

1 Supplementary Documents

S1 Supplementary Tables

Table S1. Calibrated values of reduction rate (r_{RED}), half saturation constants (K_{RED} , K_{DOC}), coefficient (q_{maxFe}), and initial concentrations of Fe^{II} , Fe^{III} , Fe^{Tot} and DOC at 23, 27, and 33 °C for all four models. Uncertainties are provided in parentheses.

T (°C)	r_{RED} (mmol kg ⁻¹ d ⁻¹)	K_{RED} (mmol kg ⁻¹)	K_{DOC} (mmol kg ⁻¹)	q_{maxFe} (-)	Fe_0^{II} (mmol kg ⁻¹)	Fe_0^{III} (mmol kg ⁻¹)	Fe_0^{Tot} (mmol kg ⁻¹)	DOC_0 (mmol kg ⁻¹)
One pool Fe^{II} model								
23	6.40 (0.15)	8.03 (0.99)	-	-	8.06 (0.44)	-	334.58 (31.96)	-
27	7.22 (0.43)	8.03 (1.01)	-	-	8.15 (0.44)	-	336.27 (32.01)	-
33	9.61 (0.27)	8.00 (0.99)	-	-	8.02 (0.44)	-	337.93 (31.80)	-
One pool Fe^{III} model								
23	9.19 (0.36)	9.45 (1.12)	-	-	-	75.53 (0.45)	-	-
27	10.13 (0.35)	8.50 (1.08)	-	-	-	75.63 (0.45)	-	-
33	15.97 (0.66)	15.28 (2.31)	-	-	-	75.32 (0.45)	-	-
Two pool model (Fe^{II} and Fe^{III})								
23	7.96 (0.20)	7.36 (0.81)	-	-	7.22 (0.40)	74.84 (0.43)	-	-
27	9.88 (0.32)	8.34 (1.07)	-	-	8.04 (0.44)	75.51 (0.44)	-	-
33	15.95 (0.64)	15.74 (2.26)	-	-	8.09 (0.43)	75.20 (0.44)	-	-
Three pool model (Fe^{II}, Fe^{III} and DOC)								
23	9.09 (0.33)	6.38 (0.72)	3.77 (0.95)	0.37 (0.03)	6.96 (0.40)	74.43 (0.43)	-	48.10 (2.67)
27	12.70 (0.81)	7.40 (0.90)	5.49 (1.40)	0.37 (0.03)	8.00 (0.44)	75.28 (0.45)	-	45.29 (2.43)
33	19.15 (1.22)	7.86 (0.96)	8.10 (1.90)	0.37 (0.03)	8.14 (0.43)	75.29 (0.43)	-	44.38 (2.35)

Table S2. Log-normal prior distribution values for one, two, and three pool model. Values are shown as mean (standard deviation).

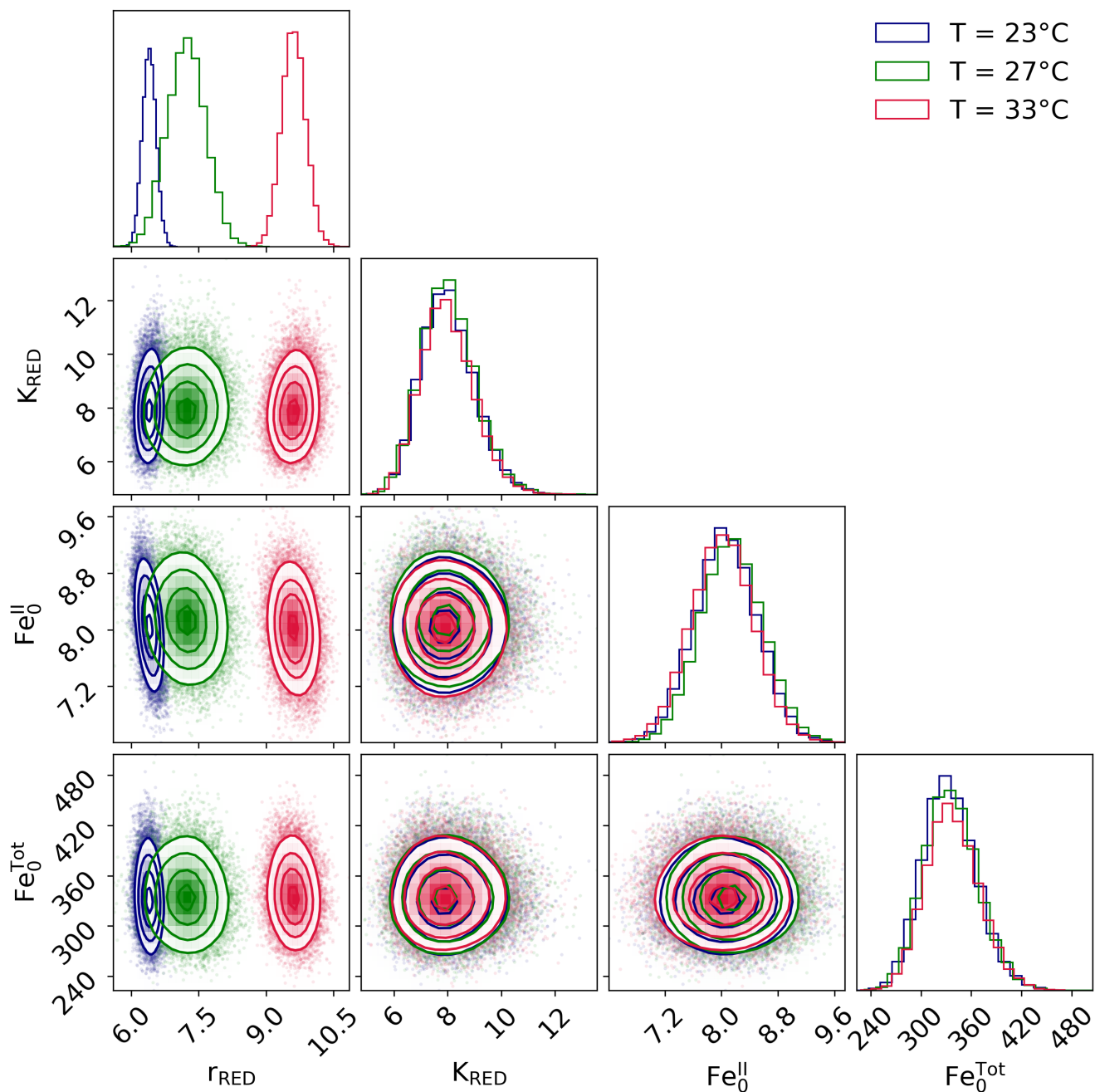
Parameter	One pool (Fe^{II})	One pool (Fe^{III})	Two pool	Three pool	Parameter description
r_{RED}	10 (2)	10 (2)	10 (2)	10 (2)	Maximum rate of reduction
K_{RED}	8 (1)	8 (1)	8 (1)	8 (1)	Half-saturation constant of reduction
K_{DOC}	-	-	-	10 (3)	Half-saturation constant of DOC
q_{maxFe}	-	-	-	0.8 (0.1)	DOC influence coefficient
Fe_0^{II}	8.23 (1)	-	8.23 (1)	8.23 (1)	Initial Fe^{II} concentration
Fe_0^{III}	-	75.67 (1)	75.67 (1)	75.67 (1)	Initial Fe^{III} concentration
DOC_0	-	-	-	22 (2)	Initial DOC concentration
Fe_0^{Tot}	336 (32)	-	-	-	Initial SRO-Fe concentration

Table S3. Comparison of Q_{10} and Arrhenius model fits for different model configurations

Model	Parameter	Q_{10}	R^2	E_a (kJ mol ⁻¹)	R^2
One pool Fe ^{II}	r_{RED}	1.50	0.985	30.65	0.983
	K_{RED}	1.00	0.842	0	0.835
One pool Fe ^{III}	r_{RED}	1.77	0.952	43.03	0.948
	K_{RED}	1.58	0.705	33.93	0.691
Two pool	r_{RED}	1.97	0.989	51.04	0.986
	K_{RED}	2.11	0.941	55.90	0.936
Three pool	r_{RED}	2.12	0.996	56.52	0.998
	K_{RED}	1.23	0.881	15.46	0.887

Table S4. Model evaluation metrics (WAIC, LPML, LOO, and R^2) for the four model structures across temperatures (23, 27, and 33 °C).

Model	Temp (°C)	WAIC	LPML	LOO	R^2
One pool Fe ^{II}	23	43.03	-22.91	45.82	0.97
	27	36.44	-18.39	36.79	0.91
	33	60.80	-32.23	64.46	0.97
One pool Fe ^{III}	23	43.07	-22.06	44.12	0.95
	27	44.95	-23.34	46.67	0.95
	33	247.78	-107.45	214.90	0.93
Two pool	23	129.51	-67.68	106.76	0.93
	27	87.36	-45.09	79.33	0.94
	33	484.56	-230.28	354.07	0.75
Three pool	23	161.51	-88.77	116.60	0.92
	27	85.40	-44.71	71.97	0.93
	33	300.09	-151.76	270.59	0.72

Corner plot for One pool (Fe^{II}) modelFigure S1. Correlations in the posterior samples after MCMC for the one pool Fe^{II} model at 23, 27, and 33°C .

Corner plot for One pool Fe^{III} model

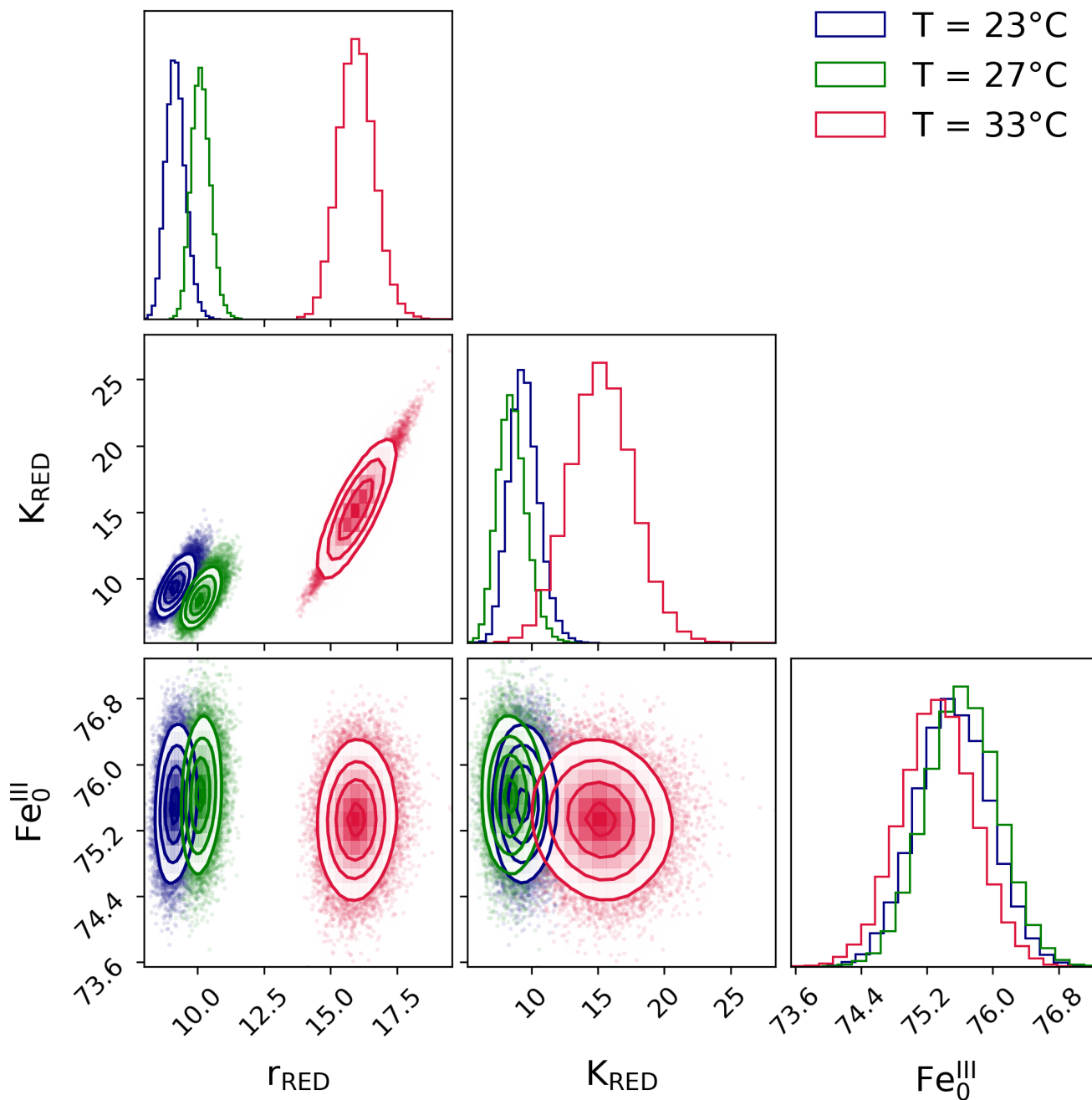


Figure S2. Correlations in the posterior samples after MCMC for the one pool Fe^{III} model at 23, 27, and 33 °C.

Corner plot for Two pool model

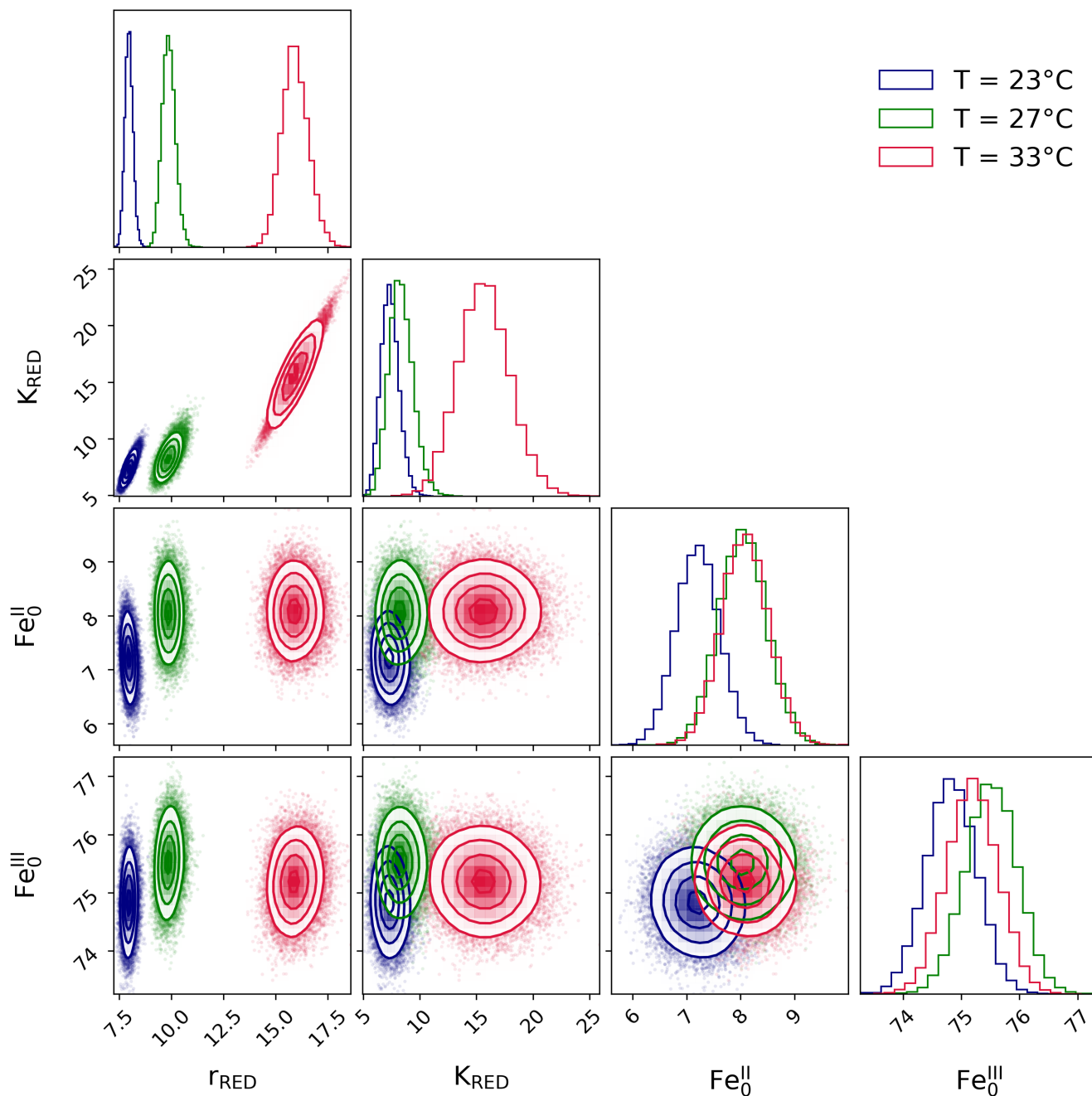


Figure S3. Posterior distributions of parameters (Γ_{RED} , K_{RED}) and initial values of Fe^{II} and Fe^{III} for 23, 27, and 33 °C in the two pool model.

Corner plot for Three pool model

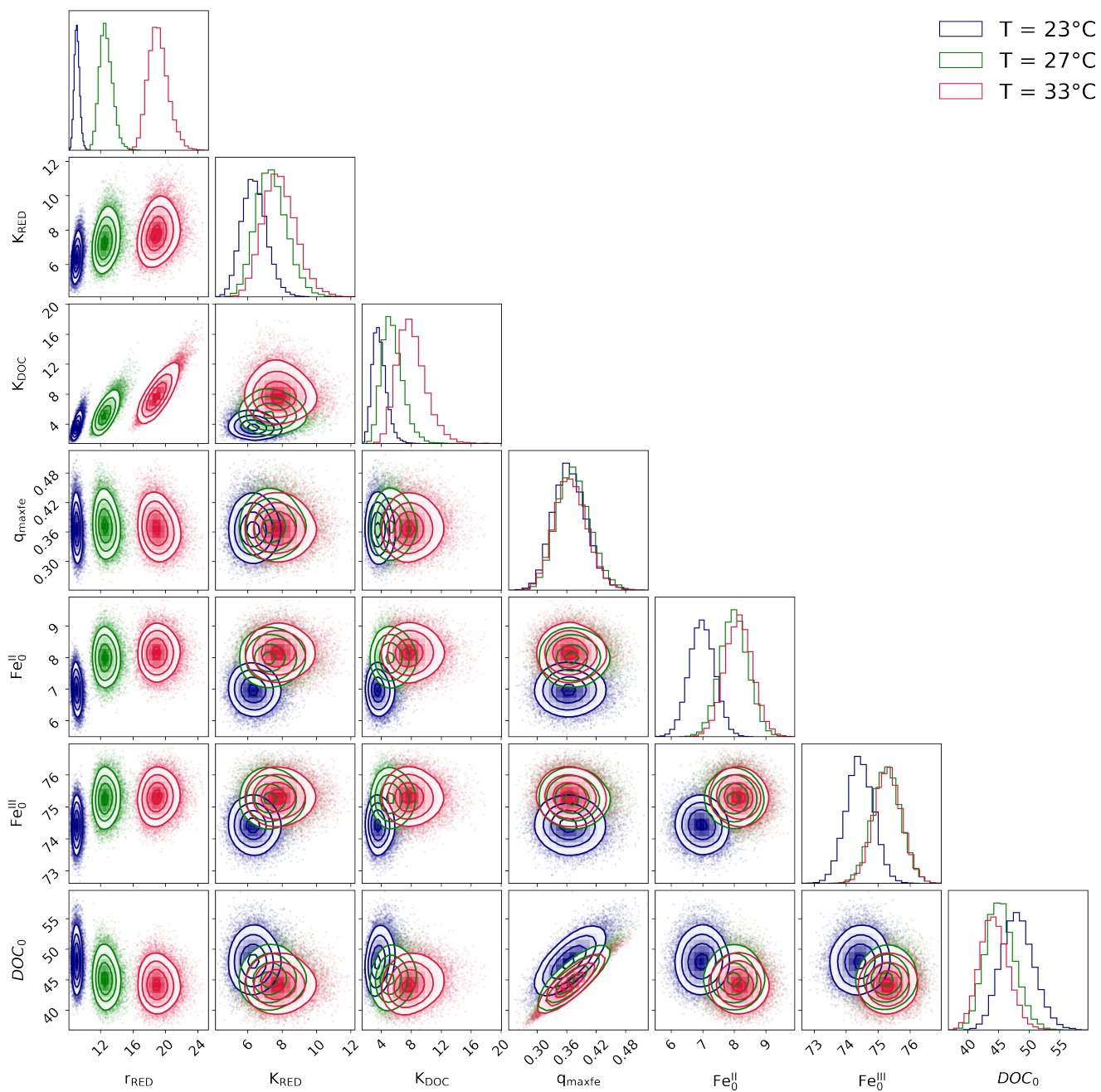


Figure S4. Posterior distributions of parameters (Γ_{RED} , K_{RED} , K_{DOC} , q_{maxfe}) and initial values of Fe^{II} , Fe^{III} , and DOC for 23, 27, and 33°C in the three pool model.