

ANNUAL REPORT

1976-77

Arizona Bureau of Mines  
Mineral Technology Branch

ARIZONA GEOLOGICAL SURVEY  
OPEN-FILE REPORT

This report is preliminary and has not been edited or reviewed for conformity with Arizona Geological Survey standards

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1. SUMMARY

Service

Table 1 summarizes the mineral identification activity for the year. A total of 1409 individual samples were examined for mineral identification. Table 2 indicates mineral identification work done on special request requiring quantitative procedures. There was a significant increase in the requests for preparation, analysis, and microphotography of polished sections.

Tables 3 and 4 outline the metallurgical amenability testing for the year. Evaluation of gold and gold-silver ores continued to be the predominant type of metallurgical testing.

Table 1. Summary of Mineralogical Service Activity

<u>Source</u>	<u>Lots of Samples</u>
Apache Co.	2
Cochise Co.	26
Coconino Co.	2
Gila Co.	8
Graham Co.	3
Greenlee Co.	2
Maricopa Co.	47
Mohave Co.	11
Navajo Co.	1
Pima Co.	261
Pinal Co.	10
Santa Cruz Co.	8
Yavapai Co.	10
Yuma Co.	10
Mexico	11
Other States	26
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Table 2. Summary of Non-Routine Mineralogical Service Activity

<u>Type</u>	<u>Number</u>
Chemical Assay	2
Xray Diffraction	6
Emission Spectrograph	8
Polished Sections	43

Table 3. Summary of Metallurgical Ore Tests

<u>Type</u>	<u>Number</u>
Leaching	11
Gravity Concentration	5
Mineral Evaluation	12
Flotation	6
Magnetic Concentration	2
Miscellaneous	6
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Table 4. Summary of Ores Subjected to Metallurgical Evaluation

<u>Ore Type</u>	<u>Number</u>
Gold	13
Gold-silver	13
Copper	1
Copper-silver	1
Base metal	5
Non-metallic	5
Platinum group	5
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Lectures on mining and mineral processing were provided for:

Grand Canyon College, high schools,  
elementary schools, and fraternal and  
social organizations.

Technical assistance was provided to:

Arizona Department of Mineral Resources,  
Arizona State Mine Inspector,  
U.S. Forest Service,  
U.S. Bureau of Mines,  
City of Tucson,  
United Nations, and  
several mining companies.

Assistance was given to:

All Arizona AIME Section Meetings,  
AIME Section Programs, and several  
professional journals.

### Research

Research into the use of City of Tucson municipal waste water in copper mining and milling operations was continued this year with the emphasis

placed on isolating and identifying components of the waste water that are detrimental to the milling processes. An article entitled, "Municipal Waste Water Utilization for Froth Flotation of Copper Ores," was accepted for publication by the Transactions of the Society of Mining Engineers of the AIME.

An article entitled, "The Kinetics of the Dissolution of Chalcocite in Alkaline Cyanide Solution," based on work sponsored by the Bureau was published in the June issue of Metallurgical Transactions.

In September 1976, the Bureau accepted responsibility for a U.S. Bureau of Mines project to study the scale up of hydrometallurgical leaching processes. The project was previously under the direction of the Department of Chemical Engineering. Current research for this project is on the kinetics of leaching chalcocite in a low pressure oxygen-ammonia system. This phase of the research will result in a M.S. degree for a student in Metallurgical Engineering.

Data previously accumulated on acid leaching of chalcocite is currently being analyzed and evaluated with the goal of publishing the results.

The Bureau continues to operate an analytic facility for use of the Bureau and College of Mines.

An analysis of the use of water by the Arizona copper industry was prepared for presentation at the Conference on Alternative Strategies for Desert Development and Management which was jointly sponsored by the United Nations and the State of California.

#### Teaching

The Bureau provided a staff member to teach a 3-unit graduate course for the Department of Metallurgical Engineering. The course, "The Physical Chemistry of Hydrometallurgy," was offered during the evening in the spring semester and was attended by 19 individuals from industry, 5 graduate students, and one faculty member.

The Bureau also provided a staff member to teach a 2-unit course, "Solution Mining," for the Department of Mining and Geological Engineering. This course was taught in the fall and attracted 10 students.

In addition, the Bureau provided several experiments for the Department of Metallurgical Engineering laboratory courses.

### 3. MAJOR LIMITATIONS

#### Space

The Bureau has only one laboratory equipped to carry our research and ore testing. At times as many as five simultaneous projects are conducted in this laboratory. Such diverse and crowded use of one laboratory leads to confusion, low efficiency, mistakes and safety hazards. The Bureau needs additional, well-equipped laboratory space if it is to function as a viable research-service organization.

#### Support Staff

The mineral technology staff is involved in both service and investigative research. The nature of the research requires a large amount of technical support for a small amount of research. Since there is no technical support staff for mineral technology, the professional staff members must be their own technicians. This is not only a wasteful use of manpower, but it limits the amount of research we can accomplish and eliminates other functions that we should be involved in. The mineral technology branch needs a metallurgical technician to free the professional staff for more productive work.

#### Safety

The Bureau is responsible for the crushing facilities that are jointly used by the Bureau, College of Mines, and College of Earth Sciences. In addition to normal University use, the crushing equipment is used by non-University personnel. The dust control system in the crushing laboratory is very poor and needs to be replaced with an improved system that will remove most of the dust from the air.

#### 4. FUTURE PLANS

##### Research

Research to determine the feasibility of using municipal waste water in copper milling and processing will be continued until September 30, 1977.

The study of scale up of hydrometallurgical leach processes will be continued until December 31, 1977.

Evaluation of data on the kinetics of leaching chalcocite in an acid media will be completed and a publication will be prepared.

A new project (dependent upon sponsor funding) will be initiated to study the recovery of copper from leach solution by cementation. The project may provide an M.S. level research thesis for a metallurgical or chemical engineering student.

Additional research of cyanide leaching of chalcocite will be initiated to obtain more refined data for a kinetic evaluation of the process.

A cooperative research effort with the Department of Metallurgical Engineering will be initiated to develop laboratory experiments in mineral processing and to accumulate operating data on pilot scale equipment.

##### Service Activities

Improved liaison with the mining industry and government organizations will be pursued through visits to mining properties, attendance at mining and mineral processing professional meetings, and contacts with individuals.

A short course entitled, "Elements of Extractive Metallurgy," will be presented at the All Arizona Section Meeting of the AIME in December 1977. The purpose of this course will be to provide an elementary introduction to extractive metallurgy for individuals working in the mining industry who have little technical training in metallurgy. The course will be offered as a joint venture with the Department of Metallurgical Engineering.