Table 3-12. Formulation of parameters for summary products

Summary product unmodified over mission
Minimally revised summary product
Fundamentally revised summary product
New summary product
Depreciated summary product (available in CRISM CAT)

#	NAME	STATUS	PARAMETER	FORMULATION	KERNEL WIDTH	RATIONALE	CAVEATS
Surface Parameters (calculated using TRDR, MRDR, TER, MTRDR Lambert albedo)							
1	R770	√	0.77-µm reflectance	$R770$	R770: 5	Higher value more dusty or icy	Sensitive to slope effects, clouds
2	RBR	√	Red/blue ratio	$R770/R440$	R440: 5 R770: 5	Higher value has more npFeOx	Sensitive to dust in atmosphere
	BD530	x	0.53-µm band depth	$1-\left(\frac{R530}{a*R709+b*R440}\right)$	R440: 5 R530: 5 R709: 5	–	–
3	BD530_2	√	0.53-µm band depth	$1-\left(\frac{R530}{a*R614+b*R440}\right)$	R440: 5 R530: 5 R614: 5	Higher value has more crystalline hematite	–
	SH600	x	0.6-µm shoulder height	$1-\left(\frac{a*R530+b*R709}{R600}\right)$	–	–	–
4	SH600_2	√	0.6-µm shoulder height	$1-\left(\frac{a*R533+b*R716}{R600}\right)$	R533: 5 R600: 5 R716: 3	Select ferric minerals, or compacted texture	Sensitive to high opacity in atmosphere
5	SH770	√	0.77-µm shoulder height	$1-\left(\frac{a*R716+b*R860}{R775}\right)$	R716: 3 R775: 5 R860: 5	Select ferric minerals, less sensitive to LCP than SH600_2	Sensitive to high opacity in atmosphere
	BD640	x	0.64-µm band depth	$1-\left(\frac{R648}{a*R600+b*R709}\right)$	R600: 5 R648: 5 R709: 5	Select ferric minerals (esp. maghemite)	Obscured by VNIR detector artifact
6	BD640_2	√	0.64-µm band depth	$1-\left(\frac{R624}{a*R600+b*R760}\right)$	R600: 5 R624: 3 R760: 5	Select ferric minerals (esp. maghemite)	Obscured by VNIR detector artifact
	BD860	x	0.86-µm band depth	$1-\left(\frac{R860}{a*R800+b*R984}\right)$	–	–	–
7	BD860_2	√	0.86-µm band depth	$1-\left(\frac{R860}{a*R755+b*R977}\right)$	R755: 5 R860: 5 R977: 5	Select ferric minerals (esp. hematite)	–
	BD920	x	0.92 µm band depth	$1-\left(\frac{R920}{a*R800+b*R984}\right)$	–	–	–
8	BD920_2	√	0.92 µm band depth	$1-\left(\frac{R920}{a*R807+b*R984}\right)$	R807: 5 R920: 5 R984: 5	Low-Ca pyroxene, crystalline ferric minerals	–
9	RPEAK1 *	√	Reflectance peak 1	wavelength where 1st derivative=0 of 5th order polynomial fit to R442, R533, R600, R710, R740, R775, R800, R833, R860, R892, R925		Longer wavelength peak in dust	–
10	BDI1000VIS	√	1-µm integrated band depth; VNIR wavelengths	divide R833, R860, R892, R925, R951, R984, R1023 by RPEAK1 then integrate over (1 – normalized radiances) to get integrated band depth		Crystalline ferrous silicates	–

#	NAME	STATUS	PARAMETER	FORMULATION	KERNEL WIDTH	RATIONALE	CAVEATS
11	BDI1000IR	√	1-µm integrated band depth; IR wavelengths	divide R1030, R1050, R1080, R1150 by linear fit from peak R (of the 15) between 1.3-1.87µm to R2530 extrapolated backwards, then integrate over (1 – normalized radiances) to get integrated band depth		Ferrous silicate once corrected for aerosol induced slope	–
12	IRA	√	IR albedo	$R1330$	R1330: 11	IR albedo	–
	OLINDEX2 (beginning with TRR3)	x	Olivine index 2	$(RB1080 * 0.1) + (RB1210 * 0.1) + (RB1330 * 0.4) + (RB1470 * 0.4)$ Where RB#### = (RC#### - R####)/RC####. RC#### denotes the value of a point at a wavelength of #### nm along a modeled line that follows the average slope of the spectrum. Slope for RC#### anchored at R1750 and R2400.	R1080: 7 R1210: 7 R1330: 7 R1470: 7	Olivines strongly > 0	Also sensitive to HCP, Fe-phyllosilicates
13	OLINDEX3 (beginning with TER, MTRDR)	√	Olivine index 3	$RB1080 * 0.03 + RB1152 * 0.03 + RB1210 * 0.03 + RB1250 * 0.03 + RB1263 * 0.07 + RB1276 * 0.07 + RB1330 * 0.12 + RB1368 * 0.12 + RB1395 * 0.14 + RB1427 * 0.18 + RB1470 * 0.18$ Slope for RC#### anchored at R1750 and R2400.	R1080: 7 R1152: 7 R1210: 7 R1250: 7 R1263: 7 R1276: 7 R1330: 7 R1368: 7 R1395: 7 R1427: 7 R1470: 7 R1750: 7 R2400: 7	Olivines strongly > 0	Also sensitive to HCP, Fe-phyllosilicates
	LCPINDEX	x	LCP index	$\left(\frac{R1330 - R1050}{R1330 + R1050}\right) * \left(\frac{R1330 - R1815}{R1330 + R1815}\right)$	–	Pyroxene is strongly +; Favors LCP	–
14	LCPINDEX2 (beginning with TER, MTRDR)	√	Detect broad absorption centered at 1.81 µm (LCP index 2)	$RB1690 * 0.20 + RB1750 * 0.20 + RB1810 * 0.30 + RB1870 * 0.30$ Slope for RC#### anchored at R1560 and R2450.	R1560: 7 R1690: 7 R1750: 7 R1810: 7 R1870: 7 R2450: 7	Pyroxene is strongly +; Favors LCP	–
	HCPINDEX	x	HCP index	$\left(\frac{R1470 - R1050}{R1470 + R1050}\right) * \left(\frac{R1470 - R2067}{R1470 + R2067}\right)$	–	Pyroxene is strongly +; Favors HCP	LCP
15	HCPINDEX2 (beginning with MTRDR)	√	Detect broad absorption centered at 2.12 µm (HCP index 2)	$RB2120 * 0.10 + RB2140 * 0.10 + RB2230 * 0.15 + RB2250 * 0.30 + RB2430 * 0.20 + RB2460 * 0.15$ Slope for RC#### anchored at R1810 and R2530.	R1810: 7 R2120: 5 R2140: 7 R2230: 7 R2250: 7 R2430: 7 R2460: 7 R2530: 7	Pyroxene is strongly +; Favors HCP	–
16	BD1300	√	1.3-µm absorption associated with Fe^{2+} substitution in plagioclase	$1 - \left(\frac{R1320}{a * R1080 + b * R1750}\right)$	R1080: 5 R1320: 15 R1750: 5	Plagioclase with Fe^{2+} substitution	Fe-rich olivine can be > 0
17	VAR	√	1.0-2.3-µm spectral variance	Fit a line from 1-2.3 microns and find variance of observed values from fit values by summing in quadrature over the # intervening wavelengths	–	Ol & Px will have high values; (to be used w/ OL, PX indices)	–
18	ISLOPE1	√	Spectral slope 1	$\left(\frac{R1815 - R2530}{W2530 - W1815}\right)$	R1815: 5 R2530: 5	ferric coating on dark rock	Sensitive to atmospheric hazes

#	NAME	STATUS	PARAMETER	FORMULATION	KERNEL WIDTH	RATIONALE	CAVEATS
19	BD1400	√	1.4-µm H_2O & -OH band depth	$1-\left(\frac{R1395}{a*R1330+b*R1467}\right)$	R1330: 5 R1395: 3 R1467: 5	Hydrated & hydroxylated minerals	–
20	BD1435	√	1.435-µm CO_2 ice band depth	$1-\left(\frac{R1435}{a*R1370+b*R1470}\right)$	R1370: 3 R1432: 1 R1470: 3	CO2 ice, some hydrated minerals	–
	BD1500	x	1.5-µm H_2O ice band depth	$1-\left(\frac{R1505+R1558}{R1808+R1367}\right)$	–	H2O ice	–
21	BD1500_2	√	1.5-µm H_2O ice band depth	$1-\left(\frac{R1525}{a*R1367+b*R1808}\right)$	R1367: 5 R1525: 11 R1808: 5	H2O ice	–
	ICER1	√	CO_2 and H_2O ice band depth ratio	$R1510/R1430$	R1510: 5 R1430: 5	CO2-H2O ice mixtures; > 1 for more CO2, < 1 for more water	–
22	ICER1_2	√	CO_2 and H_2O ice band depth ratio	$1-\left(\frac{\left(\frac{R1510}{RC1510}\right)}{\left(\frac{R1435}{RC1435}\right)}\right)$ Slope for RC#### anchored at R1850 and R2060.	R1850: 5 R1510: 5 R1435: 5 R2060: 5	CO2-H2O ice mixtures; > 1 for more CO2, < 1 for more water	–
	BD1750	x	1.7-µm H_2O band depth	$1-\left(\frac{R1750}{a*R1550+b*R1815}\right)$	–	Gypsum Alunite	–
23	BD1750_2	√	1.7-µm H_2O band depth	$1-\left(\frac{R1750}{a*R1690+b*R1815}\right)$	R1690: 5 R1750: 3 R1815: 5	Gypsum Alunite	Don't use on pre-MRDR, TER, MTRDR products
	BD1900	x	1.9-µm H_2O band depth	$1-\left(\frac{\left(\frac{R1930+R1985}{2}\right)}{a*1875+b*2067}\right)$	–	H2O in minerals	Weakly sensitive to lo-Ca pyroxene, glass, H2O ice
24	BD1900_2	√	1.9-µm H2O band depth	$0.5*\left(1-\left(\frac{R1930}{a*R1850+b*R2067}\right)\right)+0.5*\left(1-\left(\frac{R1985}{a*R1850+b*R2067}\right)\right)$	R1850: 5 R1930: 5 R1985: 5 R2067: 5	H2O in minerals	Weakly sensitive to lo-Ca pyroxene, glass, H2O ice
	BD1900r	√	1.95-µm H_2O band depth	$1-\left(\frac{R1908+R1914+R1921+R1928+R1934+R1941}{R1862+R1869+R1875+R2112+R2120+R2126}\right)$	R1862: 1 R1869: 1 R1875: 1 R1908: 1 R1914: 1 R1921: 1 R1928: 1 R1934: 1 R1941: 1 R2112: 1 R2120: 1 R2126: 1	H2O in minerals	Weakly sensitive to lo-Ca pyroxene, glass, H2O ice
25	BD1900r2	√	1.95-µm H_2O band depth	$1-\left(\frac{\frac{R1908}{RC1908}+\frac{R1914}{RC1914}+\frac{R1921}{RC1921}+\frac{R1928}{RC1928}+\frac{R1934}{RC1934}+\frac{R1941}{RC1941}}{\frac{R1862}{RC1862}+\frac{R1869}{RC1869}+\frac{R1875}{RC1875}+\frac{R2112}{RC2112}+\frac{R2120}{RC2120}+\frac{R2126}{RC2126}}\right)$ Slope for RC#### anchored at R1850 and R2060.	R1850: 1 R1862: 1 R1869: 1 R1875: 1 R1908: 1 R1914: 1 R1921: 1 R1928: 1 R1934: 1 R1941: 1 R2112: 1 R2120: 1 R2126: 1 R2060: 1	H2O in minerals	Weakly sensitive to lo-Ca pyroxene, glass, H2O ice
26	BDI2000	√	2-µm integrated band depth	divide R1660, R1811, R2009, R2141, R2206, R2253, R2292, R2318, R2352, R2391, R2431, R2457 by linear fit from peak R (of 15) between 1.3-1.87µm to R2530, then integrate over (1 – normalized radiances) to get integrated band depth	–	Pyroxene, glass	Weakly sensitive to H2O ice

#	NAME	STATUS	PARAMETER	FORMULATION	KERNEL WIDTH	RATIONALE	CAVEATS
	BD2100	x	2.1-µm shifted H_2O band depth (multispectral)	$1-\left(\frac{\left(\frac{R2120+R2130}{2}\right)}{a*R1930+b*R2250}\right)$	–	H2O in monohydrated sulfate	Alunite, Serpentine
27	BD2100_2	√	2.1-µm shifted H_2O band depth (hyperspectral)	$1-\left(\frac{R2132}{a*R1930+b*R2250}\right)$	R1930: 5 R2132: 5 R2250: 5	H2O in monohydrated sulfates	Alunite, Serpentine
28	BD2165	√	2.165-µm Al-OH band depth	$1-\left(\frac{R2165}{a*R2120+b*R2230}\right)$	R2120: 5 R2165: 3 R2230: 3	Pyrophyllite Kaolinite-group	Beidellite Allophane Imogolite
29	BD2190	√	2.190-µm Al-OH band depth	$1-\left(\frac{R2185}{a*R2120+b*R2250}\right)$	R2120: 5 R2185: 3 R2250: 3	Beidellite Allophane Imogolite	Kaolinite-group
30	D2200	√	2.2-µm dropoff	$1-\left(\frac{\frac{R2210}{RC2210}+\frac{R2230}{RC2230}}{2*\frac{R2165}{RC2165}}\right)$ Slope for RC#### anchored at R1815 and R2430.	R1815: 7 R2165: 5 R2210: 7 R2230: 7 R2430: 7	Al-OH minerals	Chlorite, Prehnite/Pumpellyite
	DOUB2200H	x	2.16-µm Si-OH band depth and 2.21-µm H-bound Si-OH band depth (doublet)	$1-\left(\frac{R2205+R2258}{R2172+R2311}\right)$	R2172: 5 R2205: 3 R2258: 3 R2311: 5	Opal and other Si-OH phases	–
31	MIN2200	√	2.16-µm Si-OH band depth and 2.21-µm H-bound Si-OH band depth (doublet)	$minimum\left[\left(1-\left(\frac{R2165}{a*R2120+b*R2350}\right)\right),\left(1-\left(\frac{R2210}{a*R2120+b*R2350}\right)\right)\right]$	R2120: 5 R2165: 3 R2120: 3 R2350: 5	Kaolinite group	–
	BD2210	x	2.21-µm Al-OH band depth	$1-\left(\frac{R2210}{a*R2120+b*R2250}\right)$	R2120: 5 R2210: 3 R2250: 5	Al-OH minerals	Gypsum, Alunite
32	BD2210_2	√	2.21-µm Al-OH band depth	$1-\left(\frac{R2210}{a*R2165+b*R2290}\right)$	R2165: 5 R2210: 5 R2290: 5	Al-OH minerals	Gypsum, Alunite
33	BD2230	√	2.23-µm band depth	$1-\left(\frac{R2235}{a*R2210+b*R2252}\right)$	R2210: 3 R2230: 3 R2252: 3	Hydroxylated ferric sulfate	Al-OH minerals
34	BD2250	√	2.25-µm broad Al-OH and Si-OH band depth	$1-\left(\frac{R2245}{a*R2120+b*R2340}\right)$	R2120: 5 R2245: 7 R2340: 3	Opal and other Si-OH minerals	–
35	MIN2250 (beginning with TER, MTRDR)	√	2.21-µm Si-OH band depth and 2.26-µm H-bound Si-OH band depth	$minimum\left[\left(1-\left(\frac{R2210}{a*R2165+b*R2350}\right)\right),\left(1-\left(\frac{R2265}{a*R2165+b*R2350}\right)\right)\right]$	R2165: 5 R2210: 3 R2265: 3 R2350: 5	Opal	–
36	BD2265 (beginning with TER, MTRDR)	√	2.265-µm band depth	$1-\left(\frac{R2265}{a*R2210+b*R2295}\right)$	R2210: 5 R2265: 3 R2295: 5	Jarosite Gibbsite Acid-treated nontronite	–
37	BD2290	√	2.3-µm Mg,Fe-OH band depth / 2.292-µm CO2 ice band depth	$1-\left(\frac{R2290}{a*R2250+b*R2350}\right)$	R2250: 5 R2290: 5 R2350: 5	Mg,Fe-OH minerals	Mg-Carbonate; Also CO2 ice
38	D2300	√	2.3-µm dropoff	$1-\left(\frac{\frac{R2290}{RC2290}+\frac{R2320}{RC2320}+\frac{R2330}{RC2330}}{\frac{R2120}{RC2120}+\frac{R2170}{RC2170}+\frac{R2210}{RC2210}}\right)$ Slope for RC#### anchored at R1815 and R2530.	R1815: 5 R2120: 5 R2170: 5 R2210: 5 R2290: 3 R2320: 3 R2330: 3 R2530: 5	Mg,Fe-OH minerals	Mg-Carbonate; Also CO2 ice

#	NAME	STATUS	PARAMETER	FORMULATION	KERNEL WIDTH	RATIONALE	CAVEATS
39	BD2355	√	2.35-µm band depth	$1-\left(\frac{R2355}{a*R2300+b*R2450}\right)$	R2300: 5 R2355: 5 R2450: 5	Chlorite Prehnite Pumpellyite	Requires normalization of atmo. CO absorption
	SINDEX	x	Detects convexity at 2.29 µm due to absorptions at 1.9/2.1 µm & 2.4 µm	$1-\left(\frac{R2100+R2400}{2*R2290}\right)$	–	Mono and polyhydrated sulfates) will be > 0	–
40	SINDEX2	√	Inverse lever rule to detect convexity at 2.29 µm due to absorptions at 1.9/2.1 µm & 2.4 µm	$1-\left(\frac{a*R2120+b*R2400}{R2290}\right)$	R2120: 5 R2290: 7 R2400: 3	Mono and polyhydrated sulfates) will be > 0	–
	ICER2	x	2.7-µm CO2 ice band	$R2530/R2600$	–	CO2 vs water ice /soil; CO2 will be >>1, water and soil will be ~1	–
41	ICER2	√	2.7-µm CO2 ice band	$RB2600$ Where RB#### = (RC#### - R####)/RC####. RC#### denotes the value of a point at a wavelength of #### nm along a modeled line that follows the average slope of the spectrum. Slope for RC#### anchored at R2456 and R2530.	R2456: 5 R2530: 5 R2600: 5	CO2 vs water ice /soil; CO2 will be >>0, water and soil will be ~0	–
	BDCARB	x	Carbonate overtone band depth, or metal-OH band	$1-\sqrt{\left(\frac{R2330}{a*R2230+b*R2390}\right)*\left(\frac{R2530}{c*R2390+d*R2600}\right)}$	–	Carbonates; both overtones need to be present to increase parameter value	Many hydroxylated silicate phases
42	MIN2295_2480 (beginning with TER, MTRDR)	√	Mg Carbonate overtone band depth and metal-OH band	$minimum\left[\left(1-\left(\frac{R2295}{a*R2165+b*R2364}\right)\right),\left(1-\left(\frac{R2480}{a*R2364+b*R2570}\right)\right)\right]$	R2165: 5 R2295: 5 R2364: 5 R2480: 5 R2570: 5	Mg -carbonates or hydroxylated silicate; both overtones need to be present to increase parameter value	–
43	MIN2345_2537 (beginning with MTRDR)	√	Ca/Fe Carbonate overtone band depth and metal-OH band	$minimum\left[\left(1-\left(\frac{R2345}{a*R2250+b*R2430}\right)\right),\left(1-\left(\frac{R2537}{a*R2430+b*R2602}\right)\right)\right]$	R2250: 5 R2345: 5 R2430: 5 R2537: 5 R2602: 5	Ca/Fe - carbonates or hydroxylated silicate; both overtones need to be present to increase parameter value	Prehnite, Serpentine
	BD2500H	x	Mg Carbonate overtone band depth	$1-\left(\frac{R2500+R2510}{R2540+R2380}\right)$	R2380: 5 R2500: 5 R2510: 5 R2540: 5	Mg-carbonates	Some zeolites
44	BD2500_2	√	Mg Carbonate overtone band depth	$1-\left(\frac{R2480}{a*R2364+b*R2570}\right)$	R2364: 5 R2480: 5 R2570: 5	Mg-carbonates	Some zeolites
45	BD3000	√	3-µm H2O band depth	$1-\left(\frac{R3000}{R2530*\left(\frac{R2530}{R2210}\right)}\right)$	R2210: 5 R2530: 5 R3000: 5	bound H2O (accounts for spectral slope)	–
46	BD3100	√	3.1-µm H2O ice band depth	$1-\left(\frac{R3120}{a*R3000+b*R3250}\right)$	R3000: 5 R3120: 5 R3250: 5	H2O ice	–
47	BD3200	√	3.2-µm CO2 ice band depth	$1-\left(\frac{R3320}{a*R3250+b*R3390}\right)$	R3250: 5 R3320: 5 R3390: 5	CO2 ice	–
48	BD3400	√	3.4-µm carbonate band depth	$1-\left(\frac{a*R3390+b*R3500}{c*R3250+d*R3630}\right)$	–	carbonates	–

#	NAME	STATUS	PARAMETER	FORMULATION	KERNEL WIDTH	RATIONALE	CAVEATS
49	BD3400_2	√	3.4-µm carbonate band depth	$1-\left(\frac{R3420}{a*R3250+b*R3630}\right)$	R3250: 10 R3420: 15 R3630: 10	carbonates	–
50	CINDEX	√	3.9-µm carbonate index	$\left(\frac{R3750+\frac{(R3750-R3630)}{(3750-3630)*(3950-3750)}}{R3950}\right)-1$	–	carbonates will be > ‘bkgrnd’ values > 0	–
51	CINDEX2	√	Inverse lever rule to detect convexity at 3.6 µm due to absorptions at 3.4 µm & 3.9 µm	$1-\left(\frac{a*R3450+b*R3875}{R3610}\right)$	R3450: 9 R3610: 11 R3875: 7	carbonates will be > ‘bkgrnd’ values > 0	–
Atmospheric Parameters (calculated using TRDR, MRDR, TER, MTRDR photometrically corrected I/F)							
52	R440	√	0.44-µm reflectance	$R440$	R440: 5	Clouds/Hazes	–
53	IRR1	√	IR ratio 1	$R800/R1020$	R800: 5 R1020: 5	Aphelion ice clouds (>1) vs. seasonal or dust (< 1)	–
54	BD2600	√	2.6-µm H2O band depth	$1-\left(\frac{R2600}{a*R2530+b*R2630}\right)$	R2530: 5 R2600: 5 R2630: 5	H2O vapor (accounts for spectral slope)	–
55	IRR2	√	IR ratio 2	$R2530/R2210$	R2210: 5 R2350: 5	aphelion ice clouds vs. seasonal or dust	–
56	IRR3	√	IR ratio 3	$R3500/R3390$	R3390: 7 R3500: 7	aphelion ice clouds (higher values) vs. seasonal or dust	–