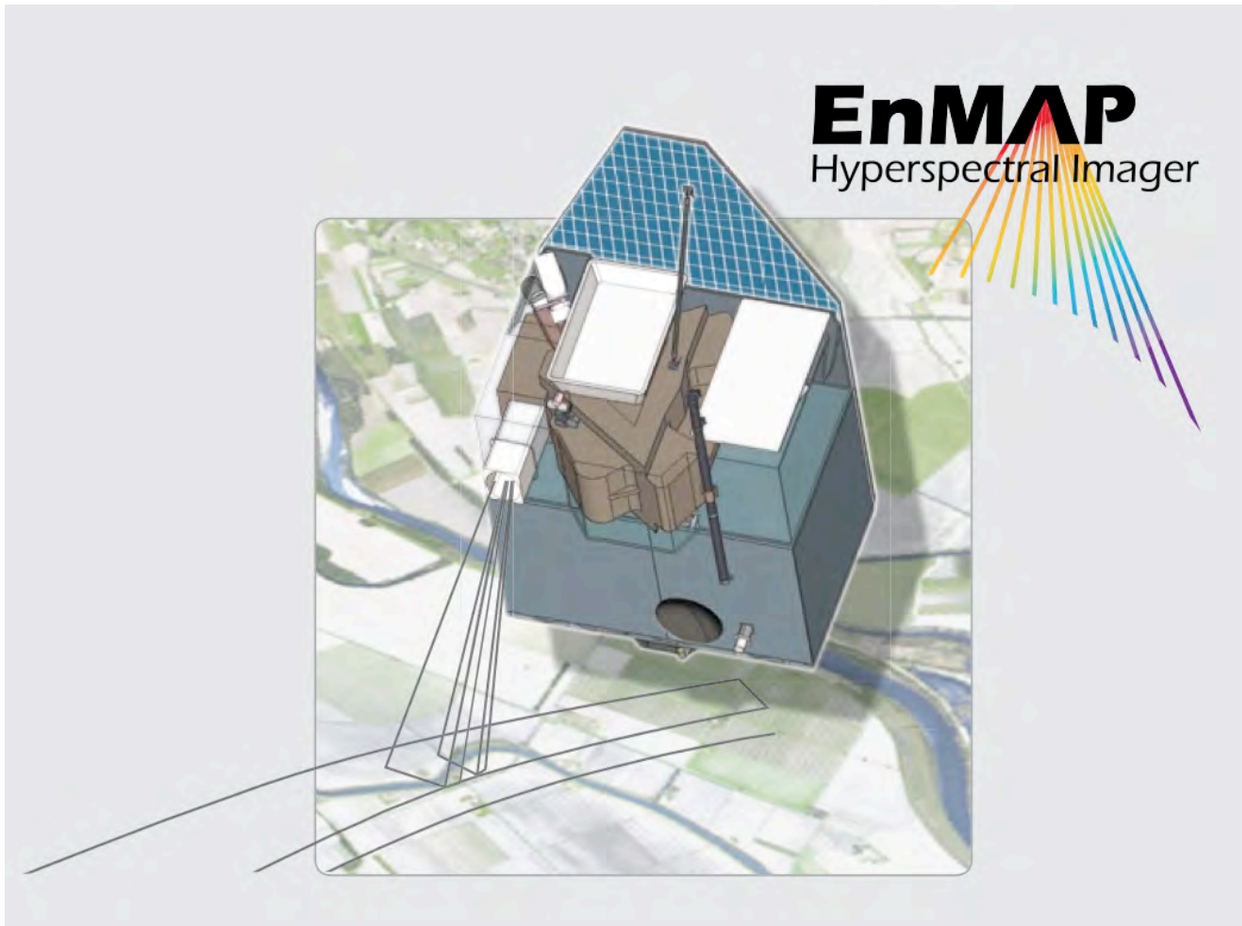
Erosion and weathering of volcanic rocks - a hyperspectral approach

14th of November 2013, EnMAP Workshop, DLR Bonn



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Sven Borchardt

Outline

Introduction

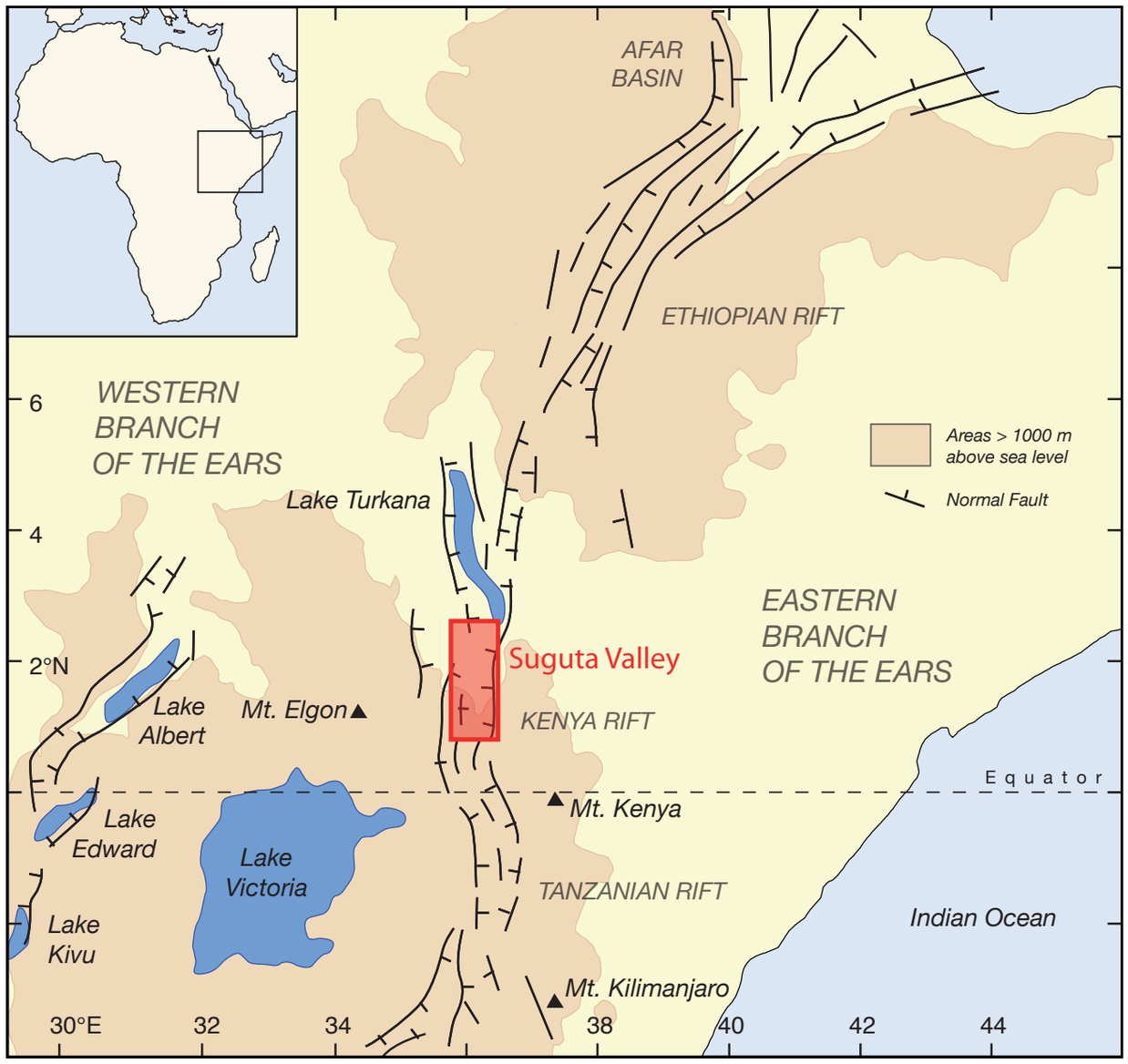

Evapotranspiration (SEBAL)


Erosion (RUSLE)


Spectral Unmixing


Weathering

Introduction



modified after Trauth et al., 2005, 2007

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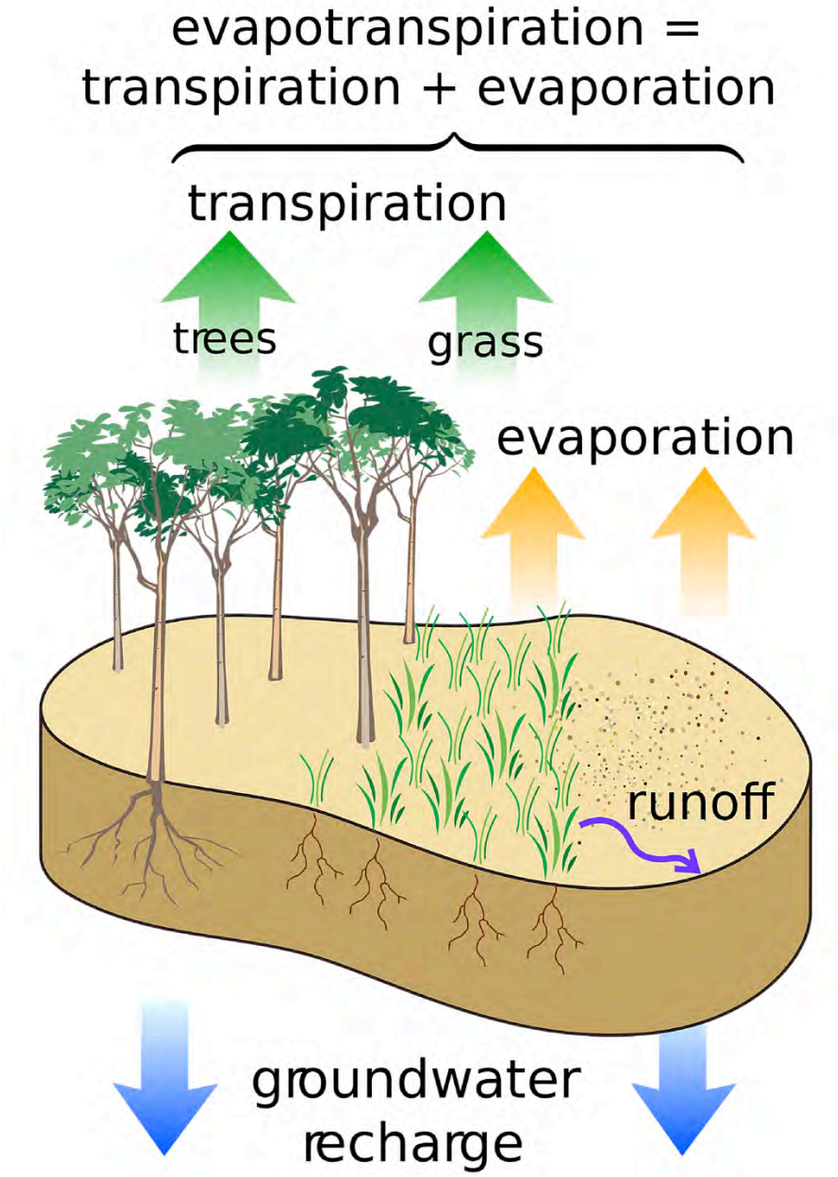
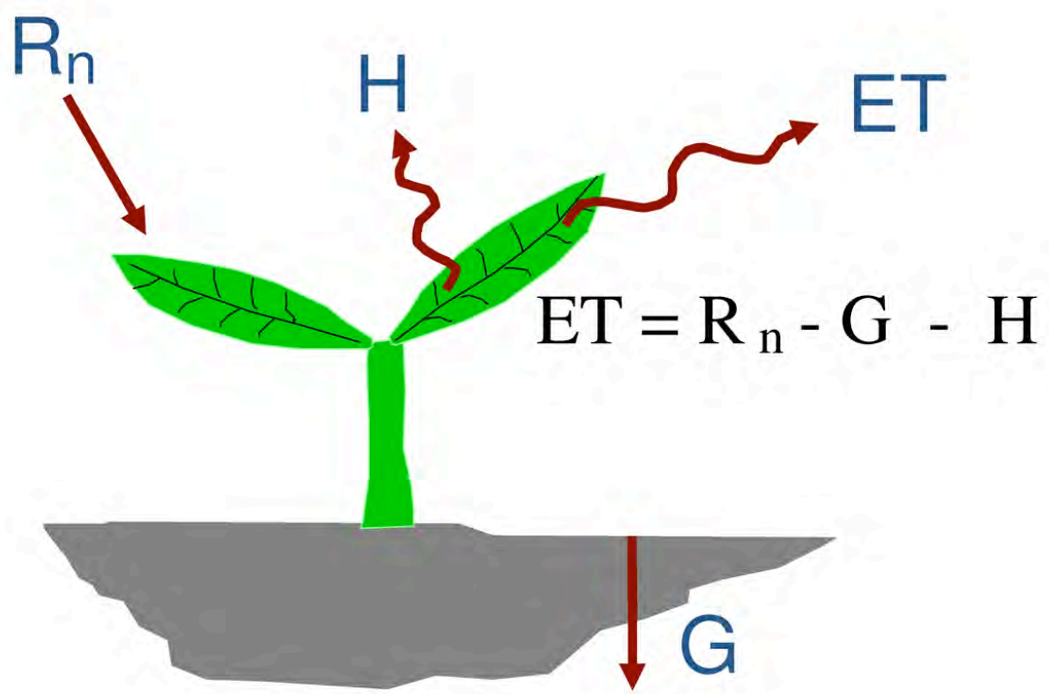
Evapotranspiration





- ET = latent heat flux (evapotranspiration)
- Rn = net radiation
- G = ground heat flux
- H = sensible heat flux

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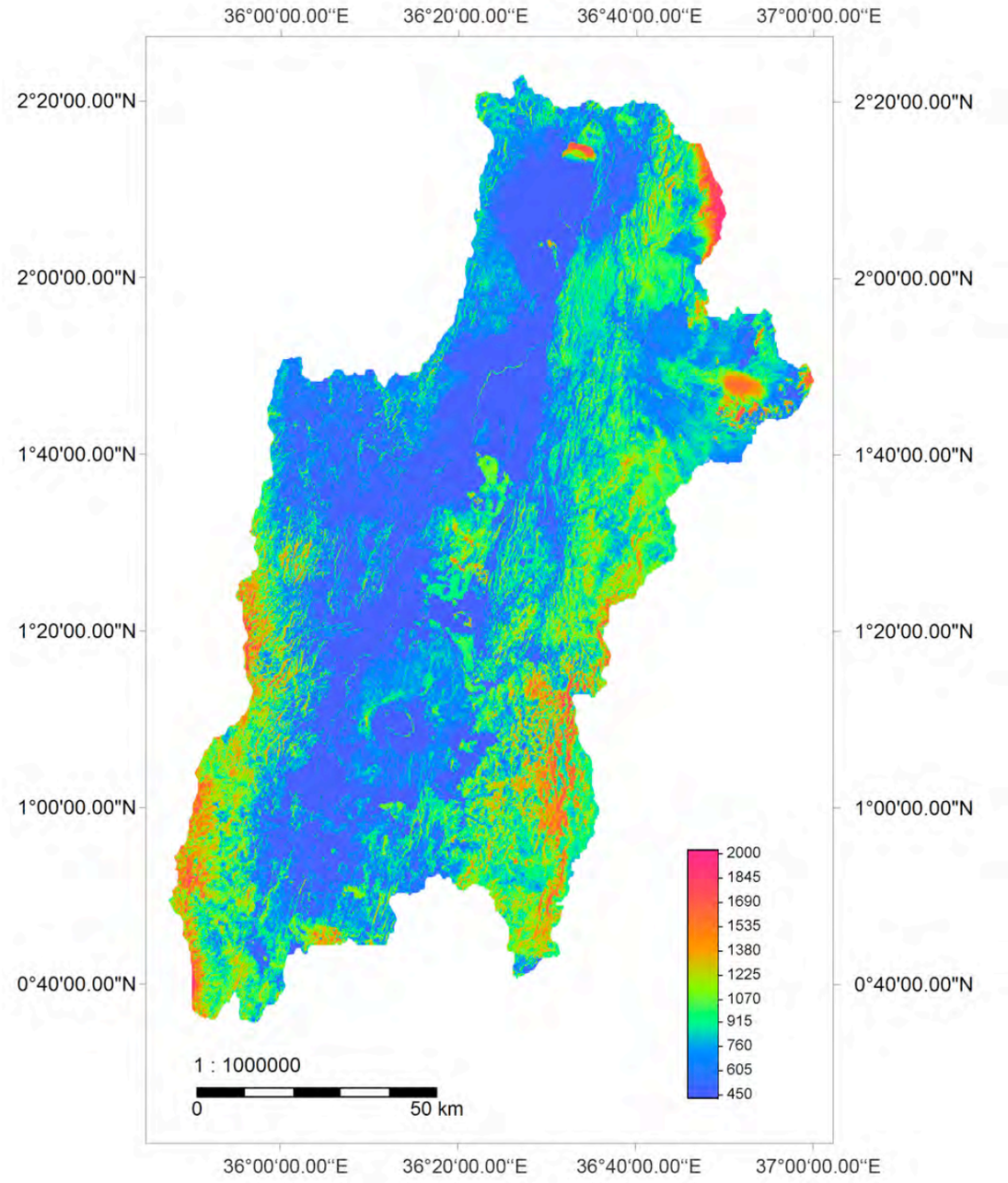
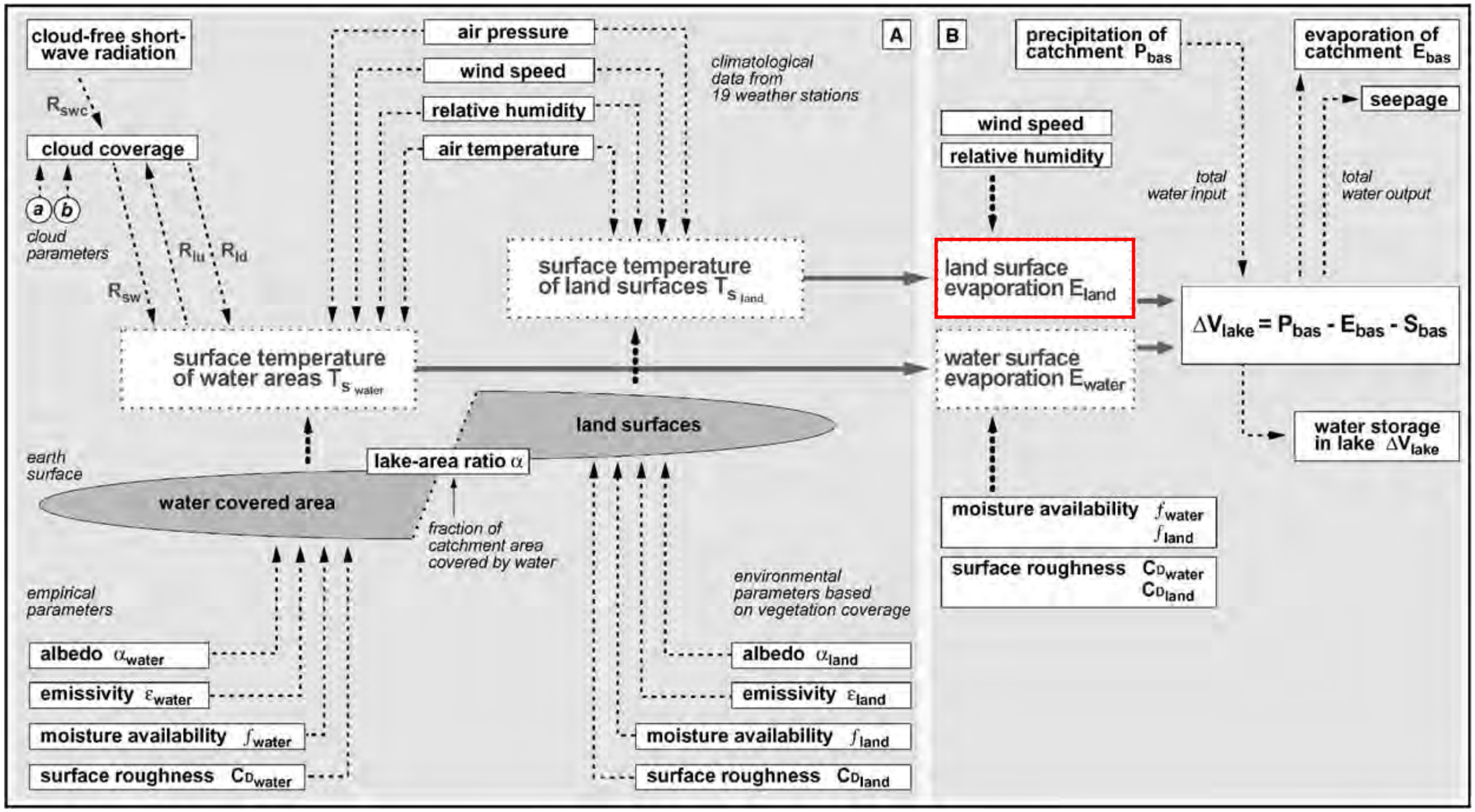
Evapotranspiration



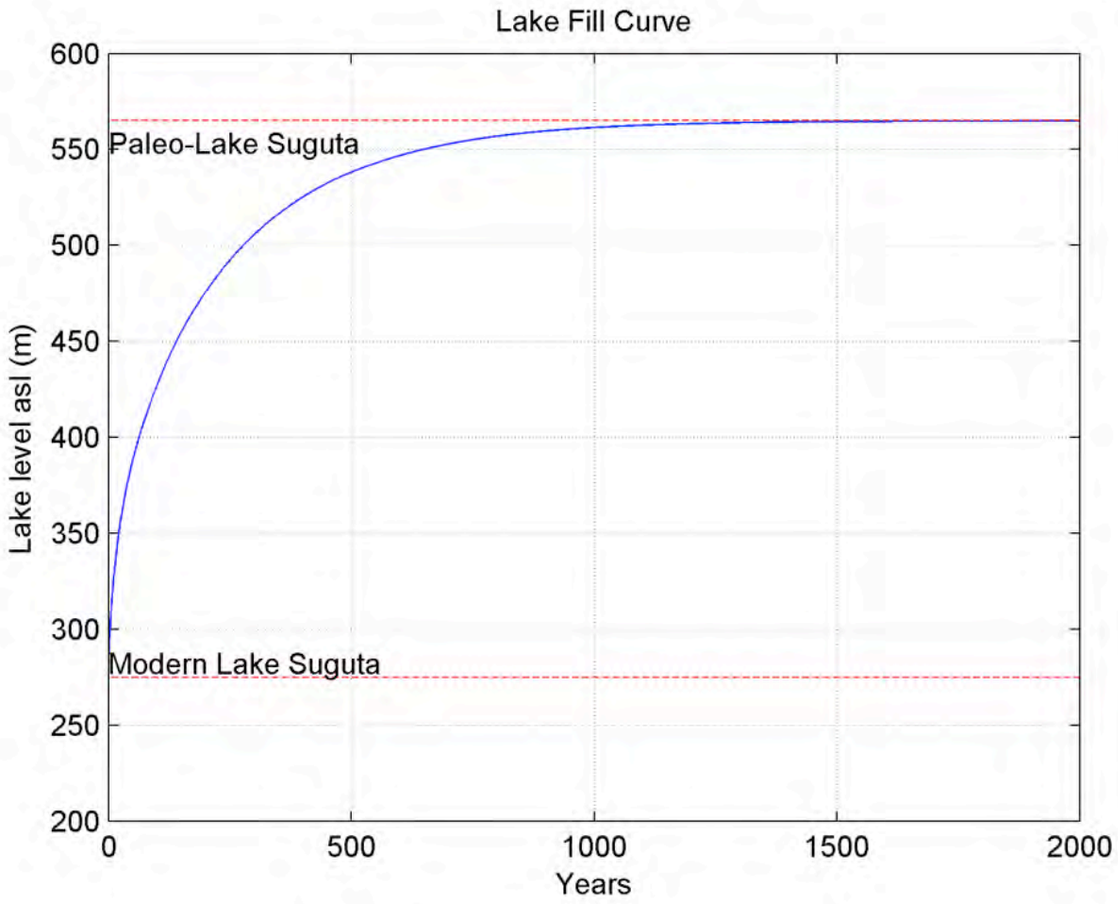
Borchardt & Trauth, 2012

Evapotranspiration



modified after Blodgett et al., 1997 & Bookhagen et al., 2001

Evapotranspiration




```
---------------------------------------
Modelled Climatological Data
---------------------------------------

T_a_ld (calc)          =    297.45
T_s_ld (calc)          =    310.20
E_ld   (calc)          =    809.10


T_a_lk (calc)          =    302.15
T_s_lk (calc)          =    310.70
E_lk   (calc)          =    2208.87

Modern Precipitation   =    856.45

Modern Lake Ratio      =    0.03

Paleo-Lake Ratio       =    0.17

---------------------------------------

Paleo-Precip (mm/yr)   =    1040.10

Paleo-Precip (% mod)   =    1.21
```

Borchardt & Trauth, 2012

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Revised Universal Soil Loss Equation

$$A = R * K * L * S * C * P$$

Erosion Factors:

Climate - Rainfall and Runoff (R)

Soil - Soil Erodibility (K)

Topography - Slope Length and Steepness (LS)

Crops - Cover Management (C)

Supporting Practices (P)

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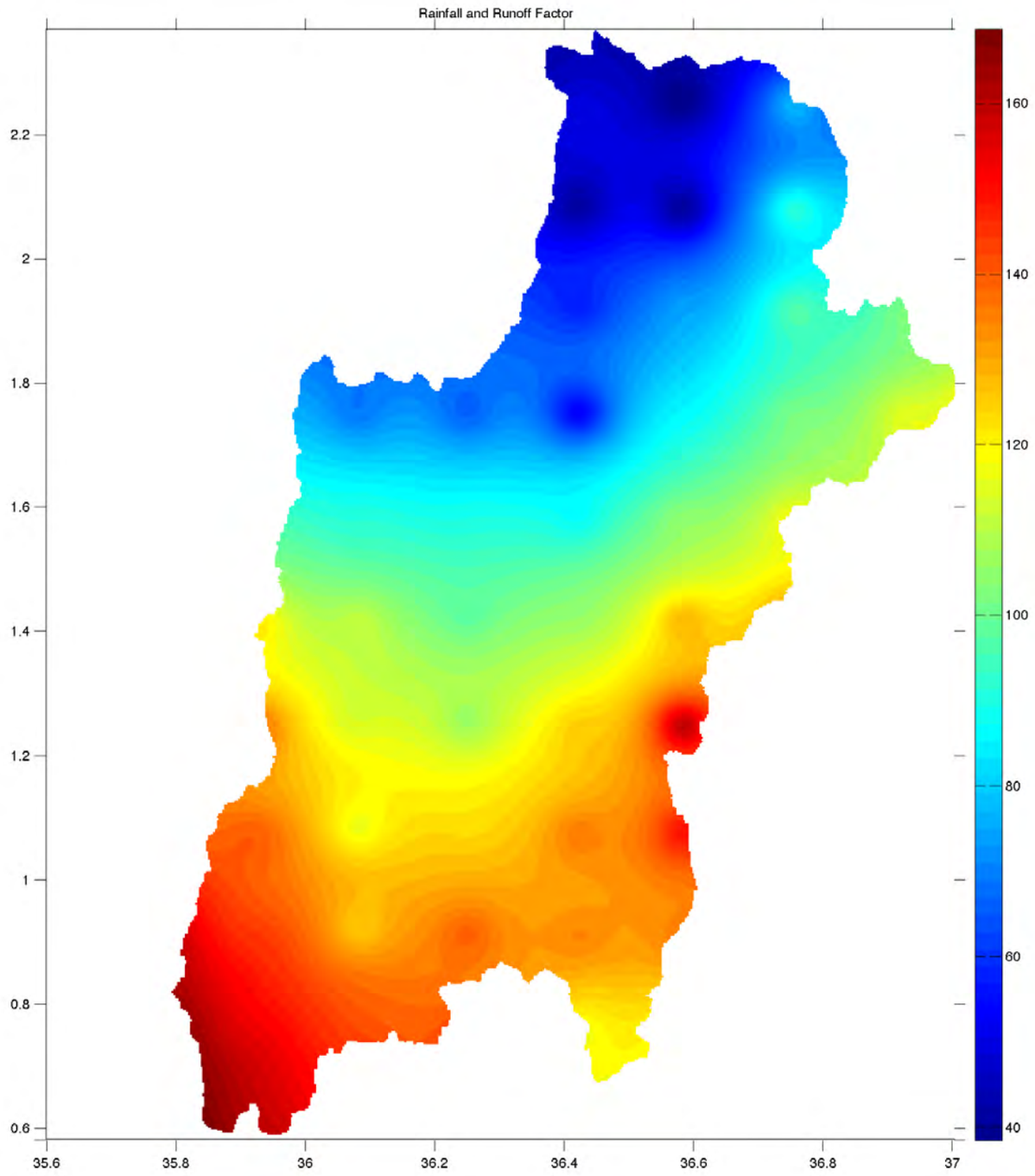
Erosion

Rainfall and Runoff Factor (R)



Borchardt et al., in prep.

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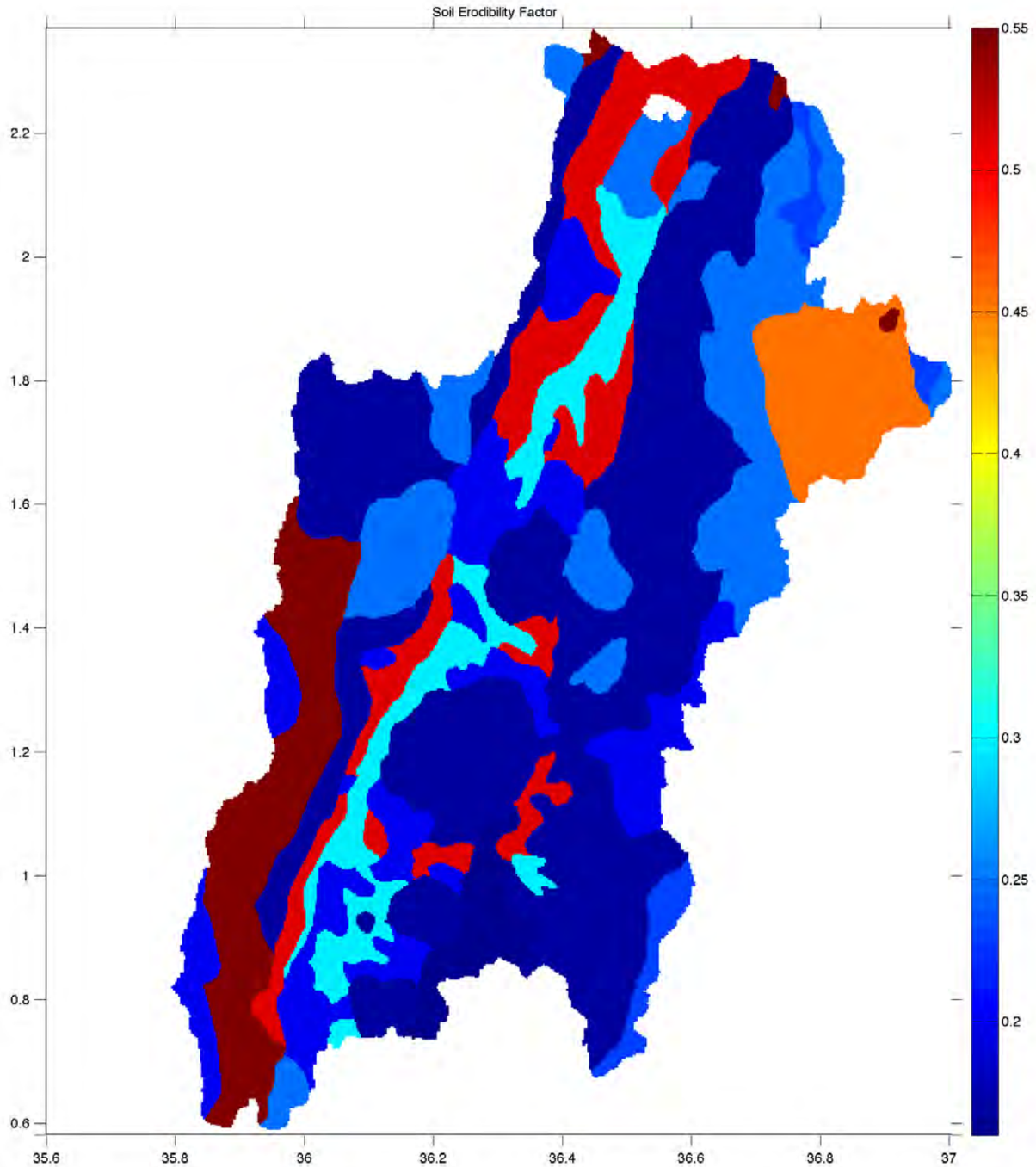
Erosion

Soil Erodibility Factor (K)



Borchardt et al., in prep.

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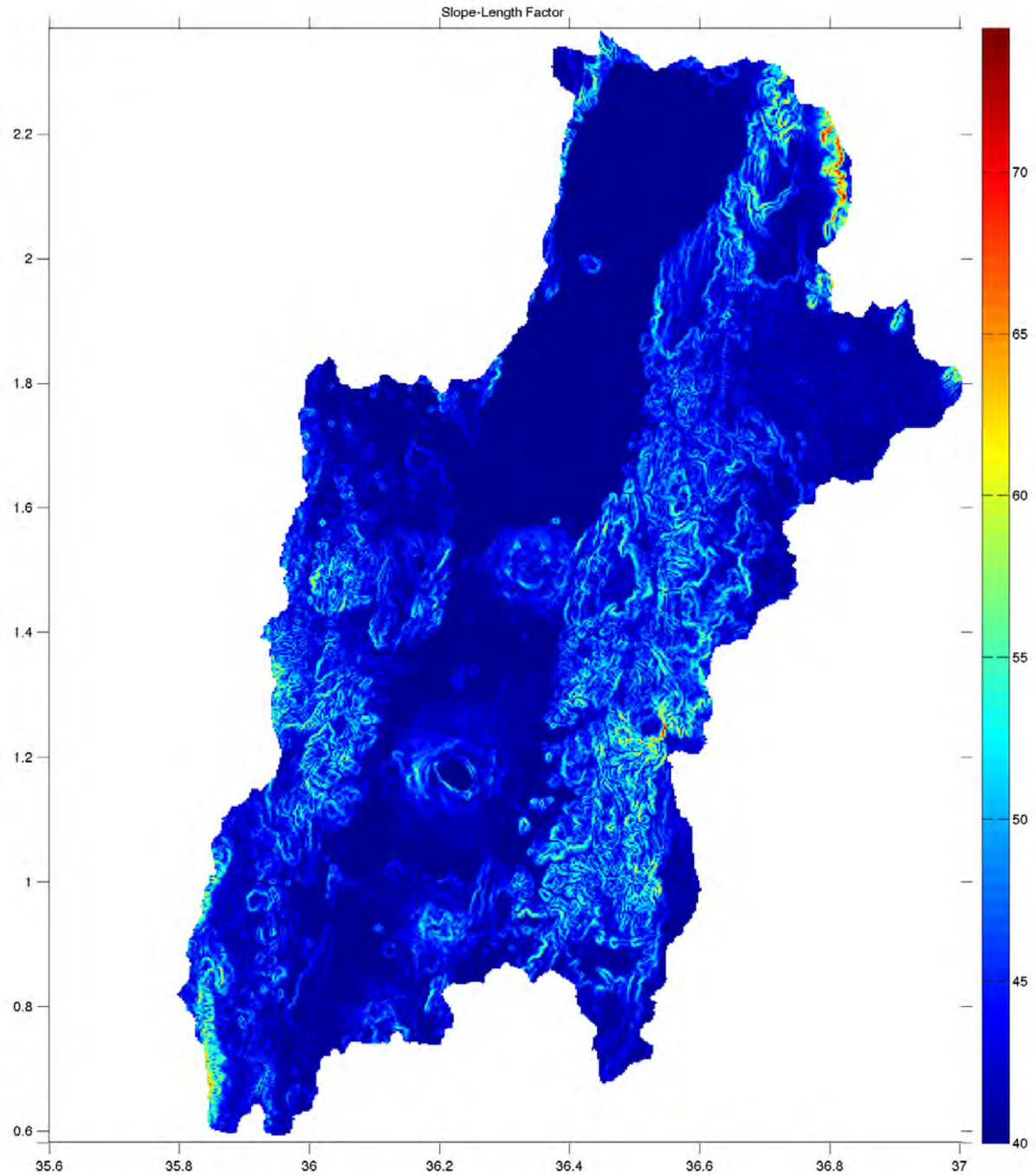
Erosion

Slope-Length Factor (LS)



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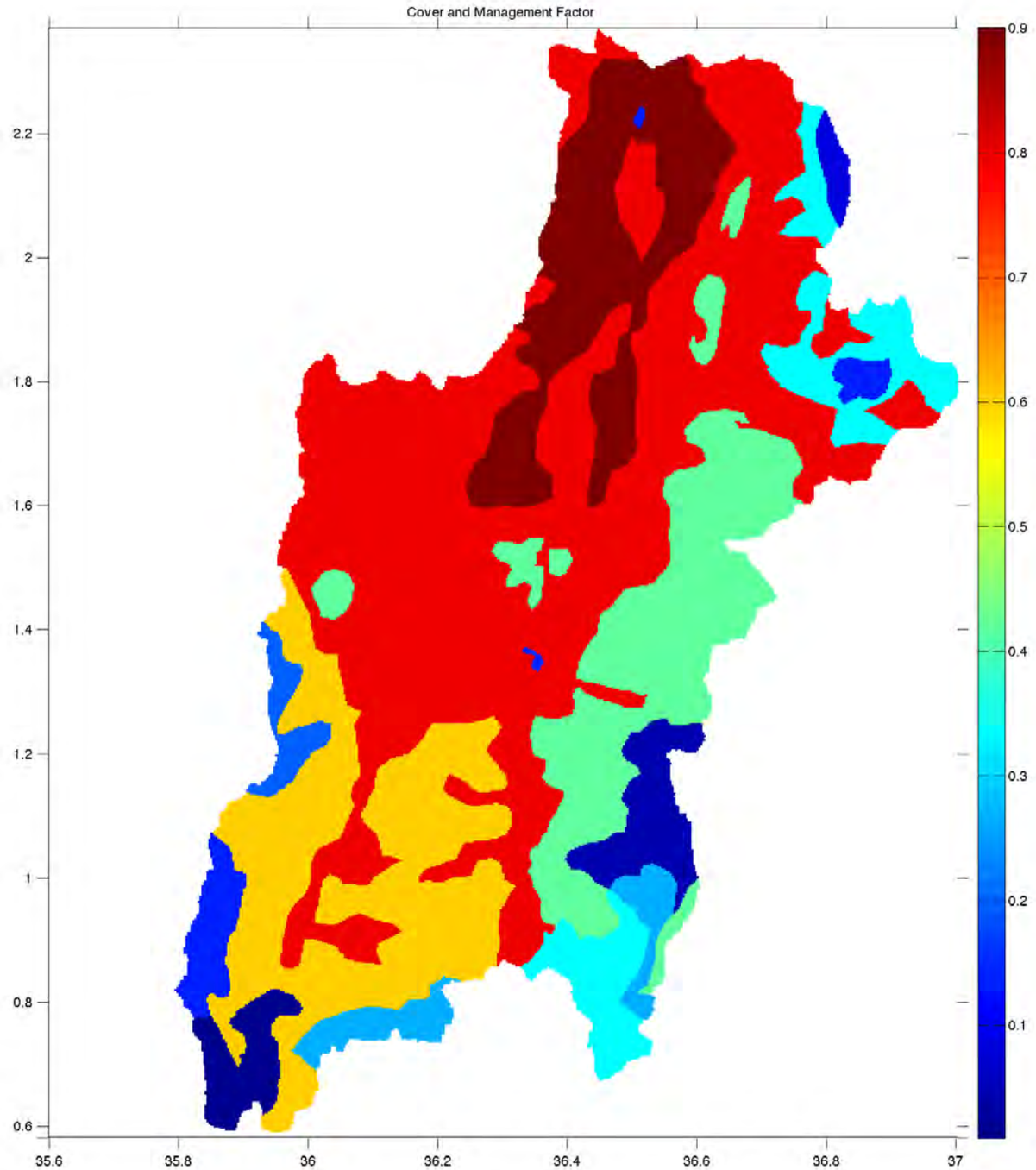
Erosion

Cover and Management Factor (C)



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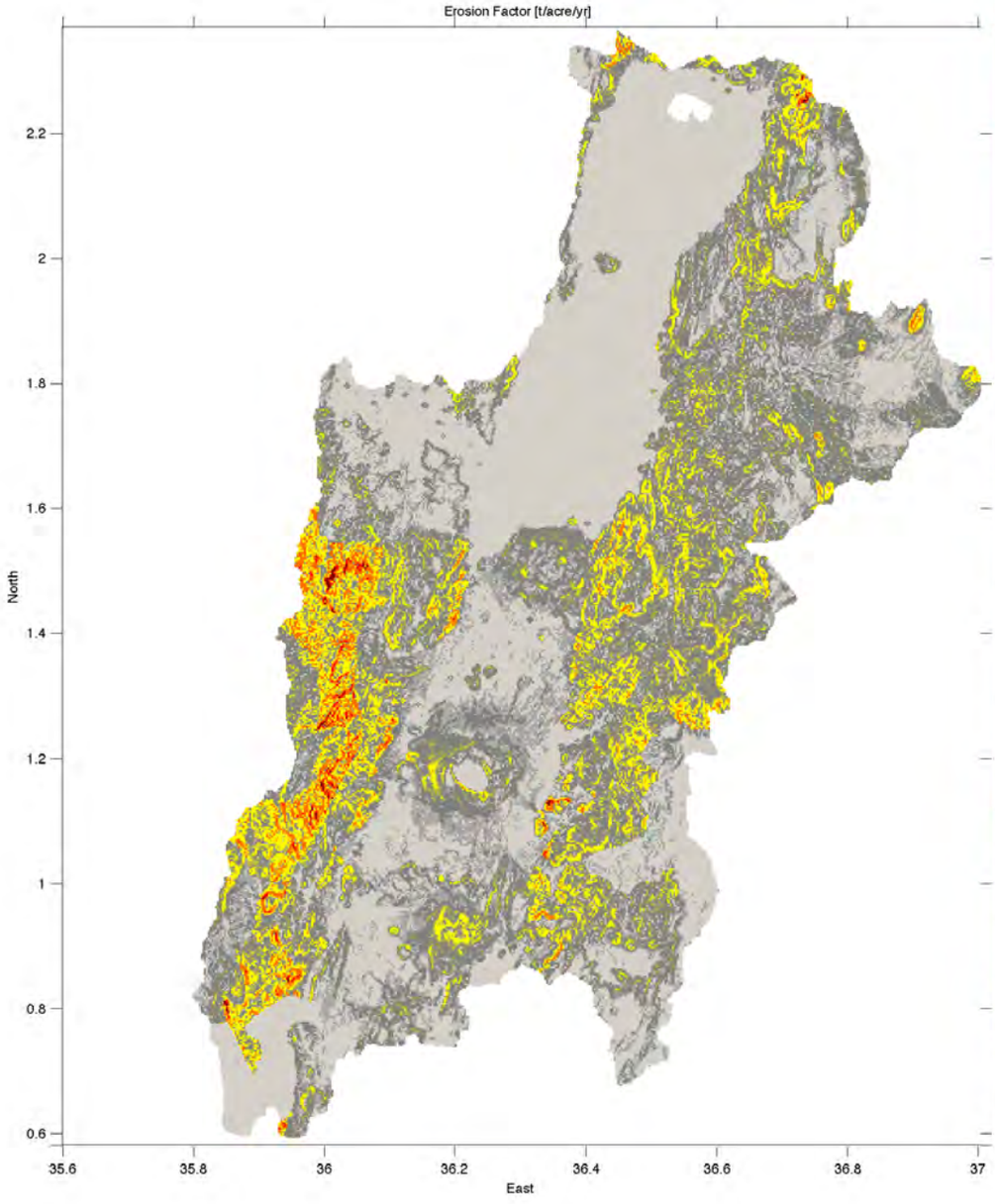
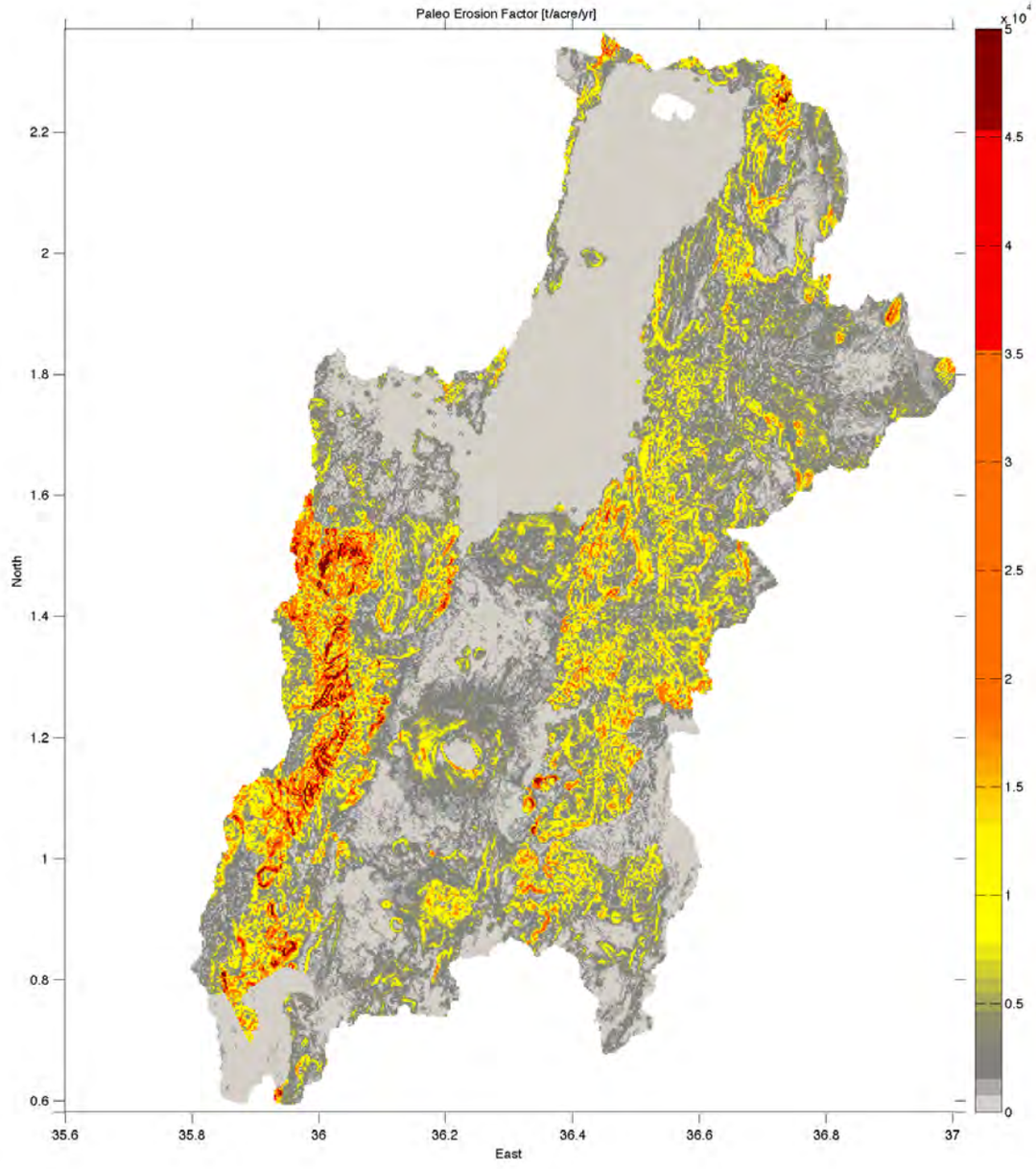
Erosion

Erosion Factor





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Borchardt et al., in prep.

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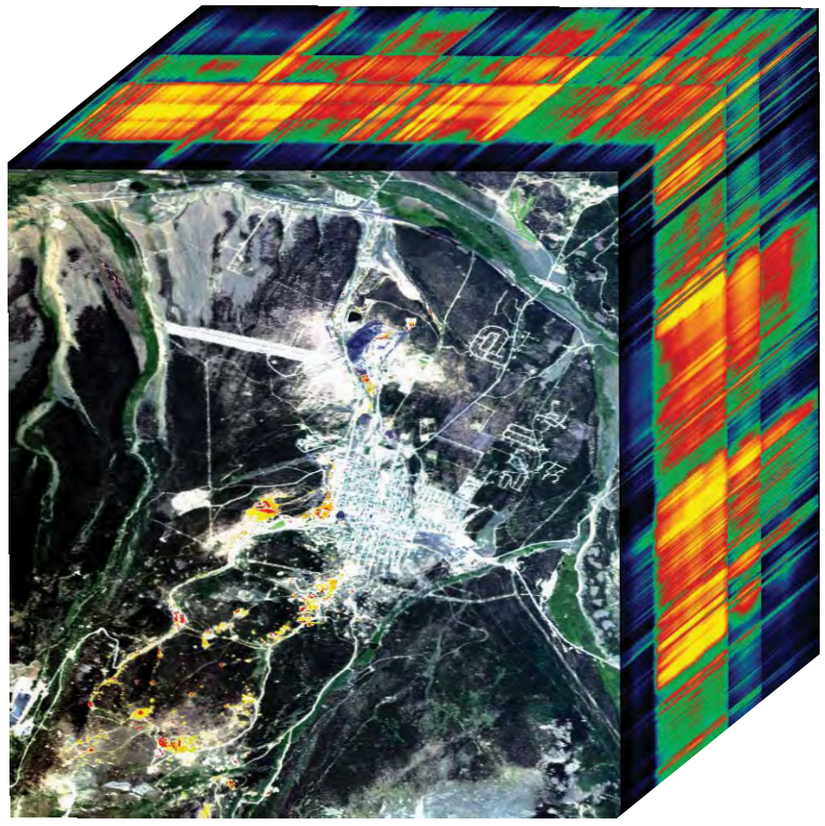
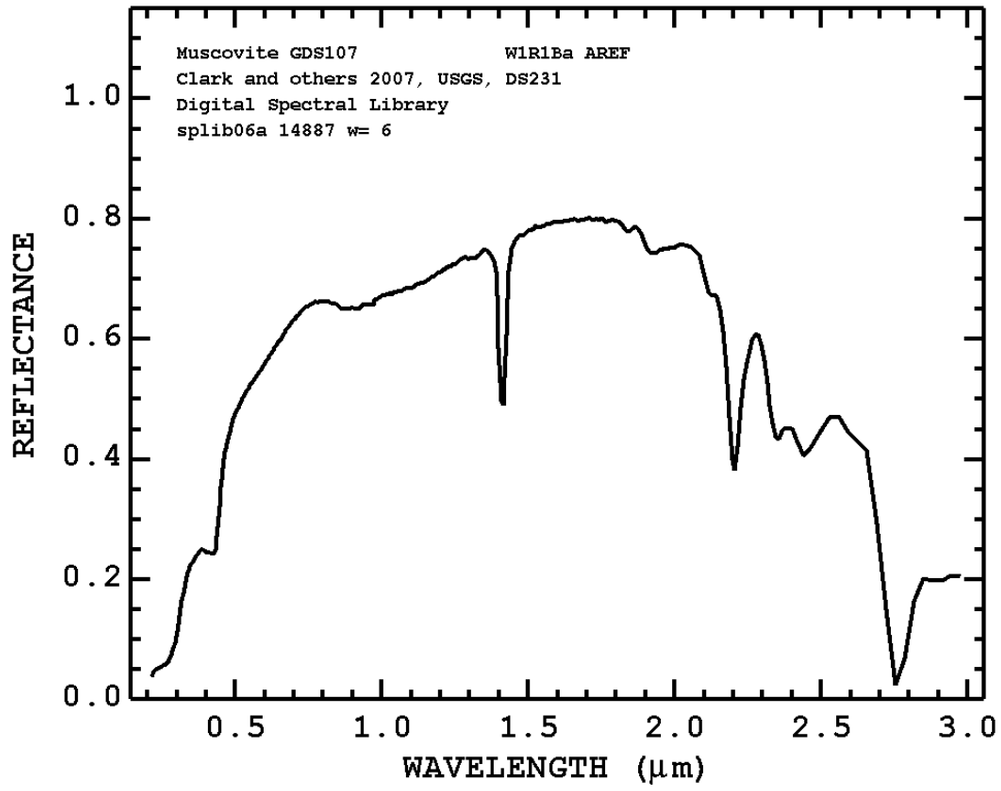
Unmixing

The hyperspectral instruments will detect the reflected solar radiation in a wide range from visible to short wave infrared





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R. N. Clark, G. A. Swayze, R. Wise, K. E. Livo, T. M. Hoefen, R. F. Kokaly, and S. J. Sutley, 2007, USGS Digital Spectral Library splib06a, U.S. Geological Survey, Data Series 231.

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Problem

The spatial pixel sizes for hyperspectral sensors are large enough that several substances can contribute to the spectrum measured from a single pixel.

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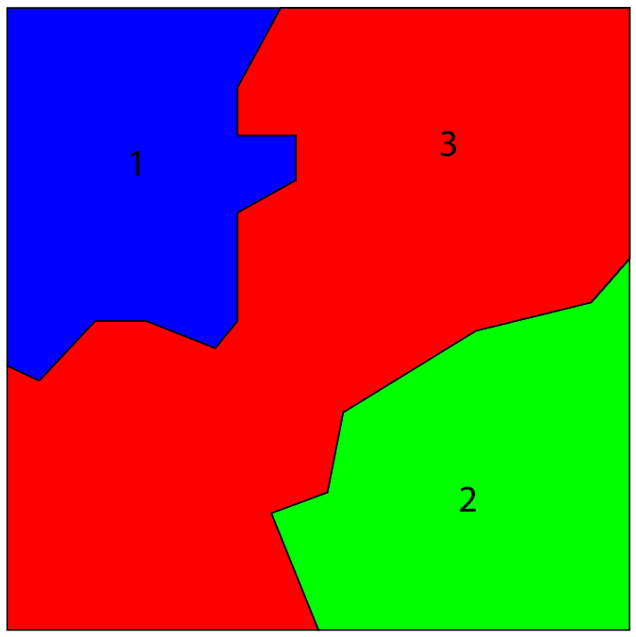
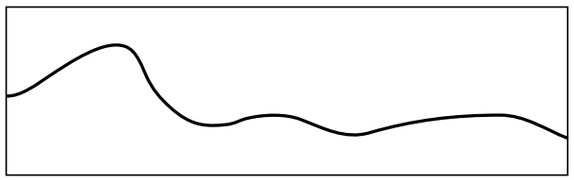
Unmixing

material abundance in pixel area



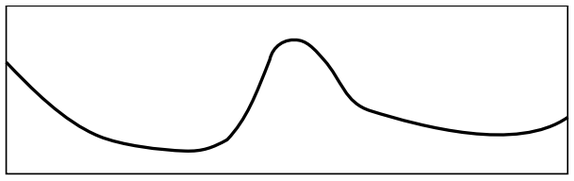
spectrum of material 1 to 3

s_1



*

s_2

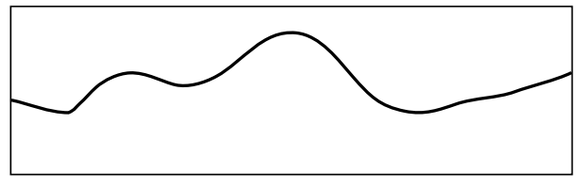


s_3

=

observed spectrum in pixel i

x_i



$x = 25\% s_1 + 35\% s_2 + 40\% s_3$

modified from ENVI Tutorial

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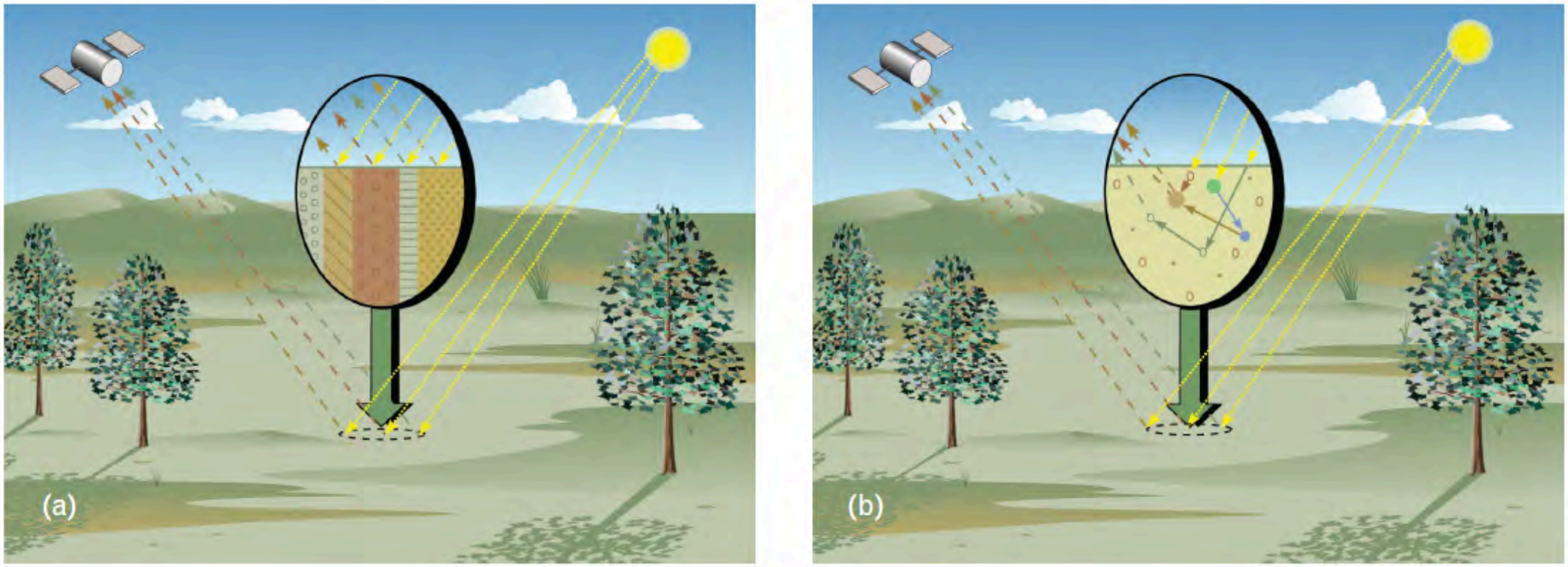
Unmixing

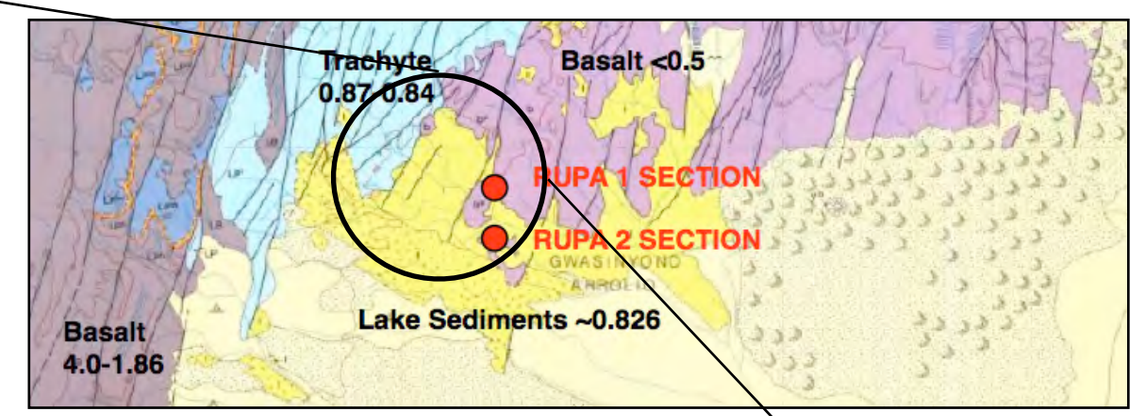
linear mixture

nonlinear mixture



Keshava, 2003

Unmixing



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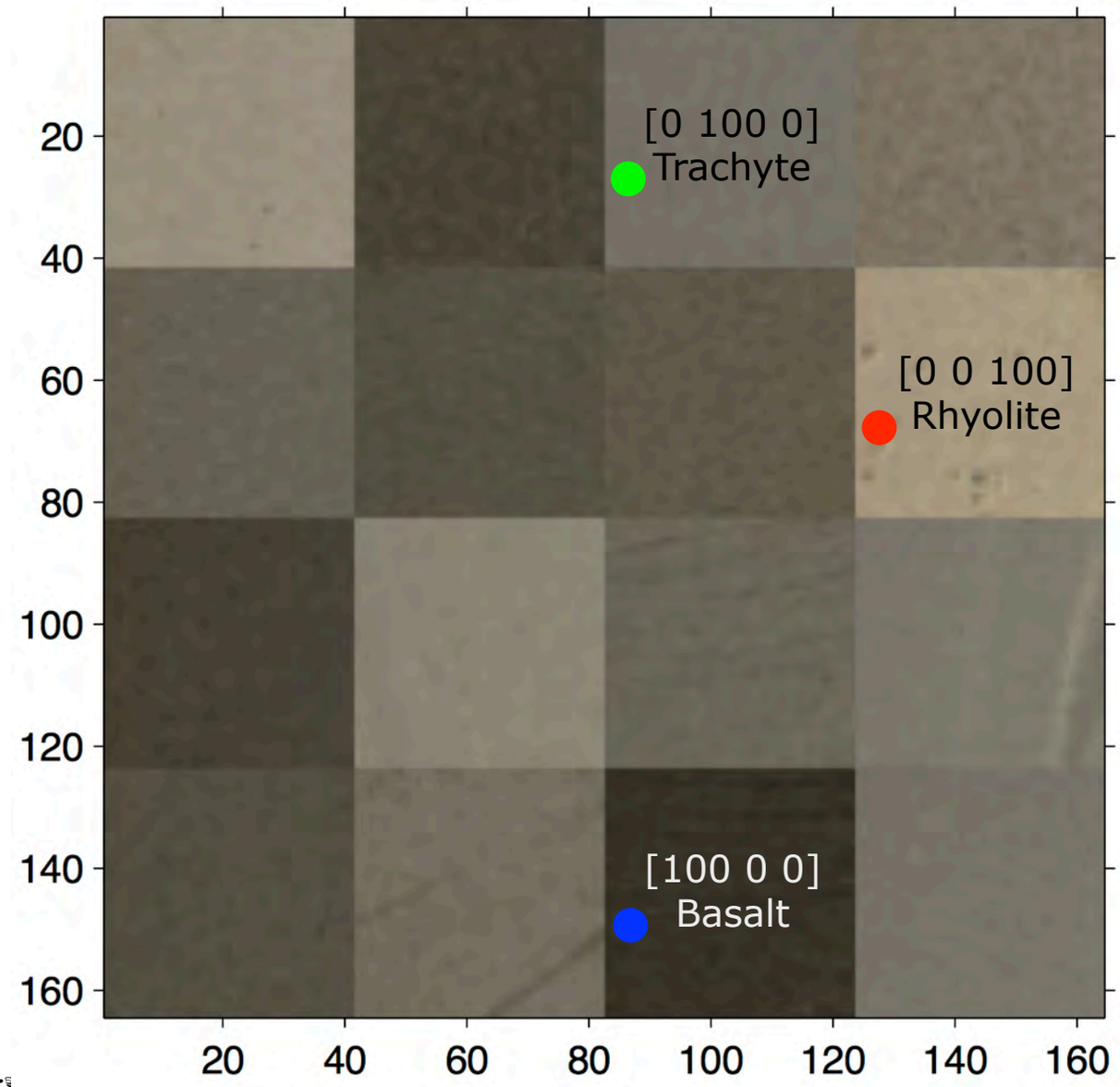
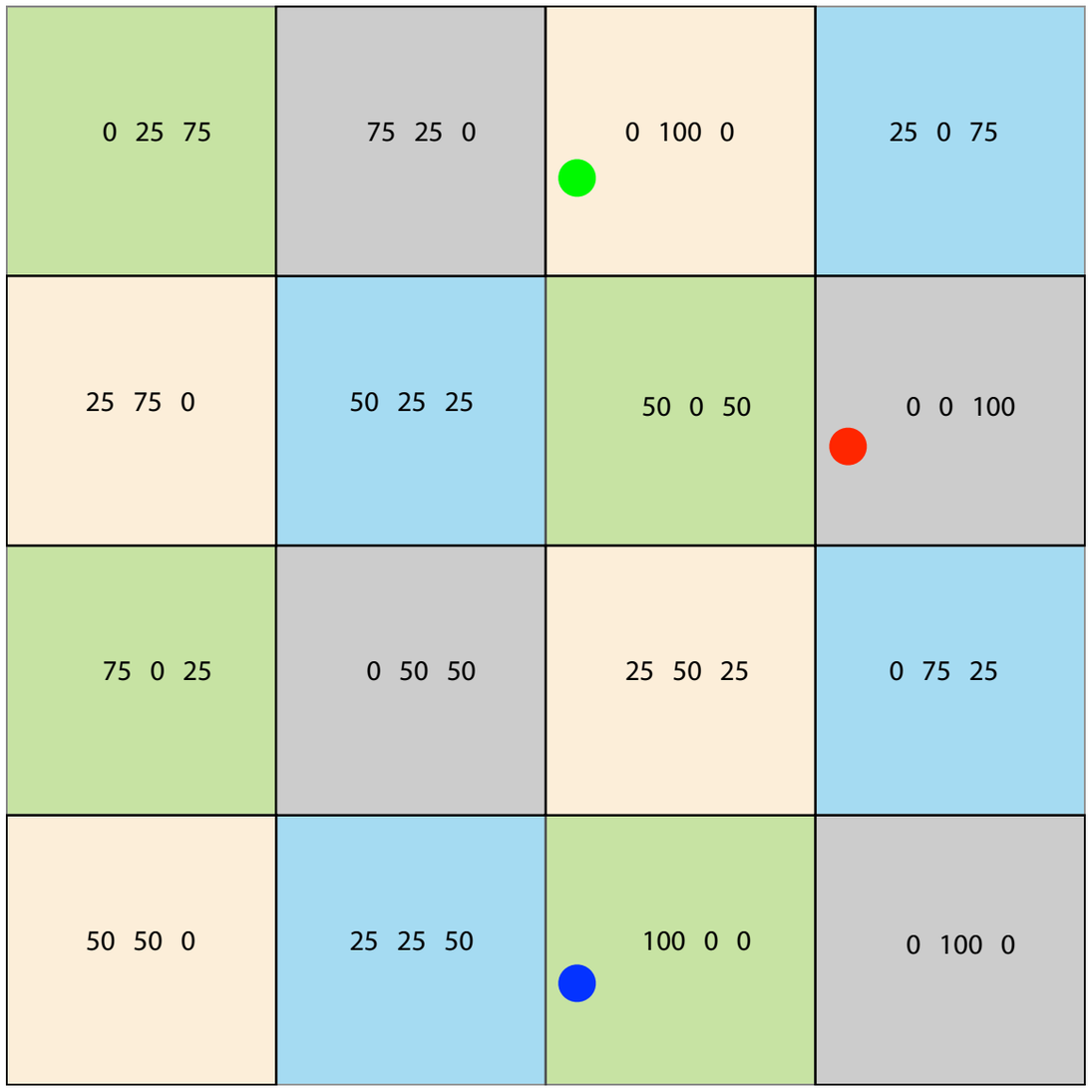
Unmixing

Volume Percentage of Basalt, Trachyte and Rhyolite [Basalt Trachyte Rhyolite]





Ebert & Borchardt, in prep.

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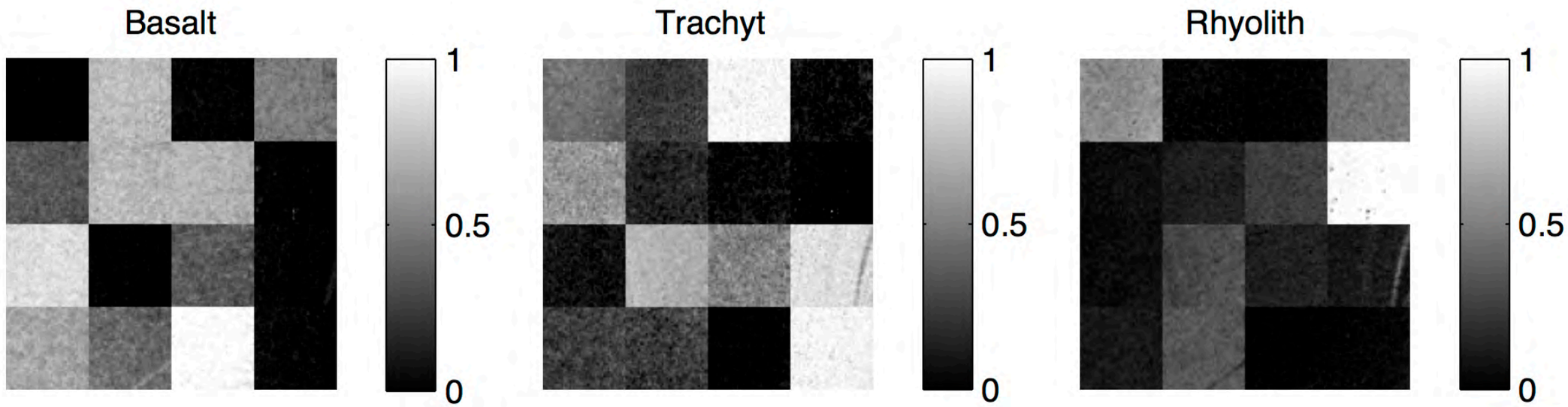
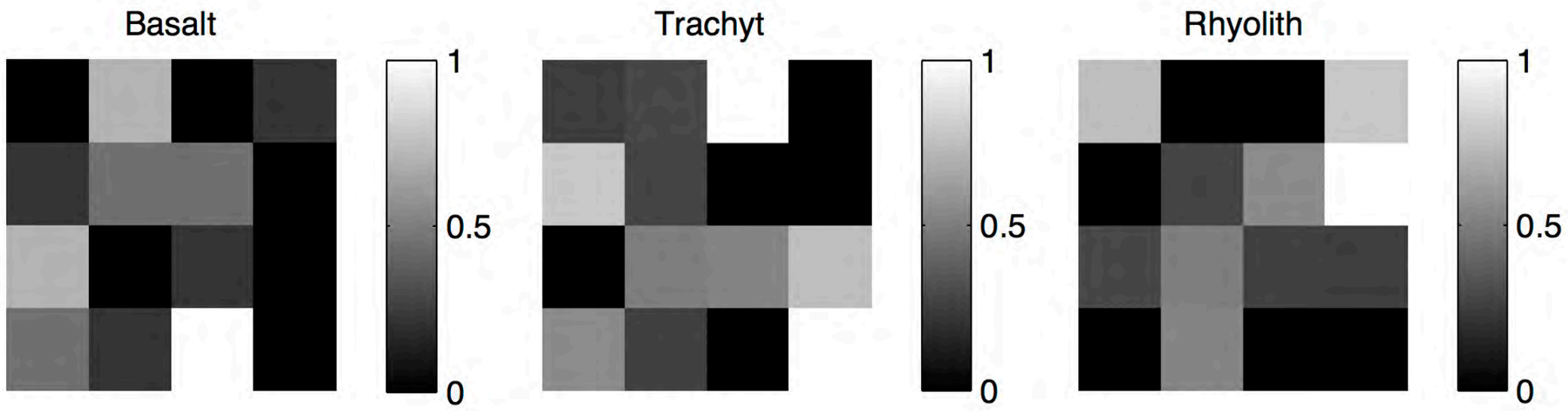
Unmixing

Real data



Synthetic data



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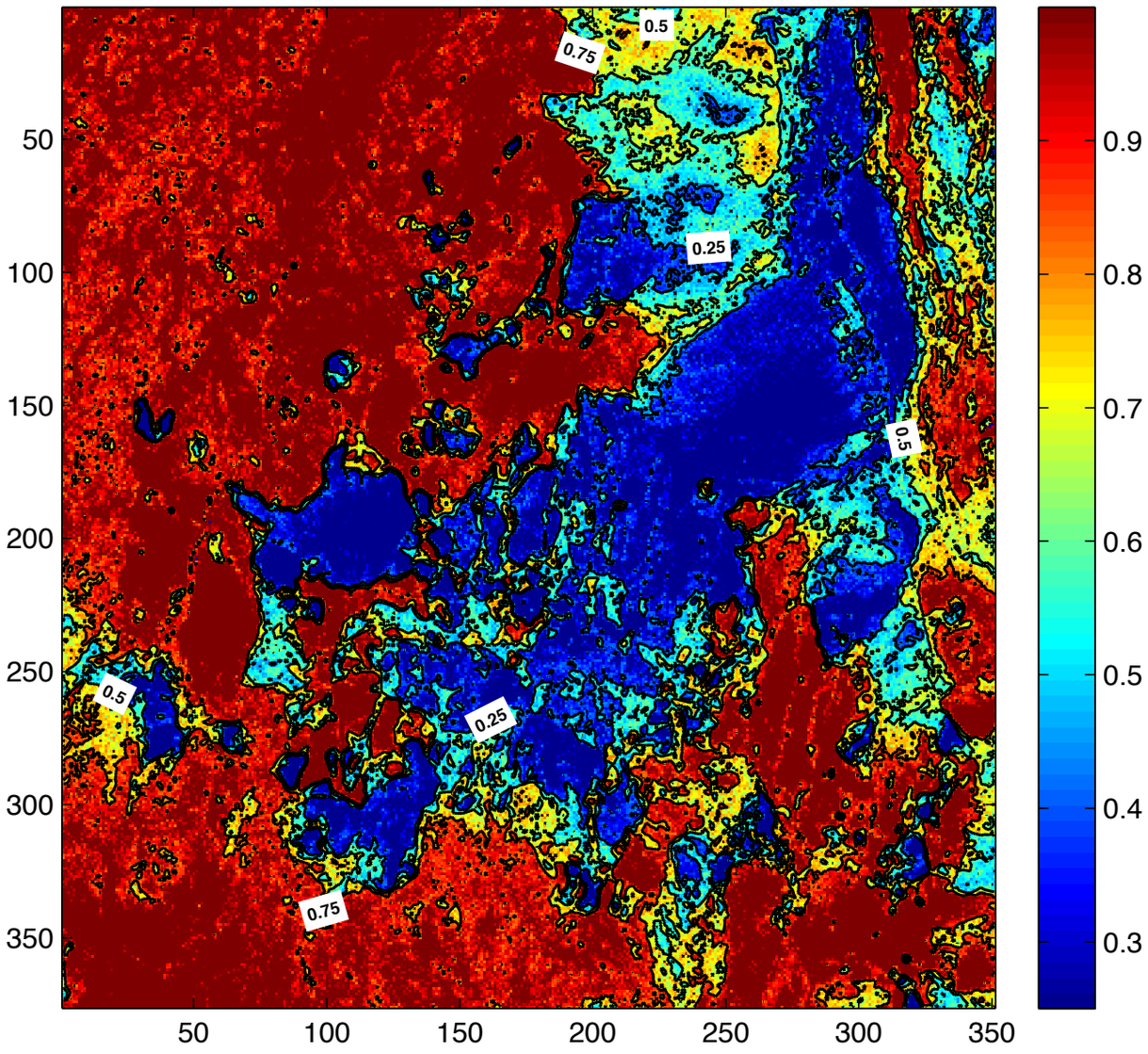
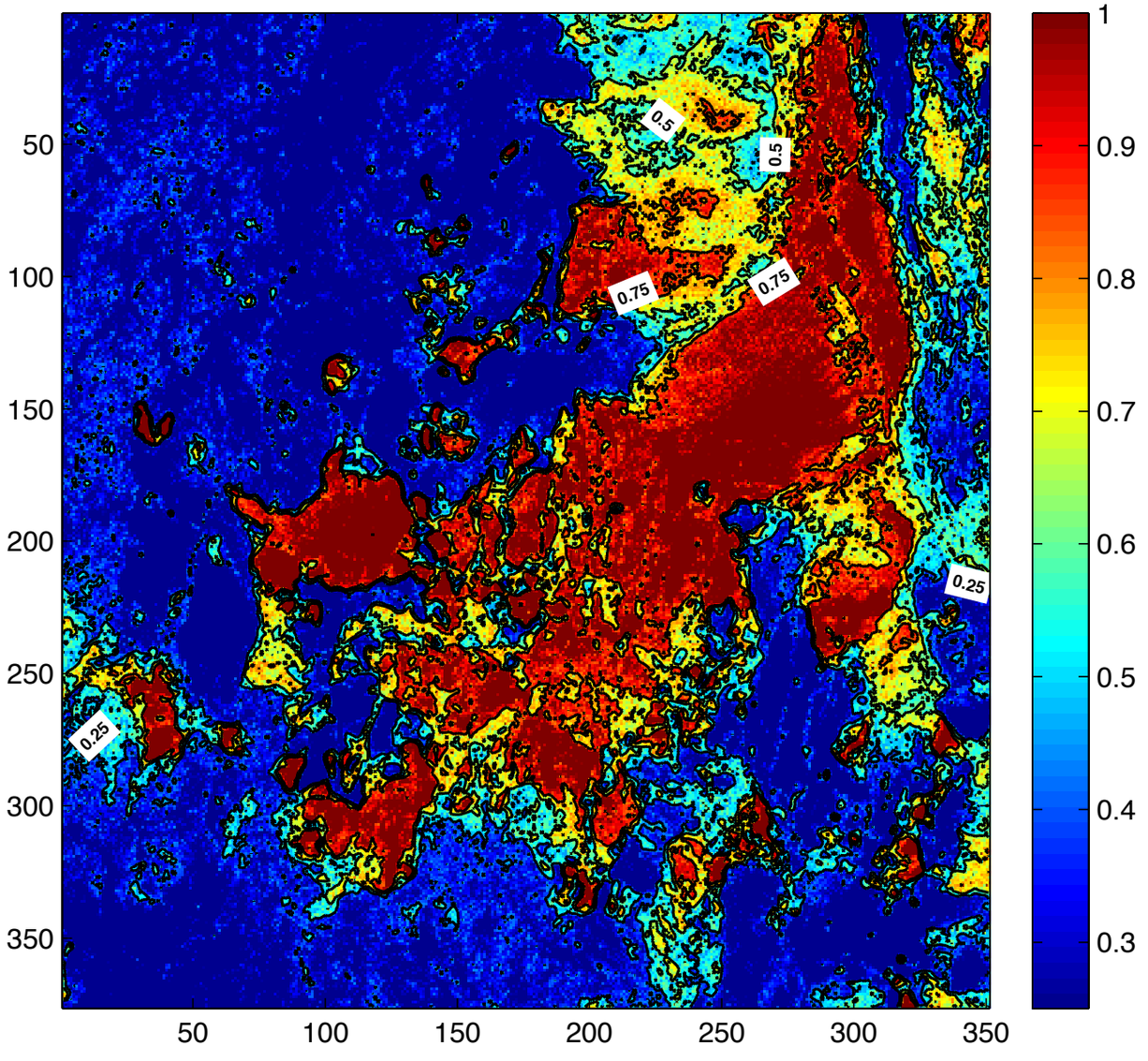
Unmixing

Basalt



Trachyte & Rhyolite



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Decades

~ 200 a

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Weathering

~ 6 Ma

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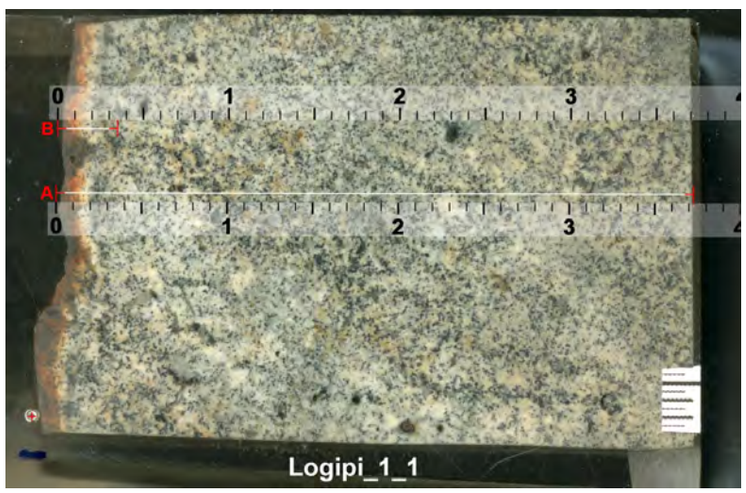

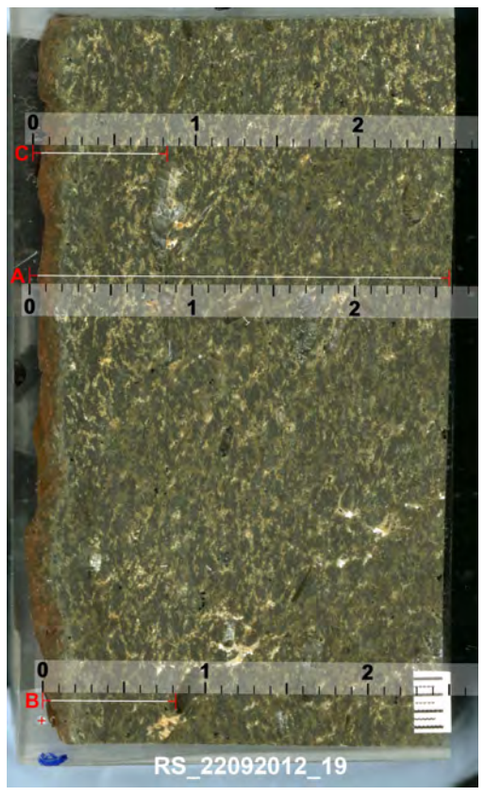

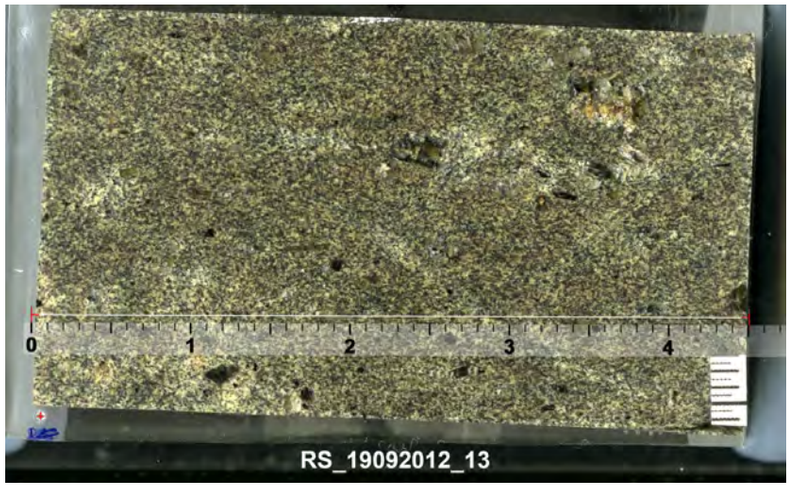

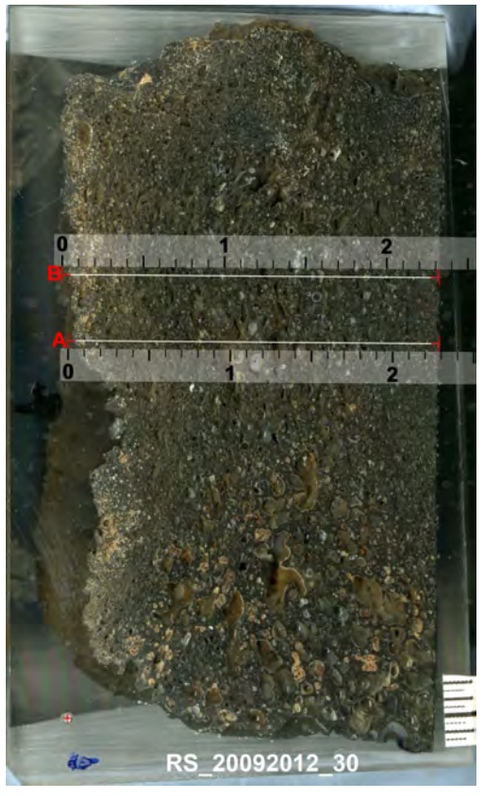

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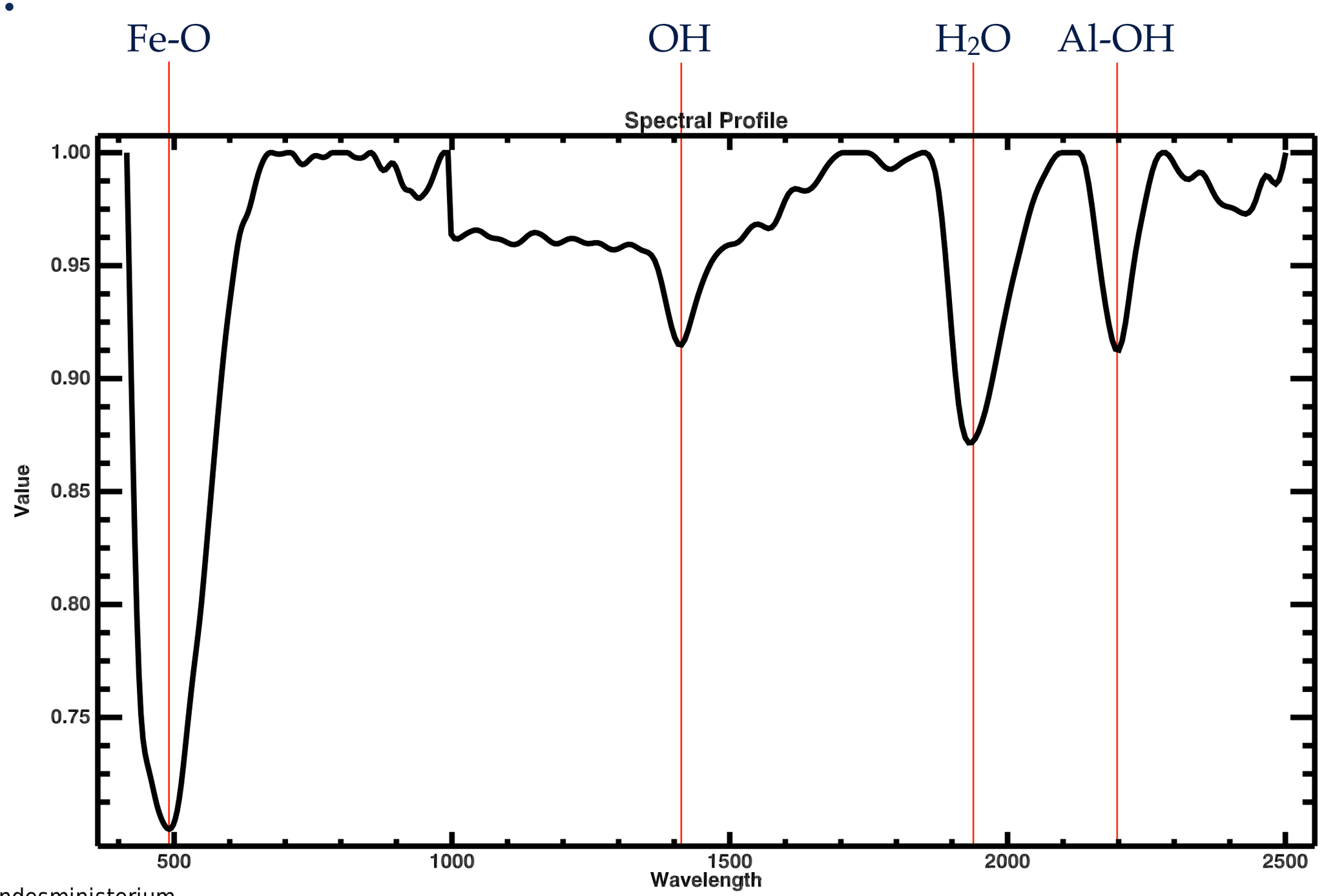

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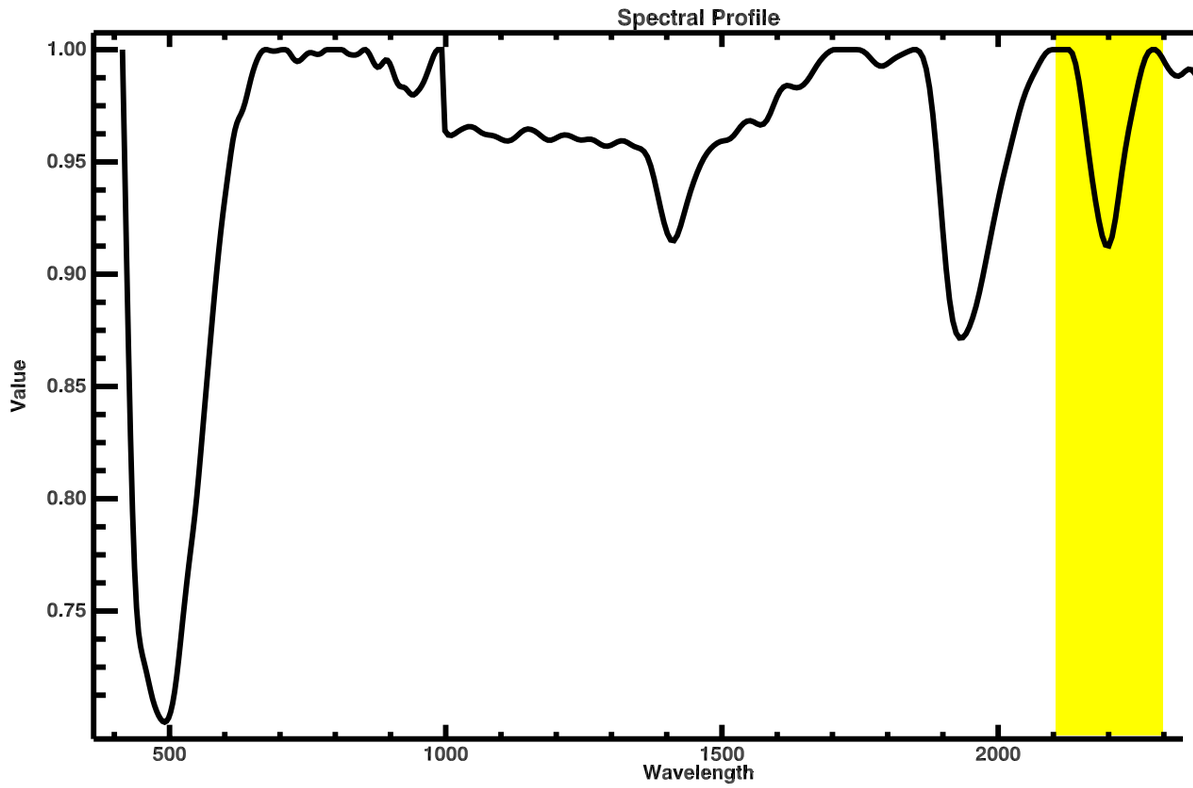

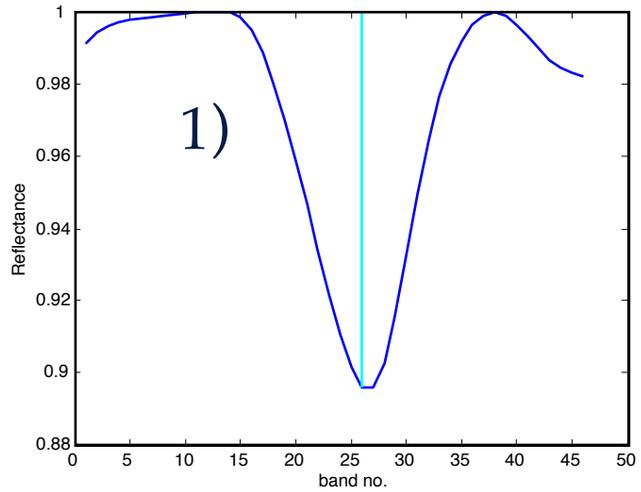

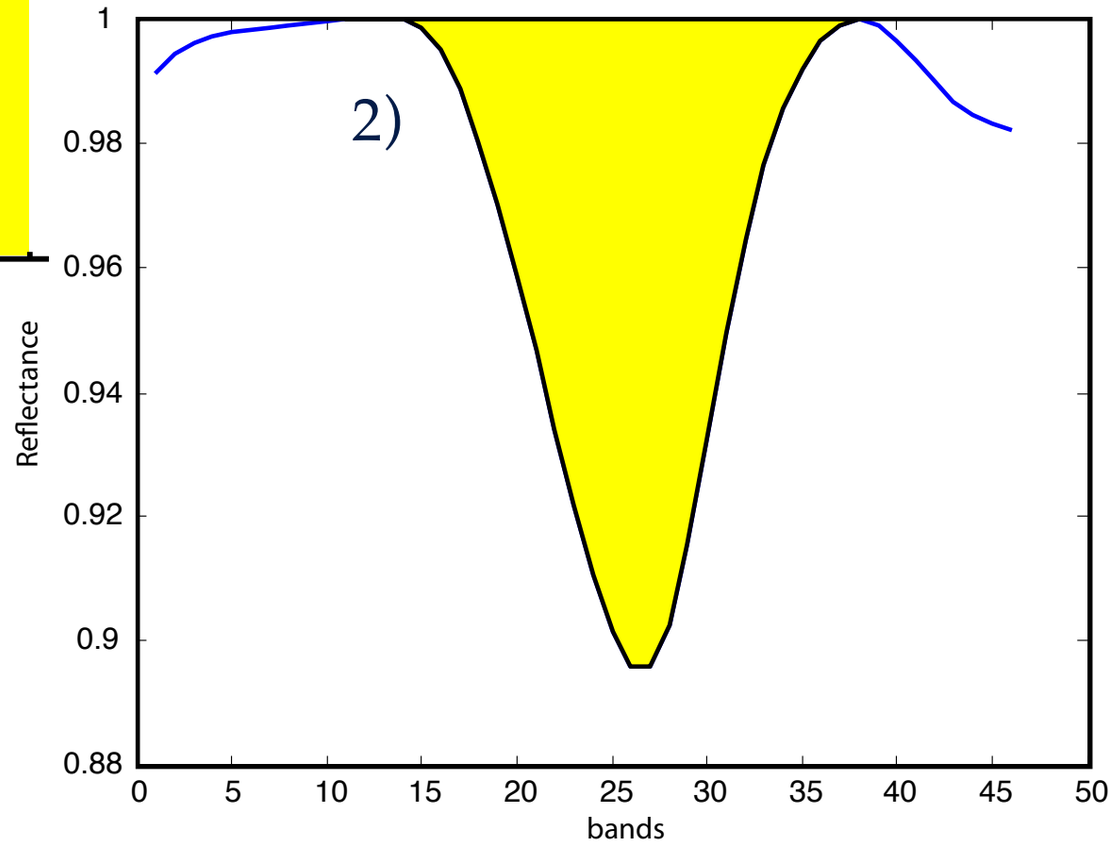

1) „feature depth“

2) „feature area“

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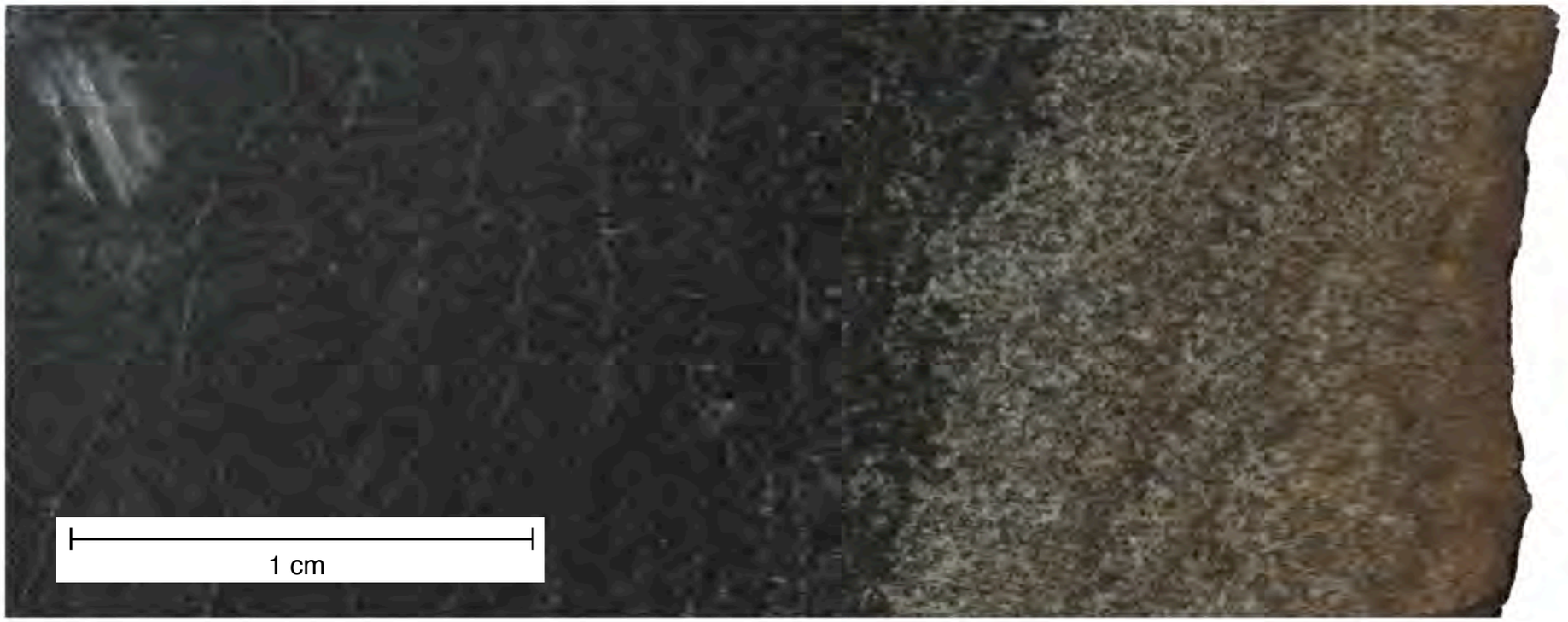
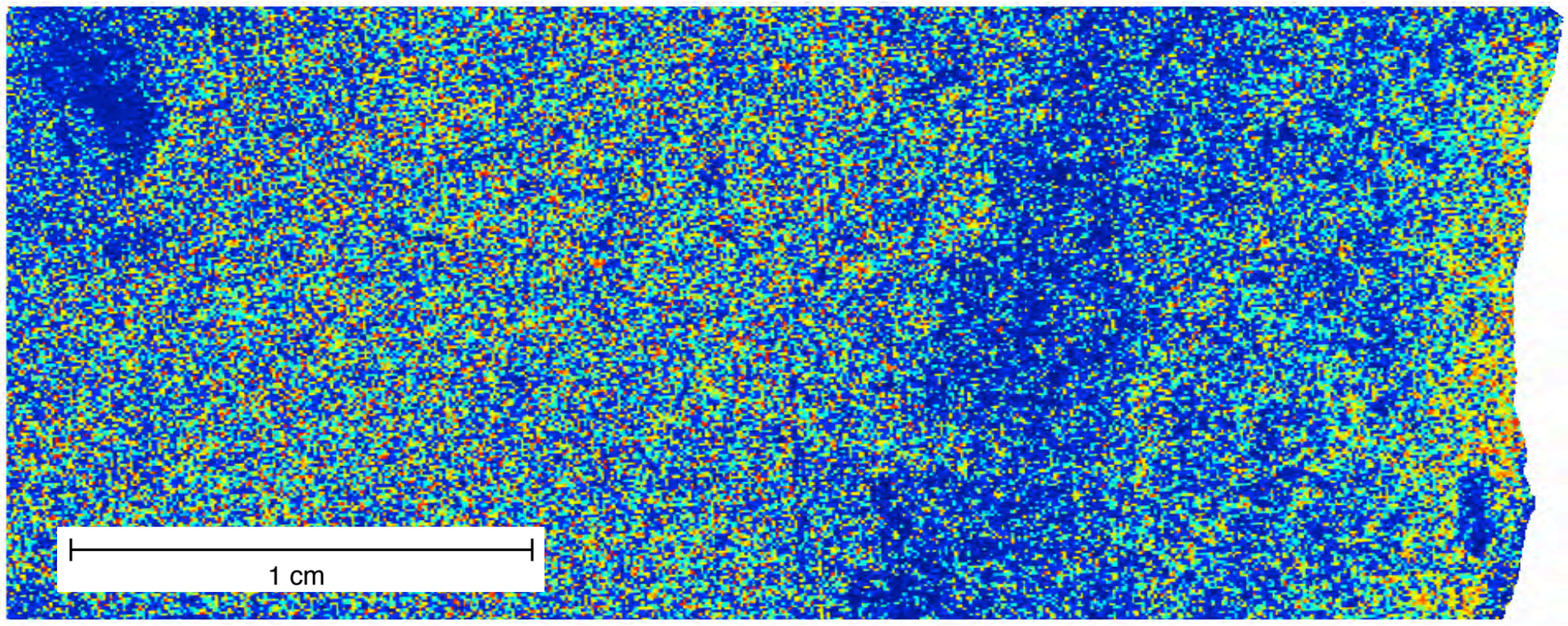
Weathering

RGB



Fe-O



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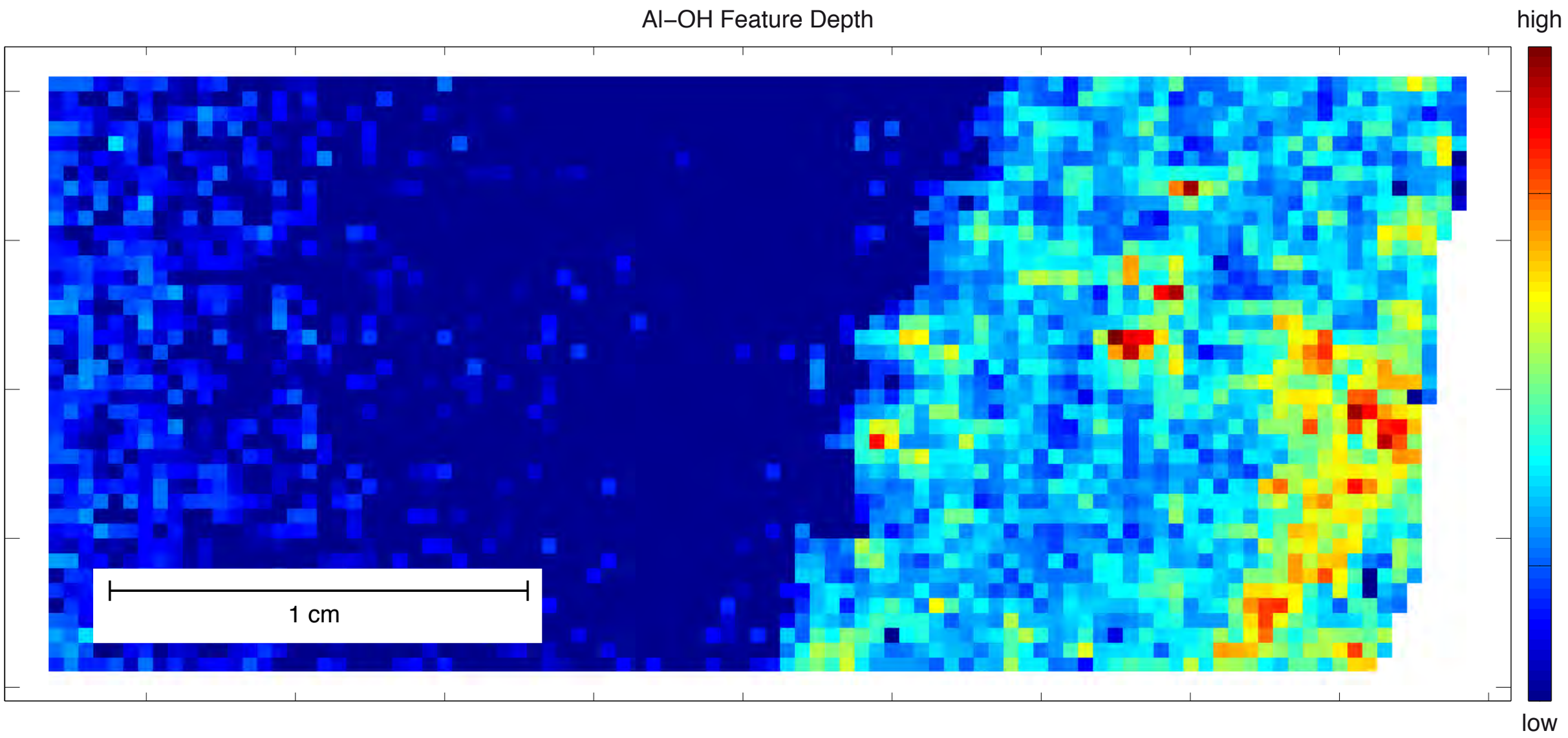
Weathering



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„Sponsored by the Space Agency of the German Aerospace Center with federal funds of the Federal Ministry of Economics and Technology in accordance with the parliamentary resolution of the German Parliament under the funding code 50 EE1012“.

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