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U.S. Geological Survey Program of Research and Resource Assessment in Uranium and Thorium

by

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Several months ago the headlines seemed full of the uranium supply crisis. Such news was spawned by two controversial reports, the one by Ford Foundation-MITRE Corporation, the other by National Academy of Sciences, and, of course, both reports were further fueled by President Carter's own concern about nuclear nonproliferation. As is usual in controversies of this dimension, elements of truth and hard fact are present on both sides of the coin, and the public is forced to choose whatever hard fact it thinks is appropriate. In this regard, I was amused the other day by a statement by Jack Watson, the presidential advisor, who noted that one thing you learn very fast in Washington is that "facts are negotiable" - and so it goes with the uranium-supply picture. Those cautioning uranium supply shortage have only to point to the Westinghouse suit, or to public utilities that are cancelling nuclear plant orders because of perceived supply limitations. On the other hand, the Ford report based its optimism on the skill of private enterprise, which it contended had not yet been tested; certainly the history of mineral exploration suggests that a neophyte industry will eventually get into gear and generate a plethora of exploration ideas fully capable of leading to discoveries that can satisfy demand. Be you an optimist or a pessimist, though, I think you can agree that it's very important to understand thoroughly those things that are of real importance to you, and understanding uranium resources is certainly vital to all nuclear energy planning and indeed to the National Energy Plan and to the energy well-being of our Nation.

The problem with this crisis is that we were not given much time to gear up for it, and we're having to do all of the gearing up in the fish bowl of Freedom of Information. In the heyday of oil and gas, they were just building the user technical capability at the time of initial discovery. In the case of nuclear power, however, we have an already developed technology just waiting to be unleashed with great industrial and capital capability behind it, such that we're able to project a massive energy conversion technology buildup with a planned resource consumption that turns out to be considerably in excess of any past discovery rates. Note, my words were "in excess of past discovery rates," not "in excess of the resource base." The same is true of oil and gas today. The problem is the rate of consumption vs. the rate of discovery and extraction, not the dimension of the resource base. At least that is our perception for the next few decades both in oil and gas and in uranium and thorium. This discovery rate problem in uranium, however, is further aggravated by the fact that a nuclear reactor has very limited alternate use and it's a very expensive device. Investors then are understandably interested in a longer term supply assurance than has been the custom of industry to demand in other energy conversion technologies. If today's generally accepted projections are accurate, we shall consume all of our present reserves by the year 2000 and at that time be at a consumption level of 60,000 tons/yr. To replace these reserves and to build our discovery rate to match consumption calls for an expansion of discovery rate by a factor of 2-4 from now until the end of the century and for maintenance of a high discovery rate thereafter--that is, if we expect to do it with domestic resources.

So much for setting the stage. The reason I am here today is not to shed any more light on the controversy of what we have or don't have, but rather to bring you up to date on the role of the Geological Survey in the illuminating exercises of resource assessment (that is, the NURE* program) that are under way now. As you all will recall, those controversial MITRE and National Academy of Sciences reports went out of their way to question the noninvolvement of the Survey in the NURE program. As a result of that questioning, high-level officials of DOE and DOI met together long enough to decree that henceforth there would be a coordinated program effort. That coordinated program has, in fact, evolved over the past few months.

The decisive issues between our two organizations revolved around a variety of problems--the use of industry proprietary data, the reporting of the resource numbers themselves, and the extent to which GS would actually participate in the planning function of the NURE program. All of these problems are to a significant extent solved, but it's important to understand, too, that relations between

* National Uranium Resource Evaluation

us relative to the development, processing, and analyzing of data are in an evolving state, the resolution of which in the end will produce a resource assessment that is the best our mutual capabilities can develop. The principal negotiators and scientific leaders involved in this evolving relationship are Don Everhart of DOE and Terry Offield of USGS. Their job is to make the coordinated program work effectively. As backup, there is a Washington-level coordinating committee that stands ready to resolve any "glitches" that develop in the system. At this reading, the scientific leaders have set up joint working committees in all component parts of the assessment activity, including mapping, drilling, resource-assessment methodology, hydrogeochemistry, geophysics, data systems, and so forth. These groups are effectively exchanging ideas and actually driving the system through their deliberations.

I don't mean to imply that coordination is such that we are of one mind in all aspects of NURE; that's certainly not true nor is it expectable that any two groups would organize a program in the same way. I do mean to say, though, that we think a creditable activity is under way; that we are taking part with considerable pleasure; and that we intend that the overall product will provide an effective resource planning base and an effective geologic base for further and continued uranium/thorium studies and assessments.

Some of the criticism leveled at this program has implied a "quick and dirty" connotation which I would argue, rather, is one of its strengths, not a weakness. The intent is to compile the best geological base possible, overprint a number of carefully measured parameters such as aeroradiometric data and geochemistry, and apply the state-of-the-art uranium geology as conceived by Government scientists and private contractors.

Nobody is naive enough to believe this is the last word. One thing you can always know about a resource assessment is that it is wrong. What you hope to accomplish is the development of a data base that will permit the recognition of anomalies at any stage as resource assessment methods are improved through time. By design, then, we believe it is eminently useful to apply the conventional wisdom to an organized data base at a given time and then reevaluate at a later stage when new ideas have developed in the system--in any active field those ideas will evolve. To be specific, let me tell you some of the things we are doing in support of NURE and some of the things NURE is doing to support us, and finally some of the things that are evolving as we participate with other NURE workers on a team basis.

The NURE program is designed around a 2° sheet; that is, a map covering 2° of longitude and 1° of latitude and scaled at 1:250,000. Obviously, the work will be conducted in a basin or along a mountain range irrespective of boundaries, but the data will be reduced to 2° rectangles for consistent reporting purposes. Phase I of the NURE program calls for the assessment of 272 high-priority quads by 1981 and the remainder of about 350 quads by 1983.

The Survey, considering that its mission is research in all minerals, not systematic nationwide assessment for any one mineral, has determined a level of program involvement that we believe utilizes our strengths to their optimum in the NURE program and yet retains a strong research component continuing to look at problems that will still be with us beyond 1983. With this in mind, we have accepted 42 "turn-key" NURE quads in particular areas as representing the amount of country we think we can adequately assess in the time allotted. The areas selected cover some of the prime uranium regions in the 272-quad effort, and all represent areas where a USGS geologist assigned to a quad has a significant claim to being something of an expert in that region. In some cases this person might be one of our Uranium/Thorium Branch personnel, such as Morris Green in the 4-corners area or Frank Armstrong in Washington State. But in other instances, the individual may come out of Mineral Resources or one of the regional mapping branches. In these cases, we have assigned Uranium/Thorium Branch geologists to those quads to bring trained commodity eyes and minds into the data development process in those areas.

So my point is, we have assigned the very best people we could to the selected quads, and I would expect them to produce model products for assessing or pacing the nationwide effort. For backup we are providing these quad teams with the best possible rock geochemical analysis program, designed and carried out by the Survey's Analytical Labs. This will also be a good general research effort for us to test the value of extensive high-sensitivity and high-quality analyses; e.g. we intend to analyze for uranium in water down to .01 ppb as compared with the spectroscopic level of 1 ppb. Likewise, in rock samples we will be analyzing the U/Th with delayed neutron techniques which afford high degree of discrimination. In that our quads cover a broad spectrum of climatic conditions, we would hope as a result of this work to be able to make a judgment on appropriate levels of analysis under different climatic conditions. This should be of marked value to future geochemical studies.

As a further aid to the field geologist, the NURE program calls for aeroradiometric and stream-sample coverage of each assessed quad. From now on, these flight plans will be flown with advice of the field geologist thereby markedly enhancing their usefulness. We hope also to develop with DOE a research activity designed to determine the optimum presentation of these data; such a determination obviously will be significant aid to all contractors. Likewise, the stream-sampling program will be tailored to the quad, and being conducted by special sampling teams for purposes of uniformity, it will free the field geologist to concentrate on the rocks and the circumstances of uranium occurrences. To aid in this latter effort, we are working with several of the States to develop the best possible computerized data base of uranium occurrences so that literally no known shows will go unexamined in any of 272 quads. The final gratuity offered to these field teams by the NURE program is the possibility of drilling or coring data in particular places, depending on overall budgets and demonstrated need. All the ingredients are in this program to develop an excellent geological and resource understanding; the next step is up to us and other contractors.

In addition to the 42 turn-key quads, which number was limited by the amount of Uranium/Thorium Branch talent we could assign to the program, the Survey has assigned additional mapping talent to several quads. The uranium-thorium commodity analyses will be provided by DOE in these cases. It is also important to note that GS has assumed the full responsibility for thorium assessment. Mort Staatz is responsible for that activity.

There are still, however, some points of disagreement between us. Initially, we perceived ourselves to be quite far apart from DOE in the methodology of resource assessment, but through the mechanism of the joint working committees, we have found a lot of common ground in our attempts to develop models of uranium occurrences which can be applied to geological terrane for purposes of the assessment. Overall, resource assessment is an activity in which we in GS think we have made quite a lot of progress in oil and gas, as well as in other commodities. I'm most excited, however, that some of the computerized objectivity that we are building into the uranium assessment has some real merit for this program as well as for all commodities. In our oil and gas work, however, in the past few weeks we have come to an interesting realization--we can get too much data, we can try to be too detailed in our assessment. I say this because Government assessment of resources must avoid bias, which in effect forces the process into extremes of objectivity and away from legitimate imagination. All of you who have been in exploration know full well that no minerals were ever discovered without plenty of optimism and imagination, and it would be unreasonable to force our resource assessment people into such a tight mold that they lose their explorationist's gleam. It's a fine line to draw but it must be drawn to achieve realistic assessments if we are to keep from downgrading areas for lack of better ideas than the conventional play-mentality wisdom can provide. After all, the role of resource assessment is to estimate what reasonably might be there, not what is there; the latter is the role for the reserves analyst.

Another area of evolving understanding relates to the classification of resources. We have argued that there should be a clear separation between resource numbers by physical geological properties (i.e., grade, tonnage, and depth) and resource numbers classified by economic parameters such as forward cost. Both methods of classification have merit, but we want to see them kept clearly separate so that the geologist can concern himself with the properties he understands and the economist/engineer with the properties and problems with which he is familiar. We think this separation will also take some of the mystery out of the reporting system, which I'm sure we would all welcome. There are other problems with the present DOE classification system which I will not address here, but suffice it to say that discussions are going forward in good faith.

In developing this program relation with DOE/NURE, we have tried not to unbalance our own ongoing research activities which we hope will contribute to uranium/thorium resource understanding and discovery in years to come. Of necessity, NURE must be based on the state-of-the-art, and Survey's role is not only to contribute whatever wisdom we have to that activity, but also to continue to investigate a spectrum of new ideas and techniques to serve the future. Our longer term research is based on the well known exploration tenet that most deposits of minerals are found initially by surface expression; then, through identification of depositional or occurrence environments, we attempt to predict likely deposit occurrences in the subsurface or in remote areas. To that end, then, we need to develop more abstract measures of U/Th favorability. One approach to this is to focus on halo effects around ore bodies. Because of the continuous decay or fractionation of uranium, plus its ready solubility, we can expect to discover isotope indicators of ore bodies at some distances from the deposit. Further, with satellite imagery one might be able to identify certain rock-alteration conditions or fault-pattern distributions useful in guiding exploration. We also intend to continue with our development of activitated borehole instrumentation to aid in the direct recognition of uranium in boreholes as well as to identify pathfinder elements that may lead to nearby ore bodies.

Another approach to broad-area favorability analysis is to attempt to develop, improve, and apply geologic model concepts to geologic terranes. One program direction is to try objectively to develop pattern-recognition criteria from satellite imagery. Another is to attempt to develop geologic models that will permit us to focus exploration activities on the basis of a broad understanding of geologic history and regional stratigraphy. An obvious example of such model development and resultation exploration is the Precambrian quartz-pebble conglomerate story. More recently we are discovering that certain unique and predictable subenvironmental conditions control the precipitation of uranium in a dominantly fluvial environment. We intend to continue to aggregate our uranium understanding into exploration models that employ computer techniques.

Clearly, there is a lot of work to be done to improve our capabilities for uranium exploration, but improve them we must if we expect to double or quadruple our discovery rates in the years to come. That, as I said at the beginning of this paper, is the task before us if we expect to meet the nuclear power development schedules set out for us in the various attempts to develop a National Energy Plan. Whatever the outcome of that, my message to you for today is that the Survey is involved fully in NURE activities, and we have every reason to expect that a reliable and credible assessment of U.S. uranium/thorium resource potential will derive from our mutual efforts.