The toxicological assessment of 17 GSCs returned aboard Soyuz 28 and 29 from the ISS is shown in Table 1. The average recoveries of the 3 surrogate standards from the GSCs were as follows: $^{13}$C-acetone, 110%; fluorobenzene, 107%; and chlorobenzene, 99%. Recoveries from formaldehyde badges, which were returned on 29S, averaged 101%.

Table 1. Analytical Summary of ISS Results

<table>
<thead>
<tr>
<th>Module/Sample</th>
<th>Date of Sample</th>
<th>NMVOCs a (mg/m$^3$)</th>
<th>Freon 218 (mg/m$^3$)</th>
<th>T Value b (units)</th>
<th>Alcohols (mg/m$^3$)</th>
<th>Formaldehyde (µg/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab</td>
<td>12/23/11</td>
<td>9</td>
<td>32</td>
<td>0.40</td>
<td>5.9</td>
<td>42</td>
</tr>
<tr>
<td>JPM</td>
<td>12/23/11</td>
<td>10</td>
<td>35</td>
<td>0.39</td>
<td>6.2</td>
<td>--</td>
</tr>
<tr>
<td>SM</td>
<td>12/23/11</td>
<td>9</td>
<td>33</td>
<td>0.36</td>
<td>5.8</td>
<td>35</td>
</tr>
<tr>
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<td>10</td>
<td>11</td>
<td>0.76</td>
<td>6.6</td>
<td>--</td>
</tr>
<tr>
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<td>7.2</td>
<td>55</td>
</tr>
<tr>
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<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>41</td>
</tr>
<tr>
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<td>--</td>
<td>37</td>
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<tr>
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<tr>
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<tr>
<td>ATV3 (first entry)</td>
<td>03/29/12</td>
<td>28</td>
<td>2</td>
<td>2.64 (0.94)</td>
<td>5.9</td>
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<tr>
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<td>4.6</td>
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<td>--</td>
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<td>&lt;1.0</td>
<td>&lt;5</td>
<td>&lt;120</td>
</tr>
</tbody>
</table>

a Non-methane volatile organic hydrocarbons, excluding Freon 218
b Based on 180-d SMACs and calculated excluding CO$_2$ and formaldehyde. Parentheses indicate 7-day SMAC comparison.

**General Observations about ISS Air Quality:** This is a very limited set of samples on which to perform an air quality assessment. However, based on these samples, we have no reason to believe that nominal ISS air is unsafe to breathe. Formaldehyde values were up some in January and early February, but were decreased to ~30 µg/m$^3$ by late February. The relatively high T value at ATV3 first entry was due to the presence of hexamethylcyclotrisiloxane, trimethylsilanol, and fluorotrimethylsilane, all compounds that are reasonably well removed by the air revitalization systems.

**Air Quality Monitor DTO:** The figures below summarize the potential for any health effects based on data from the Air Quality Monitor (AQM) DTO, CO$_2$ monitors, and formaldehyde badges. Each panel is an average of weekly panels created during the designated month with the SD of those values shown as limit bars. By remaining consistently below T=1, these data show that the air quality is nominal and stable.
January 2012

- No listed Effect
- Headache
- Gastrointestinal toxicity
- Urinary bladder injury
- Skin flushing
- Hepatotoxicant
- Visual disturbances
- Ototoxicant
- Immunotoxicant
- Hematotoxicant
- Respiratory system injury
- Reproductive toxicant
- Nephrotoxic
- CNS depression
- Carcinogen (any type)
- Mucosal irritant...
- Cardiac sensitization

February 2012

- No listed Effect
- Headache
- Gastrointestinal toxicity
- Urinary bladder injury
- Skin flushing
- Hepatotoxicant
- Visual disturbances
- Ototoxicant
- Immunotoxicant
- Hematotoxicant
- Respiratory system injury
- Reproductive toxicant
- Nephrotoxic
- CNS depression
- Carcinogen (any type)
- Mucosal irritant...
- Cardiac sensitization

March 2012

- No listed Effect
- Headache
- Gastrointestinal toxicity
- Urinary bladder injury
- Skin flushing
- Hepatotoxicant
- Visual disturbances
- Ototoxicant
- Immunotoxicant
- Hematotoxicant
- Respiratory system injury
- Reproductive toxicant
- Nephrotoxic
- CNS depression
- Carcinogen (any type)
- Mucosal irritant...
- Cardiac sensitization

April 2012

- No listed Effect
- Headache
- Gastrointestinal toxicity
- Urinary bladder injury
- Skin flushing
- Hepatotoxicant
- Visual disturbances
- Ototoxicant
- Immunotoxicant
- Hematotoxicant
- Respiratory system injury
- Reproductive toxicant
- Nephrotoxic
- CNS depression
- Carcinogen (any type)
- Mucosal irritant...
- Cardiac sensitization

John T. James, Ph.D., Chief Toxicologist

Enclosures  Table 1: Analytical concentrations of compounds found in the Soyuz 28&29 GSCs
Table 2: T-values of the compounds in table 1