Algorithm Description for Integrated Site Specific Science Value Map

Quantification of Science Value

At best, we can only produce a semi-quantitative method for weighting different elements that feed into the ISVM at a site-specific level. The very word, value, is subjective in its meaning and different scientists will emphasize the importance, or place value on, different categories of science value for different reasons. Figure 2 is a graphical representation of a weighted scoring system that directly feeds into the algorithms of each of the four Science Value Maps to produce a means of quantifying the ISVM.

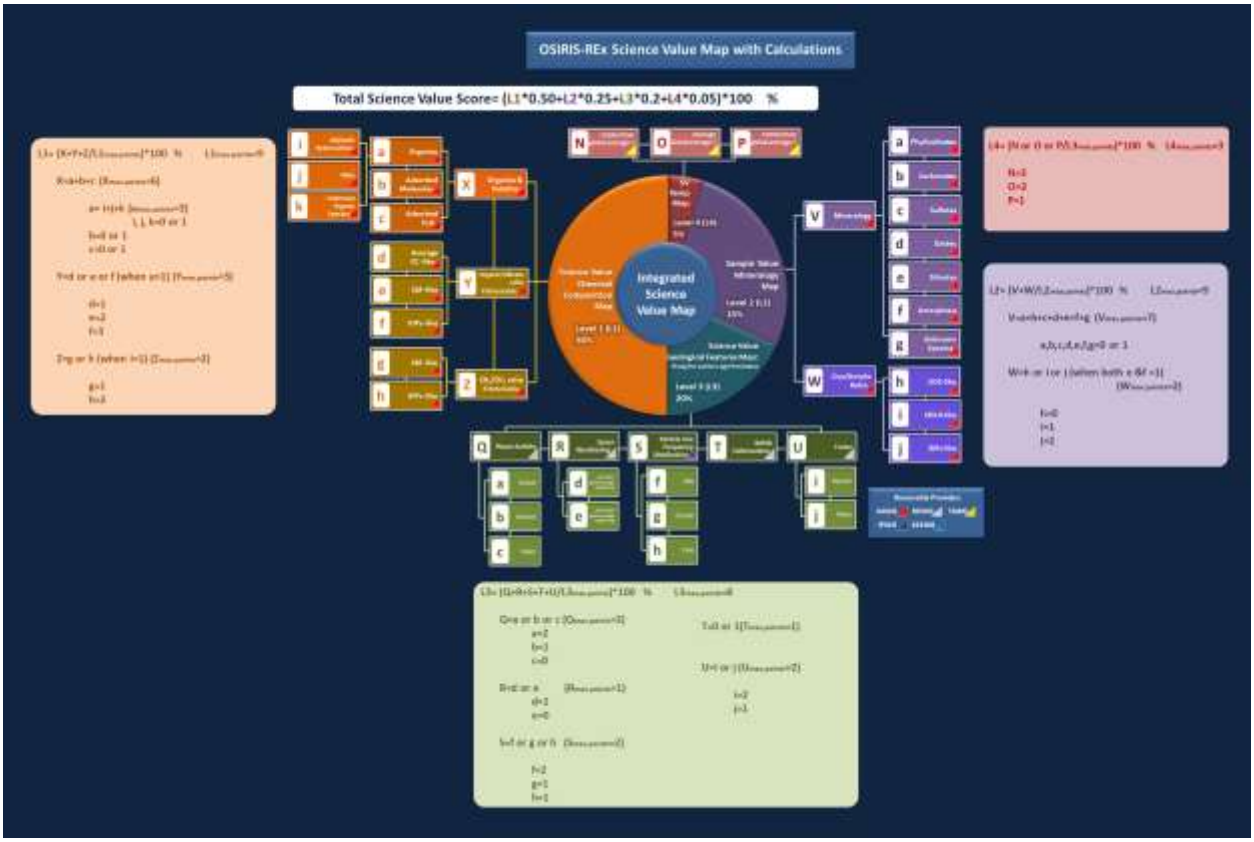

Figure 2: A graphical flow diagram representing weighted science value to produce semi-quantitative maps (typo fixed 9/20/2013 by KNM).

Each element of the science value map will be given a ranked value with simple numbers of 0,1,2 or 3, and these numbers will be added up to calculate the overall percentage for the sub Science Value maps (L1, L2, L3, and L4 %). Then for the Integrated Science Value Map, each of the sub Science Value map will be weighed according to its priority:
L1: 50% (The highest weight)
L2: 25%
L3: 20%
L4: 5% (the lowest weight)

Then each area will be shown with percentage scored from the following equation:
Total Integrated Science Value Score (%) = (L1*0.50 + L2*0.25 +L3*0.20 +L4*0.05)*100
The score (%) will be visualized at the end in color:
GREEN 100% (highest science value) –CREAM 50 % (average) – RED 0% (lowest science value)

Priority Level 1: Science Value Chemical Composition (L1) (Vicky's comments in blue.)
Science value of chemical composition (L1 %) will be calculated from the following equation:
L1 = (X + Y + Z / L1max.points)*100
where X is the total score of Organics & Volatiles feature, Y is scores of Organic/Silicate ratio, and Z is scores of CH2/CH3 ratio and maximum points of L1 (L1max.points) is 9.
X is the total score of Organics & Volatiles feature that will be calculated from the following equation:
X = a +b + c
where a is the total score of organic features,
b is the detection of adsorbed molecules, when it is detected b = 1, when it is under detection limit (featureless) then b = 0,
c is the detection of Adsorbed H2O, when it is detected c =1, when it is under detection limit (featureless) then c = 0.
a is the total score of Organic features that will be calculated from the following equation:
a = i +j+ k
where i is the detection of aliphatic hydrocarbon feature, when it is detected i = 1, when it is under detection limit i = 0,
j is the detection of polycyclic aromatic hydrocarbon (PAHs) feature, when it is detected j = 1, when it is under detection limit j = 0,
k is the detection of unknown spectral features (neither aliphatic hydrocarbons nor PAHs) but noteworthy possible organic spectra. When such a feature is detected k = 1, when not, k = 0.

Y is the score calculated from the Organics/Silicate (O/S) ratios compared to the O/S ratios from the best representative lab data of primitive astromaterials. Y will be considered only when any organic feature is detected (when a > 1). **(Calculating the ratio of organics to silicates requires having the abundances of both, but organics will likely be characterized dominantly by OVIRS and we won't have abundance information. I'm happy to think about creative ways we might go about calculating something like this, but it might require some additional effort.)**
Y= either d or e or f (when a > 1)
When a > 1 and the O/S is similar to the O/S of average carbonaceous chondrite, then
Y = d =1
When a > 1 and the O/S is similar to the O/S of CM2 carbonaceous chondrite, then
Y = e =2
When a > 1 and the O/S is similar to the O/S of IDPs, then
Y = f =3

Z is the score calculated from the CH2/CH3 ratio in aliphatic hydrocarbon compared to the ratios from the best representative lab data of primitive astromaterials. Z will be considered only when aliphatic hydrocarbon feature is detected (when i = 1). **(Similarly, we may not have the ability to calculate this ratio.)**
Z= either d or e or f (when a > 1)

When i = 1 and the CH2/CH3 ratio is similar to the ratio of CM2 carbonaceous chondrite, then
Z = g =1
When i = 1 and the CH2/CH3 ratio is similar to the ratio of IDPs, then
Z = h =2
Priority Level 2: Science Value Mineralogy (L2) (Vicky's comments in blue.)
Science value of mineralogy (L2 %) will be calculated from the following equation:
L2 = (V + W / L2max.points)*100

where V is the total score of detected mineral features, W is scores of Crystal/Amorphous ratio, and the maximum points of L2 (L2max.points) is 9.
V is the total score of detected mineral features that will be calculated from the following equation:
V = a +b + c + d +e + f +g
where a is the detection of phyllosilicates. When it is detected a =1, when the feature isn't recognized a =0. And the same for b, c, d, e, f, g where
b: carbonates
c: Sulfates
d: Oxides
e: silicates
f: amorphous feature
g: unknown but noteworthy mineralogical feature
the maximum points of V is 7 when all of the above listed minerals are detected. Therefore V expresses the mineralogical diversity.

W is the score calculated from the Crystal/Amorphous (C/A) ratios compared to the C/A ratios of the best representative lab data of primitive astromaterials. W will be considered only when both silicate (e) and amorphous (f) features are detected (when e = f = 1).

(SAWG has not been asked to identify any amorphous phases, so at present, W cannot be calculated.)
W= either h or I or j (when e = f = 1)
When e = f = 1 and the C/A ratio is similar to the C/A ratio of the most representative lab data from UOC, then
W = h = 0
When e = f = 1 and the C/A ratio is similar to the C/A ratio of the most representative lab data from CR3.0 type carbonaceous chondrites, then
W = i = 1
When e = f = 1 and the C/A ratio is similar to the C/A ratio of the most representative lab data from IDPs, then
W = j = 2
Priority Level 3: Science Value Geological Features (L3)
Science value of Geological Features (L3 %) will be calculated from the following equation:
L3 = (Q + R + S + T + U / L3max.points)*100

where Q is the score of plume activity, R is space weathering, S is Particle Size Frequency Distribution, T is the existence of Brittle Deformation, U is the score of Craters. The maximum points of L3 (L3max.points) is 8.
Q represents Plume Activity:
Q = either a or b or c

where a is the detection of active plume. When it is detected then
Q = a =2
b is the detection of recent activity (definition TBD). When it is detected then
Q = b =1
c is the detection of old plume site (definition TBD). When it is detected then
Q = c =0

R represents the degree of space weathering:
R = either d or e
when the space weathering feature is less than global average (definition TBD), therefore the site is fresher than average asteroidal surface, then
R = d =1
When the space weathering feature is more than the global average (definition TBD), therefore the site is more weathered than average asteroidal surface, then
R = e =0

S represents the particle size frequency distribution (PSFD):
S = either f or g or h
when the PSFD feature show mixture of course and fine grains, then
S = f =2
When the PSFD feature show either only coarse grains distribution, then
S = g =1
When the PSFD feature show either only fine grains distribution, then
S = h =1

T represents the existence of Brittle Deformation.
T will be contributed to the L3 only when the feature is recognized in the area, then
T = 1

U represents Crater features:
U = either i or j
where i is the detection of recent crater (definition TBD). When it is detected then
U = i =2
j is the detection of old crater (definition TBD). When it is detected then
U = j =1

Priority Level 4: Science Value Temperature (L4)
Science value of Surface Temperature (L4 %) express the temperature of the area compared to the global average T.
L3 = (N or O or P / L4max.points)*100
when the site T is less than (colder than) the global average (definition TBD), then
N = 3
When the site T is as same as the global average, then
O = 2
When the site T is more than (hotter than) the global average, then
P = 1

The final synthesis for the ISVM numerical scoring is represented in Figure 3, were we show graphically the entire flow of information from each Science Value Map.

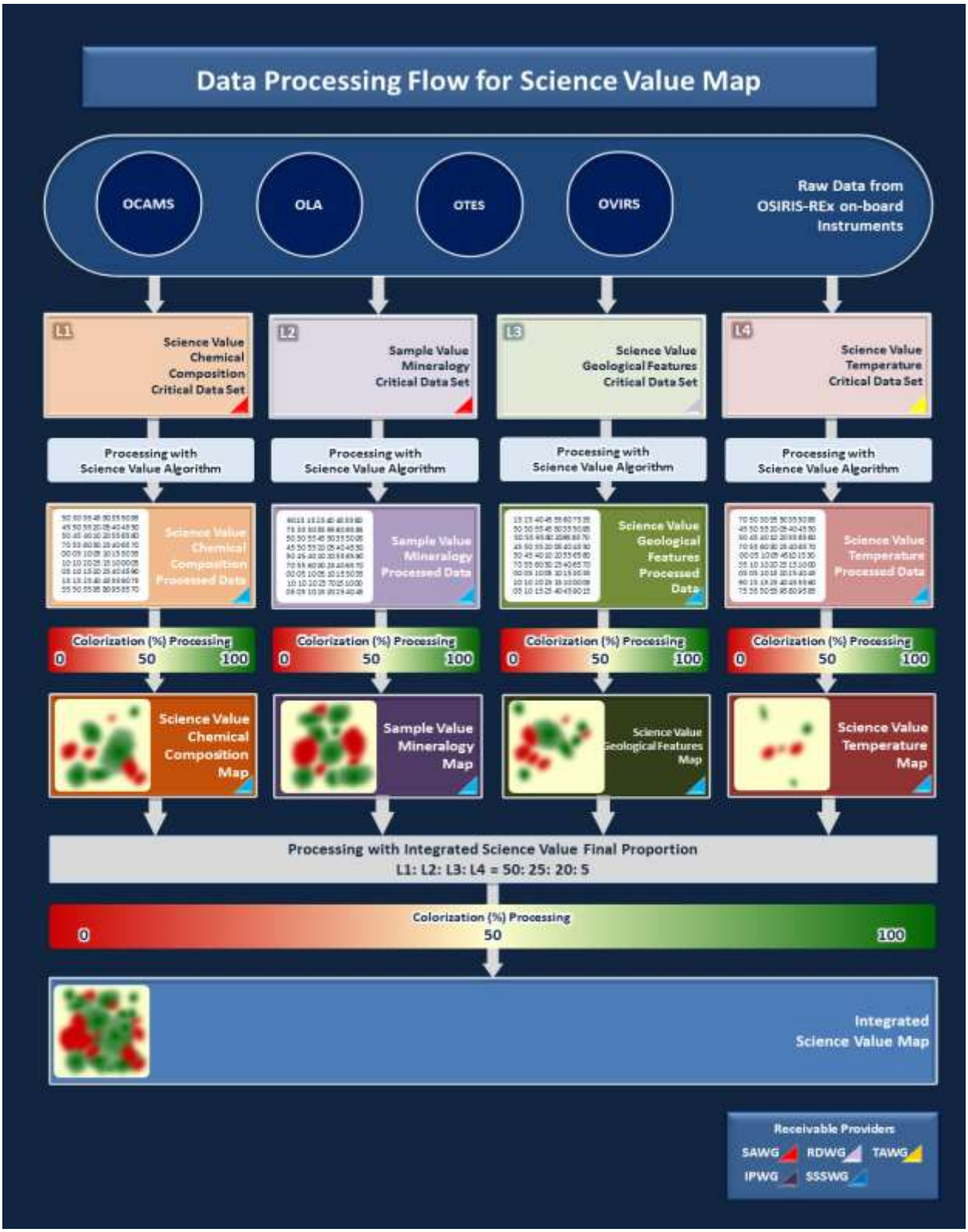

Figure 3: A graphical flow diagram conceptually representing the production of the Integrated Science Value Map.