Electronic Supplementary Material (ESI) for Metallomics.

Supplementary Information.

Metallophores associated with *Trichodesmium erythraeum* colonies from the Gulf of Aqaba

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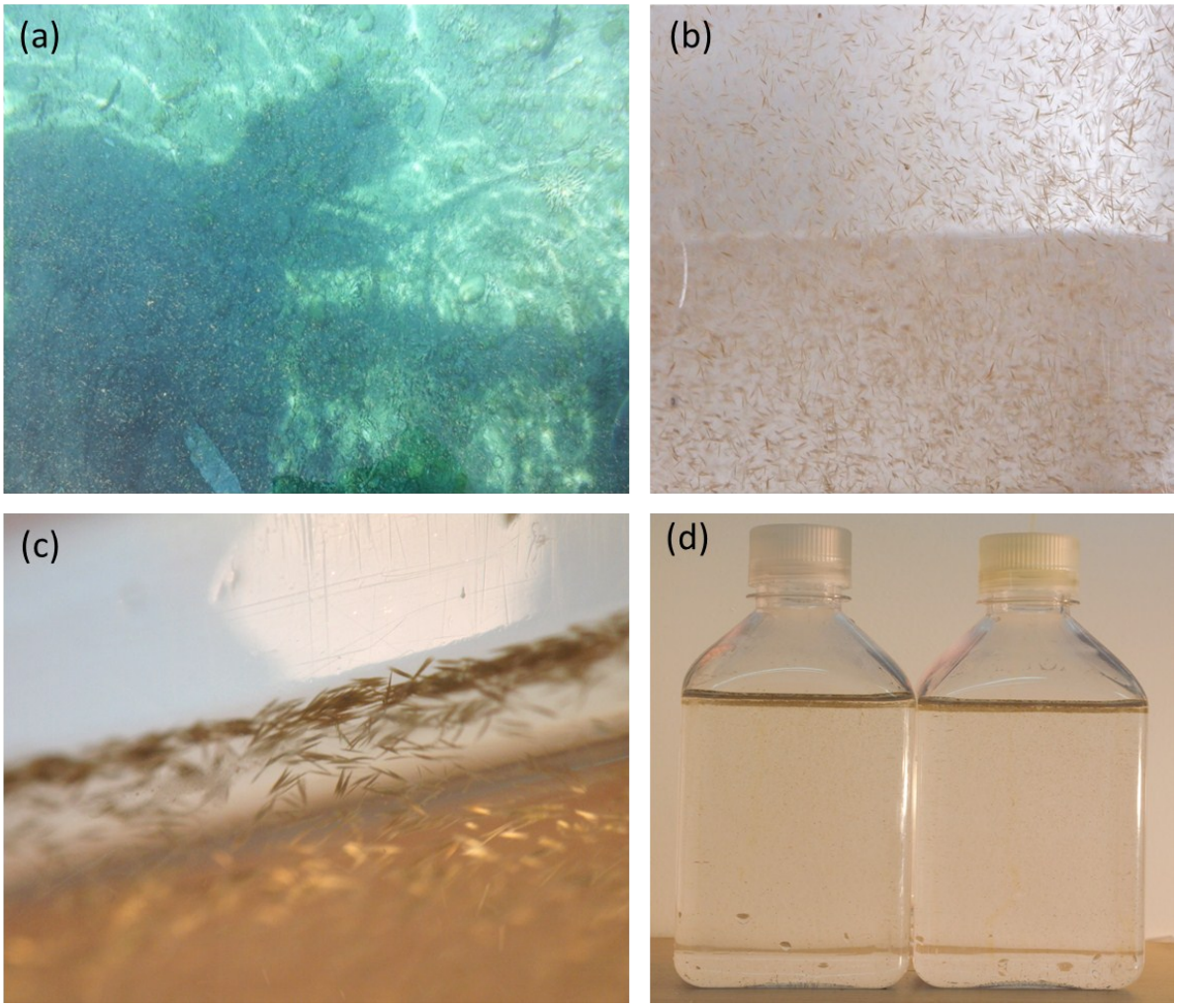
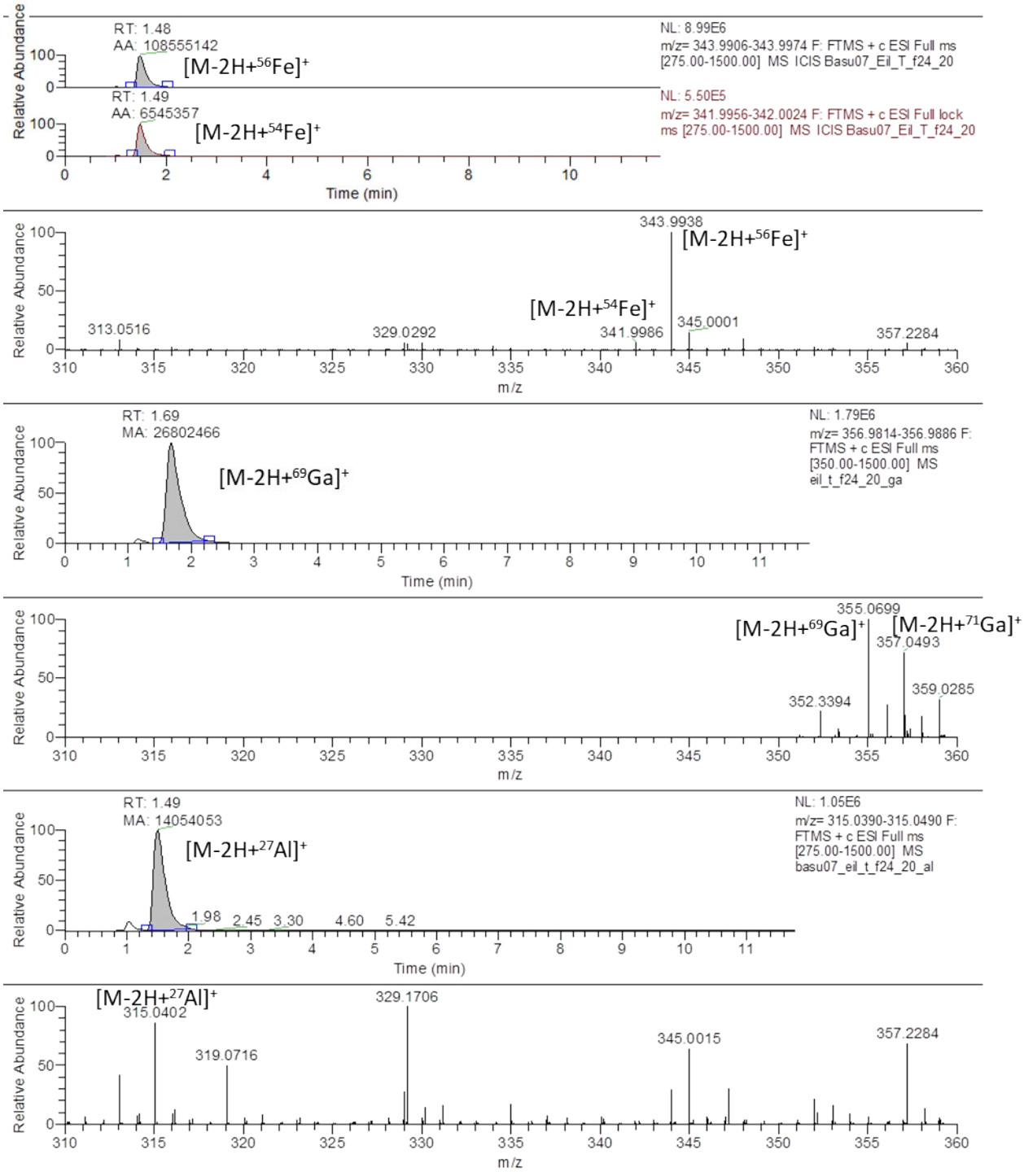


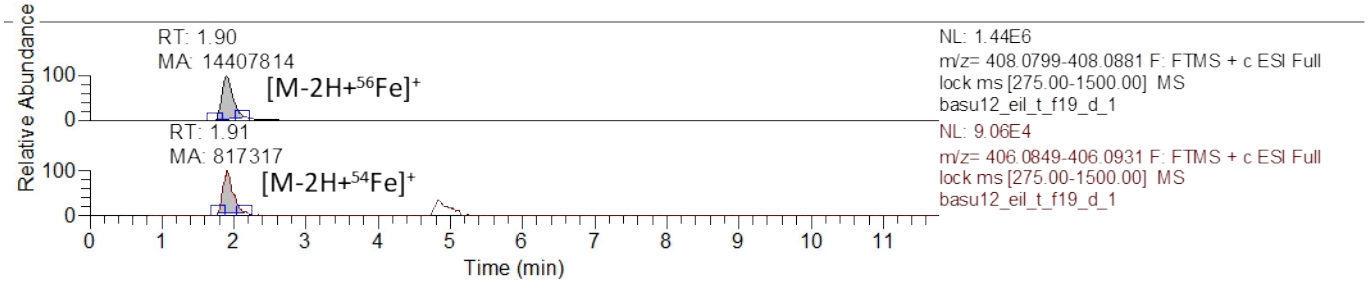
Figure S1. Observation and incubation of *Trichodesmium* bloom. (a) Saw-dust accumulation of *Trichodesmium* colonies at IUI pier, Gulf of Eilat. (b,c) Exclusive occurrence of needle shaped-tuft colonies of *Trichodesmium erythraeum,* and (d) Colonies suspended in FSW for further incubations.

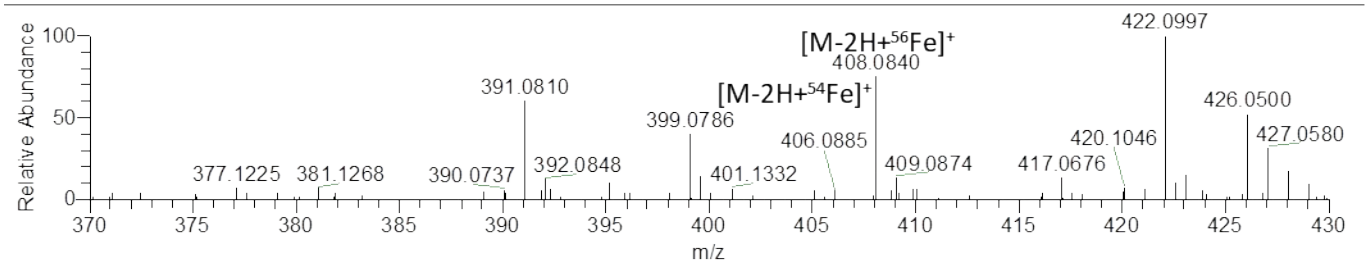
Figure S2. Extracted mass chromatograms and mass spectra for identified metallophores. In each figure the top panel shows chromatograms for a) the peaks for the ^{56}Fe and ^{54}Fe isotopes observed in the +Fe aliquot, b) the mass spectra for the Fe complex, c) the peak for the ^{69}Ga isotope observed in the +Ga aliquot, d) the mass spectra for Ga complex, e) the peak for the ^{27}Al isotope observed in +Al aliquot and f) the mass spectra for the Al complex. Mass spectra are average mass spectra observed ±0.4 minutes of the peak apex.

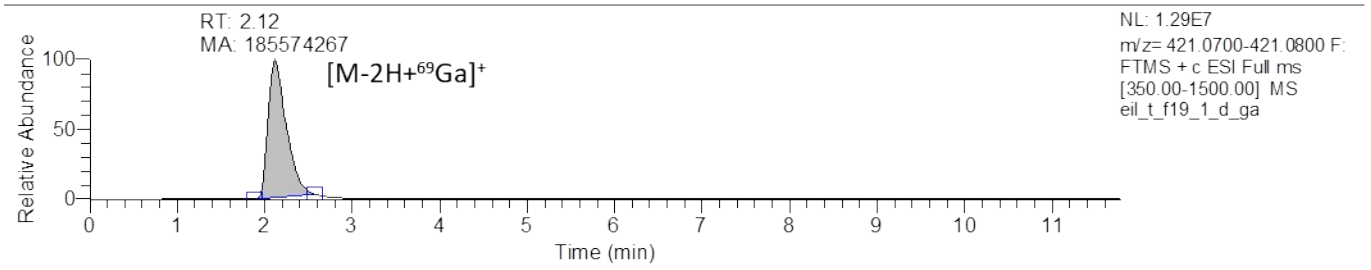
Metallophore m/z $[M-2H+Fe]^+$: 343.994

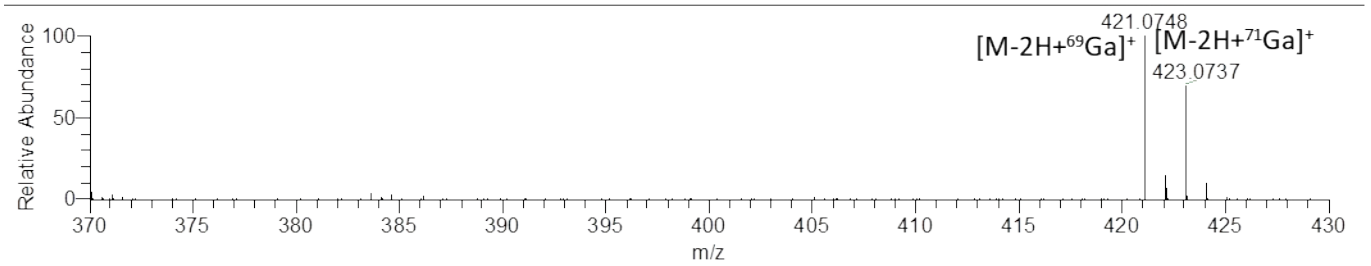


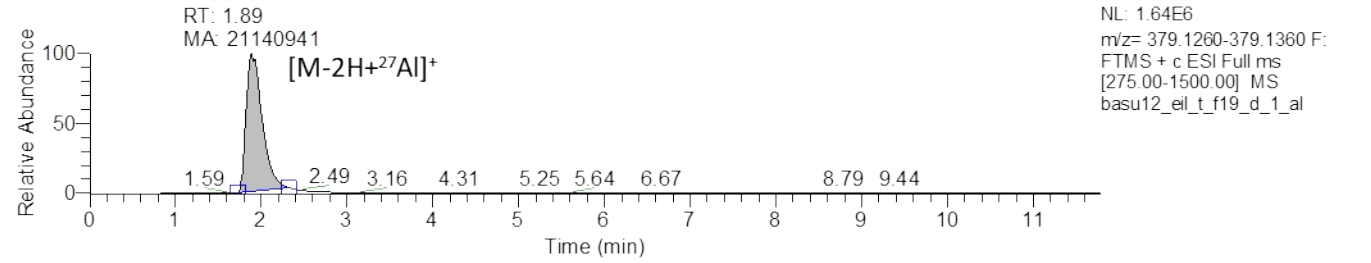
Metallophore m/z [M-2H+Fe]⁺: 408.084

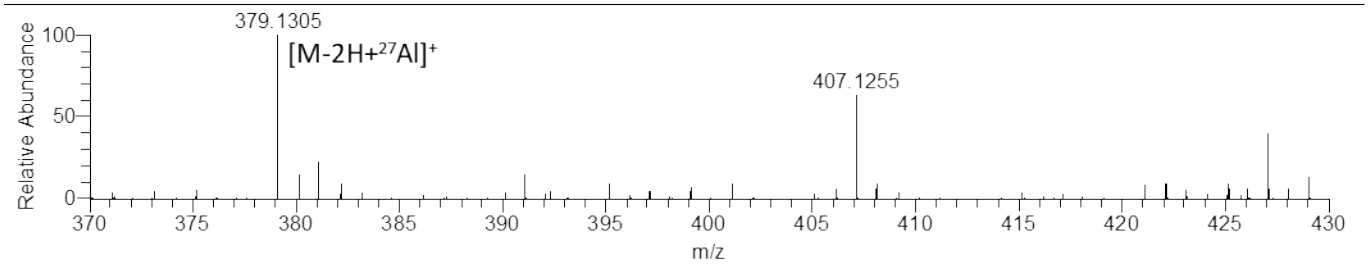




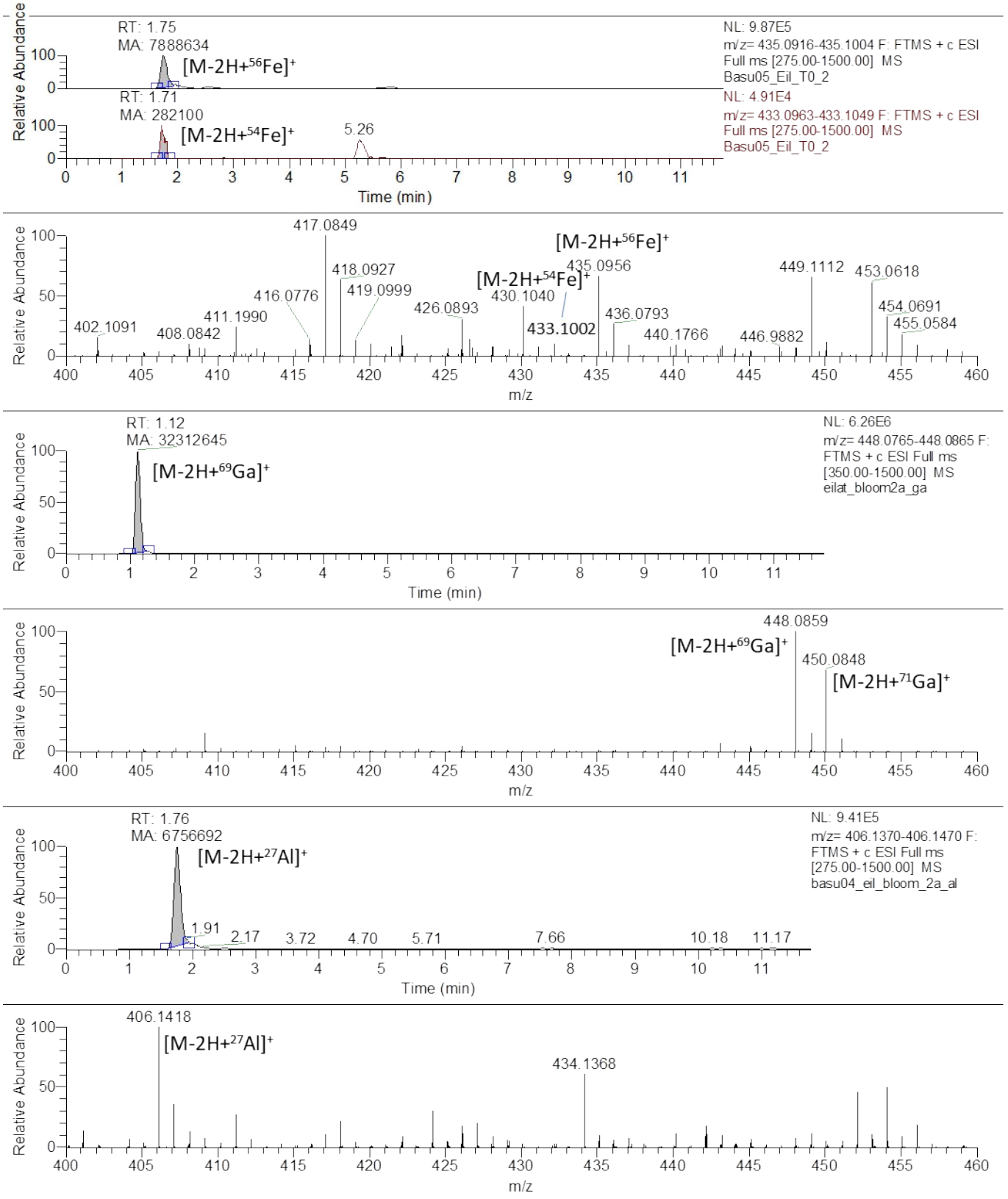




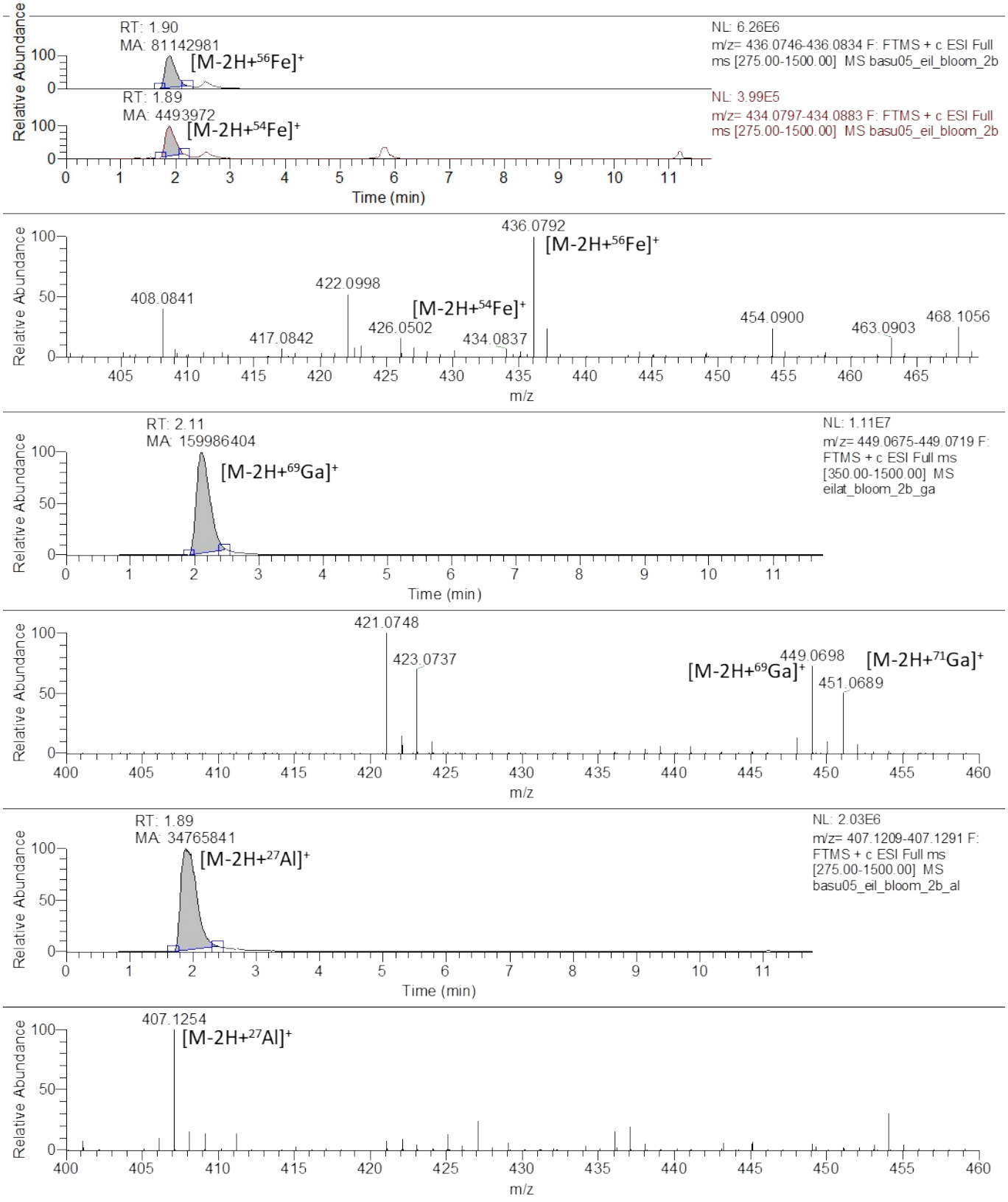




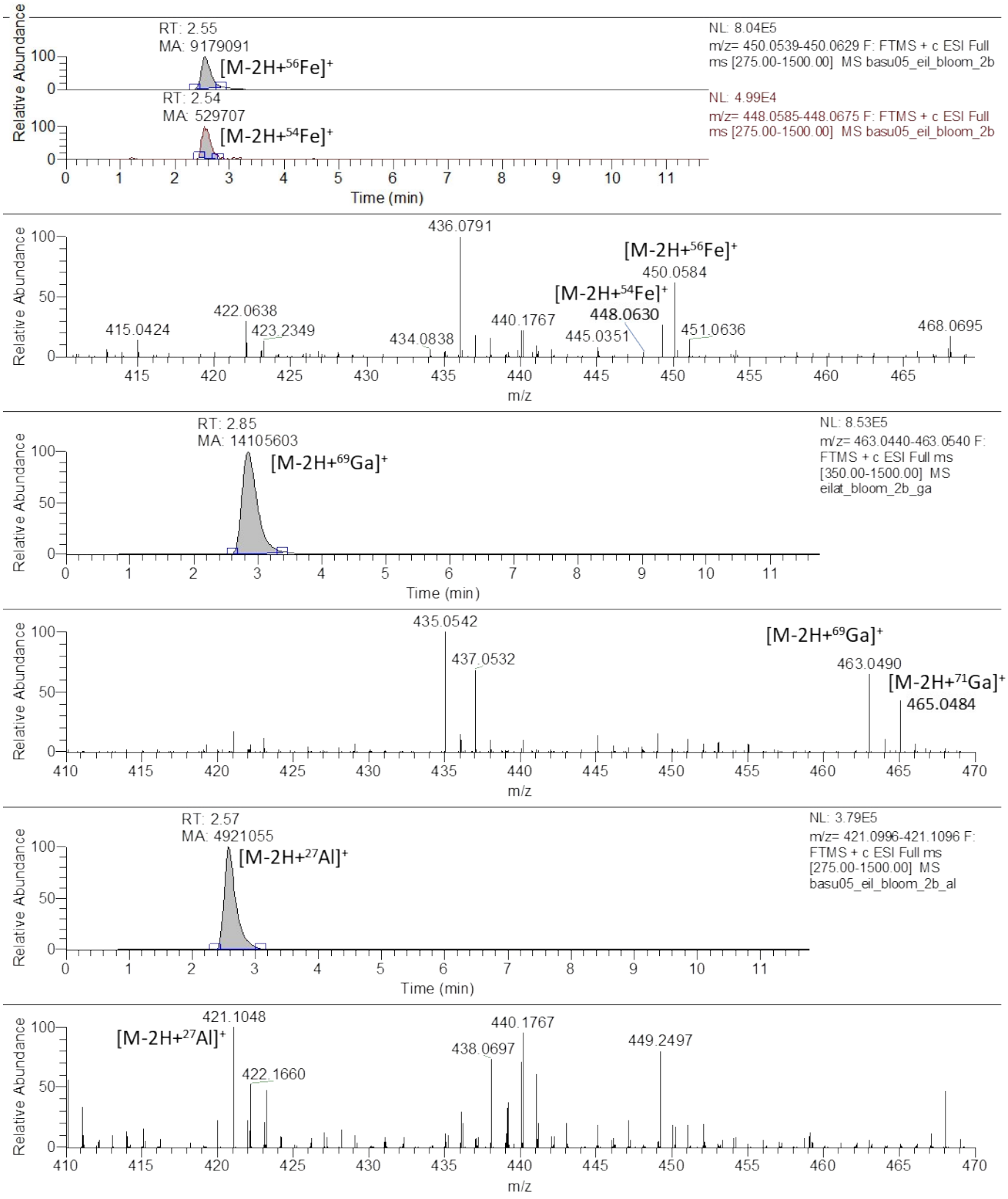
Metallophore m/z [M-2H+Fe]$^{+}$: 435.095



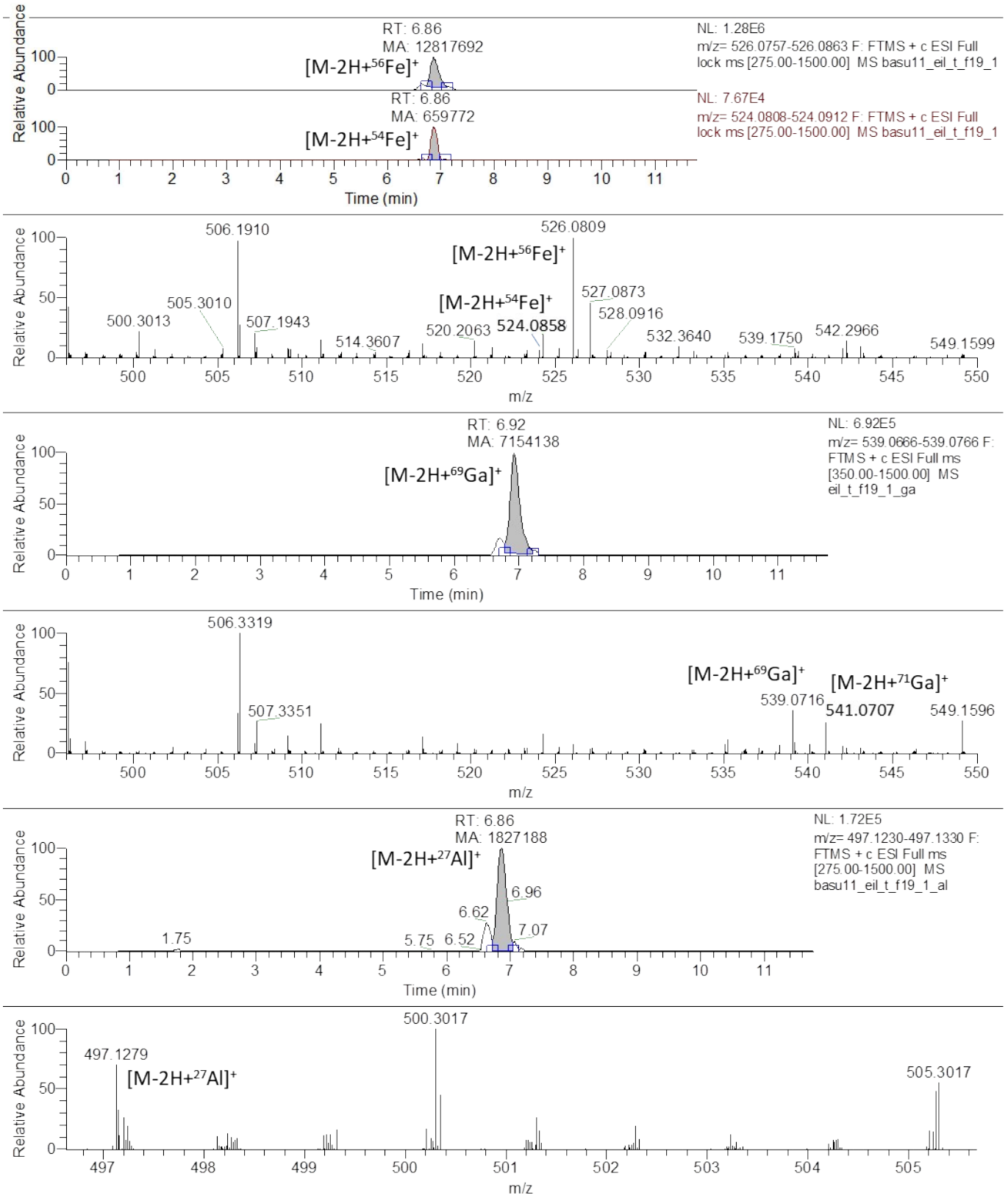
Metallophore m/z $[M-2H+Fe]^+$: 436.079



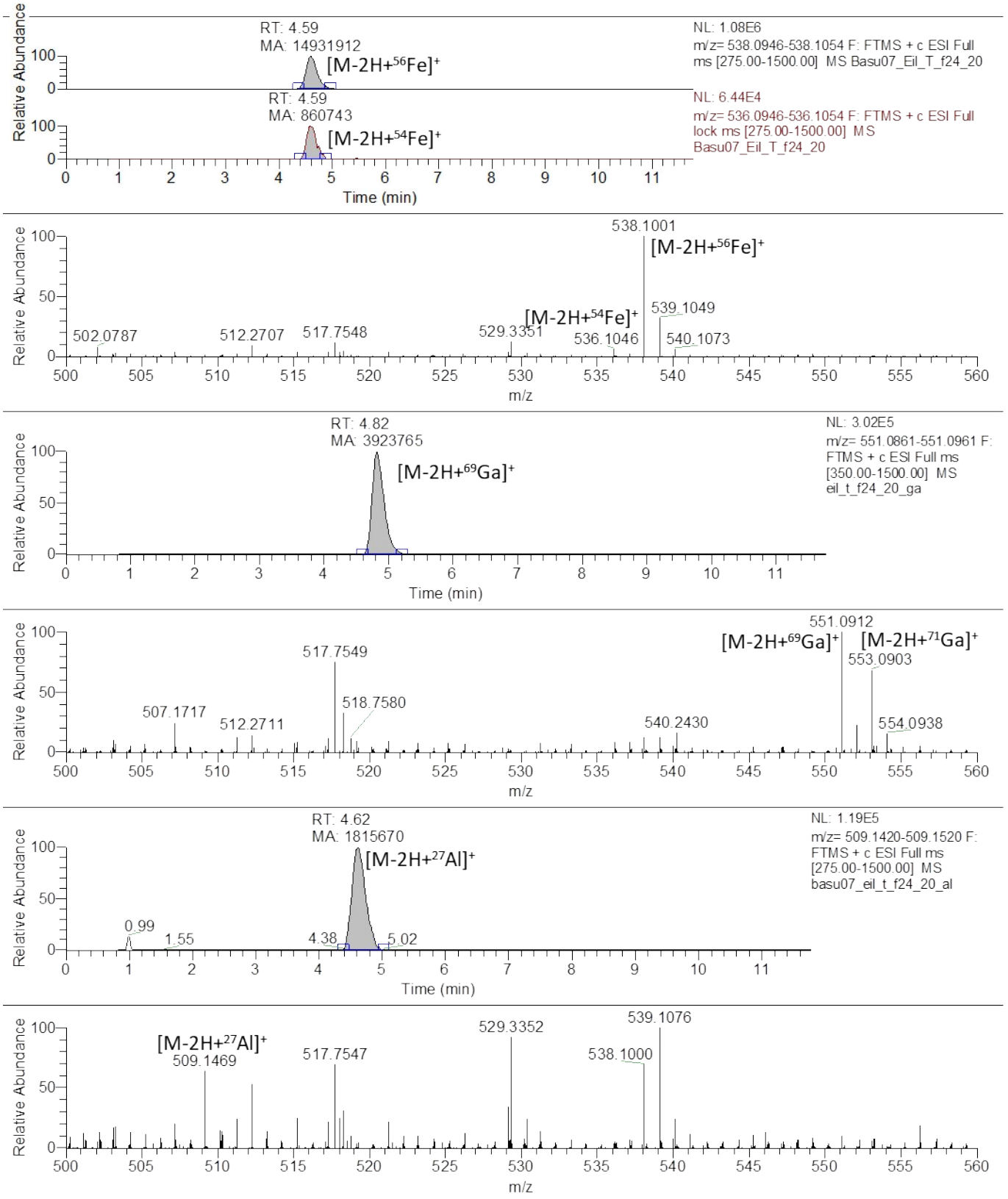
Metallophore m/z $[M-2H+Fe]^+$: 450.058



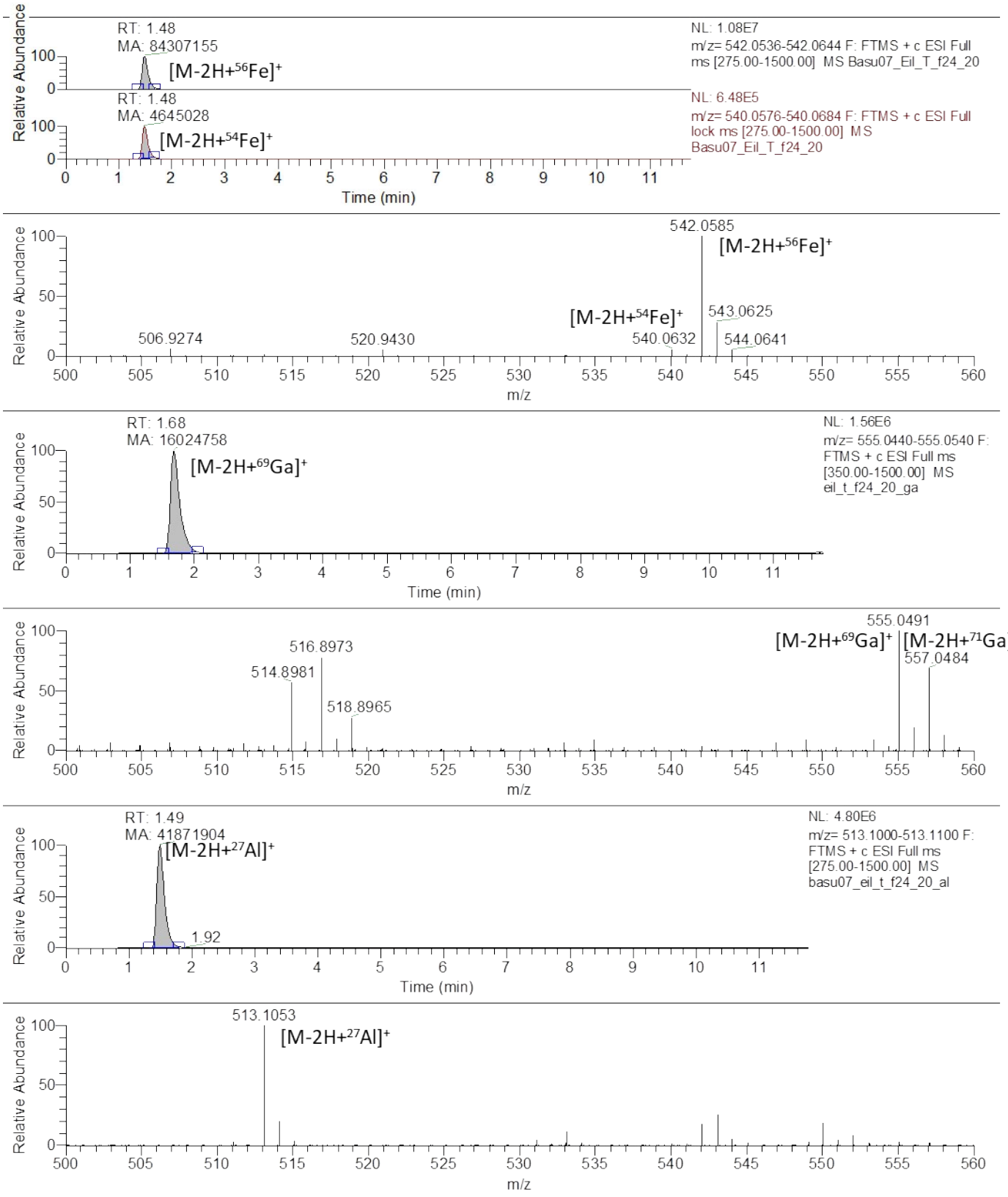
Metallophore m/z $[M-2H+Fe]^+$: 526.081



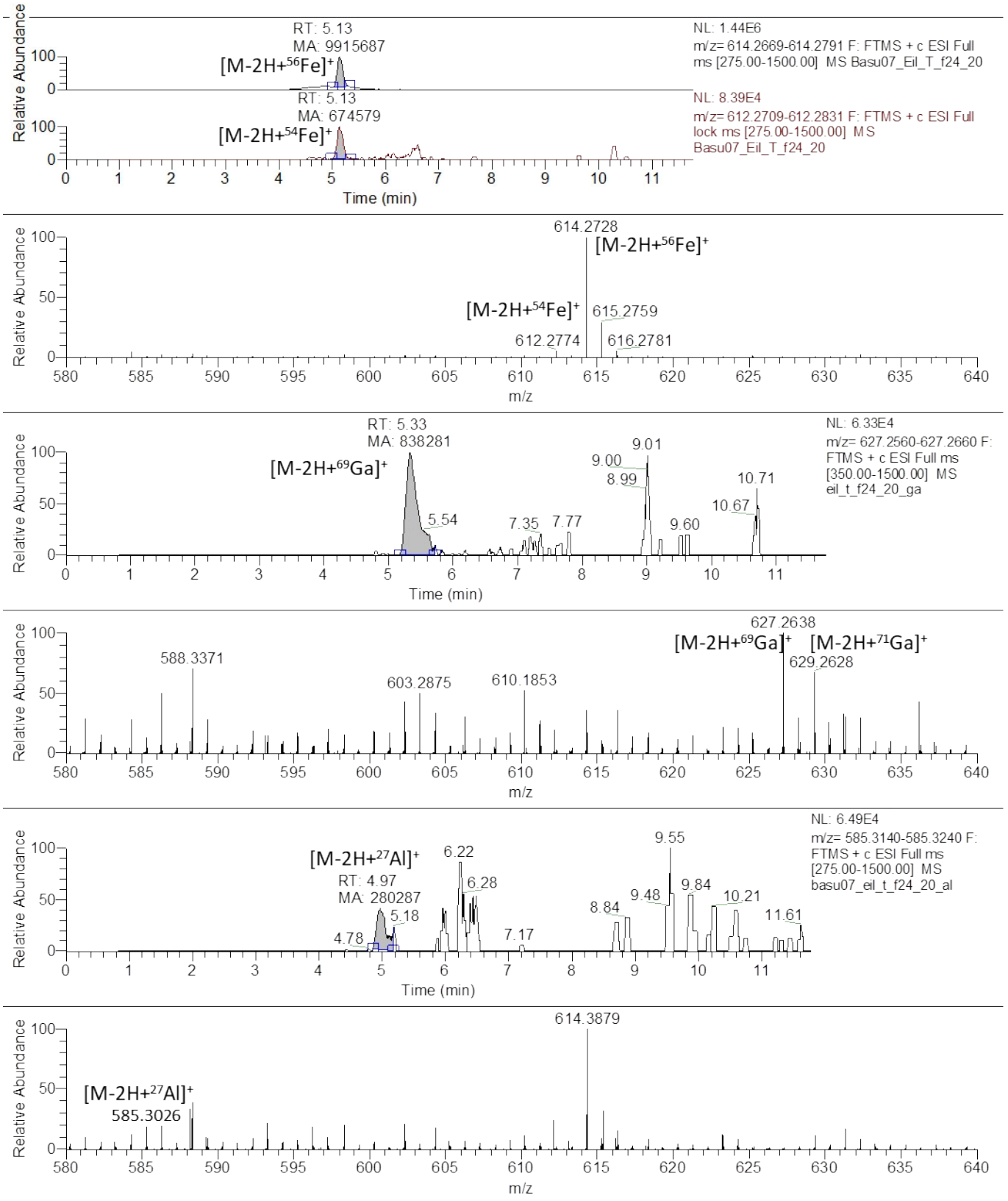
Metallophore m/z [M-2H+Fe]$^{+}$: 538.100



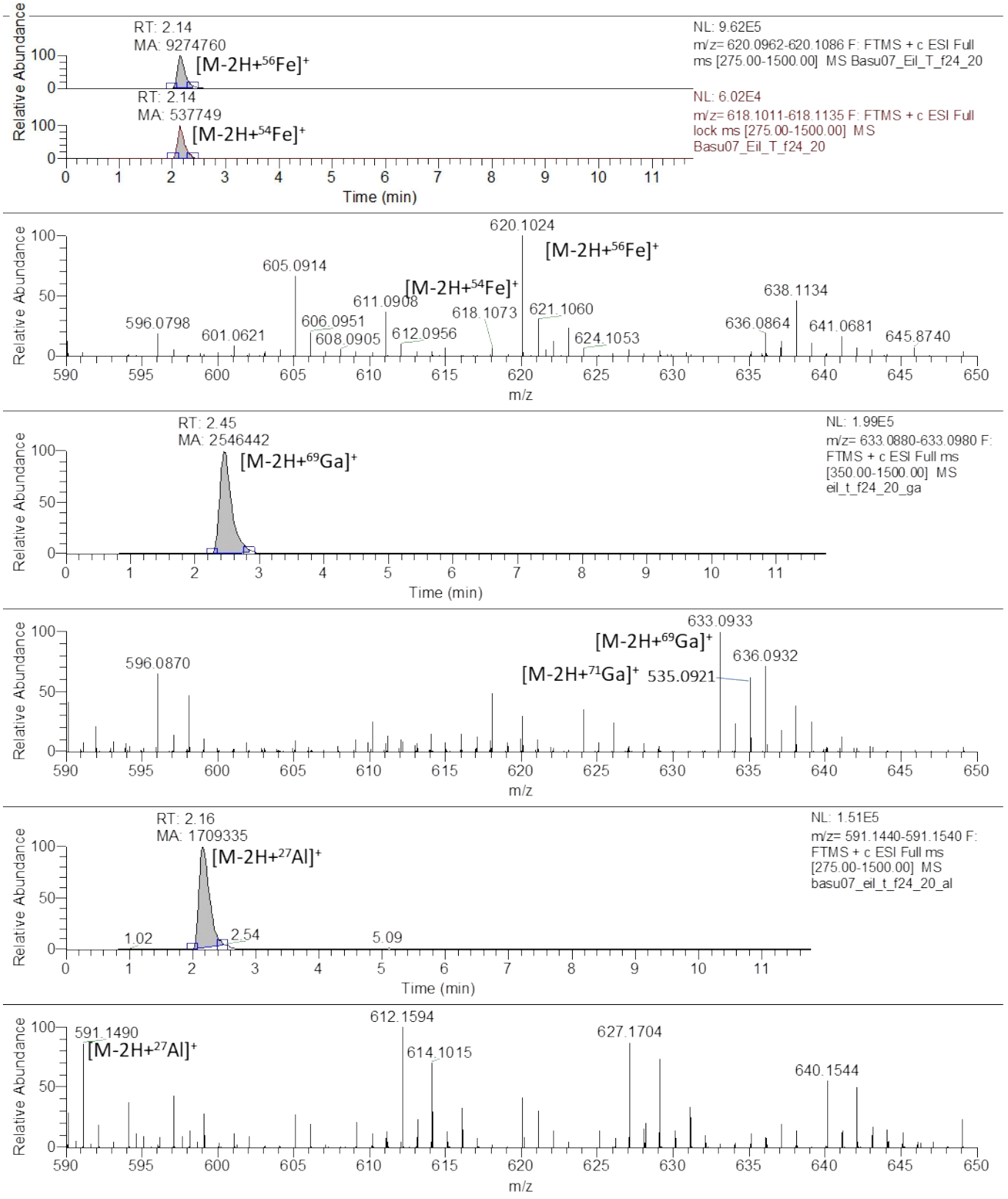
Metallophore m/z [M-2H+Fe]$^{+}$: 542.059



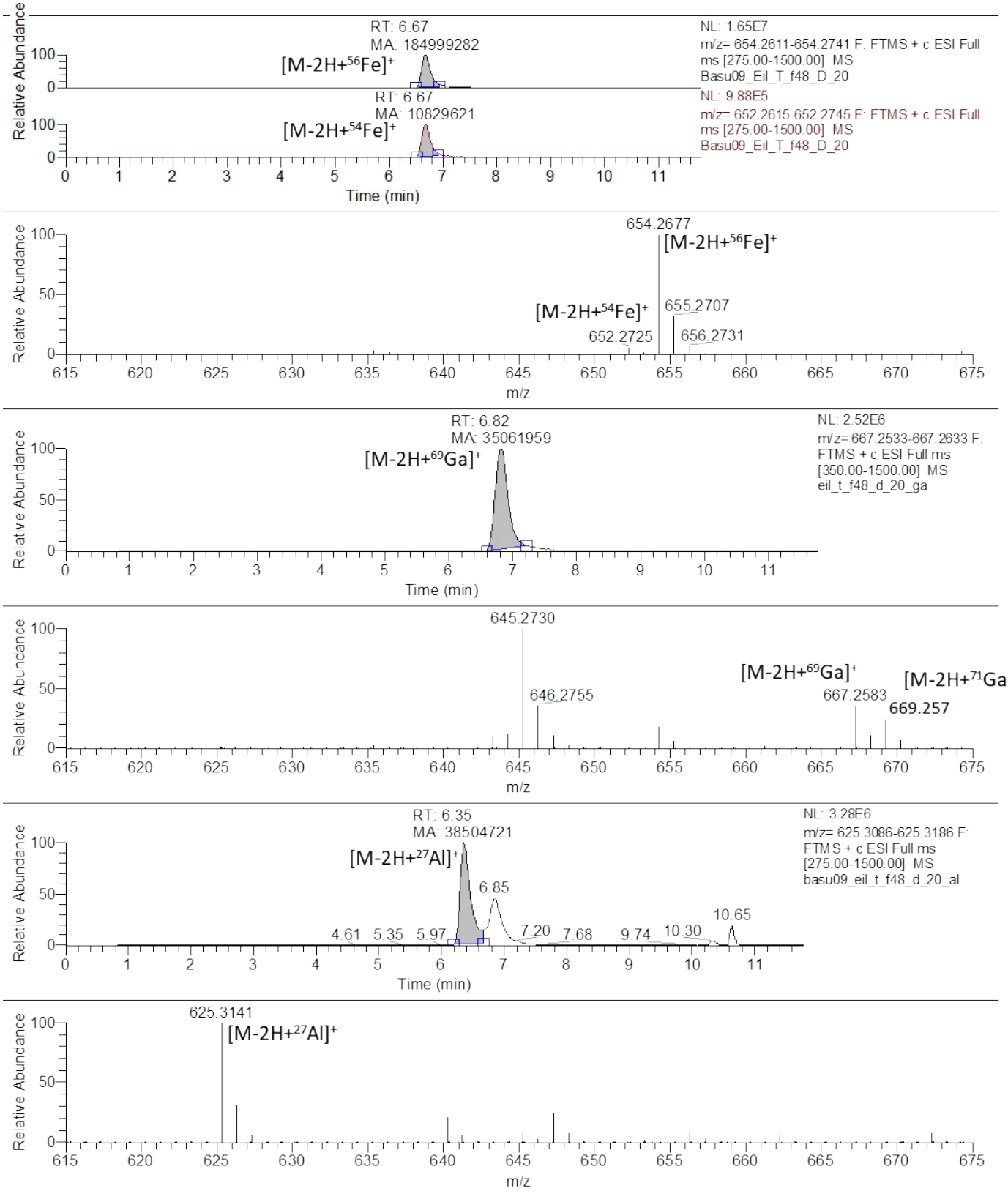
Metallophore m/z [M-2H+Fe]$^{+}$: 614.273, Ferrioxamine B



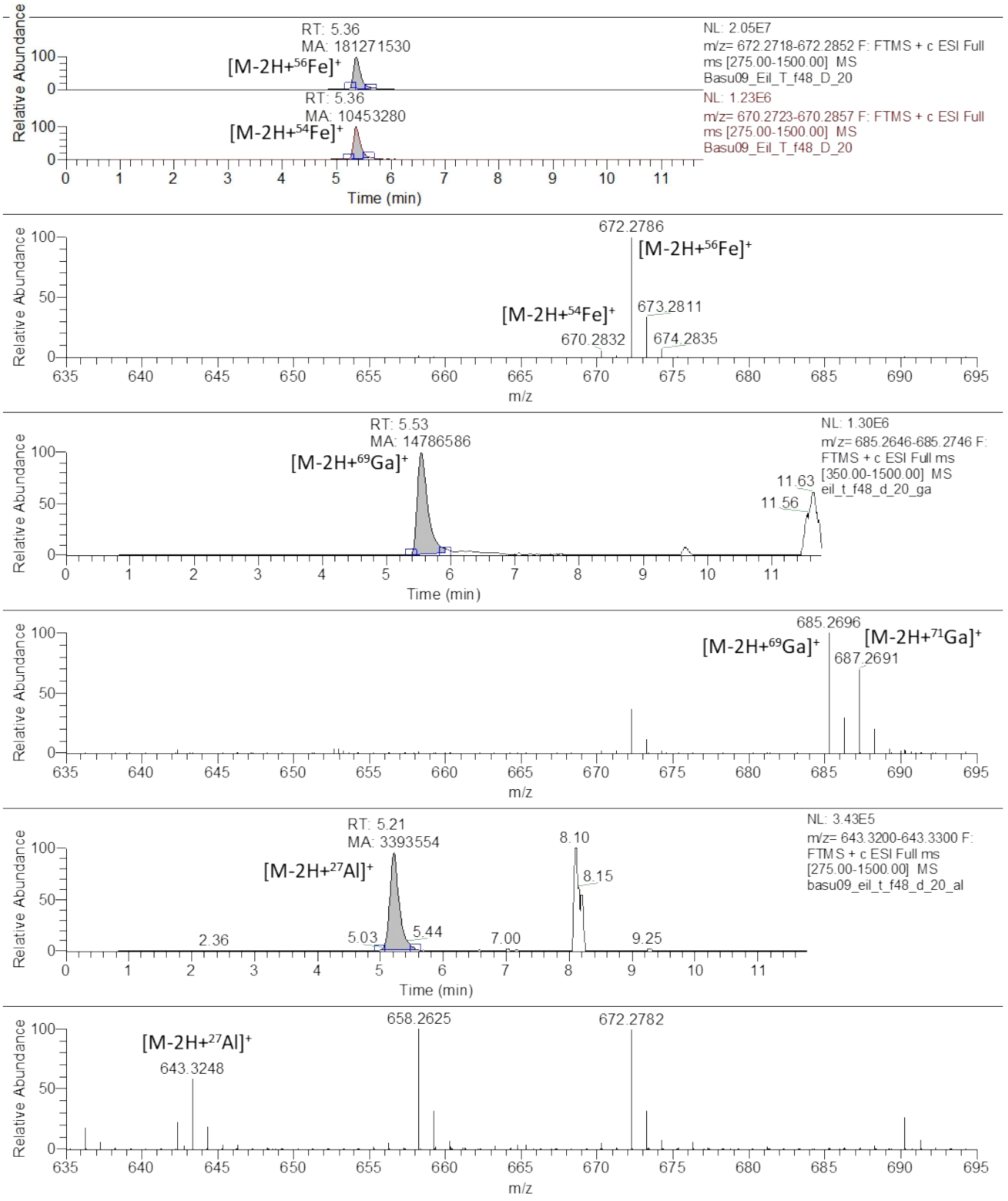
Metallophore m/z [M-2H+Fe]$^{+}$: 620.103



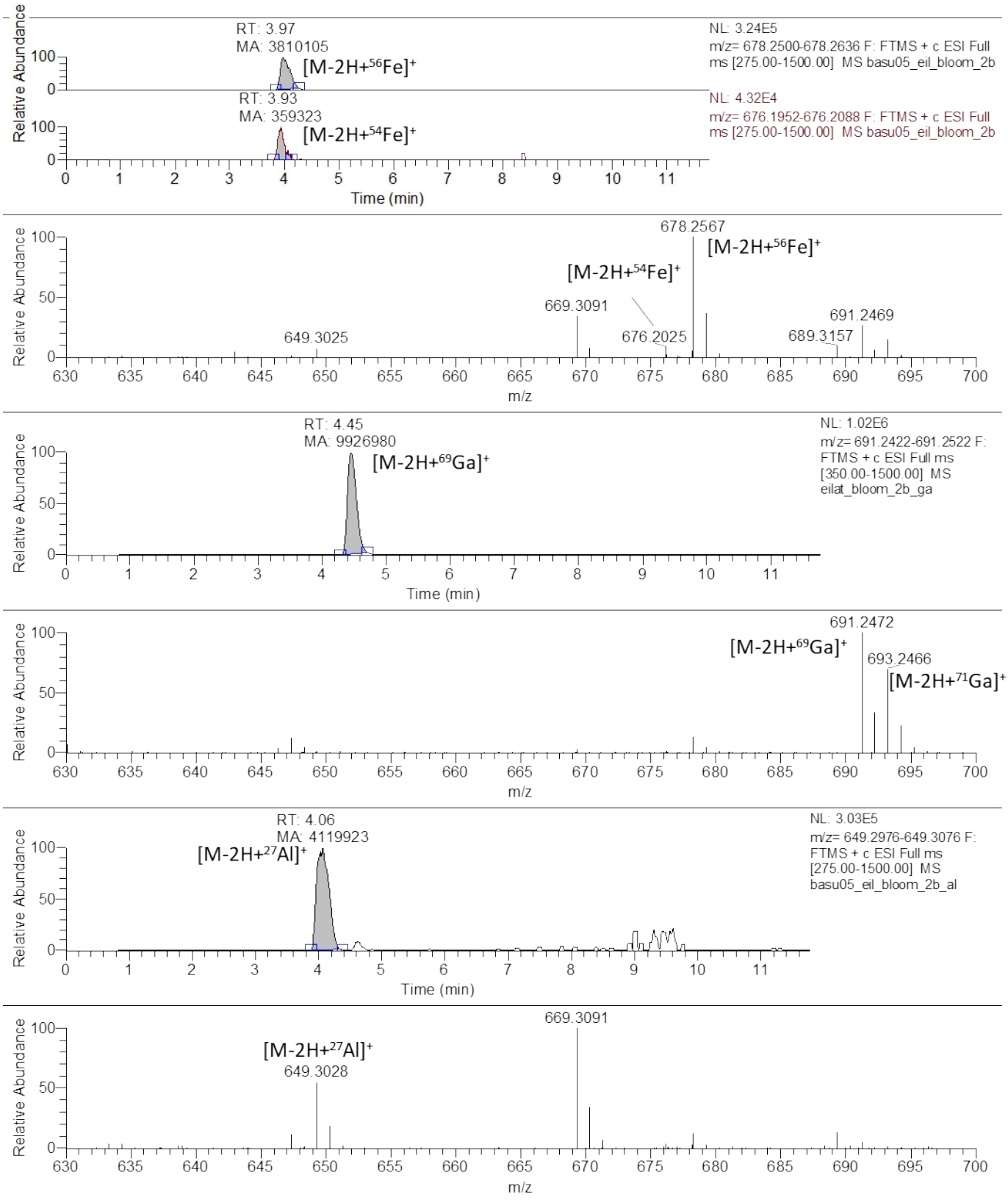
Metallophore m/z [M-2H+Fe]$^{+}$: 654.268, Ferrioxamine E



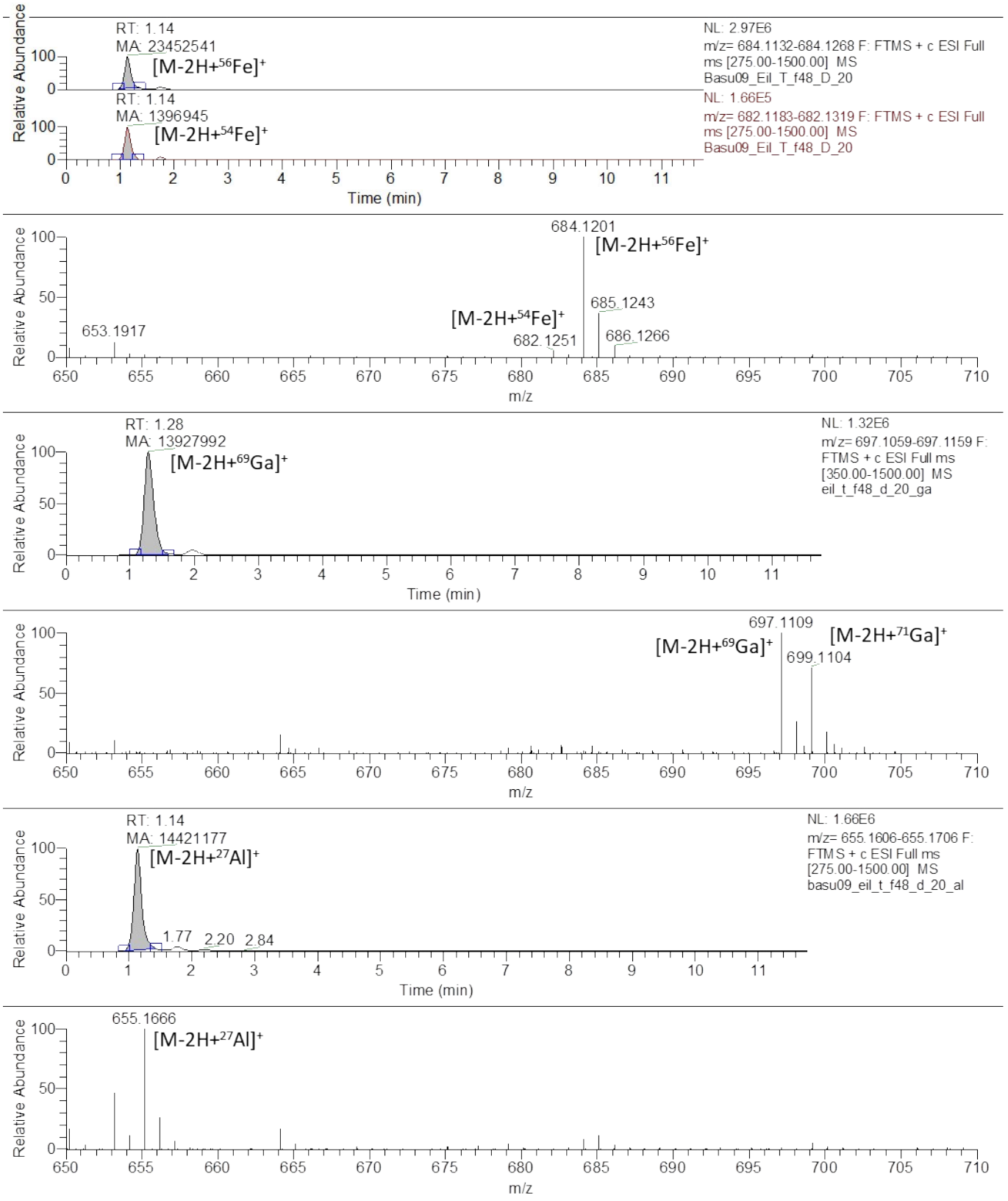
Metallophore m/z [M-2H+Fe]$^{+}$: 672.279, Ferrioxamine G



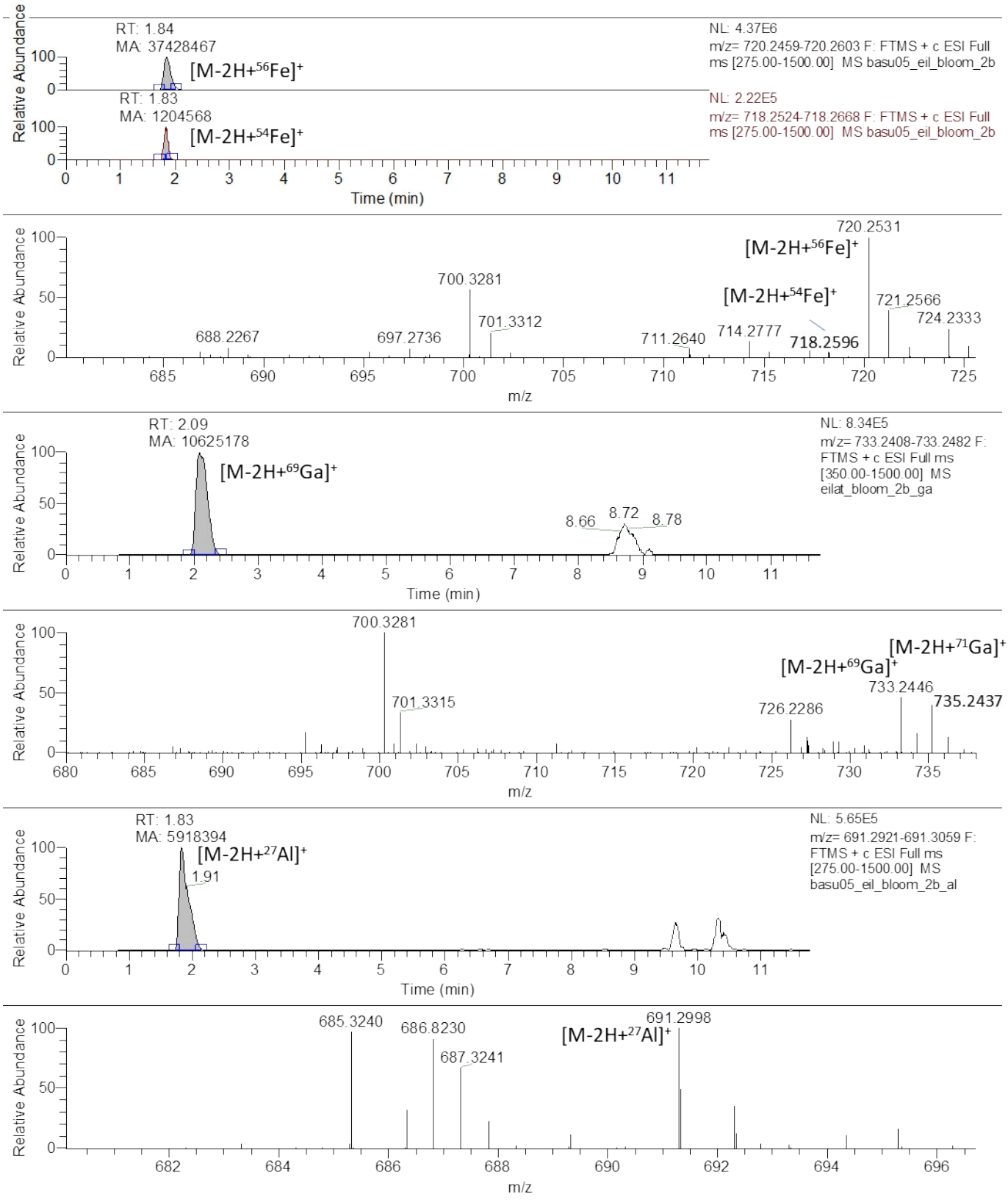
Metallophore m/z [M-2H+Fe]$^{+}$: 678.257



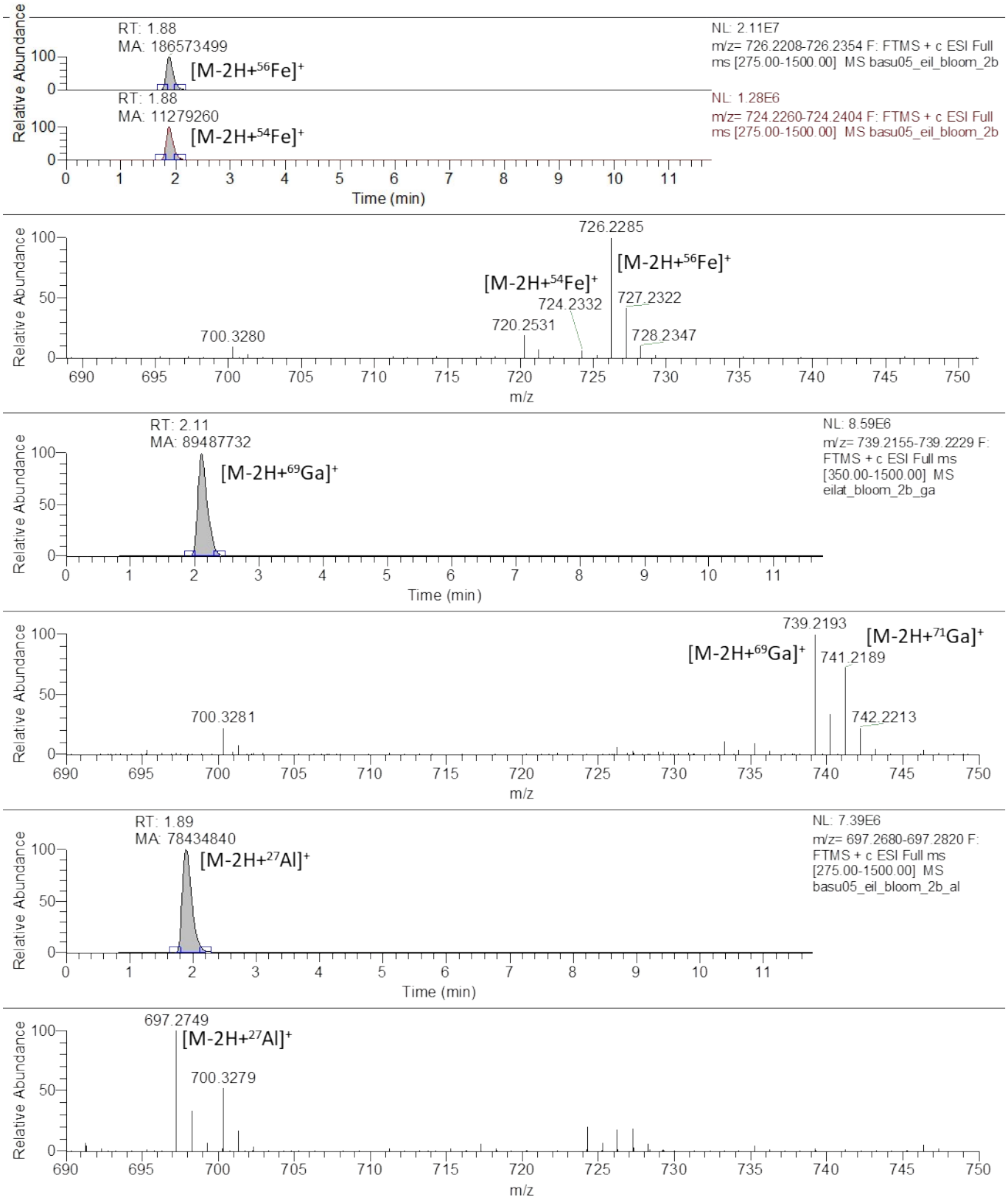
Metallophore m/z $[M-2H+Fe]^+$: 684.120



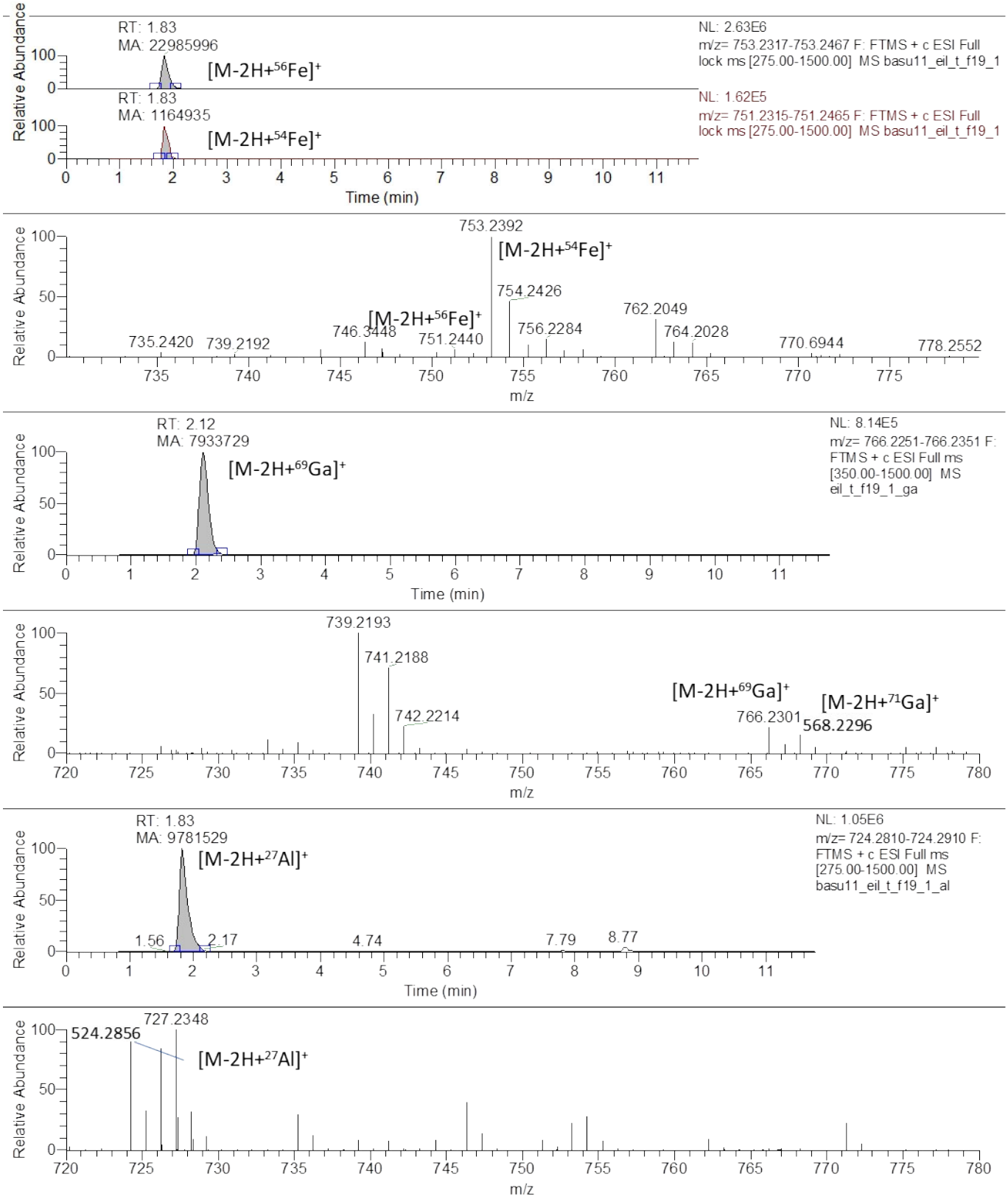
Metallophore m/z $[M-2H+Fe]^+$: 720.253



Metallophore m/z $[M-2H+Fe]^+$: 726.229



Metallophore m/z $[M-2H+Fe]^+$: 753.240



Metallophore m/z [M-2H+Fe]$^{+}$: 780.251

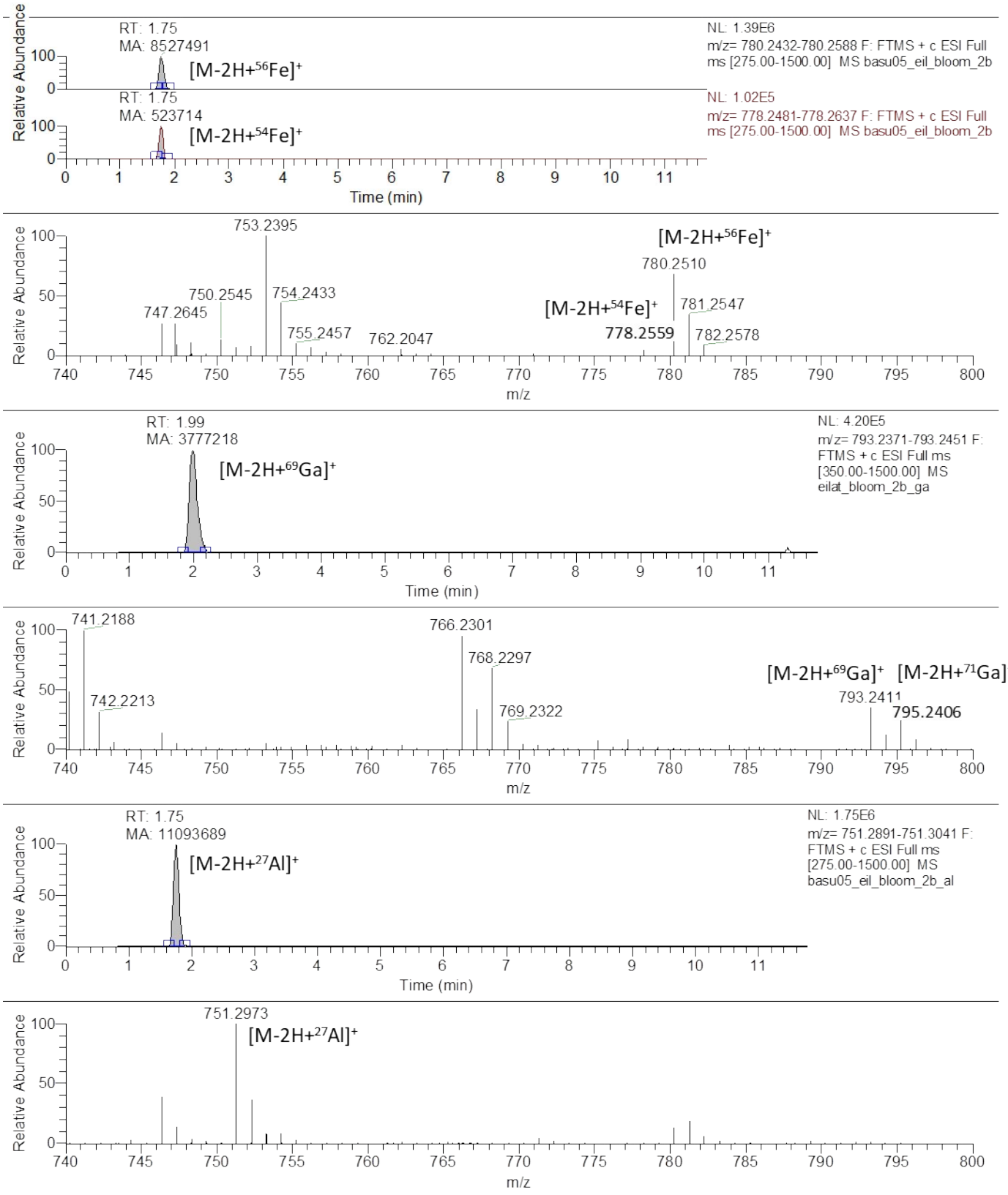


Figure S3. Example extracted ion chromatogram including all metallophore masses in Table 1 obtained for an extract of IMS101. IMS101 was grown to the stationary phase (Day 14) in a modified YBCII media with 20 µM EDTA and 40 nM Fe^{1}. We did not observe any colonies in our cultures. Filament concentrations were ca. 13,300 mL^{-1}. Ion counts are normalised to the volume of culture media extracted (100 mL). Three samples were analysed in total and the final preconcentration factor was ca. 1000. The y axis scale is the same as that used in Fig. 1 of the main manuscript.

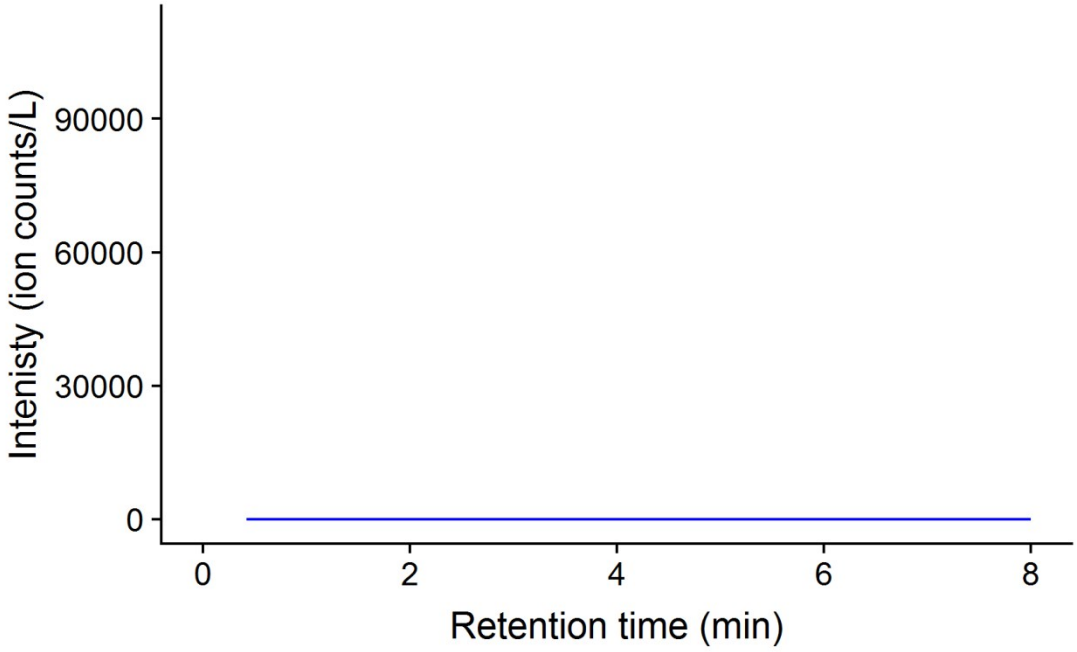


Figure S4. Correlation coefficients, r calculated between normalised metallophore abundances, bacterial numbers (B) and Trichodesmium filament counts (T). Abundances were normalised to the maximum observed value across all thirteen incubation experiments and are shown in Table S. (a) Table showing the correlation coefficient, r, obtained when comparing metallophores, bacteria numbers and Trichodesmium numbers between treatments (bottom left half of diagram). Symbol area and colour (upper right part of diagram) is proportional to the correlation coefficient (for scale see colour bar). Correlations with p>0.05 are crossed out. All incubation experiments were used for the correlations (n=13). Correlations were calculated in R and the figure constructed using the package corrplot version 0.84. (b) Example figure showing the variation of normalised ion counts for m/z 726.23 with normalised ion counts for m/z 436.08 across the incubation experiments (r=0.98, p<0.01). (c) Example figure showing variation of normalised Trichome abundance with m/z 436.08 (r=0.92, p<0.05).

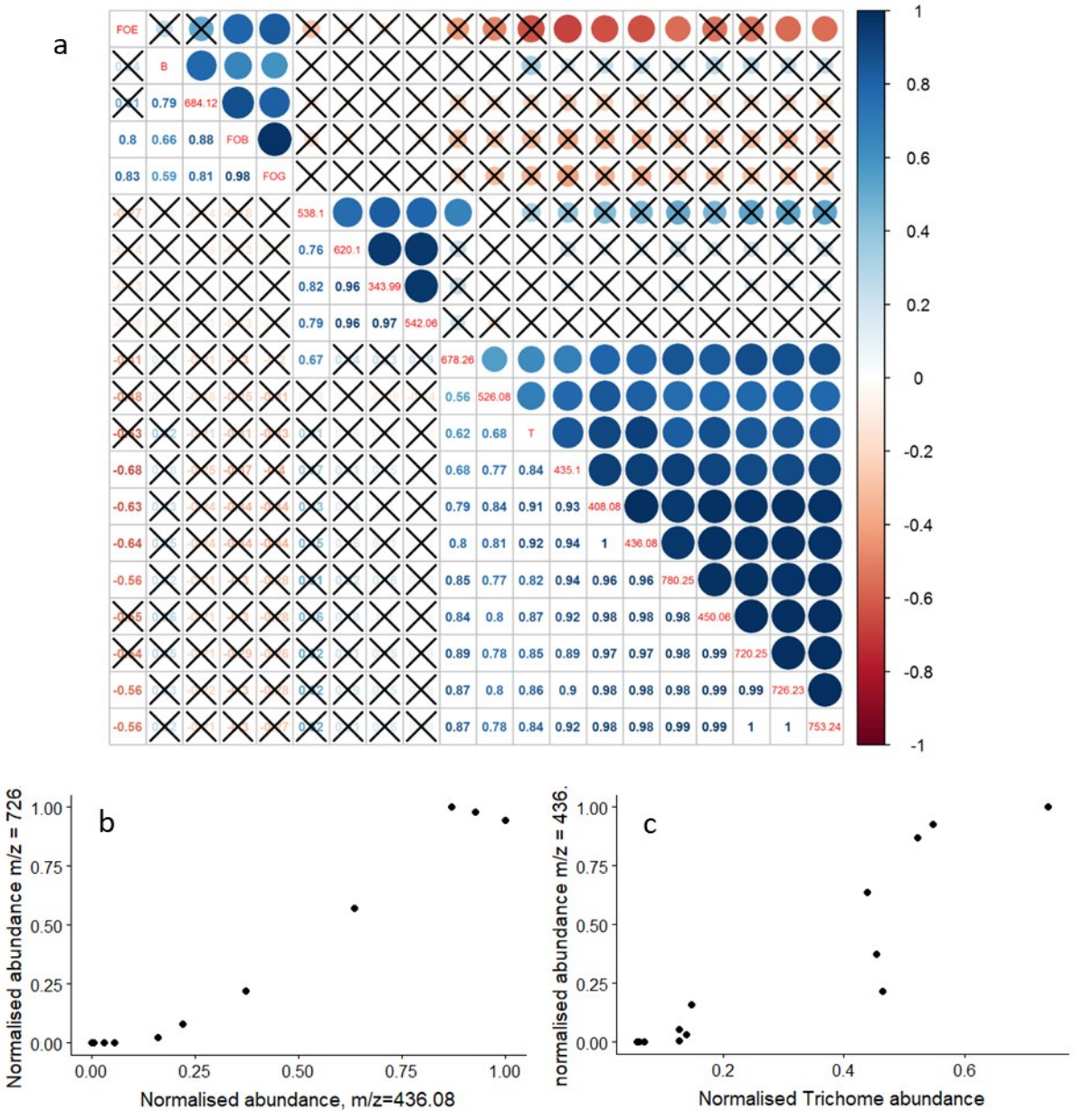


Table S2: Meterological conditions during surface *Trichodesmium* blooms sampled around IUI, pier.

Meterological Conditions	**20-Apr-16**	**01-May-16**	**02-May-16**	**07-May-17**
Surface bloom observation at IUI pier	13:30 - 14:10	11:00- 11:15	15:40 - 16:00	12:00 - 12:15
Chl*a* IUI pier (9- 10 AM) µg L^{-1}	0.268	0.253	0.327	0.214
Air Temperature	29.9	26.4	27.1	27.9
Water Temperature (^{o}C)	23.3	24.1	25.1	23.2
Barometric Pressure (mb)	1010.6	1008.7	1008.4	1011

Table S3. Normalised metallophore abundances in incubation experiments. Abundance was normalised within each experiment to identify any treatment effect and across all incubations to identify relationships with bacteria and Trichome numbers.

Metallophore identity	Experiment	Treatment	Abundance normalised to maximum observed for each metallophore in all treatments	Abundance normalised to maximum observed for each metallophore in each experiment
343.99	GoA-1	Start	0.28	0.28
343.99	GoA-1	t = 1	1.00	1.00
343.99	GoA-1	t = 3	0.07	0.07
343.99	GoA-1	Dust t = 3	0.22	0.22
343.99	GoA-2a	Start	0.13	1.00
343.99	GoA-2a	t = 1	0.05	0.41
343.99	GoA-2a	Dust t = 1	0.09	0.70
343.99	GoA-2b	Start	0.13	0.19
343.99	GoA-2b	t = 1	0.72	1.00
343.99	GoA-2b	Dust t = 1	0.14	0.20
343.99	GoA-3	Start		n.d.
343.99	GoA-3	t = 1		n.d.
343.99	GoA-3	Dust t = 1		n.d.
408.08	GoA-1	Start	0.15	1.00
408.08	GoA-1	t = 1	0.05	0.34
408.08	GoA-1	t = 3	0.00	0.02
408.08	GoA-1	Dust t = 3	0.03	0.19
408.08	GoA-2a	Start	0.21	0.30
408.08	GoA-2a	t = 1	0.71	1.00
408.08	GoA-2a	Dust t = 1	0.36	0.51
408.08	GoA-2b	Start	0.99	0.99
408.08	GoA-2b	t = 1	0.87	0.87
408.08	GoA-2b	Dust t = 1	1.00	1.00
408.08	GoA-3	Start		
408.08	GoA-3	t = 1		
408.08	GoA-3	Dust t = 1		
435.1	GoA-1	Start	0.49	1.00
435.1	GoA-1	t = 1	0.16	0.32
435.1	GoA-1	t = 3	0.00	0.00
435.1	GoA-1	Dust t = 3	0.03	0.06
435.1	GoA-2a	Start	0.15	0.26
435.1	GoA-2a	t = 1	0.58	1.00
435.1	GoA-2a	Dust t = 1	0.24	0.41
435.1	GoA-2b	Start	1.00	1.00
435.1	GoA-2b	t = 1	0.62	0.62

435.1	GoA-2b	Dust t = 1	0.78	0.78
435.1	GoA-3	Start		
435.1	GoA-3	t = 1		
435.1	GoA-3	Dust t = 1		
436.08	GoA-1	Start	0.16	1.00
436.08	GoA-1	t = 1	0.05	0.34
436.08	GoA-1	t = 3	0.00	0.02
436.08	GoA-1	Dust t = 3	0.03	0.19
436.08	GoA-2a	Start	0.22	0.34
436.08	GoA-2a	t = 1	0.64	1.00
436.08	GoA-2a	Dust t = 1	0.37	0.59
436.08	GoA-2b	Start	1.00	1.00
436.08	GoA-2b	t = 1	0.87	0.87
436.08	GoA-2b	Dust t = 1	0.93	0.93
436.08	GoA-3	Start		
436.08	GoA-3	t = 1		
436.08	GoA-3	Dust t = 1		
450.06	GoA-1	Start		
450.06	GoA-1	t = 1		
450.06	GoA-1	t = 3		
450.06	GoA-1	Dust t = 3		
450.06	GoA-2a	Start	0.04	0.08
450.06	GoA-2a	t = 1	0.53	1.00
450.06	GoA-2a	Dust t = 1	0.20	0.39
450.06	GoA-2b	Start	1.00	1.00
450.06	GoA-2b	t = 1	0.81	0.81
450.06	GoA-2b	Dust t = 1	0.83	0.83
450.06	GoA-3	Start		
450.06	GoA-3	t = 1		
450.06	GoA-3	Dust t = 1		
526.08	GoA-1	Start	0.01	0.45
526.08	GoA-1	t = 1	0.03	1.00
526.08	GoA-1	t = 3	0.00	0.00
526.08	GoA-1	Dust t = 3	0.01	0.37
526.08	GoA-2a	Start	0.08	0.13
526.08	GoA-2a	t = 1	0.58	1.00
526.08	GoA-2a	Dust t = 1	0.06	0.10
526.08	GoA-2b	Start	0.47	0.47
526.08	GoA-2b	t = 1	0.19	0.19
526.08	GoA-2b	Dust t = 1	1.00	1.00
526.08	GoA-3	Start		
526.08	GoA-3	t = 1		
526.08	GoA-3	Dust t = 1		
538.1	GoA-1	Start	0.09	0.17
538.1	GoA-1	t = 1	0.51	1.00

538.1	GoA-1	t = 3	0.05	0.09
538.1	GoA-1	Dust t = 3	0.04	0.07
538.1	GoA-2a	Start	0.02	0.38
538.1	GoA-2a	t = 1	0.05	0.71
538.1	GoA-2a	Dust t = 1	0.07	1.00
538.1	GoA-2b	Start	0.18	0.18
538.1	GoA-2b	t = 1	1.00	1.00
538.1	GoA-2b	Dust t = 1	0.18	0.18
538.1	GoA-3	Start		
538.1	GoA-3	t = 1		
538.1	GoA-3	Dust t = 1		
542.06	GoA-1	Start	0.05	0.05
542.06	GoA-1	t = 1	1.00	1.00
542.06	GoA-1	t = 3	0.00	0.00
542.06	GoA-1	Dust t = 3	0.03	0.03
542.06	GoA-2a	Start	0.03	0.03
542.06	GoA-2a	t = 1	1.00	1.00
542.06	GoA-2a	Dust t = 1	0.00	0.00
542.06	GoA-2b	Start	0.01	0.02
542.06	GoA-2b	t = 1	0.61	1.00
542.06	GoA-2b	Dust t = 1	0.01	0.02
542.06	GoA-3	Start		
542.06	GoA-3	t = 1		
542.06	GoA-3	Dust t = 1		
620.1	GoA-1	Start	0.13	0.13
620.1	GoA-1	t = 1	1.00	1.00
620.1	GoA-1	t = 3	0.02	0.02
620.1	GoA-1	Dust t = 3	0.09	0.09
620.1	GoA-2a	Start	0.02	0.74
620.1	GoA-2a	t = 1	0.01	0.38
620.1	GoA-2a	Dust t = 1	0.03	1.00
620.1	GoA-2b	Start	0.30	0.56
620.1	GoA-2b	t = 1	0.54	1.00
620.1	GoA-2b	Dust t = 1	0.08	0.15
620.1	GoA-3	Start		
620.1	GoA-3	t = 1		
620.1	GoA-3	Dust t = 1		
678.26	GoA-1	Start		
678.26	GoA-1	t = 1		
678.26	GoA-1	t = 3		
678.26	GoA-1	Dust t = 3		
678.26	GoA-2a	Start	0.02	0.12
678.26	GoA-2a	t = 1	0.14	1.00
678.26	GoA-2a	Dust t = 1	0.09	0.66
678.26	GoA-2b	Start	0.55	0.55

678.26	GoA-2b	t = 1	1.00	1.00
678.26	GoA-2b	Dust t = 1	0.68	0.68
678.26	GoA-3	Start		
678.26	GoA-3	t = 1		
678.26	GoA-3	Dust t = 1		
684.12	GoA-1	Start	0.00	0.00
684.12	GoA-1	t = 1	0.00	0.00
684.12	GoA-1	t = 3	0.03	0.03
684.12	GoA-1	Dust t = 3	1.00	1.00
684.12	GoA-2a	Start		
684.12	GoA-2a	t = 1		
684.12	GoA-2a	Dust t = 1		
684.12	GoA-2b	Start		
684.12	GoA-2b	t = 1		
684.12	GoA-2b	Dust t = 1		
684.12	GoA-3	Start		
684.12	GoA-3	t = 1		
684.12	GoA-3	Dust t = 1		
720.25	GoA-1	Start	0.01	1.00
720.25	GoA-1	t = 1	0.00	0.00
720.25	GoA-1	t = 3	0.00	0.00
720.25	GoA-1	Dust t = 3	0.00	0.00
720.25	GoA-2a	Start	0.06	0.13
720.25	GoA-2a	t = 1	0.44	1.00
720.25	GoA-2a	Dust t = 1	0.18	0.41
720.25	GoA-2b	Start	1.00	1.00
720.25	GoA-2b	t = 1	0.98	0.98
720.25	GoA-2b	Dust t = 1	0.98	0.98
720.25	GoA-3	Start		
720.25	GoA-3	t = 1		
720.25	GoA-3	Dust t = 1		
726.23	GoA-1	Start	0.02	1.00
726.23	GoA-1	t = 1	0.00	0.10
726.23	GoA-1	t = 3	0.00	0.00
726.23	GoA-1	Dust t = 3	0.00	0.00
726.23	GoA-2a	Start	0.08	0.14
726.23	GoA-2a	t = 1	0.57	1.00
726.23	GoA-2a	Dust t = 1	0.22	0.38
726.23	GoA-2b	Start	0.94	0.94
726.23	GoA-2b	t = 1	1.00	1.00
726.23	GoA-2b	Dust t = 1	0.98	0.98
726.23	GoA-3	Start		
726.23	GoA-3	t = 1		
726.23	GoA-3	Dust t = 1		
753.24	GoA-1	Start	0.08	1.00

753.24	GoA-1	t = 1	0.01	0.11
753.24	GoA-1	t = 3	0.00	0.00
753.24	GoA-1	Dust t = 3	0.00	0.00
753.24	GoA-2a	Start	0.05	0.10
753.24	GoA-2a	t = 1	0.53	1.00
753.24	GoA-2a	Dust t = 1	0.14	0.27
753.24	GoA-2b	Start	1.00	1.00
753.24	GoA-2b	t = 1	0.98	0.98
753.24	GoA-2b	Dust t = 1	0.92	0.92
753.24	GoA-3	Start		
753.24	GoA-3	t = 1		
753.24	GoA-3	Dust t = 1		
780.25	GoA-1	Start	0.17	1.00
780.25	GoA-1	t = 1	0.02	0.09
780.25	GoA-1	t = 3	0.00	0.00
780.25	GoA-1	Dust t = 3	0.00	0.00
780.25	GoA-2a	Start	0.02	0.04
780.25	GoA-2a	t = 1	0.45	1.00
780.25	GoA-2a	Dust t = 1	0.06	0.13
780.25	GoA-2b	Start	1.00	1.00
780.25	GoA-2b	t = 1	0.86	0.86
780.25	GoA-2b	Dust t = 1	0.82	0.82
780.25	GoA-3	Start		
780.25	GoA-3	t = 1		
780.25	GoA-3	Dust t = 1		
FOB	GoA-1	Start	0.00	0.00
FOB	GoA-1	t = 1	0.00	0.00
FOB	GoA-1	t = 3	0.56	0.56
FOB	GoA-1	Dust t = 3	1.00	1.00
FOB	GoA-2a	Start		
FOB	GoA-2a	t = 1		
FOB	GoA-2a	Dust t = 1		
FOB	GoA-2b	Start		
FOB	GoA-2b	t = 1		
FOB	GoA-2b	Dust t = 1		
FOB	GoA-3	Start		
FOB	GoA-3	t = 1		
FOB	GoA-3	Dust t = 1		
FOE	GoA-1	Start	0.00	0.00
FOE	GoA-1	t = 1	0.30	0.30
FOE	GoA-1	t = 3	1.00	1.00
FOE	GoA-1	Dust t = 3	0.80	0.80
FOE	GoA-2a	Start	0.00	0.01
FOE	GoA-2a	t = 1	0.00	0.00
FOE	GoA-2a	Dust t = 1	0.14	1.00

FOE	GoA-2b	Start	0.00	1.00
FOE	GoA-2b	t = 1	0.00	0.51
FOE	GoA-2b	Dust t = 1	0.00	0.42
FOE	GoA-3	Start	0.26	0.54
FOE	GoA-3	t = 1	0.47	1.00
FOE	GoA-3	Dust t = 1	0.33	0.69
FOG	GoA-1	Start	0.00	0.00
FOG	GoA-1	t = 1	0.08	0.08
FOG	GoA-1	t = 3	0.70	0.70
FOG	GoA-1	Dust t = 3	1.00	1.00
FOG	GoA-2a	Start	0.00	0.18
FOG	GoA-2a	t = 1	0.03	1.00
FOG	GoA-2a	Dust t = 1	0.02	0.82
FOG	GoA-2b	Start	0.00	0.00
FOG	GoA-2b	t = 1	0.21	1.00
FOG	GoA-2b	Dust t = 1	0.00	0.03
FOG	GoA-3	Start	0.00	0.48
FOG	GoA-3	t = 1	0.00	1.00
FOG	GoA-3	Dust t = 1	0.00	0.66