

Table S1: The average values of the band parameters of pyroxenes in the O1, O2, O3, O4, O5, K, LV1, LV2, LV3, LV4, LV5, LA1, LA2, and LA3 units, and ages of these units established by past studies.

Mare Units		Band-I center (μm)	Band-II center (μm)	B-I Area	B-II Area	BAR	B-I Strength	B-II Strength	Age (Ga)
Mare Orientale	O1	0.9618	2.106	52.3	34.65	0.7	18.26	15.1384	$3.72^c, 2.49^d$
	O2	0.9781	2.119	47.97	44.9	0.97	17.189	16.37636	$3.77^b, 3.72^c, 2.33^d$
	O3	0.9905	2.127	26.96	33.07	1.28	9.75	13.065	$3.77^b, 3.7^c, 2.82^d$
	O4	0.9797	2.122	50.91	43.41	0.9	17.9898	16.421	$2.91^b, 3.72^c, 2.65^d$
	O5	0.9684	2.141	21.73	20.72	0.95	8.38	8.59	
Kopff	K	0.9896	2.076	54.97	48.52	0.84	17.463	17.076	$3.4, 3.27^c, 2.78^d$
Lacus Veris	LV1	0.9876	2.12	40.44	33.01	0.87	14.53	14.2962	$3.44^a, 3.1^c, 3.27^d$
	LV2	0.986	2.106	37.02	39.96	1.14	14.42	15.5958	$3.22^a, 2.63^c, 3.25^d$
	LV3	0.9913	2.127	51.67	40.27	0.81	18.348	16.3791	$3.36^a, 3.3^c, 3.39^d$
	LV4	0.9818	2.123	51.8	38.66	0.78	18.012	15.224	$2.16^b, 3.24^c, 3.08^d$
	LV5	0.9786	2.116	45.95	41.23	0.94	17.23	15.923	2.20^b
Lacus Autumni	LA1	0.9671	2.077	65.26	42.19	0.65	21.32	18.56	$2.03^b, 3.41^c, 3.46^d$
	LA2	0.9669	2.06	56.22	75.81	1.38	20.9	23.032	$1.75^b, 2.01^c, 3.16^d$
	LA3	0.9757	2.112	29.88	37.79	1.32	12.91	14.8588	$2.16^b, 2.27^c, 3.37^d$
^a Whitten et al. (2011)									
^b Cho et al. (2012)									
^c Karthi & Arivazhagan (2022)									
^d Liu et al. (2022)									

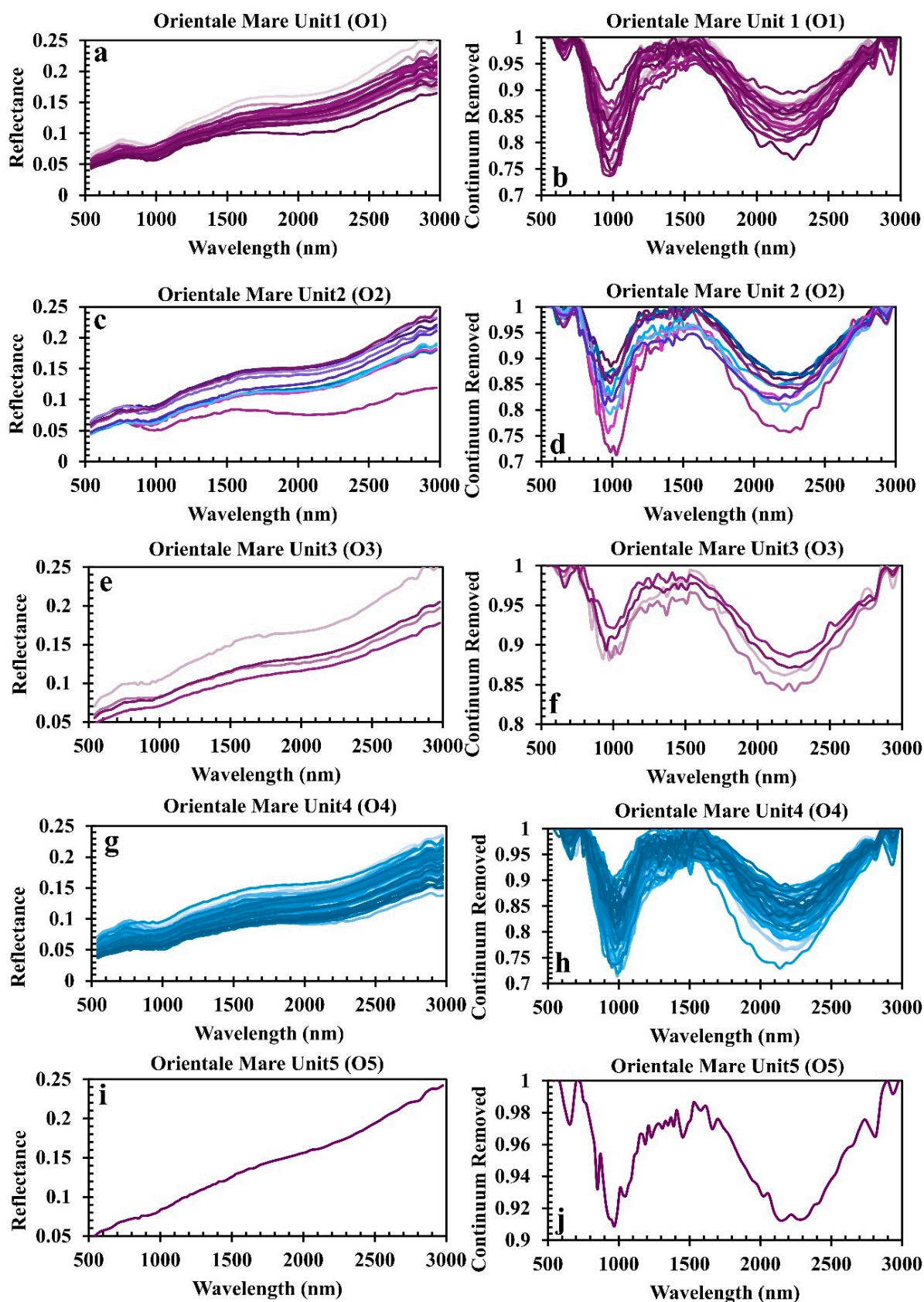


Figure S1: Reflectance spectra of different minerals from the Mare Orientale region are shown in (a-j) Normal reflectance spectra and continuum-removed reflectance spectra for O1, O2, O3, O4, and O5 basaltic units have been plotted. The locations where spectra were collected have been identified and marked in Figure 4.4d.

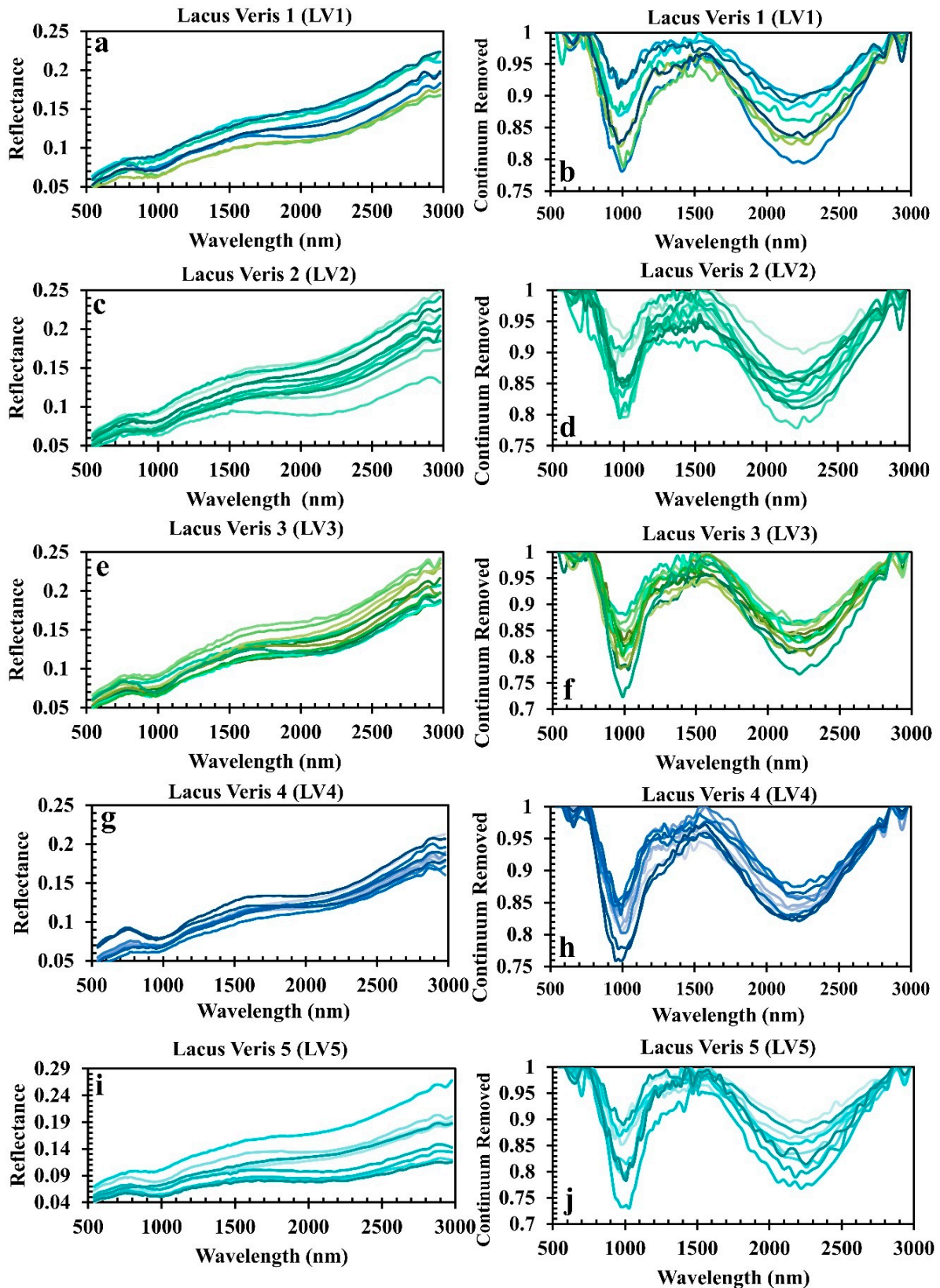


Figure S2: Reflectance spectra of different minerals from the Lacus Veris region are shown in (a-j) . Normal reflectance spectra and continuum-removed reflectance spectra for LV1, LV2, LV3, LV4, and LV5 basaltic units have been plotted. The locations where spectra were collected have been identified and marked in Figure 4.4d.

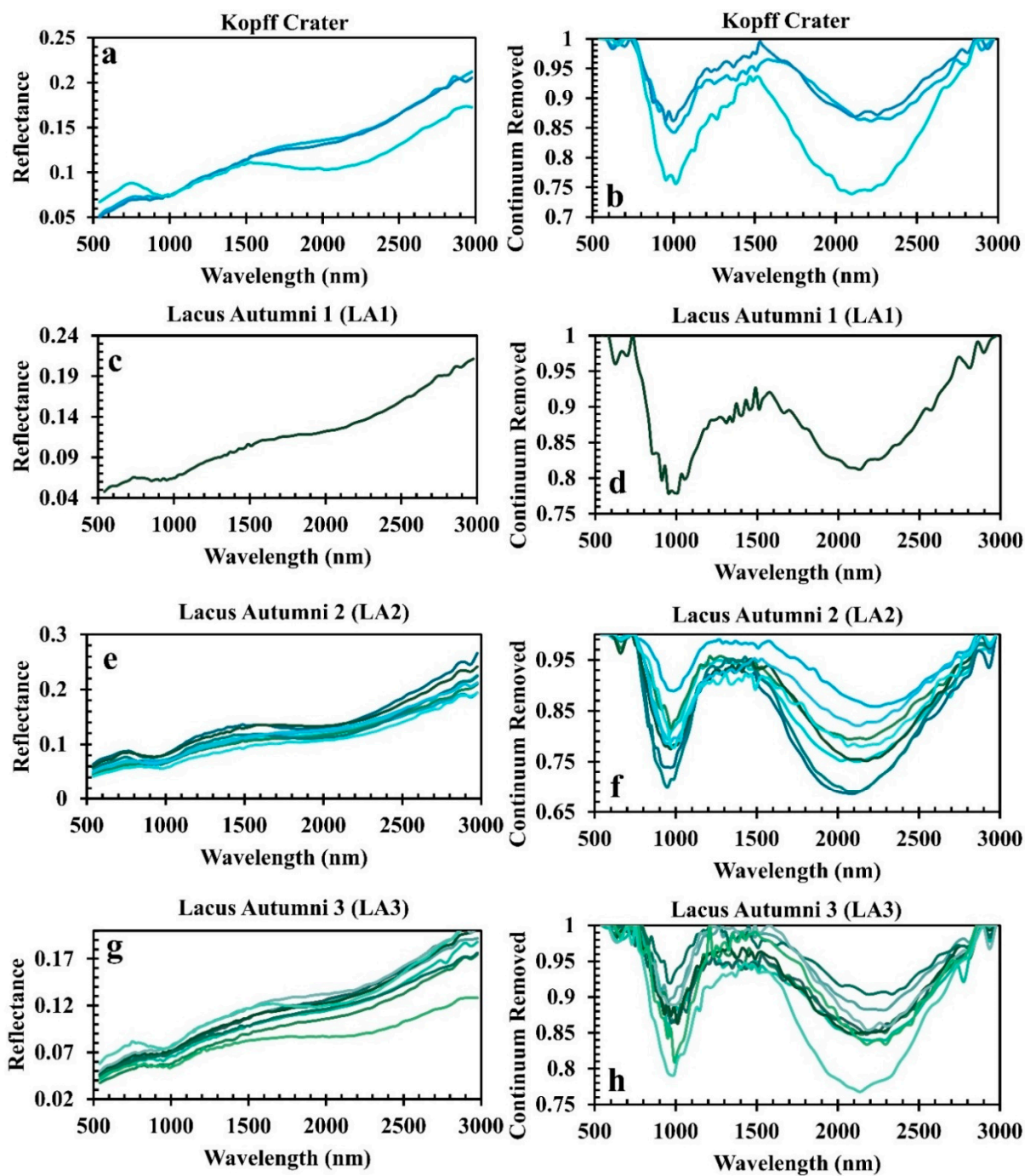


Figure S3: Reflectance spectra of different minerals from the Kopff Crater and Lacus Autumni region are shown in (a-h) . Normal reflectance spectra and continuum-removed reflectance spectra for K, LA1, LA2, and LA3 basaltic units have been plotted. The locations where spectra were collected have been identified and marked in Figure 4.4d.