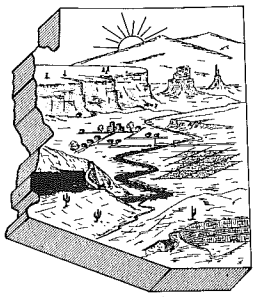

FIELDNOTES

From The State Of Arizona
Bureau Of Geology And Mineral Technology

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BACK TO BASICS

Mineral - Vegetable - Animal

No Ground, No Flea - No You, No Me

By

H. Wesley Peirce · Principal Geologist

The June 1978 issue of Geotimes contains an item that tends to confirm our more local and provincial experiences regarding the orientation of contemporary ecological-environmental education. According to the report, on February 21, the House of Representatives voted to extend for five years the Environmental Education Act of 1970, an act which omits any mention of education in the earth sciences. A group of nationally known earth scientists, in a February 27 statement to the Senate Subcommittee on Education, Arts, and Humanities, said that – "they were increasingly concerned about the lack of basic understanding by the public at large, and by their leaders, of the Earth processes and Earth materials which form the foundations of any society, and which set the limits within which human institutions must function . . . " The report suggests that: "(1) most people involved in environmental education today have been trained in the biological sciences, including ecology, or the social sciences (2) there is hardly a major national concern that is not earth-science based: energy resources, water supply, land use, mineral resources, international trade, national disasters, and (3) programs have focused on narrow issues or local problems; where there have been broader programs with potential for serving as models, the information has not been disseminated."

A major problem these days seems to be that there is so much to know that we necessarily train incompletely. Nowhere is this more obvious than in environmental statements where it takes many different "cooks" to assemble the meal and even then very few "experts" are satisfied with the treatment given their specialty. Many are clever (experts) at identifying and classifying objects, but few appear to know or comprehend relationships. (In this regard most of us remain undereducated.)

As a general rule our society appears to be poorly trained in matters pertaining to the non-living earth. Geologic narratives contained in environmental statements provide an opportunity to demonstrate and emphasize the interplay between the living and the non-living. Yet most reports are cold, insensitive recitations of an overall geologic history gleaned from noncurrent literature.

Perhaps these problems stem from a general lack of experience in dealing with ecological fundamentals – the simple "facts of life." Is our vision clouded by a bewildering array of indirectness (e.g., water comes from faucets, cement from lumber yards, milk from supermarkets, natural gas from the gas company, gasoline from the service station, etc.)? Even though these are attributes of advancing civilization, have we, at the same time, lost conscious touch with basic reality – that all are ultimately derived from non-living earth materials? Could you discourse intelligently on where anything of substance (fabricated or otherwise) actually comes from? Deliberate on the ultimate factors that make possible the lights in your home. Could you draw a cartoon representing the basics? If your cartoon doesn't lead back to rocks then you've missed the essential fact of life.

Did the word order of the subtitle, Mineral-Vegetable-Animal, elicit any reaction from you? Did you reverse the word order? The major point of this commentary is to encourage a trend away from the classic order "Animal-Vegetable-Mineral." Might there be fundamental awareness value in emphasizing the reality that both the Animal Kingdom and Vegetable Kingdom are dependent upon the Mineral Kingdom for existence, and that it is ecologically sound to place first things first?

No doubt many of us have sung an old ecological song: "The Green Grass Grows All Around." The words speak to an essential linkage between the ground (Mineral) and a flea (Animal) via the tree, branch, twig, nest, bird, and feather. The message is simple: no ground-no flea, no you, no me. The Animal Kingdom is the most dependent because it requires the other two kingdoms for subsistence. On the other hand, the Vegetable Kingdom requires but the Mineral Kingdom for life support. Is there a more basic approach to the complex "Web of life" story?

Perhaps knowledge of the controlling Mineral Kingdom is the one we know least about. Is there a relatively simple way of opening the door to this proliferating subject? One can only try. All non-living earth substances (the Mineral Kingdom) can be grouped into solids, liquids, and gasses. Most persons quickly recognize the essentiality of liquids (water) and gasses (atmosphere) to their own immediate well-being. However, recognition of the importance of solids seems to be less intutitive in that it requires more intellectualizing. "Solids," as used here, includes every non-living thing in or on the earth that is not liquid or gas. There are thousands of words for the phenomena that

belong in this broad category. Technically, the lion's share of the solids group is taken up by rocks and their contents, minerals. No minerals – no rocks; no minerals – no Vegetable Kingdom; no minerals – no vegetables – no Animal Kingdom.

It is fundamental to recognize that the earthly life support ingredients must be available to all life if all are to continue to exist. The basic survival requirements for either an individual or a group differ only in quantity. If some need is unfulfilled, discomfort results. Obviously, the discomfort level is proportional to the extent of deprivation. There is a natural tendency to escape discomfort; therefore, action or change is called for if discomfort is to be lessened. Humankind have the ability to anticipate discomfort and tend to take actions designed to mitigate deprivation (e.g., energy policies). Serious problems arise when mitigation actions are rendered impotent by an inadequate resource base. With regard to essential ingredients contained within the Mineral Kingdom where, in your opinion, is Arizona most vulnerable? Is publicity being given to this survival (comfort) parameter? Are we thinking about water?

In terms of the three kingdoms, which one most effectively controls population distribution? To think about this clearly one should first consider the beginnings of a population center, for once in existence a crowd tends to draw a crowd. Communities started by laboring people spring up where Mineral Kingdom factors permit it. Growth will tend to continue for as long as a tolerable comfort index is anticipated and maintained.

Arizona has 14 counties; one, Maricopa (home of Phoenix) contains 55% of the state's population. Coconino County (home of Flagstaff and part of the Grand Canyon region), though larger than Maricopa, contains less than three percent of the state's population. In seeking an explanation for this fact, in what terms should we think? Let's play the game that we've started and see where it might lead. Taking a look at the basics, let's investigate that part of the Mineral Kingdom that controls the extent of agricultural development – viable land and dependable water resources. Maricopa County has 34% of the state's crop acreage whereas Coconino County has less than 0.2%. The former also has 34% of the state's dependable water supply whereas data for Coconino County are insufficient to calculate this parameter. However, there is little surface water, and such features as Grand Canyon and the cliffs along the Mogollon Rim tend to keep much of the County drained of ground water at practical drilling depths.

Although these data hint at a radical difference between these two counties in the arrangement of Mineral Kingdom phenomena, it takes special knowledge to explain just what the basic differences are. A fundamental explanation is to be found in geologic contrasts, a more familiar way of alluding to Mineral Kingdom characteristics.

Although the important geologic contrasts between these two counties result from differing geologic histories, it is the end results with which we must come to terms. Whatever the details of geologic history, one simple way of describing the end result is that Maricopa County, between small mountain ranges, has broad valleys containing large expanses of loose, relatively young sediments. Importantly, these materials are sufficiently thick to hold large volumes of subsurface water. Thus, the Mineral Kingdom here contains abundant geologic materials capable of: (1) acting as a growing medium at the surface, and (2) storing large volumes of water at depth. Too, surface water draining into reservoirs along the Salt River in the mountainous region north of Phoenix is an important supporting resource.

Coconino County is "made" from relatively hard, older sedimentary rocks characteristic of the Grand Canyon region. Whereas these materials, along with a thin irregular soil zone, support native trees and shrubs, they are not capable of supporting extensive agricultural development. Too, these materials contain limited amounts of ground water, and surface water also is limited.

Simply put, the contrasting nature of the land and water resources (Mineral Kingdom parameters) in these two counties goes a long way in providing a basic explanation for the conspicuous population differences. A glance at the entire state adds emphasis to the point being made. Over 93% of the state's population, cropped acreage, value of mineral resources production, and pumped water is attributed to just the southwestern one-half of the state (the Basin and Range Province). The remaining small balance is applicable to the northeastern half, the Plateau Province. Too, these differences directly control the dynamics of future growth and development possibilities. Every place on earth can be reduced to its basic Mineral Kingdom characteristics – its geologic setting. The fact that no two places on earth are identical leads to both the large and small contrasts within which the biosphere scrambles for existence. The Mineral Kingdom is a three dimensional domain and, appreciated or not, the biosphere cannot survive in only the two dimensional world that our eyes most readily see. Like a tree, we have roots, only ours are technological. When the "roots" no longer are capable of transferring sufficient substances to the user, the discomfort index must rise. We have so much to learn and discover about the unseen portion of the earth. Perpetuated ignorance of this essential facet will do us immeasurable disservice.

Frequently, those in scientific professions are asked for their personal views (always on controversial matters as city, county, state, nation, or world citizens). However, as soon as matters of opinion are aired, the hunting season opens. Expounding the politic thing, therefore, has short range survival value. However, a few comments seem appropriate.

Is there some underlying message in the Mineral-Vegetable-Animal story that is especially applicable to our modern age? What are your thoughts? Hopefully, it might contribute to an added degree of realism in our philosophical outlook. Worldwide, it should be emphasized and remembered that the distribution of large quantities of life-sustaining Mineral Kingdom substances is grossly unequal. The phrase, "haves and have nots," refers directly to the substances that are the foundation for both the development and continuation of basic industry. Large reserves of substances considered vital in the modern world attract much attention and often become a focal point for jurisdictional disputes. The educational-news media could help the cause of reality by a more sensitive reporting of more of these root causes of turmoil. Although each nation has to fend for itself, few can afford absolute independence. It is essential, therefore, that trade take place. Presently, an attempt is being made to tell us that our nation is moving towards energy vulnerability. Although apparently not taken seriously by many, it seems likely that future changes in the discomfort index (first in prices) will encourage our attention.

The conservation ethic is indisputably valid because its purpose is to extend resources by minimizing wastage. A definition of "waste" might be the unnecessary diminution of any resource (what is "unnecessary" is a personal judgment). Some might say that such an ethic threatens the economy. However, in principle, depletion of life sustaining resources carries with it an even larger, more permanent threat. Whether an immediate, perceived threat exists or not, it simply makes good

long-range survival sense to develop some appreciation and sensitivity for the 4.5 billion years of Mineral Kingdom history that we, and all life, must exploit for as long as life exists. This fact ultimately leads to uncomfortable questions, many of which are political. There is, for instance, an inevitable clash between shorter and longer range interests. A nation tends to outlive individuals and individuals often make the supreme sacrifice on behalf of their homeland. The conservation ethic, if practiced, results in some individual "sacrifice" on behalf of the welfare of the larger community. Hopefully, enlightened self interest can lead to voluntarism with minimal governmental coercion. However, implanting the everyday "rightness" of conservation will require much educational effort. A beginning might be: Mineral-Vegetable-Animal, or, no ground, no flea – no you, no me, or, there is no second crop of Mineral Kingdom substances.

IF I WERE A ROCK

If I were a rock and I could talk
I'd be hard pressed to know what to say.

I'd probably point out that mute though I be,
there's a message in me – a message universal.
Though you might not hear it,
it is there for you to interpret.

There is no record of much of the past,
except that which I retain.
Ignore me if you wish
because ignorance is bliss,
or, too much thought is a strain.

But there are some with a curious flair
who don't take me for granted.
They prod and they poke,
with deep-felt conviction that humankind's future,
like a tree, is deeply rooted in me.

Success or failure, in the matter of survival,
seems perfectly clear to be,
related to the wisdom you manifest,
quickly, about me.

Adaptation to limitation
is the message, you see.

I'm used to extinction – I've seen much life come and go –
your passing won't be such a blow.
Though I really shouldn't care,
and you likely won't listen,
a piece of advice: you'd better learn to share.

If this you won't heed or can't do,
then the law of the jungle will assist you.

The nature of man, though firmly argued,
is yet in doubt for many.
Questions abound and your way is uncharted,
but don't give up; you've just started.

But, one more thing, you mere mortal –
if there's anything immortal – it's me!

H. Wesley Peirce

The Moores Weigh Anchor

This progress report, supplied by Joseph LaVoie of the Bureau staff, is a response to the many inquiries being made by friends and associates that viewed with anxiety Dr. Moore's decision to retire aboard a 42-foot Ketch and sail the world.

After leaving Tucson, Dick and his wife, Elizabeth, boarded a States Line freighter December 3 in San Francisco, en route for Taiwan. After three days out they were introduced to the fury of the ocean and for a day and a half, with a cold 60 mile-per-hour gale blowing, they rode 40 to 50 foot seas. In spite of a 25° to 30° roll of the ship, they experienced no ill effects. After arriving at Koo-hsiun harbor in southern Taiwan on December 16 and passing through customs, they boarded a train north to Taipei.

Taipei: After a few days at the Grand Hotel they found an apartment and also contracted at a shipyard for the construction of their boat. The next few months were anxious but busy ones, waiting for the completion day. They both studied and received their radio operator's license and made plans and lists for stocking their boat with provisions. At last came launch day (May 20), and their boat, christened "Fair Winds," was launched under the American flag. The shipyard also gave them a Taiwan flag. Before taking command of their boat, a shakedown cruise was made in the river by the shipyard employees. After a week or so of stocking provisions, moving aboard, and making last minute preparations for leaving Taipei, they set sail for Keelung to go through customs. After leaving Keelung they set their course down the east coast of Taiwan and upon running into a calm they had to use their engine. Then, among other things, they developed engine trouble and were forced to pull into Koo-hsiun harbor in southern

Continued on page 6

Launching of the "Fair Winds"

NEW GEOLOGIC MAPS OF ARIZONA 1975-1978

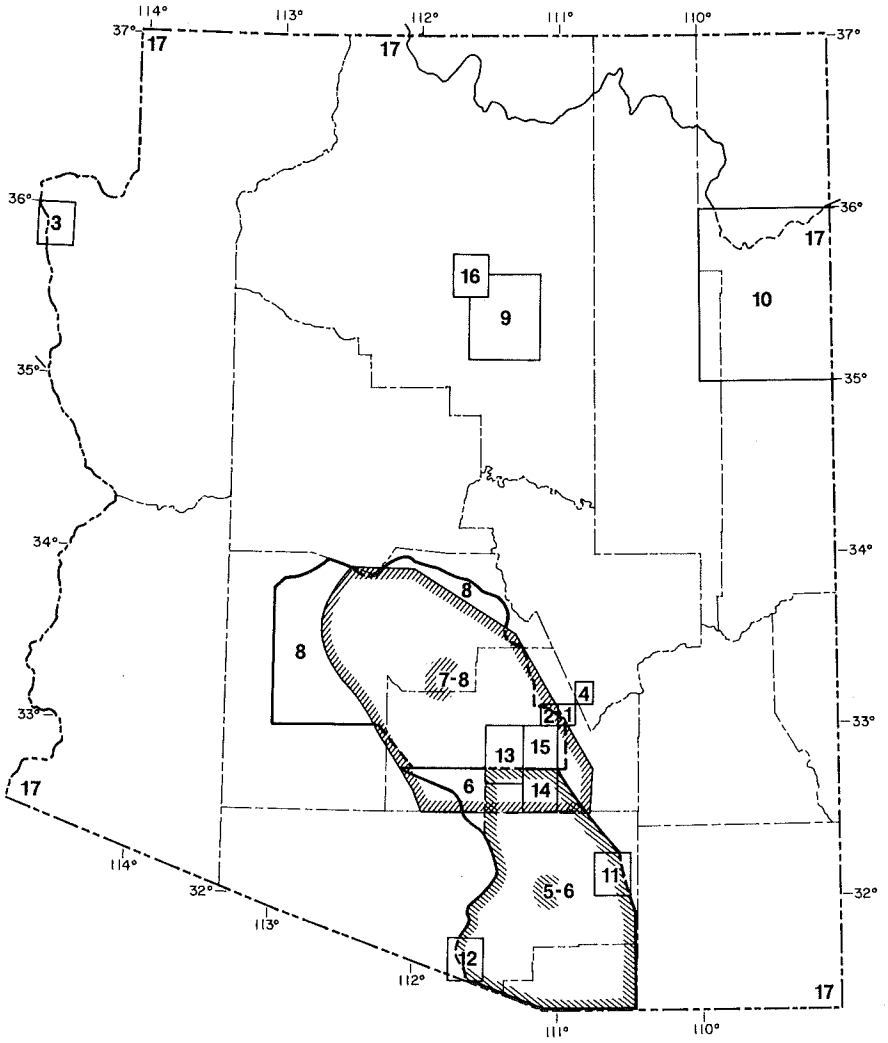
NOTE

Publications and maps issued by agencies other than the Bureau of Geology and Mineral Technology must be ordered directly from the issuing agency. Bureau of Geology and Mineral Technology publications may be purchased at or ordered from:

Publications
Bureau of Geology and Mineral Technology
845 N. Park Avenue
Tucson, AZ 85719

Payment by check or money order, including a handling charge of ten percent of the total amount of the order (.25¢ minimum), must accompany all publication orders.

Payment in U.S. Currency is required on all foreign orders and additional charges will be made to cover foreign postage (approximately 20% of order for surface mail).



U.S.G.S. Geologic Quadrangle Map Series GQ.

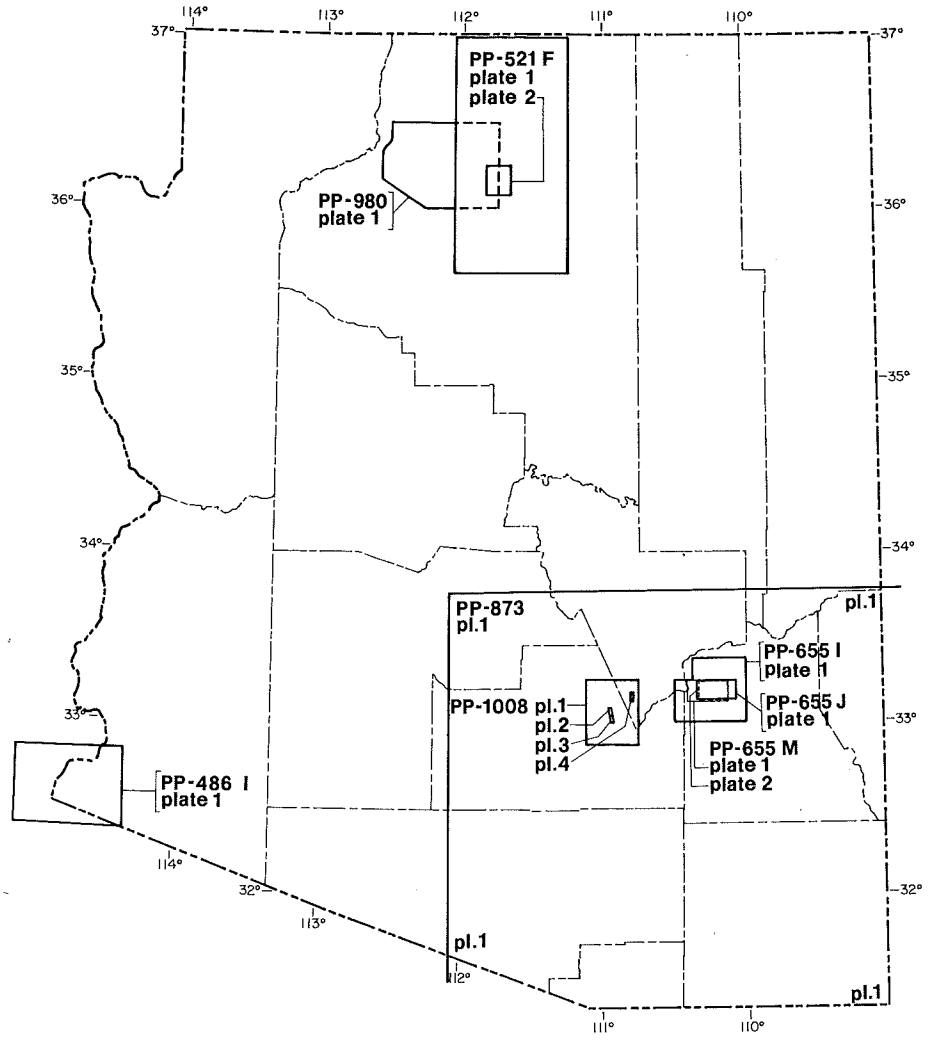
1. GQ-1188: Geologic Map of the Kearny Quadrangle, Pinal County, Arizona, by H.R. Cornwall and M.H. Krieger, 1975.
2. GQ-1206: Geologic Map of the Grayback Quadrangle, Pinal County, Arizona, by H.R. Cornwall and M.H. Krieger, 1975.
3. GQ-1394: Geologic Map of the Black Canyon 15-Minute Quadrangle, Mohave County, Arizona and Clark County, Nevada, by Ernest Anderson, 1978.
4. GQ-1442: Geologic Map of the El Capitan Mountain Quadrangle, Gila and Pinal Counties, Arizona, by H.R. Cornwall and M.H. Krieger, 1978.

U.S.G.S. Miscellaneous Investigations Map Series I.

5. I-844-M: Components of the Water Budget in the Tucson Area, Arizona, by S.G. Brown, 1976.
6. I-844-N: Arability Map of the Tucson Area, Arizona, by P.P. Ross, 1977.
7. I-845-J: Maps Showing Nonmetallic Mineral Deposits in the Phoenix Area, Arizona, by R.T. Moore and R.J. Varga: ABM (BGMT), 1976.
8. I-845-K: Map Showing Distribution of Recoverable Ground Water in the Phoenix Area, Arizona, by W.R. Osterkamp and P.P. Ross, 1976.
9. I-953: Geologic Map of the Eastern San Francisco Volcanic Field, Arizona, by R.B. Moore and E.W. Wolfe, 1976.
10. I-981: Geology, Structure, and Uranium Deposits of the Gallup 1° x 2° Quadrangle, New Mexico and Arizona, by R.J. Hackman and A.B. Olson, 1977.
11. I-997: Geologic Map and Sections of the Rincon Valley Quadrangle, Pima County, Arizona, by H. Drewes, 1977.

U.S.G.S. Miscellaneous Field Studies Map Series MF

12. MF-678: Reconnaissance Geologic Map of the Arivaca Quadrangle, Arizona, by W.J. Keith and T.G. Theodore, 1975. (Because this map is preliminary and was printed in a very limited edition, no automatic distribution will be made.)
13. MF-778: Reconnaissance Geologic Map of the Picacho Mountains, Arizona, by Warren Yeend, 1976. (Because this map is preliminary and was printed in a very limited edition, no automatic distribution will be made.)
14. MF-864: Reconnaissance Geologic Map of Tortolita Mountains Quadrangle, Arizona, by N.G. Banks, R.D. Dockter, J.A. Briskey, G.H. Davis, S.B. Keith, R.T. Budden, C.W. Kiven, and Phillip Anderson, 1977. (Because this map is preliminary and was printed in a very limited edition, no automatic distribution will be made.)
15. MF-909: Reconnaissance Geologic Map of the Ninetysix Hills NW., NE., SE., and SW. Quadrangles, Pinal



County, Arizona, by Warren Yeend, W.J. Keith, and P.M. Blacet, 1977.

U.S.G.S. Geophysical Investigations Map Series GP.

16. GP-905: Complete Bouguer Gravity Map of SP Mountain Quadrangle, Coconino County, Arizona, by J.D. Henricks, 1975.

U.S.G.S. Hydrologic Investigations Atlas Series HA

17. HA-542: Preliminary Maps Showing Ground-Water Resources in the lower Colorado River Region, Arizona, Nevada, New Mexico, and Utah, 1976.

U.S.G.S. Professional Papers.

486-I: Analog Simulation of the Ground-Water System, Yuma, Arizona, by Eugene P. Pattern Jr. 1977. (Maps on Plate 1 in pocket.)

521-F: Spring Flow from Pre-Pennsylvanian Rocks in the Southwestern Part of the Navajo Indian Reservation, Arizona, by M.E. Cooley, 1976. (Maps on Plates 1 and 2 in pocket.) Scale: 62,500.

655-J: Flow from Small Watersheds Adjacent to the Study Reach of the Gila River Phreatophyte Project, Arizona; by D.E. Burkham, 1976. (Map on Plate 1 scale 1:62,500 and photos on Plate 2 in pocket.)

655-K: Effects of Changes in an Alluvial Channel on the Timing, Magnitude, and Transformation of Flood Waves, Southeastern Arizona, by D.E. Burkham 1976.

655-L: Accuracy of Evapotranspiration Rates Determined by the Water-Budget Method, Gila River Flood Plain, Southeastern Arizona, by R.L. Hanson and D.R. Dawdy, 1976.

655-M: Effects of Phreatophyte Removal on Water Quality in the Gila River Phreatophyte Project Area, Graham County, Arizona, by R.L. Laney and H.W. Hjalmarson, 1977. (Maps on Plates 1 and 2 in pocket) scale 1:24,000.

655-N: The Hydrologic History of the San Carlos Reservoir, Arizona, 1929-71, with Particular Reference to Evapotranspiration and Sedimentation, by F.P. Kipple 1977.

873: Cambrian and Ordovician Rocks of Southern Arizona and New Mexico and Western Most Texas, by P.T. Hayes assisted by G.C. Cone, 1975. (Sections on Plate 1 in pocket.)

980: Effects of the Catastrophic Flood of December 1966, North Rim Area, Eastern Grand Canyon, Arizona, by M.E. Cooley, B.N. Aldridge, and R.C. Euler, 1977. (Map on Plate 1 in pocket) scale 1:62,500.

1008: Large Landslides, Composed of Megabreccia, Interbedded in Miocene Basin Deposits, Southeastern Arizona, by Medora H. Krieger, 1977. (Maps on Plates 1, 2, 3 and 4 in pocket) scale plate 1, 1:125,000; Plate 2, 1:6,000; Plate 3, 1:6,000; and Plate 4, 1:12,000.

U.S.G.S. Journals of Research

(3) Volcanic Rocks of the Eastern and Northern Parts of the San Francisco Volcanic Field, Arizona: U.S.G.S. Journal of Research Vol. 5 No. 5, pp. 549-560, by R.B. Moore, E.W. Wolfe, and G.E. Ulrich, 1976.

(2) Mississippian Carbonate Shelf Margins, Western United States: U.S.G.S. Journal of Research Vol. 4 No. 4, pp. 449-466, by P.R. Rose, 1976.

(1) Halogen Contents of Igneous Minerals as Indicators of Magmatic Evolution of Rocks Associated With the Ray Porphyry Copper Deposits, Arizona: U.S.G.S. Journal of Research Vol. 4 No. 1, pp. 91-117, by N.G. Banks, 1976.

(4) Middle Tertiary Plutonism in the Santa Catalina and Tortolita Mountains, Arizona: U.S.G.S. Journal of Research Vol. 5 No. 6, pp. 705-717, by S.C. Creasey, N.G. Banks, R.P. Ashley, and T.G. Theodore, 1977.

(5) Galiuro Volcanics, Pinal, Graham, and Cochise Counties, Arizona: U.S.G.S. Journal of Research Vol. 6 No. 1, pp. 115-131, by S.C. Creasey and M.H. Krieger, 1978.

News Update *continued from page 3*

Taiwan. The shipyard they went to was owned by the same person that owned the yard in Taipei, and they were able to have the necessary repairs and adjustments made, but not without some excitement. Upon entering the harbor, they were unable to contact the harbor patrol or customs so they proceeded to the shipyard. Moments later both the harbor patrol and customs agents, carrying machineguns, boarded their boat and argued among themselves as to who had the authority to take charge of them after they seemingly penetrated the tight security of the harbor. Seeing the obvious problem with the boat, and after answering some questions, Dick and Elizabeth were able to continue their journey to Hong Kong. I am happy to report that in spite of the continued calm they arrived at the Hong Kong Yacht Club safely and will remain there until the typhoon season is over. We will try to keep you informed as to the progress and adventures of Captain Richard Moore and his First Officer, Elizabeth Moore, on board the "Fair Winds" en route around the world.

Geological Survey Branch Receives Grant

The Geological Survey Branch has received a $30,000 grant from the U.S. Geological Survey to initiate certain geologic investigations pertaining to potential uranium resources in the Basin and Range Province of Arizona. The grant, designed as a phase one study, is for seven months. Dr. H. Wesley Peirce, Principal Geologist in the GSB, is Principal Investigator and Dr. Paul Damon, Chief Scientist, Laboratory of Isotope Geochemistry, University of Arizona Geosciences Department, is Co-Principal Investigator.

The initial study will focus on the gathering of data applicable to assessing the uranium favorability of sedimentary rocks that were deposited in southwestern Arizona between 45 and 12 million years ago. Exposures of these rocks are fragmentary because of later faulting, volcanism, mountain building, and erosion. However, it is a remnant of rock of this age bracket that is the host for uranium ore at the well-publicized Anderson prospect northwest of Phoenix. Elsewhere in Arizona certain rocks of this age also contain anomalous uranium mineralization.

NOTE

Revisions for Figure 7 of Fieldnotes v.8, Nos. 1 and 2

Production data for the Pima District was omitted from Figure 7. Principal copper mines in the Pima District are Pima (1951) – Mission (1954); Esperanza (1955) – Sierrita (1960/1963); Twin Buttes (1957/1963); and San Xavier North (1955/1957). Copper production for Pima District (1908-1975) is 5684 x 10^6 pounds. We are also advised by ASARCO that their mine in the Casa Grande District is informally named the "Casa Grande Mine;" not Sacaton Mine as reported in the table.

Publications *continued from page 5*

U.S.G.S. Bulletins

1278-D: Geochemical Exploration Techniques Based on Distribution of Selected Elements in Rocks, Soils, and Plants, Mineral Butte Copper Deposit, Pinal County, Arizona, by M.A. Chaffee, 1976.

1278-E: Geochemical Exploration Techniques Based on Distribution of Selected Elements in Rocks, Soils, and Plants, Vekol Porphyry Copper Deposit Area, Pinal County, Arizona, by M.A. Chaffee, 1976.

1395-J: The Supai Group-Subdivision and Nomenclature, by E.D. McKee, 1975.

U.S.G.S. Water-Supply Papers

2126: Surface Water Supply of the United States, 1966-70, Part 9. Colorado River Basin Vol. 3 Lower Colorado River Basin, 1975.

2158: Quality of Surface Waters of the United States, 1970, Parts 9 and 10. Colorado River Basin and The Great Basin, 1976.

2162: Ground-Water Levels in the United States, 1971-74, Southwestern States, 1977.

U.S.G.S. Circulars

726: Assessment of Geothermal Resources of the United States-1975, by D.E. White and D.L. Williams, Editors, 1975.

727: Summary of Miscellaneous Potassium-Argon Age Measurements, U.S. Geological Survey, Menlo Park, California, for the Years 1972-74, Compiled and Edited by A.L. Berry and others, 1976.

U.S.G.S. Open-File Reports.

The following reports and maps are available only for public inspection at the indicated depositories and are not obtainable from the U.S. Geological Survey nor from the Superintendent of Documents. Information on copying reports at private expense may be obtained by writing to the depository holding reproducibles, if any, and referring the report by title and number. Symbols listed below indicate the major depositories, and (r) indicates reproducible copies may be available.

ABGMT – Arizona Bureau of Geology and Mineral Technology
Geological Survey Branch
845 N. Park Ave. · Tucson, AZ 85719

75-15: Catalog of Earthquakes in the Lake Mead Area, Nevada-Arizona, for the Period from July 10, 1972 to December 6, 1973, by W.H.K. Lee and E.E. Matomoros. 28 p., 2 figs., 2 tables. (ABGMT); and others.

75-93: Preliminary Geologic Map of the Garnet Mountain Quadrangle, Mohave County, Arizona, by P.M. Blacet. 1 pl., scale 1:48,000. (ABGMT); and others.

75-133: Analytical Data from Two Drill Holes, Kalamazoo Porphyry Copper Deposit, Pinal County, Arizona, by M.A. Chaffee and George Van Trump, Jr. 21 p. (ABGMT); and others.

75-178: Selected Stratigraphic Sections of Cambrian and Ordovician Rocks in Arizona, New Mexico, and Western Texas (Supplementary Material to Accompany Prof. Paper 873, by P.T. Hayes. 51 p., 1 fig. (ABGMT); and others.

75-203: Atlas of Urban and Regional Change, Phoenix, Arizona, Land Use 1970, and Land Use Change 1970-72, by Geography Program Census Cities Project, a Joint NASA/-USGS Remote Sensing Experiment, J.R. Wray, Principle Investigator. 22 pls., scale 1:62,500. (State of Arizona, ARIS Program, 1812 West Monroe, Suite 202, Phoenix, AZ 85007 (r); U.S.G.S. Suite 1880, Valley Center, Phoenix, AZ 85073; U.S.G.S. Federal Bldg., 301 West Congress St., Tucson, Arizona 85701); and others.

75-204: Atlas of Urban and Regional Change, Tucson, Arizona, Land Use 1970, and Land Use Change 1970-72, by Geography Program Census Cities Project, a Joint NASA/-USGS Remote Sensing Experiment, J.R. Wray, Principle Investigator. 4 pls., scale 1:62,500. (State of Arizona, ARIS Program, 1812 West Monroe, Suite 202, Phoenix, AZ 85007 (r); U.S.G.S. Suite 1880, Val-

ley Center, Phoenix, AZ 85073; U.S.G.S. Federal Bldg., 301 West Congress St., Tucson, Arizona 85701); and others.

75-295: Preliminary Reconnaissance Geologic Map of the Bellota Ranch 15-Minute Quadrangle, Arizona, by S.C. Creasey and T.G. Theodore. 1 pl., scale 1:31,680. (ABGMT) (r); and others.

75-314: Preliminary Geologic Map of the Teapot Mountain Quadrangle, Pinal County, Arizona, by S.C. Creasey, D.W. Peterson, and N.A. Gambell. 3 pls., scale 1:24,000. (ABGMT) (r); and others.

75-416: Preliminary Report on the Use of LANDSAT-1 (ERTS-1) Reflectance Data in Locating Alteration Zones Associated with Uranium Mineralization Near Cameron, Arizona, by C.S. Spirakis and C.D. Condit, 23 p., 6 figs., 1 table. (ABGMT); and others.

75-425: Possible Effects of Vegetation Conversion on Runoff and Sediment Yield, Sycamore Creek Watersheds, Maricopa County, Arizona, Calibration-Period Analysis, by H.W. Hjalmarson. 77 p., 9 figs., 5 tables. (U.S.G.S. Federal Bldg., 301 West Congress St., Tucson, Arizona 85701; U.S.G.S. Suite 1880, Valley Center, Phoenix AZ 85073); and others.

76-120: Through 76-122. Each of these reports is a data set for a named section of ARIZONA. Each data set is a land use and land cover series of four maps keyed to U.S.G.S. topgraphic maps at a scale of 1:250,000. These maps are coded for statistical data development. These maps are: (1) land use and land cover, (2) political units (3) hydrologic units, and (4) census county subdivisions. Also included is a positive of the cultural base for the section involved. (U.S,G.S. Western Mapping Ctr., 345 Middlefield Rd., Menlo Park, CA 94025.)

76-120 Land Use and Land Cover and Associated Maps for Mesa, Arizona. Lat 33° to 34°, Long. 110° to 112°.

76-121 Land Use and Land Cover and Associated Maps for Phoenix, Arizona. Lat 33° to 34°, Long. 112° to 114°.

76-122 Land Use and Land Cover and Associated Maps for Tucson, Arizona. Lat. 32° to 33°, Long. 110° to 112°.

76-215: Mines, Mineralization, and Alteration in the Vaca Hills Quadrangle, Arizona., by N.G. Banks and R.D. Dockter. 3 pls., scale 1:62,500. (ABGMT); and others.

76-262: Middle Tertiary Plutonism in the Santa Catalina and Tortolita Mountains, Arizona, by S.C. Creasey, N.G. Banks, R.P. Ashley, T.G. Theodore. (ABGMT); and others.

76-482: Fluid Inclusions as a Guide to Porphyry Copper Deposits, by J.T. Nash. 16 p. (ABGMT); and others.

76-616: Charts Showing Rainfall and Temperature Data and Chemical Analyses for 7 Common Desert Plant Species Collected Between Oct. 1971 and Oct. 1974 at the International Biological Program Tucson Validation Site, Pima County, Arizona, by M.A. Chaffee, E.L. Mosier, J.M. Nishi, and G. Van Trump, Jr. 337 p. (ABGMT); and others.

76-671: Lithium Reconnaissance of Arizona, by J.R. Davis and A.L. Meier. 15 p., 1 fig., 3 tables. (ABGMT); and others.

76-703: Preliminary Geologic Map of the Wupatki NE Quadrangle, Arizona, by D.V. Haines and C.B. Bowles. 1 pl., scale 1:24,000. (ABGMT) (r); and others.

76-716: Availability of Ground Water in the Molenitus Area, Papago Indian Reservation, Arizona 1958, by L.A. Heindl. 9 pls., scale 1:125,000. (U.S.G.S. Federal Bldg., 301 West Congress St., Tucson, Arizona 85701.)

76-729: Geochemical Survey of the Western Energy Regions (formerly Geochemical Survey of the Western Coal Regions), Third Annual Progress Report, July 1976. 250 p., 42 figs., 20 tables. (Public Inquiries Office, Rm. 1012, Federal Bldg., 1961 Stout St., Denver, CO 80202.)

76-760: Porphyry-Type Metallization and Alteration at La Florida De Nacozari, Sonora, Mexico, by T.G. Theodore and Miguel Priego de Wit. 28 p., 7 figs., 1 table. (ABGMT); and others.

76-764: Maps Showing Mines, Mineralization, and Alteration in the Tortolita Mountains Quadrangle, Arizona, by N.G. Banks, R.D. Dockter, and J.A. Briskey. 3 pls., scale 1:62,500. (ABGMT); and others.

76-827: Leasable Mineral and Waterpower Land Classification Map, Escalante Quadrangle, Utah, Arizona, by J.E. Smedley, E.M. Pera, and G.A. Lutz. Scale 1:250,000. (Public Inquiries Office, Rm. 1012, Federal Bldg., 1961 Stout St., Denver, CO 80202 (r); and others.

76-851: Chemical Analysis and Statistical Data for Water Samples Collected in Colorado, New Mexico, and Arizona as Part of a Study of Surface-Water and Stream-Sediment Sampling Techniques Used in Uranium Exploration, by S.S. Burnside and K.J. Wenrich-Verbeek. 314 p. (ABGMT); and others.

76-864: Evapotranspiration Losses from Flood-Plain Areas in Central Arizona, by T.W. Anderson. 89 p., 15 figs., 6 tables. (U.S.G.S. Rm. 5-A, Federal Bldg., 301 West Congress St., Tucson, Arizona 85701; U.S.G.S. Suite 1880, Valley Center, Phoenix, AZ 85073.)

77-36: Uranium, Radium, and Selected Metallic-Element Analyses of Spring Water and Travertine Samples from the Grand Canyon, Arizona, by J.E. Peterson, S.E. Buell, R.A. Cadigan, J.K. Felmlee, and C.S. Spirakis. 8 p., 6 tables. (ABGMT); and others.

77-78: Maps of Lineaments, and Lineament Intersections, and Hydrothermal Alteration of Northern Sonora, Mexico, by G.L. Raines. 5 p., 12 pls. (ABGMT); and others.

77-70: Land Use and Land Cover and Associated Maps for Lukeville, Arizona. Lat. 31° to 32°, Long. 112° to 114°. This Data Set Consists of Four Maps Keyed to the U.S.G.S. Topographic Map of Lukeville, scale 1:250,000. These Maps are Coded for Statistical Data Development. The Maps are: (1) Land Use and Land Cover (2) Political Units (3) Hydrologic Units, and (4) Census County Subdivisions. Also Included is one Positive of the Cultural Base for Lukeville, Arizona. (U.S.G.S. Eastern Mapping Center, 559 National Ctr., 12201 Sunrise Valley Dr., Reston, VA 22092.)

77-127: Some Observations that Bear on the Origin of Porphyry Copper Deposits, by N.G. Banks and N.J. Page. 14 p. (ABGMT); and others.

77-149: Land Use and Land Cover and Associated Maps for Ajo, Arizona. Lat. 32° to 33°, Long. 112° to 114°. Four Maps and a Positive of the Cultural Base for Ajo, Arizona. Scale 1:250,000. (U.S.G.S. Western Mapping Center, 345 Middlefield Rd., Menlo Park, CA 94025.)

77-152: Map Showing Photo Lineaments in the Tortolita Mountains Quad-

rangle, Arizona, by R.D. Dockter and N.G. Banks. 1 pl., scale 1:62,500. (ABGMT); and others.

77-227: Preliminary Geologic Map of the Red Rock Valley NE Quadrangle, Apache County, Arizona and San Juan County, New Mexico, by C.A. Huffman, Jr. 1 pl., scale 1:24,000. (ABGMT); and others.

77-255: Igneous Rocks and Copper Mineralization in the Ray Porphyry Copper District, Arizona, by H.R. Cornwall and N.G. Banks. 11 p. (ABGMT); and others.

77-331: Map Showing Distribution Pattern of Tin from Samples of the Nonmagnetic Fraction of Heavy-Mineral Concentrates, Northern Sonora, Mexico, by J.G. Frisken, R.L. Turner, T.M. Billings, G. Monroy, and B. Ponce. 2 pls. (ABGMT); and others.

77-332: Map Showing Distribution Pattern of Molybdenum from Samples of the Nonmagnetic Fraction of Heavy-Mineral Concentrates, Northern Sonora, Mexico, by J.G. Frisken, R.L. Turner, T.M. Billings, G. Monroy, and B. Ponce. 2 pls. (ABGMT); and others.

77-333: Map Showing Distribution Pattern of Lead from Samples of the Nonmagnetic Fraction of Heavy-Mineral Concentrates, Northern Sonora, Mexico, by G.H. Allcott, G. Van Trump, Jr., Jose Lee-Moreno, and Arturo Gomez. 2 pls. (ABGMT); and others.

77-334: Map Showing Distribution Pattern of Tungsten from Samples of the Nonmagnetic Fraction of Heavy-Mineral Concentrates, Northern Sonora, Mexico, by G.H. Allcott, G. Van Trump, Jr., Jose Lee-Moreno, and Arturo Gomez. 2 pls. (ABGMT); and others.

77-335: Map Showing Distribution Pattern of Iron from Samples of the Nonmagnetic Fraction of Heavy-Mineral Concetrates, Northern Sonora, Mexico, by E.L. Mosier, Antonion Ortiz, Juan Morin, and Hector Ontiveras. 2 pls. (ABGMT); and others.

77-336: Map Showing Distribution Pattern of Silver from Samples of the Nonmagnetic Fraction of Heavy-Mineral Concentrates, Northern Sonora, Mexico, by E.L. Mosier, Antonion Ortiz, Juan Morin, and Hector Ontiveras. 2 pls. (ABGMT); and others.

77-337: Map Showing Distribution Pattern of Zinc from Samples of-80 Mesh Stream Sediment, Northern Sonora, Mexico, by G.H. Allcott, G. Van Trump, Jr., Jose Lee-Moreno, and Arturo Gomez. 2 pls. (ABGMT); and others.

77-338: Map Showing Distribution Pattern of Copper from Samples of -80 Mesh Stream Sediment, Northern Sonora, Mexico, by J.G. Frisken, R.L. Turner, T.M. Billings, Guillermo Monroy, and B. Ponce. 2 pls. (ABGMT); and others.

77-339: Map Showing Distribution Pattern of Strontium from Samples of the Nonmagnetic Fraction of Heavy-Mineral Concentrates, Northern Sonora, Mexico, by M.E. Hinkle, S.K. McDanal, G. Benitez, and L. Chavez. 2 pls. (ABGMT); and others.

77-340: Map Showing Distribution Pattern of Barium from Samples of the Nonmagnetic Fraction of Heavy-Mineral Concentrates, Northern Sonora, Mexico, by M.E. Hinkle, S.K. McDanal, G. Benitez, and L. Chavez. 2 pls. (ABGMT); and others.

77-343: Map of Arizona Showing Selected Alluvial, Structural, and Geomorphic Features, by M.E. Cooley. 20 p., 1 pl. (ABGMT); and others.

77-376: Geologic Setting and Interpretation of a Zone of Middle Tertiary Igneous-Metamorphic Complexes in South-Central Arizona, by N.G. Banks. 22 p., 14 figs. (ABGMT); and others.

77-473: Preliminary Simple Bouguer Gravity Map of Northeastern Sonora, Northwestern Chihuahua, Southeastern Arizona, U.S. Geological Survey and Consejo de Recursos Minerales. (Public Inquiries Office, Rm. 1012, Federal Bldg., 1961 Stout St., Denver, CO 80294 (r); and others.

77-500: Magmatic Behavior of Cu, S, Cl, F, and H_2O in Igneous Rocks Associated with the Ray Porphyry Copper Deposit, Arizona, by N.G. Banks. 28 p., 27 figs. (ABGMT); and others.

77-654: Chemical Isotopic, and Gas Combinations of Selected Thermal Springs in Arizona, New Mexico, and Utah, by R.H. Mariner, T.S. Presser, and W.C. Evans. 56 p., 4 figs., 8 tables. (Public Inquiries Office, Rm. 1012, Federal Bldg., 1961 Stout St., Denver, CO 80294); and others.

77-737: A Summary of the Geology and Mineral Resources of the Paria Plateau-House Rock Valley Area, Coconino County, Arizona, by M.W. Green, C.T. Pierson, D.P. Bauer, and D.B. Umshler. 10 p., 3 figs. (Energy Research and Devel. Admin., Grand Junction, CO 81501); and others. Microfiche $4.00; Paper Copy $6.50.

78-207: Principle Facts for Gravity Stations in Maricopa, Mohave, Yavapai, Yuma Counties, Arizona, by J.C. Wynn, J.K. Otton, and R.A. Stawicki. (ABGMT); and others.

78-362: Complete Bouguer Gravity Maps and Gravity Models of the Date Creek Basin and Vicinity, Maricopa, Mojave, Yavapai, and Yuma Counties, Arizona, by J.C. Wynn and J.K. Otton. 2 pls. (ABGMT); and others.

78-404: Preliminary Geologic Map of the Redrock Valley SE Quadrangle, Apache County, Arizona, and San Juan County, Arizona, by C.A. Huffman, Jr., and T.W. Jones (ABGMT); and others.

78-468: Preliminary Geologic Map of the Mineral Mountain 7½-Minute Quadrangle, Arizona, by T.G. Theodore, W.J. Keith, A.B. Till, and J. Peterson. (ABGMT); and others.

78-483: Analyses of Rock and Stream Sediments of the Superstition Wilderness, Arizona, by J.M. Motooka, 162 p., 1978, (ABGMT); and others.

78-561: Radium and Uranium Data for Mineral Springs in Eight Western States, by J.K. Felmlee and R.A. Cadigan. (ABGMT); and others.

78-566: Principle Facts for Gravity Stations in and Adjacent to the Superstition Mountains, Gila, Pinal, and Maricopa Counties, Arizona, by J.C. Wynn and S.A. Manydeeds, 9 p. (ABGMT); and others.

78-572: Four Maps Showing Lithologic Distributions of Selected Parts of the Jurassic San Rafael Group, Utah, Colorado, Arizona, and New Mexico, by J.C. Wright. (ABGMT); and others.

Bureau of Geology and Mineral Technology Publications 1975-78

Special Paper No. 1:
Late Cenozoic Geology of the White Mountains, Arizona, by R.K. Merrill and T.L. Pewe (1977) $4.50.

Special Paper No. 2:
Guidebook to the Geology of Central Arizona. (1978) $6.00.

Bulletin No. 191:
Index of Mining Properties in Santa Cruz County, Arizona, by S.B. Keith (1975) $1.50.

Bulletin No. 192:
Index of Mining Properties in Yuma County, Arizona, by S.B. Keith (1977) $3.00.

Circular No. 17:
Utilization of Municipal Waste Water for Froth Flotation of Copper and Molybdenum Sulfides, by W.W. Fisher and Samuel Rudy (1976) $.50.

Circular No. 18:
Chemical Analyses of Coal Samples from the Black Mesa Field, Arizona, Study initiated and coordinated by R.T. Moore and V.E. Swanson. (1977) $.50.

Circular No. 19:
A Survey of Uranium Favorability of Paleozoic Rocks in the Mogollon Rim and Slope Region, East-Central Arizona, by H.W. Peirce et al. Provides a Summary of the General Geology of an Interesting Region. (1977) $1.75.

Circular No. 20:
Geology of the Socorro Peak Area, Western Harquahala Mountains, by R.J. Varga (1977) $1.00.

Maps:

1. Geologic Map and Cross Sections of Arizona. Printed in color, scale approximately 40 miles/inch (1:2,500,000) (1977). $.25.
2. Geologic Map of Arizona (1969) (Reprinted 1977) Printed in color, scale approximately 8 miles/inch (1:500,00). $3.00.
3. Geothermal Energy Resources of Arizona, Map No. 1 (1978). $1.75.

Miscellaneous Geologic Investigations

1. San Carlos Indian Reservation Peridot Mine-Inspection Report B75-2, by D.D. Rabb and J.S. Vuich.
2. A Geology Evaluation of International Business Machines Corporation Plant Site, Tucson, Arizona, by J.S. Vuich and others. 1978.

U.S.B.M. Information Circulars – IC

Sales publications may be ordered only from:
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Government Printing Office
Washington, D.C. 20402
Remittance, which should be included with the order, may be in the form of checks of money orders payable to the Superintendent of Documents. Postage stamps and foreign money are not acceptable.

IC 8719: Projects to Expand Fuel Sources in Western States. Survey of Planned or Proposed Coal, Oil Shale, Tar, Sand, Uranium, and Geothermal Supply Expansion Projects, and Related Infrastructure, in States West of the Mississippi River (as of May 1976), by J.S. Coresentino. 1976. 208 p., 22 figs. $2.85.

IC 8702: Time Required in Developing Selected Arizona Copper Mines, by L.B. Burgin. 1976. 144 p., 4 figs. $2.60.

IC 8693: The Reserve Base of U.S. Coals by Sulfur Content (in two parts). 2. The Western States, by P.A. Hamilton, D.H. White, Jr., and T.K. Matson. 1975. 322 p., 7 figs.

U.S.B.M. Reports of Investigations – RI

RI 8070: Blasting Tests in a Porphyry Copper Deposit in Preparation for In Situ Extraction, by R.C. Steckley, W.C. Larson, and D.V. D'Andrea. 1975. 44 p., 34 figs. The Bureau of Mines performed a fragmentation experiment in cooperation with Duval Corp. in a prophyry copper-molybdenum deposit near the Sierrita pit south of Tucson, Arizona.

U.S.B.M. Open File Reports – NTIS

The following Bureau of Mines publications may be obtained from:
National Technical Information Service
U.S. Department of Commerce
Springfield, VA 22161
Microfiche copies are $2.25 apiece (unless otherwise noted); paper copies are available at the price indicated. Please order by numbers given below:

PB 243 075/AS: Evaluation of Mill Tailings Disposal Practices and Potential Dam Stability Problems in Southwestern United States. Phelps Dodge Corporation, Morenci Tailings Dams, Morenci, Arizona. V.2, by W.A. Wahler and Associates. 172 p., 31 figs. (BuMines OFR 50 (2) – 75. Paper copy, $7.00).

ERDA (DOE) Open File Reports (Selected)

This list of Open File Reports may be viewed at the Bureau of Geology and Mineral Technology, 845 N. Park Avenue, Tucson, Arizona, between 8 a.m. and 5 p.m., Monday through Friday except Holidays.

GJO 1649: A Comparative Study of the Geostatistical Ore Reserve Estimation Method over the Conventional, Methods, by Y.C. Kim and H.P. Knudsen, University of Arizona, Department of Mining and Geological Engineering, Tucson, Arizona. 1975.

GJBX-12 (76): A Survey and Critique of Quantitative Methods for the Appraisal of Mineral Resources, University of Arizona Department of Mining and Geological Engineering, Tucson, Arizona. 1976.

GJBX-16 (76): Uranium Deposits of the Grants, New Mexico, Mineral Belt, by D.G. Brookins, University of New Mexico, Department of Geology, Albuquerque, New Mexico. 1975.

GJBX-18 (76): Development of a Neutron Logging Tool for Uranium Exploration, by J. Reichardt. 1976.

GJBX-26 (76): Hydrogeochemical and Stream-Sediment Survey (NURE), Western United States, Quarterly Progress Report, January 1 through March 31, 1976, by Lawrence Livermore Laboratory.

GJBX-33 (76): Aerial Radiometric and Magnetic Survey Clovis National Topographic Map, Texas and New Mexico, by Geodata International, Inc. 1976.

GJBX-40 (76): Hydrogeochemical and Stream-Sediment Survey (NURE), Preliminary Report on the Walker River Basin Study (California/-Nevada), by Lawrence Livermore Laboratory. 1976.

GJBX-41 (76): Hydrogeochemical and Stream-Sediment Survey (NURE), Preliminary Report of the Winnemucca Dry Lake Basin Pilot Study (Nevada), by Lawrence Livermore Laboratory. 1976.

GJBX-42 (76): Hydrogeochemical and Stream-Sediment Survey (NURE), Preliminary Report on the Smoke Creek Desert Basin Pilot Study (Nevada), by Lawrence Livermore Laboratory. 1976.

GJBX-43 (76): Hydrogeochemical and Stream-Sediment Survey (NURE), Preliminary Report on the Cave Valley Basin Pilot Study (Nevada), by Lawrence Livermore Laboratory. 1976.

GJBX-44 (76): Hydrogeochemical and Steam-Sediment Survey (NURE), Preliminary Report on the Roach Lake Basin Pilot Study (Nevada), by Lawrence Livermore Laboratory. 1976.

GJBX-77 (78): Hydrogeochemical and Stream-Sediment Reconnaissance of the National Uranium Resource Evaluation Program, October-December

1977, The Rocky Mountain States of New Mexico, Colorado, Wyoming, and Montana and the State of Alaska, by W.A. Morris, M.E. Bunker, D.W. Steinhaus. 1978.

GJBX-78 (78): Uranium in Alkaline Rocks, by H. Wollenberg et al. 1978.

GJBX-45 (76): Study of Low-Grade Uranium Resources of the Coso Formation, Owens Valley, California, by H.J. Toohey and G.M. Cupp. 1975.

GJBX-49 (76): Construction of the Kut Test Pits, by K.E. Knapp and W.E. Bush. 1976.

GJBX-50 (76): Development of a Portable Radon Detection System, by J.W. Allen. 1976.

GJBX-51 (76): Chemical Analyses of Ground and Surface Water Samples from Parts of the United States, 1956-1975, by D.W. McCarn and R.W. Freeman. 1976.

GJBX-54 (76): Uranium Favorability of Tertiary Rocks in the Badger Flats-Elkhorn Thrust Area, Park and Teller Counties, Colorado, by P. Young and D.G. Mickle. 1976.

GJBX-55 (76): Uranium Favorability of Precambrian Rocks in the Badger Flats-Elkhorn Thrust Area, Park and Teller Counties, Colorado, by G.L. Gallaher. 1976.

GJBX-59 (76): Hydrogeochemical and Stream-Sediment Survey of the National Uranium Resources Evaluation (NURE) Program-Western United States, Quarterly Progress Report. 1976.

GJBX-61 (76): A Brief Review of the Basis for, and the Procedures Currently Utilized in Gross Gamma-Ray Log Calibration, J.R. Duray. 1976.

GJBX-65 (76): Hydrogeochemical and Stream-Sediment Reconnaissance of the National Uranium Resource Evaluation Program, April-June 1976, by W.A. Morris and P.L. Aamodt. 1976.

GJBX-1 (77): Remote Temperature Inversion Sensor, by W. Malkmus and M. Griggs. 1977.

GJBX-2 (77): Survey of Lands Held for Uranium Exploration, Development and Production in Fourteen Western States in the Six-Month Period Ending June 30, 1976, by Bendix Field Engineering Corp. 1977.

GJBX-3 (77): Geostatistical Ore Reserve Estimation for a Roll-Front Type Uranium Deposit (Practitioner's Guide), by Y.C. Kim and H.P. Knudsen, University of Arizona, Department of Mining and Geological Engineering, Tucson, Arizona. 1977.

GJBX-4 (77): Discrimination of Uranium Alteration Zones in Selected Areas by Use of Landsat MSS Imagery, Final Report, by C.L. Kober and H.D. Procteri-Gregg. 1977.

GJBX-8 (77): Microcomputer-Based Pneumatic Controller for Neutron Activation Analysis. (Microfiche). 1977.

GJBX-9 (77): Measured Sections and Analysis of Uranium Host Rocks of the Dockum Group, New Mexico and Texas, by R.E. Dickson, D.P. Drake, and T.J. Reese. 1977.

GJBX-10 (77): Hydrogeochemical and Stream-Sediment Survey of the National Uranium Resource Evaluation (NURE) Program-Western United States, Quarterly Progress Report July through September 1976, by Lawrence Livermore Laboratory. 1977.

GJBX-11 (77): Annual NURE Report 1976. (National Uranium Resource Evaluation), by Bendix Field Engineering Corporation. 1977.

GJBX-12 (77): Hydrogeochemical and Stream-Sediment Reconnaissance of the National Uranium Resource Evaluation (NURE) Program, July-September 1976, by W.A. Morris, 1977.

GJBX-13 (77): Uranium Deposits in Granitic Rocks, by R.K. Nishimori, and others, 1977.

GJBX-14 (77): Quantitative Methods for the Appraisal of Mineral Resources, by DeVerle P. Harris, University of Arizona, Department of Mining and Geological Engineering, Tucson, Arizona. 1977.

GJBX-16 (77): Geology, Uranium Deposits, and Uranium Favorability of the Hartford Hill and Truckee Formation, Southwestern Washoe County, Nevada, and Eastern Lassen County, California, G.M. Cupp and others. 1977.

GJBX-18 (77): Aerial Gamma-Ray and Magnetic Survey of the Delta Area-Utah, Final Report, by Texas Instruments Incorporated. 1977.

GJBX-20 (77): Hydrogeochemical and Stream-Sediment Reconnaissance of the National Uranium Resource Evaluation Program, October-December 1976, by P.L. Aamodt and others. 1977.

GJBX-21 (77): Uranium Hydrogeochemical and Stream-Sediment Pilot Survey of the Estancia Valley, Bernalillo, Santa Fe, San Miguel, and Torrance Counties, New Mexico, by C.E. Olsen. 1977. (Part 1 Text and Data Listings).

GJBX-22 (77): Uranium Hydrogeochemical and Stream-Sediment Reconnaissance in the San Juan Mountains, Southwest Colorado, by J.C. Maxwell. 1977.

GJBX-23 (77): Seminar Proceedings – 1. Pulsed Neutron Uranium Borehole Logging with Prompt Fission Neutrons (PFN). 2. Neutron Tube Technology for PFN Logging Equipment. 1977.

GJBX-24 (77): The Fluorometric Determination of Uranium in Natural Waters, by A.D. Hues and others. 1977.

GJBX-25 (77): Gamma-Ray Spectrum Enhancement, by J.H. Reed and G.M. Reynolds, 1977.

GJBX-27 (77): An Evaluation of High-Frequency Electromagnetic Sounding for Uranium Exploration and Mining, by R.S. Vickers. 1977.

GJBX-32 (77): Investigations of the Inductively Coupled Plasma Source for Analyzing NURE Water Samples at the Los Alamos Scientific Laboratory, by C.T. Apel and others. 1977.

GJBX-33 (77): Survey of Lands Held for Uranium Exploration, Development, and Production in Fourteen Western States in the Six-Month Period Ending December 31, 1976. Bendix Field Engineering Corporation. 1977.

GJBX-34 (77): Hydrogeochemical and Stream-Sediment Survey of the National Uranium Resource Evaluation (NURE) Program-Western United States, Quarterly Progress Report October through December 1976, by Lawrence Livermore Laboratory. 1977.

GJBX-36 (77): Rapid Determination of Uranium in Natural Waters by Thermal Emission Mass Spectrometry, by J.R. Ferguson and others. 1977.

GJBX-38 (77): Use of an Intrinsic Germanium Detector Array for an Aerial Survey of Surface Nuclear Radiation, by K.W. Marlow and G.W. Phillips. 1977.

GJBX-39 (77): Raw Data Report of Elemental Analyses from Hydrogeochemical and Stream-Sediment Samples Taken near Sterling and Fort Morgan, Northeastern Colorado, December 1976 and January 1977, by J.C. Maxwell. 1977.

GJBX-44 (77): Borehole Model Calculations for Direct Uranium Measurement with Neutrons, by W.A. Woolson and M.L. Gritzner. 1977.

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GJBX-50 (77): Geostatistics Project of the National Uranium Resource Evaluation Program, January-March 1977, by T.R. Bement. 1977.

GJBX-51 (77): Hydrogeochemical and Stream-Sediment Reconnaissance of the National Uranium Resource Evaluation Program, January-March 1977, the Rocky Mountain States of New Mexico, Colorado, Wyoming, and Montana, and the State of Alaska, by P.L. Aamodt, G.R. Waterbury, and M.E. Bunker. 1977.

GJBX-52 (77): Automated Energy-Dispersive X-Ray Determination of Trace Elements in Stream-Sediments, by J.M. Hansel and C.J. Martell. 1977.

GJBX-53 (77): Hydrogeochemical and Stream-Sediment Survey of the National Uranium Resource Evaluation (NURE) Program-Western United States, Quarterly Progress Report January through March 1977, by Lawrence Livermore Laboratory. 1977.

GJBX-58 (77): Study of the Applicability of $^{3}He/^{4}He$ Ratio for Uranium Prospecting, Final Report, by J.P. Martin and L.E. Bergquist. 1977.

GJBX-61 (77): Preliminary Evaluation of the Uranium Favorability in the Area Northeast of Gunnison, Colorado, by R.F. D'Andrea, Jr. 1977.

GJBX-65 (77): Advanced Geostatistics in Ore Reserve Estimation and Mine Planning (Practitioner's Guide), by Y.C. Kim, D.E. Myers, and H.P. Knudsen, University of Arizona, Department of Mining and Geological Engineering, Tucson, Arizona. 1977.

GJBX-72 (77): Uranium Favorability of the San Rafael Swell Area, East-central Utah, by D.G. Mickle, et al. 1977. microfiche.

GJBX-73 (77): Studies on Airborne Optical Detection of Uranium Ore, by C.M. Lampley, M.B. Wells. 1977.

GJBX-74 (77): Preliminary Study of the Favorability for Uranium in Selected Areas in the Basin and Range Province, Nevada, by G.M. Cupp, et al. 1977.

GJBX-76 (77): Geostatistics Project of the National Uranium Resource Evaluation Program, April-June 1977, by R.K. Zeigler, et al. 1977.

GJBX-77 (77): Symposium on Hydrogeochemical and Stream-Sediment Reconnaissance for Uranium in the United States, Symposium Papers. 1977.

GJBX-78 (77): Preliminary Study of the Uranium Potential of Tertiary Rocks in the Central San Juan Basin, New Mexico, by H.P. Vizcaino and A.J. O'Neill. 1977.

GJBX-82 (77): Preliminary Study of Favorability for Uranium of the Sangre de Cristo Formation in the Las Vegas Basin, Northeastern New Mexico, by R.T. May, et al. 1977.

GJBX-87 (77): Hydrogeochemical and Stream-Sediment Survey of the National Uranium Resource Evaluation (NURE) Program-Western United States, Quarterly Progress Report, April through June 1977, by Lawrence Livermore Laboratory. 1977.

GJBX-3 (78): Preliminary Study of the Uranium Favorability of Granitic and Contact-Metamorphic Rocks of the Owens Valley Area, Inyo and Mono Counties, California, and Esmeralda and Mineral Counties, Nevada, by G.M. Cupp and T.P. Mitchell. 1978.

GJBX-4 (78): Preliminary Study of the Favorability for Uranium in the Madera Limestone, and Cutler and Chinle Formations of the Sierra Nacimiento-Jemez Mountains Area, New Mexico, by H.P. Vizcaino, A.J. O'Neill, and F.E. Dotterer. 1978.

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