Curriculum Vitae - Peggy Arps - ChEMS - UC Irvine

Peggy Jean Arps

Associate Adjunct Professor
Chemical Engineering and Materials Science
University of California, Irvine
Irvine, CA 92697-2575
949-824-2800 (Office) 949-824-2931 (Lab)
pjarps@uci.edu

EDUCATION

Ph.D. **The Johns Hopkins University**
Major: *Biochemistry*. Biochemistry Division, Department of Biology, McCollum Pratt Institute, Baltimore, MD

M.A. **The Johns Hopkins University**
Major: *Biophysics*.Department of Biophysics, Baltimore, MD

B.A. **Cornell University**
Major: *Physics and Neurobiology*. School of Arts and Sciences, Ithaca, NY

RESEARCH INTERESTS

- Characterization of the microbial ecology (biodiversity) of biofilms in various environments.
- Molecular identification (16S rRNA) and culturing of bacteria involved in the oxidation and reduction of minerals and metals. Emphasis on biocorrosion and biofouling mechanisms.
- Development of biological methods for controlling corrosion in industrial water systems.
- Development of new biomedical materials that are resistant to infection.
- Optimization of microbial populations/enzymes for bioremediation of contaminated sites.
- Detoxification of cyanide and cyanide complexes in mining environments using bacteria that degrade cyanide and cyanide complexes.
- Development of heavy metals-resistant bacteria for oxidation of refractory (gold) ores.

PROFESSIONAL EXPERIENCE

University of California,Irvine, CA ***2000-present***
Chemical Engineering and Materials Science
Henry Samueli School of Engineering

ASSOCIATE ADJUNCT PROFESSOR. Environmental microbiology and related biotechlogy, molecular microbial ecology, microbially influenced corrosion (MIC) and corrosion control using biological methods. Also, biomaterials and testing of coatings for resistance to infection.

University of Nevada, Reno, NV ***1997-2000***
Chemical and Metallurgical Engineering Dept.
Mackay School of Mines

RESEARCH ASSOCIATE PROFESSOR. Environmental microbiology, molecular microbial ecology, bioprocess and bioremediation engineering, biohydrometallurgy.

Applied Microbiology and Biotechnology, Inc. ***1993-present.***
Glenwood Springs, CO

PRESIDENT. Environmental biotechnology consulting company.

University of Alaska Fairbanks ***1993-1995***
School of Mineral Engineering

ADJUNCT RESEARCH ASSOCIATE PROFESSOR. Environmental engineering. Research focused on methane-consuming bacteria and cyanide-degrading microbes.

University of Alaska Fairbanks ***1989-1993***
Chemistry Dept. & Institute of Arctic Biology

ASSISTANT PROFESSOR OF BIOCHEMISTRY. Joint appointment: Program in Biochemistry and Molecular Biology and Institute of Arctic Biology. Genetics and biochemistry of micro-organisms that utilize one-carbon compounds for growth.

California Institute of Technology ***1987-1989***
Dept. of Environmental Engineering Science

JUNIOR FACULTY / SENIOR RESEARCH FELLOW. Genetics and biochemistry of methylotrophic bacteria. Methanol oxidation (MXA) genes in a freshwater methanotroph. Carbon utilization genes of a facultative methylotroph.

Northwestern University Medical School ***1983-1987***
Dept. of Molecular Biology

RESEARCH ASSOCIATE II. Prokaryotic molecular biology and iochemistry of enteric bacteria. Regulation of pyridoxal phosphate biosynthesis in *Escherichia coli*.
POSTDOCTORAL FELLOW. Prokaryotic molecular biology. Organization and regulation of a complex operon containing the gene for a tRNA modification enzyme.

Johns Hopkins University
Department of Biology
PH.D. STUDENT. Biochemistry major. Thesis emphasis: Structure and function of skeletal muscle protein.M-line structure (CPK is a component of the M-line in rabbit striated muscle).

University of Washington
Department of Biochemistry
SUMMER RESEARCH FELLOW. Dr. Edmond Fisher (Nobel laureate). Enzymes

involved in the concerted regulation of glycogen metabolism and muscle contraction. Glycogen phosphorylase b and glycogen debranching enzyme.

Weizmann Institute of Science
Department of Cell Biology
SUMMER RESEARCH FELLOW. Dr. David Yaffe.Control of protein synthesis during the terminal differentiation of muscle cells. Myoglobin synthesis in the embryonic red muscle of chickens.

Johns Hopkins University
Department of Biophysics
M.S. STUDENT. Neurophysiology specialty. Development of neural connections in the optic tectum of amphibians.

Radiation Biology Laboratory
Smithsonian Institution
NSF RESEARCH ASSISTANT. 2 years. Regulation of the growth and development of higher plants by solar radiation. Chromosome aberrations in plants induced by UV radiation or gamma rays. Photomorphogenesis of Arabidopsis thaliana. Studies of the effects of red and far-red light on pollen tube elongation in *Tradescantia paludosa*.

CONSULTING PROJECTS
MINERAL VENTURES, LLC, Sparks, NV.1993-present.
Evaluation of microbial processes for remediation of petroleum-contaminated soils. Evaluation/optimization of a heavy metals recovery process at an acid mine drainage site. Development of a dry placer technique for gold recovery.

MSE TECHNOLOGY APPLICATIONS, INC., Butte, MT.1998-1999.
Cyanide Heap Biological Detoxification Demonstration (Mine Waste Technology Program).

U.S. FOREST SERVICE, WHITE RIVER NATIONAL FOREST, Glenwood Springs, CO.
Grant writing: Preservation, interpretation and maintenance of Camp Hale, former head-quarters and training site of the 10th Mountain Division of the U.S. Army.

VALLEY VIEW HOSPITAL, Glenwood Springs, CO.
Grant writing: Emergency Medical Services (EMS) telecommunications, telemedicine, health education issues, indigent patient medical care, low-cost mammograms (w/ Komen Fdn.).

GARFIELD COUNTY GOVERNMENT, Glenwood Springs, CO.
Grant writing: EMS telecommunications.

SUSAN G. KOMEN BREAST CANCER FOUNDATION, Aspen, CO.
Grant writing: Low-cost mammograms for underserved women in the Roaring Fork Valley.

RYAN LODE MINES, Fairbanks, Alaska.
Gold mining company in Alaska using cyanidation technology for enhanced gold recovery.

PRITZKER INVESTMENTS, Chicago, Illinois.
Biotechnology company start-up, DNA sequencing via hybridization.

GOLDSTREAM MANUFACTURING, INC., Fairbanks, Alaska.
Design and manufacture of mining equipment that interfaces with biotechnology.

BIOTECH SERVICES, Anchorage, Alaska.
Bioremediation, especially of petroleum products.

QUILLER ENTERPRISES, Washington, D.C.
Publication of science-based novels.

ABBOTT LABORATORIES,Abbott, Illinois.
Utilization of methylotrophs to make radiolabeled chemicals.

TEACHING

ASSOCIATE ADJUNCT PROFESSOR *Univ. of California, Irvine*

CBEMS 102 Biology for Engineers (undergraduate)
CBEMS 202: Biology for Engineers (graduate)
CBEMS 199: Individual Tutorial (undergraduate)
CBEMS 299: Individual Tutorial (graduate)

ASSISTANT PROFESSOR *Univ. of Alaska Fairbanks*

Chem 100:Chemistry in the Modern World (1991-92)
Chem 451: General Biochemistry (1989-91)
Chem 452: Biochemistry Laboratory (1990-91)
Chem 498: Research for Chemistry Undergraduates (1989-93)
Chem 668/692: Biochemistry & Molecular Biology Seminar (Spring/Fall 1989-91)
Chem 698: Research for Chemistry Graduate Students (1989-93)
Min 693: Cyanide in the Mining Industry (1993)

SENIOR RESEARCH FELLOW *California Institute of Technology*

Env/Bio 166: Microbial Physiology (grad level)
Env 208: Genetics of Unusual Bacteria (grad level)
Seminar: Bacterial Promoters (grad level)

GRADUATE INSTRUCTOR ***Johns Hopkins University***

Department of Biology: Biochemistry Laboratory; Cell Biology Laboratory
Department of Biophysics: Graduate level intersession course covering cell culture techniques, human genetics, and cellular immunology.

STUDENTS

Univ. of California*:*	Hai Lee, John Abdelnour, Anh Nguyen (undergrads), I.-Ti (Jessica) Li
Univ. of Alaska:	
Graduate Advisor:	Xiapeng Zheng, Ph.D. (Chemical & Metallurgical Engineering)
	Richard Smith, Ph.D. (Biochem & Molec Biol)
	Qi Li, Ph.D. (Biochem & Molec Biol)
	Qiaofei Zheng, M.S. (Biochem & Molec Biol)
	Ravonna Martin, M.S. (Biological Oceanography)
	Undergrad Advisor: Tom Kurth (Pre-med)
	Nora Norum (Pre-med)
	James Wiegers (Pre-med)
Grad. Committee:	Rebecca Reynolds, M.S. (Biochem & Molec Biol)
	David Blevins, M.S. (Chemistry)
	Frank Andel, M.S. (Chemistry)
	Scott Herndon, M.S. (Chemistry)
	Lisa Sporleder, M.S. (Mining Engineering)
Research Advisor:	Michael Medina (current),Jeannie Gleason, David Blevins, Tim Brayman,
	Kelley Lowder, Chatanika Stoop, Stephanie Forester (undergrads)
High School Students:	Erin Cunningham, Neka Bender, Vivian Lee

PROFESSIONAL SERVICE

- Reviewer for the National Science Foundation (1997-present)
- Reviewer for the Journal of Industrial Microbiology and Biotechnology (1997-present)
- Board of Directors, Aspen Science Outreach Center (1993-present).
- Nancy Davis Multiple Sclerosis Symposium, Aspen Valley Hospital, February, 1994.
- Nancy Davis WomenÌs Medical Research Workshop,Denver, Co., October 11-12, 1993.
- Educational representative,American Society for Microbiology - Alaska Branch (1991-92).
- Reviewer for the Alaska Science and Technology Foundation (1989-1992).
- Alaska Dept. of Environmental Conservation Workshop, ÏBioremediation of the Exxon
- Valdez Oil Spill - Assessment of ProceduresÓ.

UNIVERSITY SERVICE

- Arctic Pollution Task Force (1993-95)
- Alcohol and Drug Abuse Task Force (1993)
- Chair, Biochem and Molec Biology Program Grad Recruitment Committee (1989-93)
- Institute of Arctic Biology (IAB) Research Advisory Committee (1989-93)
- Committee, Mellon Awards for Professional Travel & Faculty Development (1989-93)
- ChancellorÌs Special Events Committee (1992-93)
- UAF Faculty Representative, High School Recruiting Program (1991)
- UAF Faculty Representative, Statewide Library Optimization Workshop (1992)
- Search Committee for Microbiology Faculty Position, IAB (1989-90)

FELLOWSHIPS AND AWARDS

- Associated Western Universities Faculty Fellowship (October 1998 - October 1999)
- Idaho National Engineering and Environmental Laboratory
- Microbial Metabolism and Microbial Ecology Course Fellowship
- Gray Freshwater Biological Institute, University of Minnesota
- Andrew W. Mellon Professional Travel Award to attend the American Society for Microbiology Pseudomonas Î89 meeting, Chicago, Illinois
- Advanced Bacterial Genetics Course Fellowship; Cold Spring Harbor Laboratory
- Samuel A. Talbot Memorial Fund Travel Award to attend the Biophysical Society Meeting, Jerusalem, Israel
- Department of Biology Fellowship (4 years), Johns Hopkins University
- Weizmann Institute Scientist Exchange Program, Rehovot, Israel (summer intern)
- DeanÌs Fellowship, College of Arts and Sciences (1 year), Johns Hopkins University
- Department of Biophysics Fellowship (2 years), Johns Hopkins University
- NSF Summer Science Fellowship (2 years), Smithsonian Institution

RESEARCH GRANTS

Electric Power Research Institute (EPRI) Grant($350,580). 2001-2004
Field Evaluation of Corrosion Control Using Regenerative Biofilms (CCURB) Ò Phase 3. In collaboration with Jim Earthman at University of California, Irvine.

Electric Power Research Institute Grant ($634,093). 1998-2001
Biological Methods for Controlling Corrosion in Industrial Service Water Systems. In collaboration with Jim Earthman at University of California, Irvine.

Irvine Ranch Water District ($20,000). 1998-1999
Bacterial Analysis and Biocide Testing of an IRWD Water Well Requiring Rehabilitation.

Southern Nevada Water Authority ($20,000). 1998-1999
Bacterial Analysis and Biocide Testing of Water Wells Experiencing Biofouling.

Desert Research Institute Project Assignment Grant ($8,770). 1998
Z-Pinch Apparatus Contaminant Characterization.

Ryan Lode Mines, Inc. Grant ($10,000). 1993
Direct Inoculation of a Cyanide Leach Heap with Cyanide-Degrading Bacteria.

Alaska Science and Technology Foundation Grant ($468,000). 1991
Treatment of Precious Metals Mine Wastewater - Alaska Testing of Biological Methods.

UAFFaculty Grant ($5,000).1991
Genetic Characterization of Marine Ultramicrobacteria.

Exxon Education Foundation Grant ($5,000). 1991
Genetic Characterization of Marine Ultramicrobacteria.

NSF Research Planning Grant ($18,000). 1991
Genetic Characterization of Marine Ultramicrobacteria.

Natural Resources Fund Grant ($4,000). 1990
Microorganisms for Precious Metals Leaching in Northern Environments.

Biomedical Research Grant ($2,200). 1990
Transformation as a Means of Understanding Gene Expression and Protein/Structure Relationships

EDUCATION GRANTS

- **ChancellorÌs Graduate University Fellowship Program Grant ($88,000), 1991-95.**
- **PresidentÌs Special Projects Fund ($3,450), 1992.** Integrating Math and Science in the 90Ìs. Series of workshops with Sheila Tobias.
- **ChancellorÌs Graduate Fellowships Program Grant ($4,000), 1991.**
- **ChancellorÌsScholarships for Third World Students Program Grant ($7,800), 1991.**

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

- American Association for the Advancement of Science (AAAS), 1985-present
- American Society for Microbiology,1985-present
- NACE International, The Corrosion Society, 2001-present
- Phi Kappa Phi,1992-present
- Sigma Xi, 1993-present

LION TRAILS MINERALS, INC., Redding, California. 1993-present.
Evaluation of microbial processes for remediation of petroleum-contaminated soils.
Evaluation/optimization of a heavy metals recovery process at an acid mine drainage site.
Development of a dry placer technique for gold recovery.

U.S. FOREST SERVICE, WHITE RIVER NATIONAL FOREST, Glenwood Springs, CO.
Grant writing: Preservation, interpretation and maintenance of Camp Hale, former head-quarters and training site of the 10th Mountain Division of the U.S. Army.

VALLEY VIEW HOSPITAL, Glenwood Springs, CO.
Grant writing: Emergency Medical Services (EMS) telecommunications, telemedicine, health education issues, indigent patient medical care, low-cost mammograms (w/ Komen Fdn.).

GARFIELD COUNTY GOVERNMENT, Glenwood Springs, CO.
Grant writing: EMS telecommunications.

SUSAN G. KOMEN BREAST CANCER FOUNDATION, Aspen, CO.
Grant writing: Low-cost mammograms for underserved women in the Roaring Fork Valley.

RYAN LODE MINES, Fairbanks, Alaska.
Gold mining company in Alaska using cyanidation technology for enhanced gold recovery.

PRITZKER INVESTMENTS, Chicago, Illinois.
Biotechnology company start-up, DNA sequencing via hybridization.

GOLDSTREAM MANUFACTURING, INC., Fairbanks, Alaska.
Design and manufacture of mining equipment that interfaces with biotechnology.

BIOTECH SERVICES, Anchorage, Alaska.
Bioremediation, especially of petroleum products.

QUILLER ENTERPRISES, Washington, D.C.
Publication of science-based novels.

ABBOTT LABORATORIES, Abbott, Illinois.
Utilization of methylotrophs to make radiolabeled chemicals.

TEACHING

ASSOCIATE ADJUNCT PROFESSOR ***Univ. of California, Irvine***
- CBEMS 102 Biology for Engineers (undergraduate)
- CBEMS 202 Biology for Engineers (graduate)
- CBEMS 199 Individual Tutorial (undergraduate)
- CBEMS 299 Individual Tutorial (graduate)

ASSISTANT PROFESSOR ***Univ. of Alaska Fairbanks***
- Chem 100: Chemistry in the Modern World (1991-92)

Chem451: General Biochemistry (1989-91)
Chem 452: Biochemistry Laboratory (1990-91)
Chem 498: Research for Chemistry Undergraduates (1989-93)
Chem 668/692: Biochemistry & Molecular Biology Seminar (Spring/Fall 1989-91)
Chem 698: Research for Chemistry Graduate Students (1989-93)
Min 693: Cyanide in the Mining Industry (1993)

SENIOR RESEARCH FELLOW ***California Institute of Technology***
Env/Bio 166: Microbial Physiology (grad level)
Env 208: Genetics of Unusual Bacteria (grad level)
Seminar: Bacterial Promoters (grad level)

GRADUATE INSTRUCTOR ***Johns Hopkins University***
Department of Biology: Biochemistry Laboratory; Cell Biology Laboratory
Department of Biophysics: Graduate level intersession course covering cell culture techniques, human genetics, and cellular immunology.

STUDENTS

Univ. of California:	Hai Lee, John Abdelnour, Anh Nguyen (undergrads), I.-Ti (Jessica) Li
Univ. of Alaska:	
Graduate Advisor:	Xiapeng Zheng, Ph.D. (Chemical & Metallurgical Engineering)
	Richard Smith, Ph.D. (Biochem & Molec Biol)
	Qi Li, Ph.D. (Biochem & Molec Biol)
	Qiaofei Zheng, M.S. (Biochem & Molec Biol)
	Ravonna Martin, M.S. (Biological Oceanography)
	Undergrad Advisor:Tom Kurth (Pre-med)
	Nora Norum (Pre-med)
	James Wiegers (Pre-med)
Grad. Committee:	Rebecca Reynolds, M.S. (Biochem & Molec Biol)
	David Blevins, M.S. (Chemistry)
	Frank Andel, M.S. (Chemistry)
	Scott Herndon, M.S. (Chemistry)
	Lisa Sporleder, M.S. (Mining Engineering)
Research Advisor: (undergrads)	Michael Medina (current),Jeannie Gleason, David Blevins, Tim Brayman, (Undergrads)Kelley Lowder, Chatanika Stoop, Stephanie Forester
High School Students:	Erin Cunningham, Neka Bender, Vivian Lee

PROFESSIONAL SERVICE

- Reviewer for the National Science Foundation (1997-present)

- Reviewer for the Journal of Industrial Microbiology and Biotechnology (1997-present)
- Board of Directors, Aspen Science Outreach Center (1993-present).
- Nancy Davis Multiple Sclerosis Symposium, Aspen Valley Hospital, February, 1994.
- Nancy Davis Womenís Medical Research Workshop, Denver, Co., October 11-12, 1993.
- Educational representative, American Society for Microbiology - Alaska Branch (1991-92).
- Reviewer for the Alaska Science and Technology Foundation (1989-1992).
- Alaska Dept. of Environmental Conservation Workshop, "Bioremediation of the Exxon Valdez Oil Spill - Assessment of Procedures".

UNIVERSITY SERVICE

- Arctic Pollution Task Force (1993-95)
- Alcohol and Drug Abuse Task Force (1993)
- Chair, Biochem and Molec Biology Program Grad Recruitment Committee (1989-93)
- Institute of Arctic Biology (IAB) Research Advisory Committee (1989-93)
- Committee, Mellon Awards for Professional Travel & Faculty Development (1989-93) Chancellorís Special Events Committee (1992-93)
- UAF Faculty Representative, High School Recruiting Program (1991)
- UAF Faculty Representative, Statewide Library Optimization Workshop (1992)
- Search Committee for Microbiology Faculty Position, IAB (1989-90)

FELLOWSHIPS AND AWARDS

- Associated Western Universities Faculty Fellowship (October 1998 October 1999) Idaho National Engineering and Environmental Laboratory
- Microbial Metabolism and Microbial Ecology Course Fellowship Gray Freshwater Biological Institute, University of Minnesota
- Andrew W. Mellon Professional Travel Award to attend the American Society for Microbiology Pseudomonas ‘89 meeting, Chicago, Illinois
- Advanced Bacterial Genetics Course Fellowship; Cold Spring Harbor Laboratory
- Samuel A. Talbot Memorial Fund Travel Award to attend theBiophysical Society Meeting, Jerusalem, Israel
- Department of Biology Fellowship (4 years), Johns Hopkins University
- Weizmann Institute Scientist Exchange Program, Rehovot, Israel (summer intern)
- Dean’s Fellowship, College of Arts and Sciences (1 year), Johns Hopkins University
- Department of Biophysics Fellowship (2 years), Johns Hopkins University
- NSF Summer Science Fellowship (2 years), Smithsonian InstitutIon

RESEARCH GRANTS

Electric Power Research Institute (EPRI) Grant ($350,580). 2001-2004
Field Evaluation of Corrosion Control Using Regenerative Biofilms (CCURB) – Phase 3. In collaboration with Jim Earthman at University of California, Irvine.

Electric Power Research Institute Grant ($634,093). 1998-2001
Biological Methods for Controlling Corrosion in Industrial Service Water Systems. In collaboration with Jim Earthman at University of California, Irvine.

Irvine Ranch Water District ($20,000). 1998-1999
Bacterial Analysis and Biocide Testing of an IRWD Water Well Requiring Rehabilitation.

Southern Nevada Water Authority ($20,000). 1998-1999
Bacterial Analysis and Biocide Testing of Water Wells Experiencing Biofouling.

Desert Research Institute Project Assignment Grant ($8,770). 1998
Z-Pinch Apparatus Contaminant Characterization.

Ryan Lode Mines, Inc. Grant ($10,000). 1993
Direct Inoculation of a Cyanide Leach Heap with Cyanide-Degrading Bacteria.

Alaska Science and Technology Foundation Grant ($468,000). 1991
Treatment of Precious Metals Mine Wastewater - Alaska Testing of Biological Methods.

UAF Faculty Grant ($5,000). 1991
Genetic Characterization of Marine Ultramicrobacteria.

Exxon Education Foundation Grant ($5,000). 1991
Genetic Characterization of Marine Ultramicrobacteria.

NSF Research Planning Grant ($18,000). 1991
Genetic Characterization of Marine Ultramicrobacteria.

Natural Resources Fund Grant ($4,000). 1990
Microorganisms for Precious Metals Leaching in Northern Environments.

NIH Biomedical Research Grant ($2,200). 1990
Transformation as a Means of Understanding Gene Expression and Protein/Structure Relationships

EDUCATION GRANTS

- **Chancellor's Graduate University Fellowship Program Grant ($88,000), 1991-95.**
- **President's Special Projects Fund ($3,450), 1992.** Integrating Math and Science in the 90's. Series of workshops with Sheila Tobias.

- **Chancellor's Graduate Fellowships Program Grant ($4,000), 1991.**
- **Chancellor's Scholarships for Third World Students Program Grant ($7,800), 1991.**

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

American Association for the Advancement of Science (AAAS), 1985-present
American Society for Microbiology, 1985-present
NACE International, The Corrosion Society, 2001-present
Phi Kappa Phi, 1992-present
Sigma Xi, 1993-present

REFERENCES

Dr. James C. Earthman
Associate Professor, Chemical Engineering and Materials Science
916 Engineering Tower
University of California, Irvine
Irvine, CA 92697-2575
Phone: 949-824-5018 FAX: 949-824-2541 E-mail: earthman@uci.edu

Dr. Mary E. Lidstrom
Professor, Department of Chemical Engineering
Box 35170
University of Washington
Seattle, WA 98195-1750
Phone: 206-616-5282 FAX: 206-616-5721 E-mail: lidstrom@u.washington.edu

Dr. Francisco F. Roberto
Group Leader, Biotechnologies Department
P.O Box 1625, Idaho National Engineering and Environmental Laboratory
Idaho Falls, ID 83415-2203
Phone: 208-526-1096 FAX: 208-526-0828 E-mail: ffr@inel.govf

Dr. Simon Silver
Professor, Department of Microbiology & Immunology
M/C 790, Room E704, 835 South Wolcott Avenue
University of Illinois at Chicago
Chicago, IL 60612-7344
Phone: 312-996-9608 FAX: 312-996-6415 E-mail: Simon@uic.edu

Dr. Erik Spiller

Adjunct Professor, Metallurgical and Materials Engineering
Colorado School of Mines
Golden, CO 80401
Home Phone: 303-221-1565

Dr. Wallace Whiting
Professor and Chairman, Chemical & Metallurgical Engineering Dept.
Mackay School of Mines, Mail Stop 170
University of Nevada, Reno
Reno, NV 89557-0136
Phone: 702-784-6360 FAX: 702-784-4764 E-mail: wwhiting@unr.edu