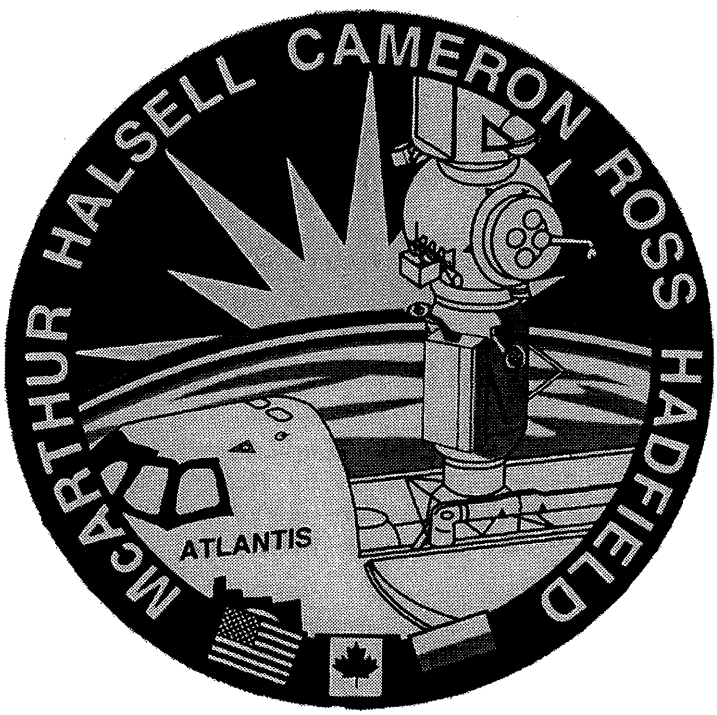
MIR-19 / STS-74
180-DAY PRELIMINARY REPORT



National Aeronautics
and Space Administration

Lyndon B. Johnson Space Center
Houston, TX

Trace Chemical Contamination: Water Quality

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INTRODUCTION

APPROXIMATELY FIFTY PERCENT of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. The remainder comes from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water that is transferred from the Shuttle. This experiment is being conducted to determine the potability of the recycled water, to assess the reliability of the water supply systems, and to provide inflight testing of water collection hardware.

Objectives

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit to determine potability

Characterize the chemical composition of Mir recycled water to determine potability

Evaluate the efficiency of onboard water processors to aid in the development of ISS water processing and monitoring technology

Characterize the chemical composition of Mir humidity condensate to support development of the water recycling and monitoring systems for the International Space Station (ISS)

Provide inflight testing of water collection hardware being developed to collect water samples on ISS

Provide a better understanding of the interaction between atmospheric and water contaminants

Hypothesis

Detailed analysis of reclaimed waters will confirm that the Mir water reclamation system and the ground supplied water system deliver water for crew consumption that meets established water quality requirements.

Background/History

Historically, water provided for crew consumption during U.S. space missions has either been launched from the ground or produced as a byproduct of the operation of fuel cells. Reclamation and purification of spacecraft wastewaters as practiced on the Russian Space Station Mir, will be required for supplying crewmembers of the International Space Station with potable and hygiene water. To date, both U.S. and Russian programs have limited information on the composition of spacecraft and reclaimed waters.

METHODS/SCIENCE OPERATIONS

Functional Objectives

FO1. Preflight collection of ground-supplied water at RSC Energia, Kalingrad, Russia

FO2. Water Sampling Hardware Setup

FO3. Inflight collection of hot, cold, and SVO-ZV (ground supplied) water

FO4. Inflight collection of humidity condensate

FO5. Postflight analysis of samples

Hardware Items

Major hardware items used inflight for this experiment:

HW1. Water Sampling Kit - NASA provided

HW2. Disinfectant/Antiseptic Wipes - NASA provided

HW3. Potable Water Samplers (with Mir port adapter interfaces) - NASA provided

HW4. Waste bags and Archival Chemical Sample Bags - NASA provided

HW5. Self Sealing Storage Bags - NASA provided

HW6. Atmospheric Condensate Sampler - RSA provided

Major hardware items used postflight for this experiment:

HW7. HP 5890 Gas Chromatograph (GC) with HP5971A Mass Spectrometer (MS) - NASA provided

HW8. Waters Quanta 4000 Capillary Electrophoresis System - NASA provided

HW9. OI 700 Carbon Analyzer - NASA provided

HW10. Sievers Model 800 Total Organic Carbon Analyzer - NASA provided

HW11. HP 7694 Headspace sampler with a HP 5890 GC and 5972 Mass Selective Detector - NASA provided

HW12. HP 5989 Mass Spectrometer (MS) with a 1090 Liquid Chromatograph with Particle beam & Thermospray interfaces - NASA provided

Method/Protocol

During inflight water sampling sessions on board Mir, the water sampling kit was unstowed from its storage location. The water sampling kit contained the disinfectant wipes, potable water samplers, waste bags, archival chemical sample bags, and storage bags needed for water sampling. A prepackaged disinfectant wipe containing 1 ml of benzalkonium chloride in 250 ml of water, was retrieved from the kit and used to disinfect the Mir galley water port. Next, a potable water sampler was connected to the galley port. A waste bag was then connected to the potable water sampler. Using the waste bag, 200 ml of water was collected and discarded. Next, 1000 ml of water was collected into the archival chemical sample bag. (See Figure 1) The archival chemical sample bag was placed in a self sealing storage bag and stowed for return on the Shuttle. These procedures were used to collect hot, cold, and SVO-ZV (ground supplied) water for chemical analysis for Experiment 5.3. Following the collection of the chemical samples, microbiological samples were obtained for a separate experiment.

Postflight chemical analysis of samples occurred at Johnson Space Center (JSC) and the Institute for Biomedical Problems (IBMP). Following recovery of the samples on the ground, the samples were allocated (See Table 1) for distribution to the water analysis laboratories at JSC and IBMP. Parameters tested at JSC included total carbon (total inorganic carbon, purgeable organic carbon, nonpurgeable organic carbon and total organic carbon), specific organics (alcohols, organic acids, semivolatiles, volatiles, nonvolatiles, formaldehyde), and silver. Parameters tested by IBMP included conductivity, pH, color, chemical oxygen demand, total solids, calcium, magnesium, total hardness, and silver.

RESULTS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment

Inflight Anomalies

Mir 19

None.

Mir 20

None.

STS-74

During Mir 20 on November 6, approximately 1.8 liters of a 37% ethylene glycol solution leaked into the Mir core module and potentially contaminated the Mir environment. Because of the attendant potential contamination of the humidity condensate and concern over the ability of the Russian water processors to efficiently remove ethylene glycol, the potable water production unit was shut down. Hence, no regenerated hot or cold water was available for sampling during STS-74 docking. In lieu of these samples, the equipment was used to collect samples of humidity condensate from three-22 liter EDV tanks that were sequentially filled following the ethylene glycol leak, while the water processor was not operating.

Postflight Anomalies

None.

Completeness/Quality of Data

Data for this experiment are derived from analysis of water samples received. Two water samples (one hot, one cold) were not collected inflight, during the docked phase as planned because the potable water processor was not being operated at this time. Hence, for these samples, no data will be available.

Tables, Graphs, Figures Index

Table 1. Allocation of Mir 18 Samples

Table 2. Joint U.S./Russian Potable Water Specifications for International Space Station

Table 3. Regenerated Water Results

Table 4. Ground Supplied Water Results

Table 5. Humidity Condensate Report

Figure 1. Sample Collection Methodology

DISCUSSION

Status of Data Analysis

Most analyses of Mir 19 and Mir 20 (STS-74) samples have been completed. Those analyses yet to be completed

on the Mir 19 and Mir 20 samples include color, odor, taste, chemical oxygen demand, total hardness, and total solids. These results should be completed by July 1996.

Preliminary Science Findings

Three recycled water samples were collected during Mir 19. All parameters tested met the Joint U.S./Russian water quality specifications except the NASA standards for turbidity, total phenols, and total organic carbon. Turbidity measurements in the Mir 19 samples ranged from 0.95 NTU to 1.91 NTU. The NASA limit for turbidity is 1 NTU. Total organic carbon (TOC) levels in the reclaimed water also exceeded NASA spacecraft limits. TOC levels ranged from 1.48 to 2.86 mg/L compared to the NASA limit of 0.5 mg/L. These levels do not exceed the Russian water quality limit of 25 mg/L. Total phenol levels were exceeded in all of the samples collected during Mir 19. These levels were 5.7 μg/L, 5.9 μg/L, and 6.0 μg/L; the standard for total phenols is 1 μg/L.

Ground supplied samples were collected prior to Mir 20, and inflight during the docked phase of STS-74. A preflight sample was collected from RSC Energia in Kalingrad, Russia on November 2, 1995. An inflight sample was taken on November 17, 1995. Tap water from Johnson Space Center was also collected for comparison. Turbidity levels on the preflight sample exceeded the Joint U.S./Russian water quality specification of 1 NTU. This sample showed a turbidity level of 11.14 NTU. Both the preflight and inflight ground supplied water samples exceeded the U.S. standard of 0.5 mg/L for TOC. TOC levels ranged were 6.99 mg/L in the inflight sample and 8.72 in the preflight sample. Also, chloroform concentrations in the ground supplied water samples (205.5 μg/L and 184.9 μg/L) exceeded the current EPA maximum contaminant level of 100 μg/L for chloroform. At this time, there are no NASA or Russian Space Agency (RSA) specifications for these compounds. Ammonia (as nitrogen) was the only ionic species detected at levels exceeding the Joint U.S./Russian water quality specification. One sample had an ammonia (as nitrogen) concentration of 2.37 mg/L compared to the limit of 2.0 mg/L.

Humidity condensate samples were collected during Mir 19 and Mir 20. One sample was collected during Mir 19 and four samples were collected during Mir 20. Three of these were collected because of a 1,2 ethanediol (ethylene glycol) coolant leak in the Mir Core Module. Ionic species identified in these samples include chloride (0.321 - 1.120 mg/L), nitrate (2.09 - 9.30 mg/L), sulfate (0.237 - 1.01 mg/L), lithium (0.51 - 0.64 mg/L), sodium (1.25 - 9.38 mg/L), potassium (0.40 - 0.57 mg/L), ammonium (4.93 - 61.8 mg/L), magnesium (0.34 - 1.15 mg/L) and calcium (0.73 - 2.49 mg/L). Volatile organic compounds detected above method detection limits include acetaldehyde, acetone, 2-butanone, carbon disulfide, chloroform, diethyl ether, iodomethane, perfluoro-1,3-dimethylcyclohexanone, methylene chloride, and o-xylene. Approximately sixty different semivolatile organic compounds were present in the Mir humidity condensate. Those detected at the highest levels include 3-t-butylphenol (70.6-195.8 μg/L), diethylene glycol monoethyl ether (50.1 - 96.5 μg/L), n,n-Dimethylacetamide (58.2 - 132.1 μg/L), n,n-dimethylformamide (nondetectable - 701.8 μg/L), 2-Ethoxyethanol (nondetectable - 147.7 μg/L), 4-Ethylmorpholine (66.1 - 166.7 μg/L) and 2-Hydroxybenzothiazole (nondetectable levels - 359.7 μg/L). Methanol, 1-methoxy-2-propanol, 1,2-propanediol, formaldehyde, and 1,2 ethanediol was also detected above minimum detection limits in these samples. 1,2 Ethanediol (ethylene glycol) was nondetectable in the Mir 20 sample taken before the coolant leak and was detected at levels of 149.2 mg/L, 152.8 mg/L, and 76.8 mg/L in those samples collected after the leak.

As part of Detailed Supplementary Objective 317 (1,2) humidity condensate samples were collected onboard the Shuttle during STS-45, STS-47, and STS-68. These results were averaged and compared to the Mir humidity condensate results from those samples taken before the ethylene glycol leak. Approximately sixty compounds identified in the Shuttle condensate were not detected in the Mir condensate, and about ten compounds found in the Mir condensate were not detected in the Shuttle condensate. The average organic carbon recovery from the Shuttle condensate samples was 72.0% compared to the Mir condensate average organic carbon recovery of 21.0% (excluding those samples contaminated with ethylene glycol). Alcohol, organic acid, formaldehyde, and caprolactam levels were significantly higher in the Shuttle condensate as compared to the Mir condensate. Those compounds present in larger quantities in the Mir condensate include 1,2-methoxy-2-propanol, acetaldehyde, and acetone.

Conclusions

Findings from the analysis of the reclaimed water show that the water met all requirements of the Joint NASA/RSA spacecraft water quality standards except for the NASA TOC requirement, the NASA turbidity requirement, and the NASA phenol requirement. Although the exceeding of these specifications is a concern, the reclaimed water is considered potable. The ground supplied water is also considered potable, although it exceeded the NASA requirements for TOC, turbidity, and ammonia and the U.S. EPA maximum contaminant levels for chloroform.

The Mir humidity condensate had significantly lower levels of alcohols and organic acids as compared to the Shuttle condensate. TOC levels were also much lower than levels previously measured in the Shuttle. Compounds detected in the Mir condensate which were

much higher than those measured on the Shuttle include acetaldehyde, acetone, 1,2-ethanediol, and 1,2-methoxy-2-propanol. One source of 1,2-methoxy-2-propanol is from the Sharpie® markers used in a number of experiments onboard Mir. Also, the high levels of 1,2 ethanediol were due to a leak of 1,2 ethanediol from a coolant loop in the Mir core module. The ability to collect humidity condensate was critical in planning the operational response to this leak.

REFERENCES

Muckle, S.V., Schultz, J.R., and Sauer, R.L., Characterization of Spacecraft Humidity Condensate, SAE #932176, 23rd International Conference on Environmental Systems, Colorado Springs, Colorado, July 1993.

Straub, J.E., Schultz, J.R., Michalek, W.F., and Sauer, R.L., Further Characterization and Multifiltration Treatment of Shuttle Humidity Condensate, SAE #951685, 25th International Conference on Environmental Systems, San Diego, California, July 1995.

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Straub, J.E., Schultz, J.R., Michalek, W.F., and Sauer, R.L., Further Characterization and Multifiltration Treatment of Shuttle Humidity Condensate, SAE #951685, 25th International Conference on Environmental Systems, San Diego, California, July 1995.

TABLE 1. DATA COLLECTION SESSIONS/FUNCTIONAL OBJECTIVES

Mission	Session Name	FO#	HW#	Scheduled Day	Actual Day	Scheduled Subject(s)	Actual Subject(s)	Samples/ Parameters	Method
Mir 19	hot water collection	2,3	2,3,4,5	MD8	MD23 27 Jul 95	N/A	N/A	821.5 ml of water Split: 537.5 ml US, 284 ml RSA	N/A
Mir 19	hot water collection	2,3	2,3,4,5	MD32	MD42 15 Aug 95	N/A	N/A	1003 ml of water Split: 582.5 ml US, 448 ml RSA	N/A
Mir 19	hot water collection	2,3	2,3,4,5	MD55	MD55 28 Aug 95	N/A	N/A	1024 ml of water Split: 582.5 ml US, 442 ml RSA	N/A
Mir 19	humidity condensate collection	4	6	unknown	MD62 4 Sep 95	N/A	N/A	21 ml of condensate Split: 21 ml US, 0 ml RSA	N/A
Mir 20	ground supplied water collection at RSC-Energia, Kalingrad, Russia	1	N/A	N/A	2 Nov 95	N/A	N/A	1000 ml of water Split: 1000 ml US, 0 ml RSA	N/A
Mir 20	humidity condensate collection	4	6	unknown	MD60 16 Nov 95	N/A	N/A	79 ml of condensate Split: 74 ml US, 5 ml RSA	N/A
STS-74	SVO-ZV (ground supplied water) collection	2,3	2,3,4,5	FD7	FD7 17 Nov 95	N/A	N/A	920 ml of water Split: 537.5 ml US, 383 ml RSA	N/A
STS-74	humidity condensate collection	4	6	FD7	FD6 16 Nov 95	N/A	N/A	855.5 ml of condensate Split: 537.5 ml US, 318 ml RSA	N/A
STS-74	humidity condensate collection	4	6	FD7	FD6 16 Nov 95	N/A	N/A	920.5 ml of condensate Split: 537.5 ml US, 383 ml RSA	N/A
STS-74	humidity condensate collection	4	6	FD7	FD6 16 Nov 95	N/A	N/A	976.5 ml of condensate Split: 582.5 ml US, 400 ml RSA	N/A

TABLE 2. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATION FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH1	5.5-9.0 pH units	5.5-9.0 pH units
Color2	15 Pt-Co units	20 degrees
Taste2	3 TTN	2 grade
Odor2	3 TON	2 grade
Total Dissolved Solids3	100-1,000 mg/L	100-1,000 mg/L
Turbidity2	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20oC	5% volume @1 ATM, 20oC
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	200 mg/L	200 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual4	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria2	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 µg/L	200 µg/L
Total Phenols	1 µg/L	1 µg/L
Total Organic Carbon (TOC)	500 µg/L	25,000 µg/L
Uncharacterized TOC	100 µg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

1 pH range applies only before iodination

2 Parameters have different values for U.S. and Russian supplied water

3 The 100 mg/L limit applies to the water before mineralization.

After mineralization, this parameter will not exceed 1,000 mg/L.

4 Range of required level if iodine is used as a biocide

TABLE 3. REGENERATED WATER RESULTS

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 19 hot regenerated water 7/27/95 95-1122-01	Mir 19 hot regenerated water 8/15/95 95-1122-02	Mir 19 hot regenerated water 8/28/95 95-1122-03
pH		5.5-9.0	NASA/RSA	7.06	6.77	6.75
Color	degrees	15 Pt-Co units/20	NASA/RSA	*	*	*
Odor at 20°C	grade	3 TON/2	NASA/RSA	*	*	*
Taste at 20°C	grade	3 TTN/2	NASA/RSA	*	*	*
Total Solids	mg/L	1.5	NASA/RSA	*	*	*
Total Hardness	meq/L	7	NASA/RSA	*	*	*
Chemical Oxygen Demand	mg O_2/L	no limit/100	NASA/RSA	*	*	*
Conductivity	µS/cm			60.6	39.3	36.5
Turbidity	NTU	1/1.5 mg/L	NASA/RSA	1.74	1.91	0.95
Anions (CZE)						
Chloride	mg/L	200	NASA/RSA	0.92	0.42	0.20
Nitrate	mg/L	10	NASA/RSA	0.65	ND	ND
Phosphate	mg/L			ND	ND	ND
Fluoride	mg/L	1.5	NASA/RSA	ND	ND	ND
Sulfate	mg/L	250	NASA/RSA	0.88	0.22	ND
Cations (CZE)						
Lithium	mg/L			ND	ND	ND
Sodium	mg/L			0.95	0.87	0.95

TABLE 3 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 19 hot regenerated water 7/27/95 95-1122-01	Mir 19 hot regenerated water 8/15/95 95-1122-02	Mir 19 hot regenerated water 8/28/95 95-1122-03
Cations (CZE) contd.						
Potassium	mg/L			ND	ND	ND
Ammonium (as N)	mg/L	2	NASA/RSA	ND	0.30	0.34
Magnesium	mg/L			0.96	0.33	0.33
Calcium	mg/L			8.44	6.15	6.54
Metals						
Calcium	µg/L	100000	NASA/RSA	NA	NA	NA
Magnesium	µg/L	50000	NASA/RSA	NA	NA	NA
Sodium	µg/L			NA	NA	NA
Potassium	µg/L			NA	NA	NA
Silver	µg/L	5000	NASA/RSA	55.0	62.0	65.0
Aluminum	µg/L			NA	NA	NA
Arsenic	µg/L	10	NASA/RSA	NA	NA	NA
Barium	µg/L	1000	NASA/RSA	NA	NA	NA
Chromium	µg/L	50	NASA/RSA	NA	NA	NA
Cobalt	µg/L			NA	NA	NA
Copper	µg/L	1000	NASA/RSA	NA	NA	NA
Iron	µg/L	300	NASA/RSA	NA	NA	NA
Mercury	µg/L	2	NASA/RSA	NA	NA	NA
Manganese	µg/L	50	NASA/RSA	NA	NA	NA
Molybdenum	µg/L			NA	NA	NA
Nickel	µg/L	50	NASA/RSA	NA	NA	NA
Lead	µg/L	50	NASA/RSA	NA	NA	NA
Selenium	µg/L	10	NASA/RSA	NA	NA	NA
Zinc	µg/L	5000	NASA/RSA	NA	NA	NA
Silicon	µg/L			NA	NA	NA

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Total Organic Carbon						
TIC (OI 1010)	mg/L			5.50	3.45	3.07
POC (OI 1010)	mg/L			NA	NA	NA
NPOC (OI 1010)	mg/L			2.54	1.83	1.04
TOC (OI 1010)	mg/L			NA	NA	NA
TOC (Sievers 800)	mg/L	0.5/25	NASA/RSA	2.79	2.86	1.48
Volatile Organics						
Acetaldehyde	µg/L			ND	ND	ND
Acetone	µg/L			99.60	131.70	78.2
Bromodichloromethane	µg/L	100	EPA	ND	ND	ND
Bromoform	µg/L	100	EPA	ND	ND	ND
2-Butanone	µg/L			ND	ND	ND
Carbon disulfide	µg/L	1000	EPA	ND	ND	ND
Chloroform	µg/L	100	EPA	8.61	2.17	ND
1,4-Dichlorobenzene	µg/L	75	EPA	ND	ND	ND
Dibromochloromethane	µg/L	100	EPA	ND	ND	ND
Dichlorodifluoromethane	µg/L	1000	EPA	ND	ND	ND
Diethyl ether	µg/L			ND	ND	ND
Iodomethane	µg/L			ND	ND	ND
Methylene chloride	µg/L	5	EPA	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L			ND	ND	ND
m&p-Xylene	µg/L	10,000	EPA	ND	ND	ND
o-Xylene	µg/L	10000	EPA	ND	ND	ND
Extractable Organics						
Acetophenone	µg/L			3.8	ND	3.4
2-Aminonaphthalene	µg/L			ND	0.5	ND

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Extractable Organics contd.						
Aniline	µg/L			0.5	0.9	0.9
Azobenzene	µg/L			ND	ND	ND
Benzaldehyde	µg/L			2.2	2.3	2.8
Benzoic acid	µg/L			ND	ND	ND
Benzothiazole	µg/L			7.8	12.6	23.3
Benzyl alcohol	µg/L			1.9	1.0	2.2
2-Butoxyethanol	µg/L			ND	ND	ND
Butylated hydroxyanisole (BHA)	µg/L			ND	ND	ND
3-t-Butylphenol	µg/L			ND	0.4	ND
Caffeine	µg/L			ND	ND	ND
Cyclohexanone	µg/L			0.4	ND	ND
Decamethylcyclopentasiloxane	µg/L			ND	ND	ND
1,4 Diacetylbenzene	µg/L			ND	ND	ND
1,3- Dichlorobenzene	µg/L	600	EPA	ND	ND	ND
1,4-Dichlorobenzene	µg/L	75	EPA	ND	0.9	ND
Dibutyl phthalate	µg/L			ND	ND	ND
Di-n-butylamine	µg/L			ND	ND	ND
n,n-Dibutylformamide	µg/L			ND	ND	ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L			ND	ND	ND
2,4-Di-t-butylphenol	µg/L			ND	ND	ND
n,n-Diethylformamide	µg/L			ND	ND	ND
Diethylene glycol monoethyl ether	µg/L			ND	ND	ND
Diethyl phthalate	µg/L	5000	EPA	ND	ND	ND
n,n-Dimethylacetamide	µg/L			ND	ND	ND
Dimethylthiocarbamoyl chloride	µg/L			ND	ND	ND
Dimethylcarbamoyl chloride	µg/L			1.7	2.1	2.0
Dimethyl phthalate	µg/L			ND	ND	ND

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Extractable Organics contd.						
Dioctyl phthalate	µg/L	700	EPA	ND	ND	ND
Dipropylene glycol methyl ether	µg/L			ND	ND	ND
Dodecamethylcyclohexasiloxane	µg/L			ND	0.2	ND
Eicosane	µg/L			ND	ND	ND
2-Ethylhexanoic acid	µg/L			ND	3.9	ND
2-Ethyl-1-hexanol	µg/L			ND	ND	ND
bis-Ethylhexyl adipate	µg/L			ND	ND	ND
4-Ethylmorpholine	µg/L			ND	ND	ND
1-Formypiperidine	µg/L			ND	ND	ND
Heneicosane	µg/L			ND	ND	ND
2-Hexanol	µg/L			ND	ND	ND
2-Hydroxybenzothiazole	µg/L			3.4	3.6	5.5
4-Hydroxy-4-methyl-2-pentanone	µg/L			2.1	1.9	3.0
Isophorone	µg/L	100	EPA HA	ND	ND	ND
Menthol	µg/L			ND	ND	ND
Methyl sulfone	µg/L			ND	ND	ND
4-Methylphenol	µg/L			0.1	0.1	ND
1-Methyl-2-pyrrolidinone	µg/L			ND	ND	ND
2-Methylthiobenzothiazole	µg/L			8.8	12.5	13.8
Monomethyl phthalate	µg/L			ND	ND	ND
Octadecanol	µg/L			ND	ND	ND
Octamethylcyclotetrasiloxane	µg/L			ND	ND	ND
4-t-Octylphenol	µg/L			ND	ND	ND
Pentacosane	µg/L			ND	ND	ND
Phenol	µg/L	1/4000	NASA/EPA HA	5.7	6.0	5.9
s-Phenethyl alcohol	µg/L			ND	ND	ND
2-Phenylphenol	µg/L			ND	ND	ND
2-Phenyl-2-propanol	µg/L			ND	ND	ND

TABLE 3 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 19 hot regenerated water 7/27/95 95-1122-01	Mir 19 hot regenerated water 8/15/95 95-1122-02	Mir 19 hot regenerated water 8/28/95 95-1122-03
Extractable Organics contd.						
N-Phenyl-2-naphthylamine	µg/L			ND	0.3	1.8
1-alpha-Terpineol	µg/L			ND	ND	ND
Tetramethylthiourea	µg/L			3.0	3.2	3.4
Tetramethylurea	µg/L			3.0	ND	ND
Toluene	µg/L	1000	EPA	ND	ND	ND
Tricosane	µg/L			ND	ND	ND
Triethyl Phosphate	µg/L			ND	ND	ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L			ND	0.1	ND
Urethane	µg/L			2.3	2.8	2.2
Alcohols (DAI/GC/MS)						
Ethanol	µg/L			ND	ND	ND
Methanol	µg/L			ND	ND	ND
1-Methoxy-2-propanol	µg/L			NA	NA	NA
Glycols (DAI/GC/MS)						
1,2-Propanediol	µg/L			ND	ND	ND
1,2-Ethanediol	µg/L	7.0	EPA HA	ND	ND	ND
Organic Acids (SPE/GC/MS)						
Acetic acid	µg/L			ND	ND	ND
Propanoic acid	µg/L			ND	ND	ND
Aldehydes						
Formaldehyde	µg/L	1000	EPA HA	ND	ND	ND

TABLE 3 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 19 hot regenerated water 7/27/95 95-1122-01	Mir 19 hot regenerated water 8/15/95 95-1122-02	Mir 19 hot regenerated water 8/28/95 95-1122-03
Carboxylates (CZE)						
Acetate	mg/L			ND	ND	ND
Lactate	mg/L			ND	ND	ND
Amines (CZE)						
Methylamine	mg/L			ND	ND	ND
Urea	µg/L			ND	ND	ND
Organic Carbon Recovery	percent			3.19	3.98	6.16

NA=not analyzed
ND=not detected
*=data not available

TABLE 4. GROUND SUPPLIED WATER RESULTS

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 20 ground supplied water 11/17/95 95-1122-04	RSC Processed tap water 11/2/95 95-1128-01	JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01
pH		Russia	5.5-9.0	NASA/RSA	NA	7.68	7.33
Color	degrees	Russia	15 Pt-Co units/20	NASA/RSA	*	*	*
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	*	*	*
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	*	*	*
Total Solids	mg/L	Russia	1.5	NASA/RSA	*	*	*
Total Hardness	meq/L	Russia	7	NASA/RSA	*	*	*
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	*	*	*
Conductivity	µS/cm	U.S.			NA	227.0	344.0
Turbidity	NTU	U.S.	1/1.5 mg/L	NASA/RSA	NA	11.14	0.424
Anions (CZE)		U.S.					
Chloride	mg/L		200	NASA/RSA	13.2	9.14	29.1
Nitrate	mg/L		10	NASA/RSA	6.48	ND	ND
Phosphate	mg/L				ND	ND	ND
Fluoride	mg/L		1.5	NASA/RSA	ND	0.20	0.68
Sulfate	mg/L		250	NASA/RSA	14.1	7.5	20.7
Cations (CZE)		U.S.					
Lithium	mg/L				ND	ND	ND
Sodium	mg/L				5.96	7.48	28.0

TABLE 4 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 20 ground supplied water 11/17/95 95-1122-04	RSC Processed tap water 11/2/95 95-1128-01	JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01
Cations (CZE) contd.		U.S.					
Potassium	mg/L				2.45	2.40	4.36
Ammonium (as N)	mg/L		2	NASA/RSA	ND	2.37	ND
Magnesium	mg/L				11.9	6.51	3.42
Calcium	mg/L				30.0	25.3	39.3
Metals		U.S.					
Calcium	µg/L		100000	NASA/RSA	NA	30800	41600
Magnesium	µg/L		50000	NASA/RSA	NA	7650	3440
Sodium	µg/L				NA	4900	21900
Potassium	µg/L				NA	1820	3710
Silver	µg/L		5000	NASA/RSA	77.0	441.0	1.2
Aluminum	µg/L				NA	43.1	85.9
Arsenic	µg/L		10	NASA/RSA	NA	3.8	3.1
Barium	µg/L		1000	NASA/RSA	NA	66.0	102.0
Chromium	µg/L		50	NASA/RSA	NA	0.5	ND
Cobalt	µg/L				NA	ND	1.2
Copper	µg/L		1000	NASA/RSA	NA	4.8	171.0
Iron	µg/L		300	NASA/RSA	NA	54.4	37.9
Mercury	µg/L		2	NASA/RSA	NA	0.9	ND
Manganese	µg/L		50	NASA/RSA	NA	21.3	3.7
Molybdenum	µg/L				NA	1.3	3.0
Nickel	µg/L		50	NASA/RSA	NA	1.5	2.3
Lead	µg/L		50	NASA/RSA	NA	0.6	2.5
Selenium	µg/L		10	NASA/RSA	NA	4.8	4.0
Zinc	µg/L		5000	NASA/RSA	NA	5.0	6.7
Silicon	µg/L				NA	NA	NA

TABLE 4 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 20 ground supplied water 11/17/95 95-1122-04	RSC Processed tap water 11/2/95 95-1128-01	JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01
Total Organic Carbon							
TIC (OI 1010)	mg/L	U.S.			20.44	26.71	21.71
POC (OI 1010)	mg/L	U.S.			NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.			8.40	10.99	3.90
TOC (OI 1010)	mg/L	U.S.			NA	NA	NA
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	6.99	8.72	2.66
Volatile Organics		U.S.					
Acetaldehyde	µg/L				3034.0	ND	ND
Acetone	µg/L				125.9	79.7	123.2
Bromodichloromethane	µg/L		100	EPA	4.9	4.91	50.5
Bromoform	µg/L		100	EPA	ND	ND	1.9
2-Butanone	µg/L				ND	ND	ND
Carbon disulfide	µg/L		1000	EPA	ND	ND	ND
Chloroform	µg/L		100	EPA	205.5	184.9	112.0
1,4-Dichlorobenzene	µg/L		75	EPA	ND	ND	ND
Dibromochloromethane	µg/L		100	EPA	ND	ND	19.3
Dichlorodifluoromethane	µg/L		1000	EPA	ND	ND	ND
Diethyl ether	µg/L				ND	ND	ND
Iodomethane	µg/L				ND	ND	ND
Methylene chloride	µg/L		5	EPA	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L				ND	ND	ND
m&p-Xylene	µg/L		10,000	EPA	ND	ND	ND
o-Xylene	µg/L		10000	EPA	ND	ND	ND
Extractable Organics		U.S.					
Acetophenone	µg/L				0.1	ND	ND
Aniline	µg/L				ND	ND	ND

TABLE 4 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 20 ground supplied water 11/17/95 95-1122-04	RSC Processed tap water 11/2/95 95-1128-01	JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01
Extractable Organics contd.		U.S.					
Azobenzene	µg/L				ND	ND	ND
Benzaldehyde	µg/L				ND	ND	ND
Benzoic acid	µg/L				ND	ND	ND
Benzothiazole	µg/L				6.9	ND	ND
Benzyl alcohol	µg/L				ND	ND	ND
2-Butoxyethanol	µg/L				ND	ND	ND
Butylated hydroxyanisole (BHA)	µg/L				ND	ND	ND
3-t-Butylphenol	µg/L				ND	ND	ND
Caffeine	µg/L				ND	ND	ND
Cyclohexanone	µg/L				ND	ND	ND
Decamethylcyclopentasiloxane	µg/L				ND	ND	ND
1,4 Diacetylbenzene	µg/L				ND	ND	ND
1,3- Dichlorobenzene	µg/L		600	EPA	ND	ND	ND
1,4-Dichlorobenzene	µg/L		75	EPA	ND	ND	ND
Dibutyl phthalate	µg/L				ND	ND	ND
Di-n-butylamine	µg/L				ND	ND	ND
n,n-Dibutylformamide	µg/L				ND	ND	ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L				ND	ND	ND
2,4-Di-t-butylphenol	µg/L				0.8	ND	ND
n,n-Diethylformamide	µg/L				ND	ND	ND
Diethylene glycol monoethyl ether	µg/L				3.2	ND	ND
Diethyl phthalate	µg/L		5000	EPA	ND	ND	ND
n,n-Dimethylacetamide	µg/L				ND	ND	ND
n,n-Dimethylbenzylamine	µg/L				ND	ND	ND
Dimethylcarbamyl chloride	µg/L				1.6	ND	ND
n,n-Dimethylformamide	µg/L				ND	ND	ND
Dimethylthiocarbamoyl chloride	µg/L				ND	ND	ND

TABLE 4 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 20 ground supplied water 11/17/95 95-1122-04	RSC Processed tap water 11/2/95 95-1128-01	JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01
Extractable Organics contd.		U.S.					
Dimethylcarbamoyl chloride	µg/L				1.6	ND	1.0
Dimethyl phthalate	µg/L				ND	ND	ND
Dioctyl phthalate	µg/L		700	EPA	ND	ND	2.2
Dipropylene glycol methyl ether	µg/L				ND	ND	ND
Dodecamethylcyclohexasiloxane	µg/L				0.2	ND	ND
Eicosane	µg/L				ND	ND	ND
2-Ethoxyethanol	µg/L				ND	ND	ND
2-Ethylhexanoic acid	µg/L				ND	ND	ND
2-Ethyl-1-hexanol	µg/L				ND	ND	ND
bis-Ethylhexyl adipate	µg/L				0.7	ND	ND
4-Ethylmorpholine	µg/L				ND	ND	ND
1-Formypiperidine	µg/L				ND	ND	ND
Heneicosane	µg/L				ND	ND	ND
2-Hexanol	µg/L				ND	ND	ND
2-Hydroxybenzothiazole	µg/L				2.9	ND	ND
4-Hydroxy-4-methyl-2-pentanone	µg/L				ND	ND	ND
Isophorone	µg/L		100	EPA HA	ND	ND	ND
Menthol	µg/L				ND	ND	ND
2-Mercaptobenzothiazole	µg/L				ND	ND	ND
Methyl sulfone	µg/L				ND	ND	ND
2-Methyl-2,4-pentanediol	µg/L				ND	ND	ND
4-Methylphenol	µg/L				ND	ND	ND
1-Methyl-2-pyrrolidinone	µg/L				ND	ND	ND
2-Methylthiobenzothiazole	µg/L				0.7	0.1	ND
Monomethyl phthalate	µg/L				ND	ND	ND
Octadecanol	µg/L				ND	ND	ND
Octamethylcyclotetrasiloxane	µg/L				ND	ND	ND

TABLE 4 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 20 ground supplied water 11/17/95 95-1122-04	RSC Processed tap water 11/2/95 95-1128-01	JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01
Extractable Organics contd.		U.S.					
4-t-Octylphenol	µg/L				0.1	ND	ND
Pentacosane	µg/L				ND	ND	ND
Phenol	µg/L		1/4000	NASA/EPA HA	ND	ND	ND
Phenoxyacetic acid	µg/L				ND	ND	ND
s-Phenethyl alcohol	µg/L				ND	ND	ND
2-Phenylphenol	µg/L				ND	ND	ND
2-Phenyl-2-propanol	µg/L				ND	ND	ND
N-Phenyl-2-naphthylamine	µg/L				ND	ND	ND
Phenyl sulfone	µg/L				ND	ND	ND
1-alpha-Terpineol	µg/L				ND	ND	ND
Tetramethylsuccinonitrile	µg/L				ND	ND	ND
Tetramethylthiourea	µg/L				ND	ND	ND
Tetramethylurea	µg/L				ND	ND	ND
Toluene	µg/L		1000	EPA	2.3	ND	0.4
Tricosane	µg/L				ND	ND	ND
Triethyl Phosphate	µg/L				ND	ND	ND
Triethylamine	µg/L				ND	ND	ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L				ND	0.2	ND
Urethane	µg/L				ND	ND	ND
Alcohols (DAI/GC/MS)		U.S.					
Ethanol	µg/L				ND	ND	ND
Methanol	µg/L				ND	ND	ND
1-Methoxy-2-propanol	µg/L				NA	NA	NA
1,2-Propanediol	µg/L				ND	ND	ND
1,2-Ethanediol	µg/L		7000.0	EPA HA	ND	ND	ND

TABLE 4 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 20 ground supplied water 11/17/95 95-1122-04	RSC Processed tap water 11/2/95 95-1128-01	JSC Bldg 37 Room 1132 tap water 11/29/95 95-1129-01
Organic Acids (SPE/GC/MS)		U.S.					
Acetic acid	µg/L				ND	ND	ND
Propanoic acid	µg/L				ND	ND	ND
Aldehydes		U.S.					
Formaldehyde	µg/L		1000	EPA HA	ND	ND	17.7
Carboxylates (CZE)		U.S.					
Acetate	mg/L				ND	ND	ND
Lactate	mg/L				ND	ND	ND
Amines (CZE)							
Methylamine	mg/L				ND	ND	ND
Urea	µg/L	U.S.			ND	ND	ND
Organic Carbon Recovery	percent	U.S.			25.25	0.79	3.82

NA=not analyzed
ND=not detected
*=data not available

TABLE 5. HUMIDITY CONDENSATE RESULTS

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Mir 19 Russian sampler humidity condensate 9/4/95 95-0928-01	Mir 20 Russian sampler humidity condensate 10/30/95 95-1122-08	Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05	Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06	Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07
pH		Russia	NA	6.79	6.57	6.28	6.95
Color	degrees	Russia	NA	NA	NA	NA	NA
Odor at 20°C	grade	Russia	NA	NA	NA	NA	NA
Taste at 20°C	grade	Russia	NA	NA	NA	NA	NA
Total Solids	mg/L	Russia	NA	NA	NA	NA	NA
Total Hardness	meq/L	Russia	NA	NA	NA	NA	NA
Chemical Oxygen Demand	mg O_2/L	Russia	195	*	*	*	*
Conductivity	µS/cm	U.S.	NA	168.0	160.0	156.0	150.0
Turbidity	NTU	U.S.	NA	8.0	8.04	12.2	7.43
Anions (CZE)		U.S.					
Chloride	mg/L		1.12	0.395	0.45	0.7710	0.32
Nitrate	mg/L		ND	ND	2.10	1.85	0.47
Phosphate	mg/L		ND	ND	ND	ND	ND
Flouride	mg/L		ND	ND	ND	ND	ND
Sulfate	mg/L		1.01	0.26	ND	0.24	ND
Bromide	mg/L		ND	ND	ND	ND	ND
Nitrite	mg/L		ND	ND	ND	ND	ND

TABLE 5 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Mir 19 Russian sampler humidity condensate 9/4/95 95-0928-01	Mir 20 Russian sampler humidity condensate 10/30/95 95-1122-08	Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05	Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06	Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07
Cations (CZE)		U.S.					
Lithium	mg/L		ND	ND	0.62	0.64	0.51
Sodium	mg/L		1.25	1.44	9.38	1.81	1.29
Potassium	mg/L		0.57	0.45	0.40	ND	ND
Ammonium (as N)	mg/L		4.93	17.4	48	14.4	11.0
Magnesium	mg/L		1.15	0.36	0.49	0.48	0.34
Calcium	mg/L		1.22	0.73	2.49	1.02	0.82
Metals		U.S.					
Calcium	µg/L		NA	NA	NA	N/A	NA
Magnesium	µg/L		NA	NA	NA	N/A	NA
Sodium	µg/L		NA	NA	NA	NA	NA
Potassium	µg/L		NA	NA	NA	NA	NA
Silver	µg/L		NA	NA	56.0	100.0	55.0
Aluminum	µg/L		NA	NA	NA	NA	NA
Arsenic	µg/L		NA	NA	NA	NA	NA
Barium	µg/L		NA	NA	NA	NA	NA
Chromium	µg/L		NA	NA	NA	NA	NA
Cobalt	µg/L		NA	NA	NA	NA	NA
Copper	µg/L		NA	NA	NA	NA	NA
Iron	µg/L		NA	NA	NA	NA	NA
Mercury	µg/L		NA	NA	NA	NA	NA
Manganese	µg/L		NA	NA	NA	NA	NA
Molybdate	µg/L		NA	NA	NA	NA	NA
Nickel	µg/L		NA	NA	NA	NA	NA
Lead	µg/L		NA	NA	NA	NA	NA
Selenium	µg/L		NA	NA	NA	NA	NA

TABLE 5 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Mir 19 Russian sampler humidity condensate 9/4/95 95-0928-01	Mir 20 Russian sampler humidity condensate 10/30/95 95-1122-08	Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05	Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06	Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07
Metals contd.		U.S.					
Zinc	µg/L		NA	NA	NA	NA	NA
Silicon	µg/L		NA	NA	NA	NA	NA
Cadmium	µg/L		NA	NA	NA	NA	NA
Lithium	µg/L		NA	NA	NA	NA	NA
Total Organic Carbon							
TIC (OI 1010)	mg/L	U.S.	13.01	28.92	19.72	24.62	24.28
POC (OI 1010)	mg/L	U.S.	3.93	NA	NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.	14.52	31.96	72.18	74.72	46.65
TOC (OI 1010)	mg/L	U.S.	18.45	NA	NA	NA	NA
TOC (Sievers 800)	mg/L	U.S.	17.55	36.82	70.85	79.79	44.03
Volatile Organics		U.S.					
Acetaldehyde	µg/L		ND	ND	2538.2	2563.2	2145.6
Acetone	µg/L		1613.6	11.6	78.1	73.8	75.0
Bromodichloromethane	µg/L		ND	ND	ND	ND	ND
Bromoform	µg/L		ND	ND	ND	ND	ND
2-Butanone	µg/L		4.71	ND	ND	ND	ND
Carbon disulfide	µg/L		ND	2.0	ND	ND	ND
Chloroform	µg/L		ND	ND	ND	1.4	ND
1,4-Dichlorobenzene	µg/L		ND	ND	ND	ND	ND
Dibromochloromethane	µg/L		ND	ND	ND	ND	ND
1,2 Dichlorobenzene	µg/L		ND	ND	ND	ND	ND
Dichlorodifluoromethane	µg/L		ND	ND	ND	ND	ND
Diethyl ether	µg/L		ND	ND	2.1	ND	ND
2,6-Dimethyl-4-Heptanone	µg/L		ND	ND	ND	ND	ND

TABLE 5 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Mir 19 Russian sampler humidity condensate 9/4/95 95-0928-01	Mir 20 Russian sampler humidity condensate 10/30/95 95-1122-08	Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05	Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06	Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07
Volatile Organics contd.		U.S.					
Ethyl butyrate	µg/L		ND	ND	ND	ND	ND
Ethyl valerate	µg/L		ND	ND	ND	ND	ND
2-Heptanone	µg/L		ND	ND	ND	ND	ND
4-Heptanone	µg/L		ND	ND	ND	ND	ND
Iodomethane	µg/L		1.3	ND	ND	ND	ND
Methylene chloride	µg/L		28296	1.7	ND	ND	ND
4-Methyl-2-Pentanone			ND	ND	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L		13.0	ND	ND	ND	ND
Tetrachloroethene	µg/L		ND	ND	ND	ND	ND
Toluene	µg/L		ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L		ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	µg/L		ND	ND	ND	ND	ND
1,1,1-Trichloroethane	µg/L		ND	ND	ND	ND	ND
m&p-Xylene	µg/L		ND	ND	ND	ND	ND
o-Xylene	µg/L		ND	1.5	ND	ND	ND
Extractable Organics		U.S.					
Acetophenone	µg/L		3.3	23.2	2.7	2.8	3.4
Adipic acid, bis-2-ethylhexyl ester	µg/L		ND	ND	ND	ND	ND
Adipic acid, diisopropyl ester	µg/L		ND	ND	ND	ND	ND
Aniline	µg/L		ND	ND	ND	ND	ND
Azobenzene	µg/L		ND	ND	ND	ND	ND
Benzaldehyde	µg/L		ND	ND	ND	ND	ND
Benzoic acid	µg/L		ND	ND	ND	ND	ND
Benzothiazole	µg/L		131.6	60.1	15.6	16.2	5.1
Benzyl alcohol	µg/L		ND	ND	ND	ND	ND

TABLE 5 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Mir 19 Russian sampler humidity condensate 9/4/95 95-0928-01	Mir 20 Russian sampler humidity condensate 10/30/95 95-1122-08	Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05	Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06	Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07
Extractable Organics contd.		U.S.					
2-Butoxyethanol	µg/L		ND	ND	ND	ND	ND
2-(2-Butoxyethoxy) ethanol	µg/L		ND	ND	ND	ND	ND
2-(2-Butoxyethoxy) ethanol acetate	µg/L		ND	ND	ND	ND	ND
Butylated hydroxyanisole (BHA)	µg/L		ND	4.6	2.7	3.2	3.4
n-Butylbenzenesulfonamide	µg/L		ND	ND	ND	ND	ND
n-Butyl Palmitate	µg/L		ND	ND	ND	ND	ND
3-t-Butylphenol	µg/L		70.6	195.8	118.6	141.7	156.8
Caffeine	µg/L		ND	2.7	ND	ND	ND
Caprolactam	µg/L		ND	ND	ND	ND	ND
Trans-Cinnamic Acid	µg/L		ND	ND	ND	ND	ND
Tris-2-Chloroethyl phosphate	µg/L		ND	ND	ND	ND	ND
Cyclohexanone	µg/L		ND	3.1	2.8	3.8	3.3
Decamethylcyclopentasiloxane	µg/L		1.0	ND	ND	0.1	ND
Decanoic Acid	µg/L		ND	ND	ND	ND	ND
1,4 Diacetylbenzene	µg/L		ND	ND	0.2	0.7	1.8
1,3- Dichlorobenzene	µg/L		ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L		ND	ND	ND	ND	ND
Dibutyl phthalate	µg/L		ND	ND	ND	ND	ND
Di-n-butylamine	µg/L		ND	ND	13.1	13.7	13.3
n,n-Dibutylformamide	µg/L		ND	0.8	1.4	1.7	2.9
2,6-Di-t-butyl-1,4-benzoquinone	µg/L		ND	2.0	5.1	5.4	5.9
2,4-Di-t-butylphenol	µg/L		ND	ND	1.8	1.2	1.5
n,n-Diethylformamide	µg/L		ND	15.8	15.8	15.5	16.7
Diethylene glycol monoethyl ether	µg/L		ND	50.1	63.6	74.3	96.5
n,n-Diethyl-m-Toluamide	µg/L		ND	ND	ND	ND	ND
Diethyl phthalate	µg/L		ND	1.0	ND	ND	ND

TABLE 5 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Mir 19 Russian sampler humidity condensate 9/4/95 95-0928-01	Mir 20 Russian sampler humidity condensate 10/30/95 95-1122-08	Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05	Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06	Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07
Extractable Organics contd.		U.S.					
Diisobutyl phthlate	µg/L		ND	ND	ND	ND	ND
n,n-Dimethylacetamide	µg/L		ND	132.1	58.2	79.2	90.2
n,n-Dimethylbenzylamine	µg/L		ND	5.5	ND	2.2	ND
Dimethylcarbamyl chloride	µg/L		ND	6.1	2.3	2.4	3.6
n,n-Dimethylformamide	µg/L		ND	701.8	ND	267.9	318.6
Dimethylthiocarbamoyl chloride	µg/L		ND	56.1	ND	ND	ND
Dimethyl phthalate	µg/L		ND	0.5	ND	ND	ND
Dioctyl phthalate	µg/L		ND	25.4	43.2	93.6	ND
Dipropylene glycol methyl ether	µg/L		ND	52.4	67.1	67.4	62.2
Dodecamethylcyclohexasiloxane	µg/L		10.8	1.1	ND	0.4	0.1
Dodecanoic Acid	µg/L		ND	ND	ND	ND	ND
Eicosane	µg/L		ND	ND	ND	ND	ND
2-Ethoxyethanol	µg/L		ND	ND	56.6	90.4	147.7
2-Ethylhexanoic acid	µg/L		ND	ND	ND	ND	ND
2-Ethyl-1-hexanol	µg/L		ND	ND	ND	3.8	4.7
bis-Ethylhexyl adipate	µg/L		ND	ND	ND	ND	ND
4-Ethylmorpholine	µg/L		66.1	144.0	120.5	126.0	166.7
1-Formypiperidine	µg/L		ND	ND	ND	ND	0.4
Heneicosane	µg/L		ND	ND	ND	ND	ND
Heptanoic Acid	µg/L		ND	ND	ND	ND	ND
2-Hexanol	µg/L		ND	ND	ND	ND	ND
Hexanoic Acid	µg/L		ND	ND	ND	ND	ND
2-Hydroxybenzothiazole	µg/L		ND	359.7	9.3	4.6	4.4
4-Hydroxy-3-Methoxybenzaldehyde	µg/L		ND	ND	ND	ND	ND
4-Hydroxy-4-methyl-2-pentanone	µg/L		ND	30.6	28.6	28.7	46.5
Isophorone	µg/L		ND	4.6	1.6	1.7	1.7

TABLE 5 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Mir 19 Russian sampler humidity condensate 9/4/95 95-0928-01	Mir 20 Russian sampler humidity condensate 10/30/95 95-1122-08	Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05	Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06	Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07
Extractable Organics contd.		U.S.					
Menthol	µg/L		ND	5.4	2.7	3.4	3.4
2-Mercaptobenzothiazole	µg/L		ND	58.5	9.3	10.2	10.3
Methyl sulfone	µg/L		ND	16.8	16.7	15.1	16.8
Methyl 4-Hydroxybenzoic Acid	µg/L		ND	ND	ND	ND	ND
2-Methyl-2,4-pentanediol	µg/L		ND	9.3	2.4	6.9	3.9
4-Methylphenol	µg/L		ND	ND	ND	ND	ND
1-Methyl-2-pyrrolidinone	µg/L		ND	26.6	22.1	23.8	24.6
2-Methylthiobenzothiazole	µg/L		21.4	132.1	14.5	4.1	3.9
Monomethyl phthalate	µg/L		ND	ND	1.4	ND	1.5
Nonadecane	µg/L		ND	ND	ND	ND	ND
Nonanoic Acid	µg/L		ND	ND	ND	ND	ND
Octadecanol	µg/L		ND	ND	ND	ND	ND
Octamethylcyclotetrasiloxane	µg/L		ND	ND	ND	ND	ND
Octanoic Acid	µg/L		ND	ND	ND	ND	ND
4-t-Octylphenol	µg/L		ND	ND	ND	ND	ND
Pentacosane	µg/L		ND	15.0	ND	ND	ND
Pentanoic Acid	µg/L		ND	ND	ND	ND	ND
Phenol	µg/L		ND	ND	6.2	ND	6.7
Phenoxyacetic acid	µg/L		ND	17.6	19.4	57.0	35.6
s-Phenethyl alcohol	µg/L		ND	11.1	5.6	7.0	7.5
2-Phenylphenol	µg/L		ND	6.7	0.9	1.1	1.1
2-Phenyl-2-propanol	µg/L		ND	24.9	15.9	19.5	19.9
N-Phenyl-2-naphthylamine	µg/L		ND	75.3	0.3	0.5	0.5
Phenyl sulfone	µg/L		ND	48.5	ND	21.4	20.8
2-Phenoxyethanol	µg/L		ND	ND	ND	ND	ND
Propylene glycol methyl ether acetate	µg/L		ND	ND	ND	ND	ND

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Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Mir 19 Russian sampler humidity condensate 9/4/95 95-0928-01	Mir 20 Russian sampler humidity condensate 10/30/95 95-1122-08	Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05	Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06	Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07
Extractable Organics contd.		U.S.					
Stearic Acid, Butyl Ester	µg/L		ND	ND	ND	ND	ND
1-alpha-Terpineol	µg/L		ND	10.9	ND	ND	ND
Tetramethylsuccinonitrile	µg/L		ND	21.8	27.3	26.7	28.1
Tetramethylthiourea	µg/L		151.8	23.8	5.1	ND	7.7
Tetramethylurea	µg/L		ND	15.4	13.7	14.1	16.0
Tributyl Phosphate			ND	ND	ND	ND	ND
Tricosane	µg/L		ND	8.1	ND	ND	ND
1,3,5-Triazine-2,4,6(1H,3H,5H)-			ND	ND	ND	ND	ND
Triethyl Phosphate	µg/L		ND	ND	1.1	1.3	ND
Triethylamine	µg/L		ND	16.2	9.2	9.5	10.8
2,2,4-Trimethyl-1,3-pentanediol	µg/L		ND	ND	ND	ND	ND
Urethane	µg/L		ND	ND	17.2	14.2	13.6
Alcohols (DAI/GC/MS)		U.S.					
Ethanol	µg/L		ND	ND	ND	ND	ND
Methanol	µg/L		427	ND	ND	ND	ND
1-Methoxy-2-propanol	µg/L		NA	3964	ND	3262	3426
2-Propanol	µg/L		ND	ND	ND	ND	ND
Glycols (LC/MS)							
1,2-Propanediol	mg/L		1.0	ND	3.9	3.0	2.8
1,2-Ethanediol	mg/L		NA	ND	149.2	152.8	76.8
Organic Acids (SPE/GC/MS)		U.S.					
Acetic acid	µg/L		ND	ND	240.0	ND	ND
Lactic acid	µg/L		140	NA	ND	NA	ND

TABLE 5 CONTD.

Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Mir 19 Russian sampler humidity condensate 9/4/95 95-0928-01	Mir 20 Russian sampler humidity condensate 10/30/95 95-1122-08	Mir 20 EDV #1 humidity condensate 11/16/95 95-1122-05	Mir 20 EDV #2 humidity condensate 11/16/95 95-1122-06	Mir 20 EDV #3 humidity condensate 11/16/95 95-1122-07
Organic Acids (SPE/GC/MS) contd.		U.S.					
Propanoic acid	µg/L		ND	ND	ND	ND	ND
Formic Acid	µg/L		ND	NA	ND	NA	ND
Butyric	µg/L		ND	ND	ND	ND	ND
Pentanoic	µg/L		ND	ND	ND	ND	ND
Hexanoic	µg/L		ND	ND	ND	ND	ND
Heptanoic	µg/L		ND	ND	ND	ND	ND
Octanoic	µg/L		ND	ND	ND	ND	ND
Nonanoic	µg/L		ND	NA	ND	NA	ND
Decanoic			ND	NA	ND	NA	ND
Aldehydes		U.S.					
Formaldehyde	µg/L		60.4	35.0	19.5	25.5	22.0
Carboxylates (CZE)		U.S.					
Acetate	mg/L		ND	ND	0.244	0.220	ND
Lactate	mg/L		0.14	ND	ND	ND	ND
Amines (CZE)							
Methylamine	mg/L		ND	0.24	0.33	0.30	ND
Ethylamine	mg/L		ND	ND	ND	ND	ND
Urea	µg/L	U.S.	ND	ND	ND	ND	ND
Organic Carbon Recovery	percent	U.S.	32.45	8.61	89.84	86.26	78.59

NA = not analyzed
ND = not detected
* = data not available

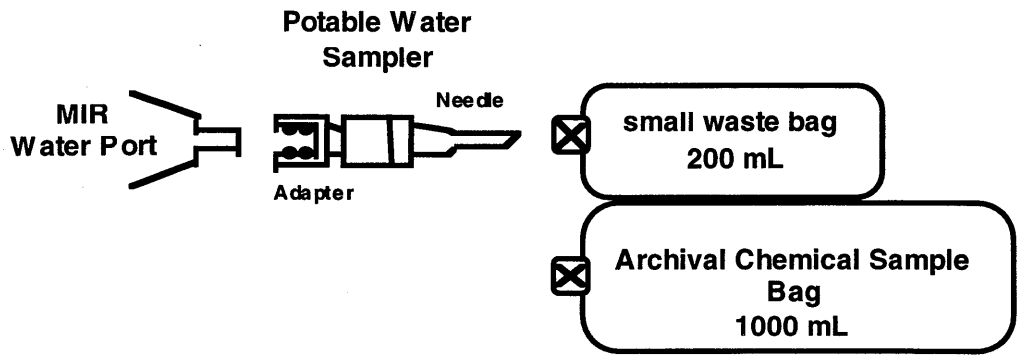

Figure 1. Sample Collection Methodology. Note: This system was also used to collect samples for microbial analysis as part of a separate experiment.