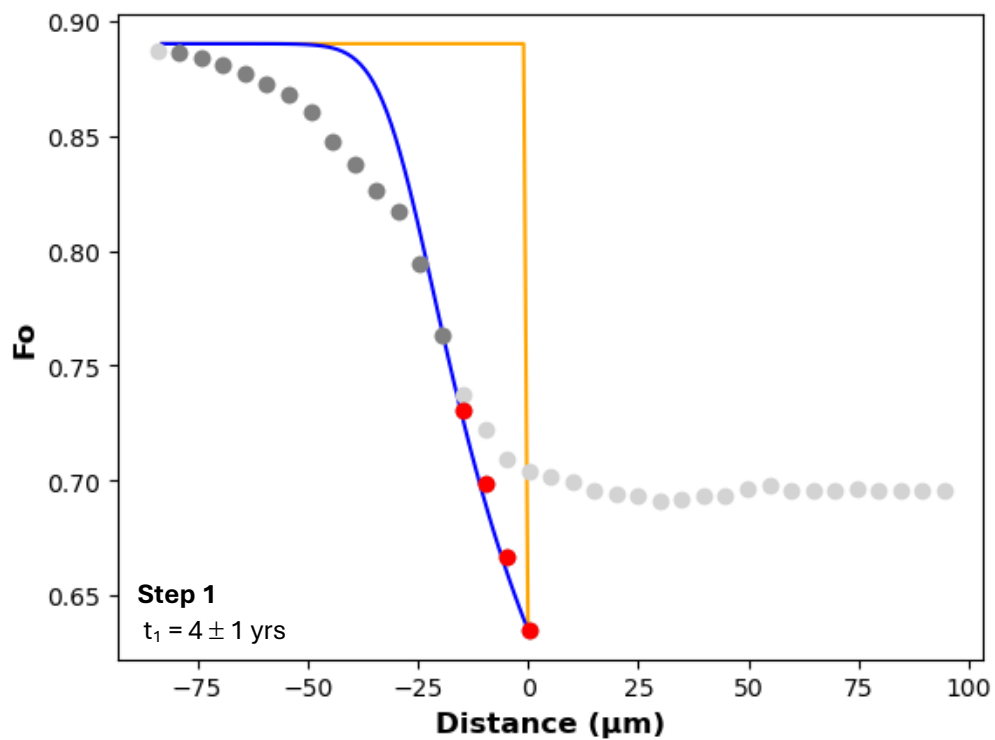
Profile P1



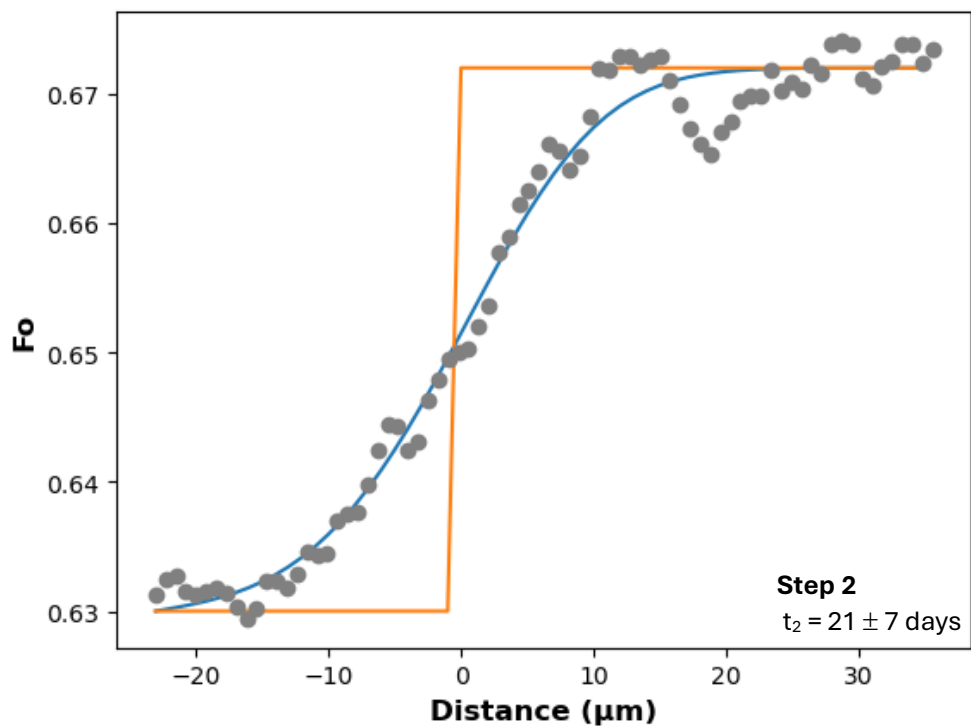
Profile P2



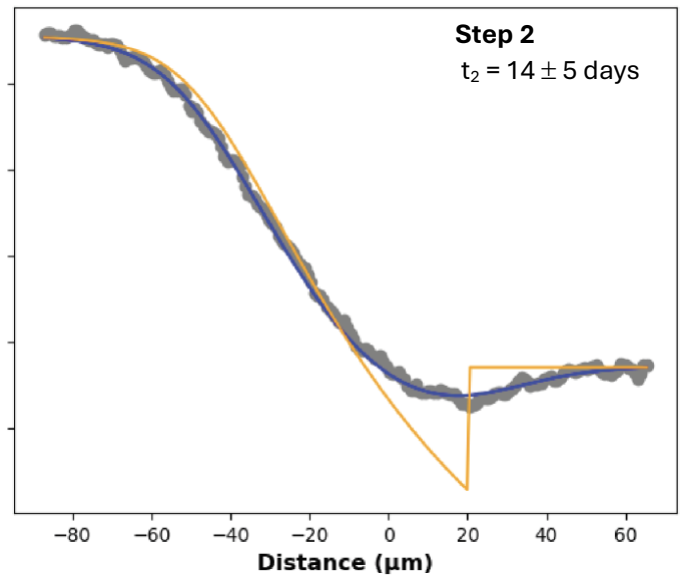
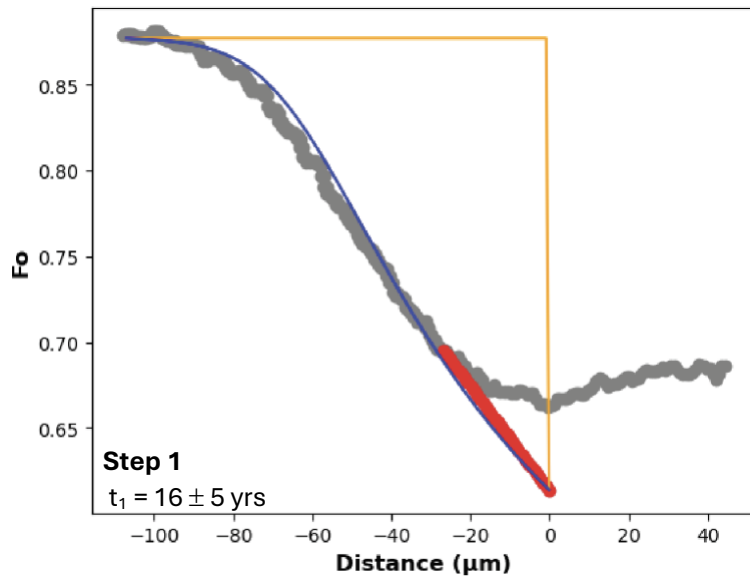
Profile PE



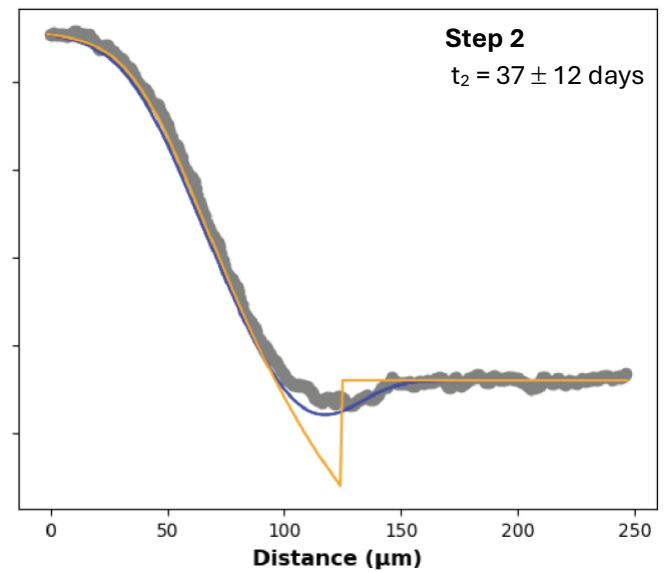
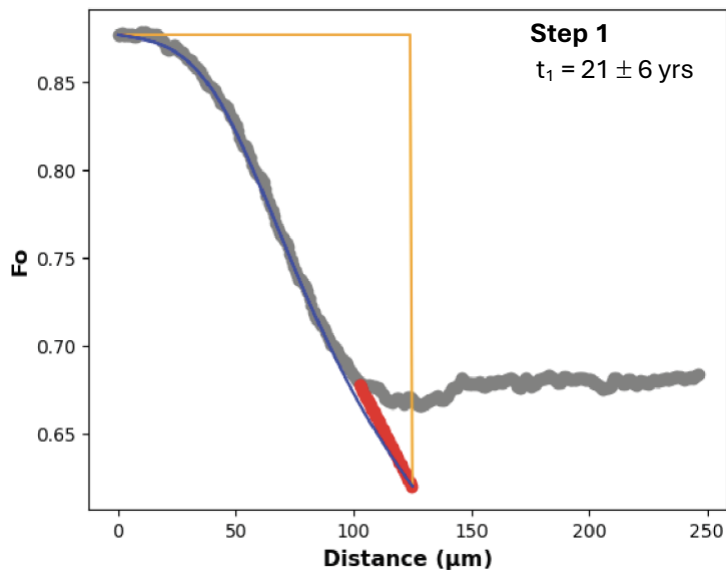
Gs_RimP



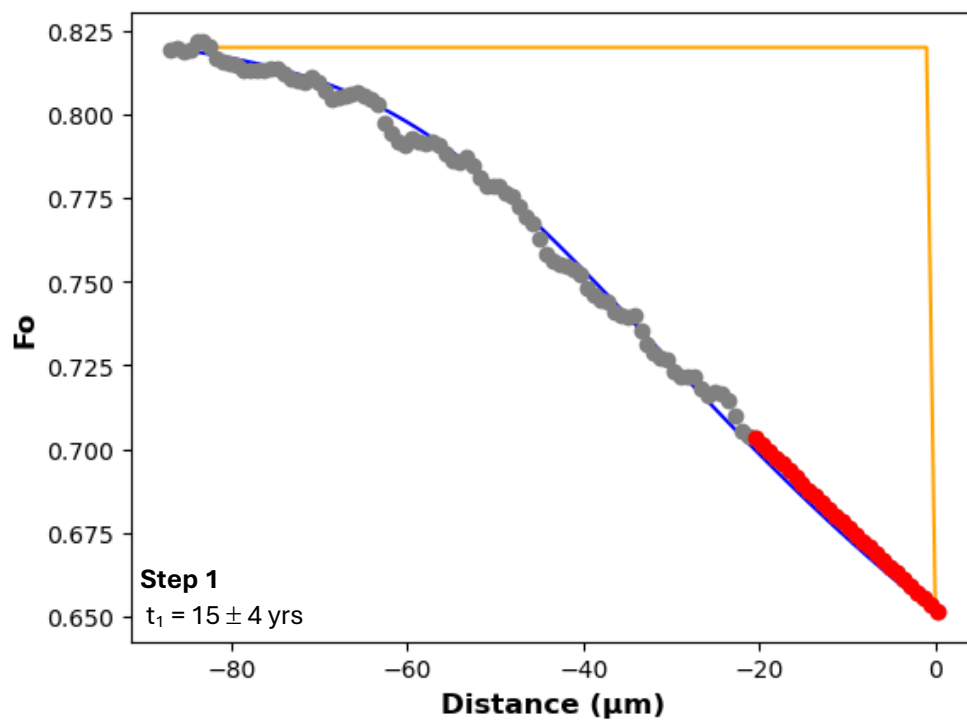
Gs_P1



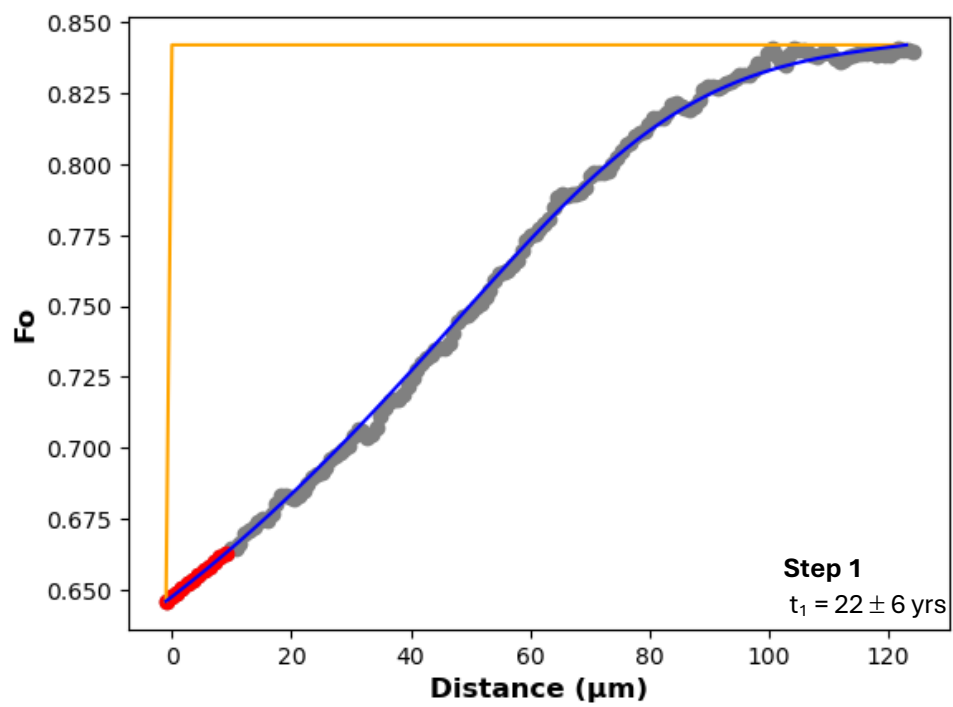
Gs_P2



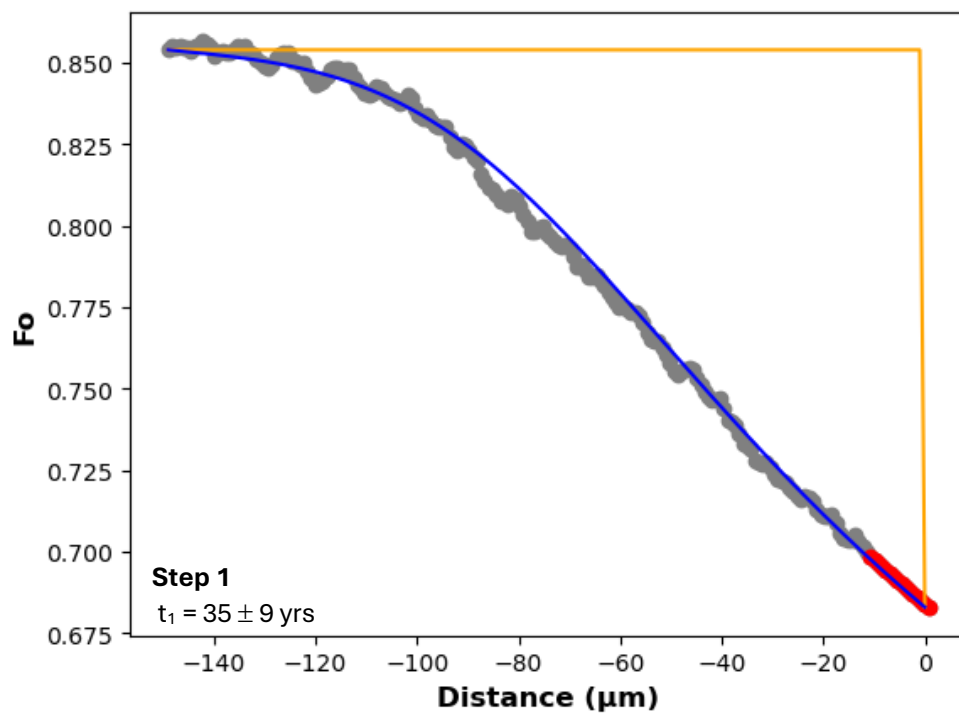
Gs_P3



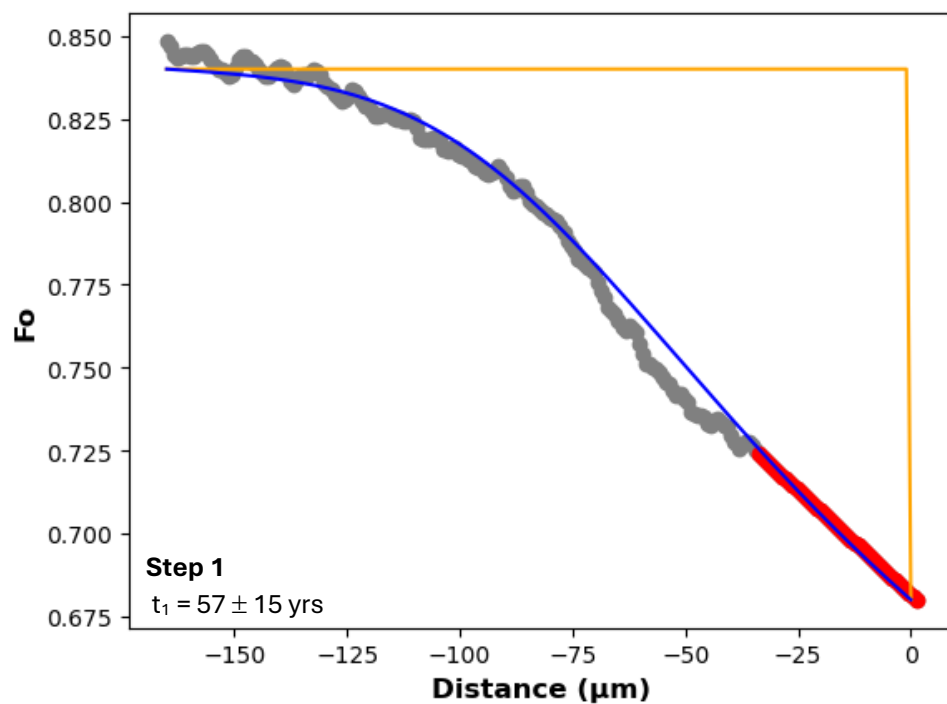
Gs_P4



Gs_P5



Gs_P6



Gs_P7

