ABSTRACTS

IN SITU RESOURCE UTILIZATION (ISRU II)
TECHNICAL INTERCHANGE MEETING

November 18–19, 1997

Lunar and Planetary Institute
Houston, Texas
IN SITU RESOURCE UTILIZATION (ISRU II)
TECHNICAL INTERCHANGE MEETING

November 18–19, 1997
Lunar and Planetary Institute
Houston, Texas

Convened by
David Kaplan, NASA Johnson Space Center
R. Stephen Saunders, Jet Propulsion Laboratory

Sponsored by
National Aeronautics and Space Administration
Lunar and Planetary Institute

LPI Contribution No. 930
PREFACE

This volume contains abstracts that have been accepted for presentation at the In Situ Resource Utilization (ISRU II) Technical Interchange Meeting, November 18–19, 1997, at the Lunar and Planetary Institute, Houston, Texas.

Logistics, administration, and publication support for this meeting were provided by the staff of the Publications and Program Services Department at the Lunar and Planetary Institute.
AGENDA

Tuesday, November 18, 1997

7:30 a.m. REGISTRATION AND CONTINENTAL BREAKFAST

8:30 a.m. WELCOME AND INTRODUCTION

9:00 a.m. Connolly J. F.*
HEDS Strategy for Robotic Mars Mission

9:30 a.m. Stancati M. L.* Niehoff J. C. Jacobs M. K. German D.
Mars In Situ Propellant Production (ISPP) Assessment

10:15 a.m. BREAK

10:45 a.m. Zubrin R.* Kito T. Frankie B.
Report on the Construction and Operation of a Mars In Situ Propellant Production Unit Utilizing Reverse Water Gas Shift

11:15 a.m. Lawless W. N.*
Oxygen Extraction Using a Ceramic Honeycomb Technology

11:45 a.m. Hu H.* Yadav T.
Intermediate-Temperature Electrolysis Cells for Oxygen Production from Carbon Dioxide

12:15 p.m. LUNCH and MIST Facility Tour

1:45 p.m. Wiens R. C. Cremers D. A. Blacic J. D.* Funsten H. O. Nordholt J. E.

In Situ Resource Assessment and Process Control with Laser Raman Spectroscopy

2:45 p.m. Cooper B. L.* McKay D. S. Allen C. C. Hoffman J. H. Gittleman M. E.
Characterization of the Resource Potential of Martian Soil Using the Integrated Dust/Soil Experiment Package (IDEP)

3:15 p.m. BREAK

3:45 p.m. Mueller P. J.* Rapp D.
Hydrogen Transport to Mars Enables the Sabatier/Electrolysis Process

4:15 p.m. Lin F. N.* Bollo T. R. Peterson D. M.
Oxygen Liquefaction and Zero-Loss Storage System

4:45 p.m. Fenner J. E.* Edman K. A.
Gas Generation and Cryogenic Refrigeration Technologies

5:15 p.m. WRAP-UP

5:30 p.m. ADJOURN

6:30 p.m. DINNER AT A LOCAL RESTAURANT
Wednesday, November 19, 1997

8:00 a.m.  REGISTRATION AND CONTINENTAL BREAKFAST

8:30 a.m.  ANNOUNCEMENTS

8:45 a.m.  Jake P.*

Microtel: A TV Microscope for Planetary Field Geology and Resource Evaluation

9:15 a.m.  Drake D. M.* Clark B. C. Jakosky B. M. Reedy R. Squyres S. W.

A LiF Silicon Sandwich Counter to Measure Water Content of Planetary Surfaces

9:45 a.m.  Marshall J.* Koppel L. Bratton C. Metzger E. Hecht M.

In Situ Identification of Mineral Resources with an X-Ray-Optical “Hand-Lens” Instrument

10:15 a.m.  BREAK

10:45 a.m.  Gorevan S.* Rafeek S. Myrick T. Kong K. Y. Mahaffey P.

Minaturized Material Sampling and Transfer Devices for Extraterrestrial Exploration

11:15 a.m.  Finn J. E.* Sridhar K. R.

In Situ Generation of Carrier Gases for Scientific Analyses on Mars

11:45 a.m.  LUNCH

1:30 p.m.  Wegeng R. S.* TeGrotenhuis W. E. Tonkovich A. L. Y.

In Situ Propellant Production Based on Micro Chemical Systems

2:00 p.m.  Vuskovic L.* Ash R. L. Popovic S. Dinh T. VanOrden A.

Oxygen Production and Separation from Martian Atmosphere by the Radio-Frequency Discharge

2:30 p.m.  Bruckner A. P.* Coons S. C. Williams J. D.

Feasibility Studies of the Extraction of Water Vapor from the Martian Atmosphere by Adsorption in Zeolite 3A

3:00 p.m.  BREAK

3:30 p.m.  Johnson S. W.* Chua K. M.

Engineering Properties of the Regolith on the Moon and Mars Related to ISRU

4:00 p.m.  Kaplan D. I.*

Mars ISPP Flight Demonstration: A Status Update

4:30 p.m.  WRAP-UP

4:45 p.m.  ADJOURN
# CONTENTS

In Situ Resource Assessment and Process Control with Laser Raman Spectroscopy  
D. G. Agresti, T. J. Wdowiak, S. B. Mirov, A. B. Kudryavtsev, and T. R. Kinney ................................................................. 1

Feasibility Studies of the Extraction of Water Vapor from the Martian Atmosphere by Adsorption in Zeolite 3A  
A. P. Bruckner, S. C. Coons, and J. D. Williams ...................................... 3

Characterization of the Resource Potential of Martian Soil Using the Integrated Dust/Soil Experiment Package (IDEP)  
B. L. Cooper, D. S. McKay, C. C. Allen, J. H. Hoffman, and M. E. Gittleman .............. 5

A LiF Silicon Sandwich Counter to Measure Water Content of Planetary Surfaces  
D. M. Drake, B. C. Clark, B. M. Jakosky, R. Reedy, and S. W. Squyres .............................. 7

Gas Generation and Cryogenic Refrigeration Technologies  
J. E. Fenner and K. A. Edman ........................................................................ 9

In Situ Generation of Carrier Gases for Scientific Analyses on Mars  
J. E. Finn and K. R. Sridhar ........................................................................ 11

Miniaturized Material Sampling and Transfer Devices for Extraterrestrial Exploration  
S. Gorevan, S. Rafeek, T. Myrick, K. Y. Kong, and P. Mahaffey ......................... 13

Intermediate-Temperature Electrolysis Cells for Oxygen Production from Carbon Dioxide  
H. Hu and T. Yadav ................................................................................ 15

Microtel: A TV Microscope for Planetary Field Geology and Resource Evaluation  
P. Jakeš .................................................................................................. 17

Engineering Properties of the Regolith on the Moon and Mars Related to ISRU  
S. W. Johnson and K. M. Chua .................................................................. 21

Oxygen Extraction Using a Ceramic Honeycomb Technology  
W. N. Lawless ...................................................................................... 23

Oxygen Liquefaction and Zero-Loss Storage System  
F. N. Lin, T. R. Bollo, and D. M. Peterson ............................................. 25
In Situ Identification of Mineral Resources with an X-Ray-Optical "Hand-Lens" Instrument
J. Marshall, L. Koppel, C. Bratton, E. Metzger, and M. Hecht .............................................. 27

Hydrogen Transport to Mars Enables the Sabatier/Electrolysis Process
P. J. Mueller and D. Rapp ............................................................................................................. 29

Mars In Situ Propellant Production (ISPP) Assessment
M. L. Stancati, J. C. Niehoff, M. K. Jacobs, and D. German .................................................. 31

Oxygen Production and Separation from Martian Atmosphere by the Radio-Frequency Discharge
L. Vuskovic, R. L. Ash, S. Popovic, T. Dinh, and A. Van Orden ............................................. 33

In Situ Propellant Production Based on Micro Chemical Systems
R. S. Wegeng, W. E. TeGrotenhuis, and A. L. Y. Tonkovich ................................................... 35

R. C. Wiens, D. A. Cremers, J. D. Blacic, H. O. Funsten, and J. E. Nordholt ......................... 37

Report on the Construction and Operation of a Mars In Situ Propellant Production Unit Utilizing the Reverse Water Gas Shift
R. Zubrin, T. Kito, and B. Frankie .......................................................................................... 41