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Comments on classification of uranium resources

by

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National resource assessments are intended to give some insight into future possibilities for the recovery of a desired resource. The resource numbers themselvesare only useful when related to economically controlled factors, such as industry capability as reflected in rates of production, rates of discovery, and technology development. To that end, it is useful to divide the resource base into component parts to which appropriate econometrics can be applied. A system of resource reporting adhering to these principles has been agreed to by the two major resource agencies in Government, the U.S. Geological Survey and the U.S. Bureau of Mines (USGS Bulletin 1450-A). Conceptually, then, a plan for resource reporting has been devised, and all resource reporting by these two agencies follows the agreed-upon pattern. Though conceptual agreement has been reached, each commodity has its own peculiar data problems; hence an operational definition to fit the conceptual pattern must be evolved for each mineral. Coal is the only commodity to date for which an operational agreement has been reached (USGS Bulletin 1450-B), but the basic essentials of an operational classification within the guidelines of Bulletin 1450-A have been reported for oil and gas in USGS Circular 725. The basic classification system is now well established and has received general endorsement by Resources for the Future in a study of mineral resource classification

systems prepared for the Electric Power Research Institute (Schanz, 1976), and with respect to coal by the International Energy Agency.

Resource assessments, in general, are prepared for a very broad audience, and they must be both reliable and credible to that audience. The reliability, of course, depends on the data and methodology used in developing the assessment. Its credibility, however, depends on many subjective factors including consistency and clarity of presentation to that large audience. To the extent that all mineral assessments are reported in similar terms, greater understanding can be anticipated. The writer recommends, therefore, that DOE abandon its system of classification and that DOE and DOI devise operational definitions for uranium resource reporting that are consistent with the conceptual classification system reported in USGS Bulletin 1450-A.

Following the concepts developed for other minerals, certain resource reporting factors are important for uranium and thorium: 1) there should be a clear distinction between identified and undiscovered resources, 2) the undiscovered resources should be reported as a range of values reflecting a spread of uncertainty about the resource base, 3) to avoid assessing elements in crustal abundance, there should be a lower-boundary limit, and 4) reporting units should be in physical terms (tonnage and grade) with inferences as to specific cost or price reserved for separate analysis.

The Geological Survey-Bureau of Mines system (see Figure 1) attempts to separate clearly those resources which are truly "undiscovered" from those portions of the resources that will become reserves as a result of

extensions and revisions to already identified measured reserves. The former are classified as undiscovered-hypothetical (USGS Bulletin 1450-A), whereas the latter are classified as identified-inferred; identified because they are a part of a known accumulation, inferred because they have not yet been delineated by mining or the drill. Those deposits that are not an extension of existing measured reserves clearly cannot be assessed with the same degree of probability as those that are; therefore, it is not statistically accurate to combine the two estimates. For this reason, the DOE classification of probable potential should be abandoned because of its inclusion, in a single category, of resources attributed to extension of known deposits, as well as to resources attributed to new discoveries, however well controlled by geology.

The undiscovered resources (DOE's possible and speculative potential plus that part of probable potential that is not related to the extension of known deposits) should be recorded as a range of values (Harris, 1976), reflecting on the one hand a low probability of occurrence and on the other hand a high probability of occurrence. The former can be considered speculative resources in GS-BuMines terminology and the latter, hypothetical resources (Sheldon, 1975). The range of probabilities for national resource reporting should represent a substantial portion of the resources conceived possible to exist, but it need not include those resources, conceived or unconceived, that are of such low probability of occurrence as to be an inappropriate basis for the development of national resource policy. For oil and gas, the Geological Survey estimates have included 90 percent of the conceived potential by reporting a range of

probabilities from 95 percent-5 percent probability. In the writer's judgment, this is an appropriate range of probabilities for most natural resource reporting.

Because a resource represents an accumulation of minerals that has the potential of becoming a reserve, it is important to exclude from the designation of resources large low-grade deposits that in the perception of the estimator will never become a reserve. The idea here is to exclude "gold in the ocean" from the resource concept, or specifically, in this case, uranium in the Chattanooga shale, to give one example. The highest grade reported in the Chattanooga is .007% U_3O_8 and the lowest cutoff grade commercial deposit is probably about .02% U_3O_8, in a deposit where the average grade is close to .1% U_3O_8. A lower limit of .01% U_3O_8, therefore, would encompass all known commercial deposits and would exclude an accumulation that in many people's judgment probably will never be a resource. At this stage, the precise recommended grade is not so important as the concept of a lower boundary limit determined by grade rather than by forward cost. A grade limitation does not preclude the assessment of Chattanooga uranium content but it does relegate that assessment clearly to a non-resource category of reporting where the tonnage reported likely will not confound the issue of reasonably expected potential availability of uranium resources.

In any resource assessment a distinction must be made between accumulations perceived now to be economic and accumulations considered only potentially economic or subeconomic. When considering the economics of a deposit, there are obviously many variables. Physically, the

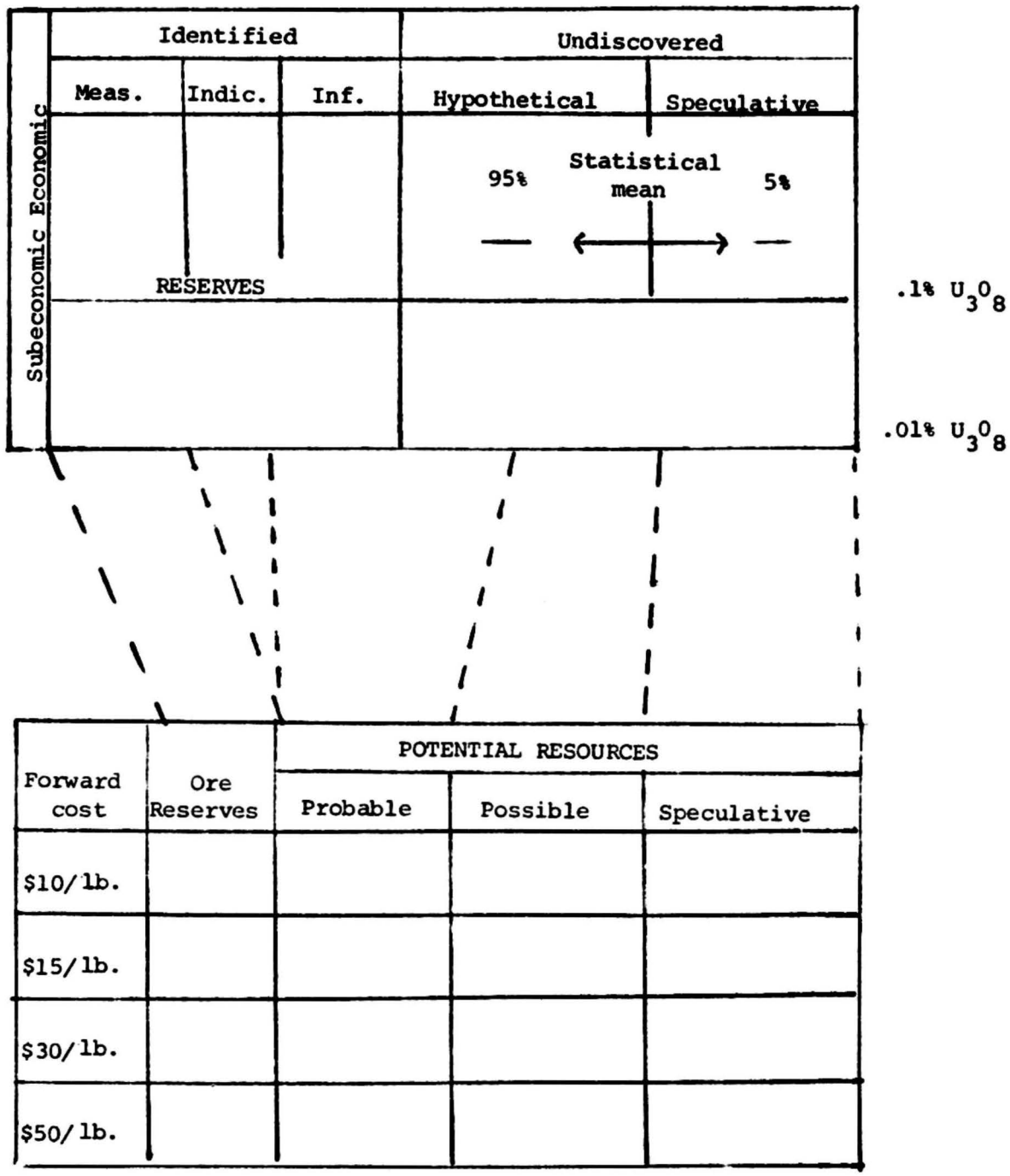
variables of greatest concern are deposit size, grade, and location (geographic as well as geologic). All of these factors must be considered in an economic analysis but probably grade is the most important consideration. In that all uranium ore that is being mined today can be presumed to be economic, a weighted average grade (approximately .1% U_3O_8) of the total tonnage mined is a useful national measure of approximate economic richness and serves as a guide to project into the category of undiscovered resources. It must be remembered that the numbers being reported are national averages and that it is expected that local exceptions occur; for national planning, the local conditions are not significant. This system is to be preferred over reporting numbers in forward cost categories, because variations in inflation can change the tonnage reported in a given forward cost category with there having been no additions or subtractions of the physical resource. Resources should be defined physically as well as economically, but the two should be kept separate except in very general terms (Harris, 1977).

One final area of resource reporting that is included in the Geological Survey-Bureau of Mines system is the category of Indicated Reserves. That category is intended to describe reserve potential that is intermediate in geologic assurance between measured and inferred reserves. In fact, it has proved difficult to delineate quantitatively that segment of reserves. In oil and gas, indicated reserves are those accumulations that are potentially subject to fluid injection, but the engineering has yet to be applied to commence production of the additional oil. The category is useful to describe known reserves of any kind that

are not yet readied for production by whatever appropriate engineering applications. I recommend that the category "indicated reserves" remain undefined until such time as further studies of the reserves data might permit a useful distinction to be made.

In conclusion, it is the writer's considered judgment, given the high visibility of uranium-resource reporting in the next few years, that the Government should change the reporting classification now to conform to the Geological Survey-Bureau of Mines classification. Such a change would make uranium-resource reporting parallel with that of other minerals and thereby improve overall understanding. The valuable economic analyses represented by forward cost can be retained but as a separate presentation. To not do so will obfuscate the national assessment presented in 1981, and to delay for any substantial period of time will weaken the impact of that assessment.

GS/BuMines Classification
RESOURCES
in tons U_3O_8



DOE Classification

Fig. 1. Geological Survey/BuMines and DOE Classification Systems showing approximate correlation lines.

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