STS 130 Return Samples: Assessment of Air Quality aboard the Shuttle (STS-130) and International Space Station (20A)

Space Shuttle: The toxicological assessments of 3 grab sample canisters (GSCs) from the Shuttle are reported in Table 1. Analytical methods have not changed from earlier reports. The recoveries of the 3 surrogates (^{13}C-acetone, fluorobenzene, and chlorobenzene) from the 3 Shuttle GSCs averaged 96, 90, and 85 %, respectively. Based on the end-of-mission sample, the Shuttle atmosphere was acceptable for human respiration.

Table 1. Analytical Summary of Shuttle Samples

Sample Location	Date of Sample	NMVOCs [a] (mg/m^3)	Freon 218 (mg/m^3)	T Value[b] (units)	Alcohols (mg/m^3)	Formaldehyde ($\mu g/m^3$)
Preflight	2/07/10 @ 2045	0.3	0	0.00	0.3	--
Preflight	2/07/10 @ 2341	1.6	0	0.02	1.6	--
Mid-deck (end mission)	2/21/10	2.9	35	0.12	0.9	--
Guideline		*25*	*none*	*1.0*	*none*[c]	*<120*

[a] Non-methane volatile organic hydrocarbons, excluding Freon 218

[b] Based on 7-day SMACs and calculated excluding CO_2, formaldehyde, and siloxanes.

[C] There is no value here because water is not recovered from humidity condensate on Shuttle as it is on ISS.

International Space Station: The toxicological assessment of 10 GSCs from the ISS is shown in Table 2. The recoveries of the 3 surrogates (as listed above) from the ISS GSCs averaged 91, 83 and 74%, respectively. The low recovery of chlorobenzene was due to analytical interference from high levels of Freon 218. Results of one GSC sample (1/04/10) were not reported due to problems with surrogate recoveries. Formaldehyde-badges were not returned on this flight.

Table 2. Analytical Summary of ISS Results

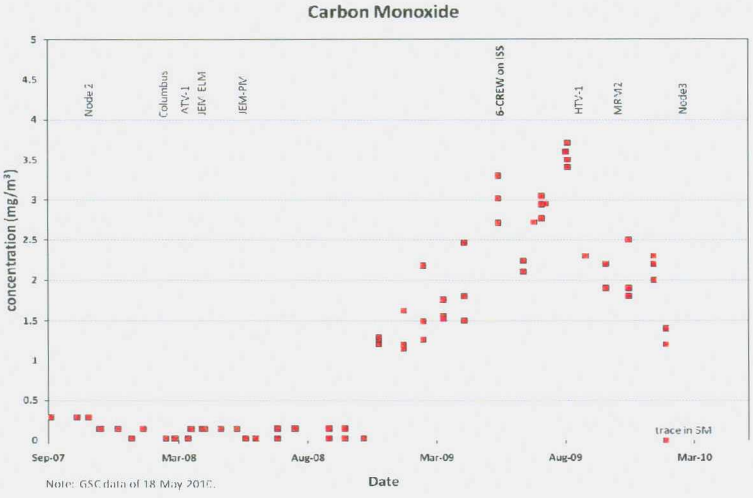
Module/Sample	Approx. Date	NMVOCs[a] (mg/m^3)	Freon 218 (mg/m^3)	T Value[b] (units)	Alcohols (mg/m^3)	Formaldehyde ($\mu g/m^3$)
MRM2 (first entry)	11/13/09	130	18	7.6	21	--
SM	11/29/09	6	110	1.0	4	--
Lab	11/29/09	6	110	2.0[c]	4	--
Columbus	11/29/09	7	110	1.0	5	--
Lab	1/04/10	12	110	2.3[c]	8	--
JEM	1/04/10	10	110	1.1	7	--
SM	1/21/10	12	59	1.8[c]	8	--
Lab	1/21/10	6	79	1.4[c]	5	--
Columbus	1/21/10	7	84	1.4[c]	5	--
Node 3 (first entry)	2/13/10	12	46	2.6	8	--
Guideline		*<25*	*none*	*<1.0*	*<5*	*<120*

[a] Non-methane volatile organic hydrocarbons, excluding Freon 218

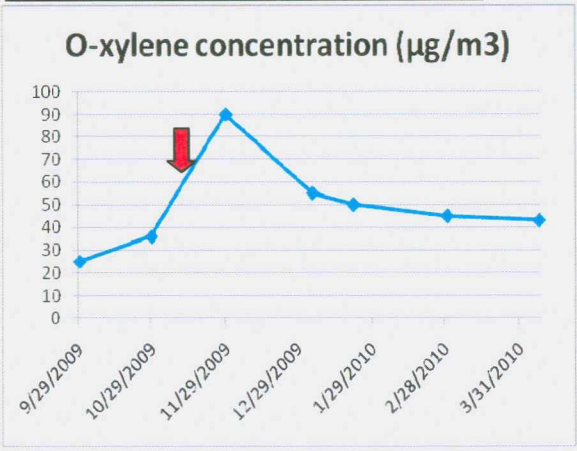
[b] Based on 180-d SMACs and calculated excluding CO_2, formaldehyde, and siloxanes.

[c] Higher T value is due to traces of propenal, an irritant.

Carbon Monoxide Accumulation aboard ISS: Before August 2009 the nominal concentrations of CO had been increasing gradually (see figure to the left). The results from samples returned on this flight indicate that the CO concentrations have continued to drop since that time; however, they have not returned to pre-October 2008 levels (<0.5 mg/m^3). In any case, these changes are well below the 180-day SMAC for CO, which is 17 mg/m^3. There is no threat to crew health. The source of additional CO is unknown.



General Observations about ISS Air Quality: The figure to the left shows changes in average o-xylene concentrations before and after hatch opening (red arrow) to the MRM2. The first-entry sample of that module showed high levels of o-xylene (30 mg/m^3 on 11/13/2009), and the figure shows evidence that slightly elevated concentrations were evident 16 days later on 11/29/2009. The last two points are from preliminary data on samples returned on a later flight. The 180-day SMAC for o-xylene is 37 mg/m3.



This is a limited set of samples on which to perform an air quality assessment. However, based on these samples and past experience with ISS air quality assessments, we have no reason to believe that nominal ISS air is unsafe to breathe. Past observations of sporadic elevations of propenal have recurred. We must continue to be vigilant when dealing with nominal atmospheres in ISS. Based on high pollution levels at first entry, unmanned modules require special attention when the crew first enters.

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Enclosures
Table 1A: Analytical concentrations of compounds found in the STS-130 GSCs
Table 1B: Analytical concentrations of compounds found in 20A GSCs
Table 2A: T-values of the compounds in table 1A
Table 2B: T-values of the compounds in table 1B