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Repository Item #1

Detailed Varnish Microlamination Descriptions

Microscopic Analyses of Ultra-thin Sections
By Tanzhuo Liu, 1995

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Boulder name Sample number	Sample location	Microlamination sequence and varnish thickness	Estimated varnish age (ka)
Victorville			
N. Skyline #1 B	Pedestal mid-face	LU-1: orange layer on top; LU-2: one black layer at bottom (YD). 25 µm	>10.5
N. Skyline #2 UF	Precarious upper face	LU-1: thin orange layer on top; LU-2: three thin black layers (YD and H1); LU-3: thick orange layer; LU-4: one basal black layer (H2). 25 µm.	>21.0
P	Pedestal mid-face	LU-1: thin orange layer on top; LU-2: one thin black layer (YD); LU-3: thick orange layer; LU-4: one basal black layer (H2). 25 µm.	>21.0
Rich II A	Pedestal lower face	LU-1: very thin orange layer on top; LU-2: at least two thin black layers (YD and H1); LU-3: thick orange layer; LU-4: one thick basal black layer (H2). Oldest varnish sample from exposure. 25 µm.	>21.0
B	Pedestal mid-face	LU-1: orange layer on top; LU-2: one black layer in the middle (YD) with a basal orange layer. 15 µm	>10.5 <14.5
D	Precarious lower face	LU-1: orange layer on top; LU-2: one basal black layer (YD). 25 µm.	>10.5 <14.5
R^3 A	Rock face adjoining pedestal	LU-1: orange layer on top; LU-2: weak black layer (YD). 10 µm.	>10.5
B	Precarious lower face	LU-1: orange layer on top; LU-2: one black layer (YD) in middle with a basal orange layer. 8 µm.	>10.5 <14.5

C	Precarious upper face	LU-1: orange layer on top; LU-2: one black layer near base is probably YD. 40 µm.	>10.5
D	Pediment tors adjoining precarious rock.	LU-1: orange layer on top; multiple lower orange and black layers have been leached; no diagnostic black layers are identifiable but multiple black layers may correspond to LU-4. Oldest varnish collected at Victorville. 100 µm.	<70
TL-1 A	Precarious mid-face	*LU-1: orange layer on top;* LU-2: several thin black layers (YD and H1); LU-3 basal orange layer. 13 µm.	*>14.5 <21.0*
B	Precarious lower face	LU-1: orange layer on top; LU-2: one basal black layer (YD). 25 µm.	>10.5
C	Pedestal lower face	LU-1: orange layer on top; LU-2: one basal black layer (YD). 25 µm.	>10.5
TL-2 B	Pedestal upper face	LU-1: orange layer on top; LU-2 one black layer (YD) in middle over basal orange layer. 13 µm.	>10.5 <14.5
C	Precarious mid-face	LU-1: orange layer on top; LU-2: weak basal black layer is probably YD. 16 µm.	>10.5
JB-2 P	Pedestal upper face	LU-1: thick orange layer on top; LU-2: one black layer (YD) in middle with basal orange layer. 13 µm.	>10.5 <14.5
Jacumba Steve Day 2 A	Precarious lower face	LU-1: orange layer on top; LU-2: weak black layer in middle is probably YD over basal orange layer. 16 µm.	>10.5
D	Precarious mid-face	Partial sequence with LU-1 orange layer over several black layers that are probably H2 from LU-4; YD and H1 are missing. 40 µm.	possibly >21.0

E	Pedestal upper face	LU-1: thick orange layer on top; LU-2: two basal black layers correspond to YD and H1. 32 µm.	>14.5
F	Pedestal lower face	LU-1: single orange layer; no black layers. 8 µm.	<10.5
Steve Day 3			
A	Pedestal upper face	LU-1: orange layer on top; LU-2: one basal black layer is probably YD. 40 µm.	>10.5
B	Pedestal mid-face	LU-1 orange layer on top; LU-2: one basal black layer is probably YD. 30 µm.	>10.5
C	Pedestal upper face	LU-1: thick orange layer on top; LU-2: one basal black layer is YD. 50 µm.	>10.5
D	Pedestal upper face	LU-1: orange layer on top; LU-2: one basal black layer corresponds to YD. 15 µm.	>10.5
Yucca Mountain			
Pillow			
YM-TL-1A	Pedestal upper face	LU-1: orange layer on top; LU-2: one black layer (YD) partially leached with basal orange layer. 13 µm.	>10.5
YM-TL-1C	Precarious upper face	LU-1: thin orange layer on top; LU-2: two black layers (YD and H1) separated by one orange layer; LU-3: thick orange layer; LU-4: one basal black layer (H2). 52 µm.	>21.0
Cliff			
YM-TL-2A	Pedestal upper face	LU-1: thick orange layer on top; LU-2: two basal black layers (YD and H1). 52 µm.	>14.5
Redeye			
YM-TL-3A	Pedestal mid-face	LU-1: thin orange layer on top; LU-2: missing; LU-3: thick orange layer; LU-4: two black layers (H2 and H3); LU-4 basal orange layer younger than H4. 52 µm.	>27.0 <35.0

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Sue YM-TL-4A	Pedestal upper face	LU-1: orange layer on top; LU-2: basal black layer is YD. 13 μm.	>10.5
Whitney YM-TL-5B	Precarious mid-face	LU-1: orange layer on top; LU-2 one black layer (YD) in middle with basal orange layer. 25 μm.	>10.5 <14.5
Len YM-TL-6A	Rock wall behind precarious column.	LU-1: orange layer on top; LU-2: one black layer (YD) in middle with basal orange layer. 20 μm.	>10.5 <14.5
Tripod YM-TL-7B	Pedestal upper face	LU-1: orange layer on top; LU-2 one basal black layer is YD. 40 μm.	>10.5
Doozey YM-TL-8B	Pedestal upper face	LU-1: orange layer on top; LU-2 one basal black layer is YD. 25 μm.	>10.5
Honeycomb YM-TL-9A	Pedestal upper face	LU-1: orange layer on top; LU-2 one basal black layer is YD. 25 μm.	>10.5
Colluvial boulder YM-TL-10	Boulder face	LU-1: orange layer on top; LU-2: black layer is H1 and YD layer is missing; LU-3: orange layer; LU-4 basal black layer is H2. 75 μm.	>21.0

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Repository Item #2

Results of ^{36}Cl Analyses,
Scaling Factors for Elevation and Topographic Shielding,
and Rock Chemistries

Sample	R^3 V95-5	Split Rock V95-16	Skyline #2 V95-17	Rich II V95-1	Steve Day #2 J95-11	Campo C95-14	Banning B95-8
Elevation of sample site (m.a.s.l.)	930	853	811	951	853	829	1341
Latitude (degrees N)	34.5825	34.5528	34.5489	34.5555	32.6611	32.6278	33.8519
Longitude (degrees E)	242.6844	242.716	242.7149	242.7289	243.7944	243.5583	243.1715
Elevation & latitude (dimensionless)	1.87	1.762	1.706	1.899	1.699	1.667	2.5
$^{36}Cl/Cl$ (1E-15)	700	1660	2220	1250	1220	270	292
Bulk rock density (g/cm^3)	2.65	2.65	2.65	2.65	2.65	2.65	2.65
Sample thickness (cm)	2	4	3	2	2	3	3
Water content (dimensionless)	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Topographic shielding factor (dimensionless)	0.95	0.5	0.5	0.5	0.583	0.5	0.5
Na_2O (weight %)	4.15	2.96	3.27	4.05	3.20	4.13	3.627
MgO (weight %)	0.59	0.18	0.22	0.55	0.07	0.61	0.37
Al_2O_3 (weight %)	16.1	11.7	13.4	15.7	11.90	15.1	13.98
SiO_2 (weight %)	67.1	75.9	73.3	69.2	77.40	69.8	72.12
P_2O_5 (weight %)	0.02	0.01	0.02	0.02	0.03	0.01	0.018
K_2O (weight %)	2.56	3.85	4.01	2.38	3.24	1.38	2.903
CaO (weight %)	4.72	2.24	2.77	3.65	1.97	5.17	3.42
TiO_2 (weight %)	0.398	0.125	0.174	0.506	0.04	0.314	0.259
MnO (weight %)	0.02	0.01	0.01	0.03	0.03	0.03	0.022
Fe_2O_3 (weight %)	2.28	1.32	1.43	2.95	0.88	1.93	1.798
Cl (ppm)	13.7	10.8	7.1	13.8	5.90	35	20.7
B (ppm)	3.5	5.5	5.5	4	3.50	6	4.667
Sm (ppm)	2.5	0.5	1	1.5	1.50	2	1.5
Gd (ppm)	2.5	0.5	1	1.5	1.50	2	1.5
U (ppm)	0.5	0.7	1.3	0.5	0.80	0.7	1
Th (ppm)	3.4	2.4	5.7	4.6	3.30	1.8	3
Exposure age (ky) $\varepsilon = 0$ mm/ky	15	57.8	49.2	61	23.6	34	13
Exposure age (ky) $\varepsilon = 5$ mm/ky	15.3	68.9	58.6	71.8	25.3	32.4	13

A conservative estimate of the combined error for the boulder ages is 15-20%. This error includes uncertainties associated with analytical methods (on the order of 5-15%), production rates (about 10% plus possible systematic uncertainty), production rate scaling factors (EL), and effects of topographic shielding (TOPO).